

**EXPLORING A SHIFT IN TEACHER PRACTICES AFTER GOING
THROUGH AN INTERVENTION ON THE INTEGRATION OF LOCAL
KNOWLEDGE IN GRADE 9 PHYSICAL SCIENCE LESSONS**

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By

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DECLARATION OF ORIGINALITY

I, Rauha Tufilonghenda Mika, declare that this thesis is my own original work that is submitted at Rhodes University and has not been submitted at any other university. All ideas and citations used in this study derived from other people are acknowledged and indicated in the list of references.



Signature

Date: 14 December 2018

DEDICATION

This thesis is dedicated to my late father, Junias Simon Ihalwa who inspired me to be as substantial and mindful as an iron lady with the essence of ubuntu; to my aunt Tuhafeni Nambala for raising me up, teaching me the ethics of life, to be a strong woman and motivating me to study in the field of education. Finally, I further dedicate this thesis to my lovely husband Paulus Mika for being a responsible, caring, and loving husband and encouraging me to study.

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ABSTRACT

It has been advocated by many scholars that the integration of local or indigenous knowledge into science classrooms might make science more relevant and accessible to learners, particularly in culturally diverse classrooms. As a result, the Namibian Grade 9 Physical Science curriculum expects teachers to integrate learners' local or indigenous knowledge in their science classrooms. Despite these ideals, there are no clear instructions on how to go about doing this. This is exacerbated in part by the poor or lack of continuing professional development for science teachers. It is against this background that this study sought to explore an intervention on the integration of local or indigenous knowledge in Grade 9 Physical Science lessons.

The study is underpinned by an interpretive paradigm and is informed by Vygotsky's socio-cultural theory and Wenger's community of practice. Within the interpretive paradigm, a qualitative case study approach was employed. It was carried out in four schools with four Physical Science teachers from Otjiwarongo circuit in Namibia. Qualitative data were generated using workshop discussions, document analysis, semi-structured interviews, classroom observations and reflections. A variety of data generation techniques were used for triangulation and validity purposes. Data were subsequently analysed inductively to come up with themes.

The findings of the study revealed that before the intervention the teachers involved in this study had little knowledge about the integration of local or indigenous knowledge in science lessons. However, after their voluntary participation in the intervention, they were enabled to develop and mediate model lessons that integrated local or indigenous knowledge in their classrooms which their learners subsequently found to be stimulating. The findings of the study further revealed that integrating local or indigenous knowledge in science lessons had the potential to promote active participation by learners and foster learning using easily accessible resources. The study thus recommends that teachers should, where possible, strive to integrate learners' local or indigenous knowledge in science lessons.

Keywords: *Physical Science, scientific knowledge, local or indigenous knowledge, professional development, socio-cultural theory, community of practice*

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LIST OF ABBREVIATIONS AND/OR ACRONYMS

AKRSI – Alaska in United States initiated Alaska Rural Systemic Initiative

CK – Content Knowledge

CoP – Community of Practice

CPD – Continuing Professional Development

CTL – Contextualised Teaching and Learning

CTLPP - Contextualised Teaching and Learning Pedagogical Practices

EFA – Education for All

ESD – Education for Sustainable Development

IK – Indigenous Knowledge

IKSs – Indigenous Knowledge Systems

LC – Local Knowledge

LCE – Learners’ Centred Education

LTSMs – Learning Teaching Support Materials

TLSP – Traditional Life Skills Projects

MER – Model for Education Reconstruction

MoEAC – Ministry of Education, Arts and Culture

NIED - National Institute for Educational Development

NNPST - Namibian National Professional Standards for Teachers

PIP – Performance Improvement Program

PK – Pedagogical Knowledge

PLC – Professional Learning Community

PQA – Programs and Quality Assurance

QTM – Quality Teaching Model

RMIT - Royal Melbourne Institute of Technology

SADC - Southern African Development Community

UNESCO - United Nations Educational, Scientific, and Cultural Organisation

UNICEF – United Nations International Children Emergency Fund’s

WS – Westernised science

CHAPTER ONE

SITUATING THE STUDY

1.1 INTRODUCTION

The goal of my study was to explore impact of an intervention on the integration of local knowledge in Grade 9 Physical Science lessons. It has been advocated by some scholars that the integration of indigenous knowledge into science classrooms might make science more relevant to learners, particularly in culturally diverse classrooms (de Beer & Whitlock, 2009). It is believed that such integration would reflect the diverse cultural backgrounds of the learners and enhance their knowledge construction (Botha, 2012; Mavuru & Ramnarain, 2017). In addition, the Namibian Grade 9 Physical Science curriculum expects teachers to integrate learners' prior knowledge (of which local knowledge is a part), but there are no clear instructions on how to go about doing this. Furthermore, the Namibian National Programme on Research, Science, Technology and Innovation (2014 - 2017), prioritises Indigenous Knowledge (IK) as a critical area of research that can address Namibia's social challenges. These ideals prompted me to carry out a research investigating an intervention of integrating local or indigenous knowledge in Physical Science lessons. The research was aimed at supporting Grade 9 Physical Science teachers in enacting indigenised lessons in their science classrooms. In this chapter, I thus present the contextual background of the study, statement of the problem, significance of the study, research goals and objectives, definition of the concepts used in the thesis and the thesis outline. The chapter ends with some concluding remarks.

1.2 BACKGROUND OF THE STUDY

The European National Policies, Practices and Research for Science Education (2011) emphasised that embedding science into its social/cultural context is considered important. That is, when teaching science, the development of scientific knowledge is viewed as a social practice, which is dependent on the political, social, historical and cultural realities. The report for European National Policies, Practices and Research for Science Education (2011) revealed that formal workshops were conducted within professional development learning communities, to improve teachers'

content knowledge and pedagogical skills. Reflecting on the European science curriculum, it could be said that teachers' professional development interventions play an important role in enhancing innovative teaching approaches. In addition, Mavuru and Ramnarain (2017) stressed that effective teaching should recognise the students' socio-cultural practices and experiences (which could be referred to as Indigenous Knowledge Systems) during the process of knowledge construction.

Some African educators are of the view that science that is taught in Africa, does not carry the African identity and that indigenous ways of knowing are not recognised by the teachers (Semali & Kincheloe, 1999). Wangola (2002) contended that indigenous knowledge is not well acknowledged and supported in the African education system because westernised science (WS), culture and values are regarded as powerful and significant. More often "the indigenous knowledges are looked down upon in the classroom context and viewed as irrational and backwards, thus creating, like in South Africa, alienation and cultural and epistemological disillusionment among the children of indigenous communities" (Bredlid & Botha, 2015, p. 333).

Katjavivi, the Speaker for the Namibian National Assembly (2016, p. 11) observed that the Namibian teachers are characterised by poor teaching methodologies. In other words, teachers do not explain the meaning of the text, from textbooks and other sources, using understandable local examples that would relate to the everyday life of the learners. Consequently, Namibian science teachers teach their students scientific knowledge within a foreign context that they are not familiar with. This might make it more difficult for students to show interest, something that could ensure that they perform better in science subjects. It does not mean that WS is not relevant for African students, but it is in line with the former South African president, Mbeki's words (1998) that Africans need to embrace the culture of the globe, while still ensuring that they do not discard their own culture.

Richerson and Boyd (2005, p. 4) defined "culture as information capable of affecting individuals' behaviour that they acquire from other members of their species through teaching, imitation, and other forms of social transmission". Culture influences how individuals approach education. Mills (2000) maintained that society's culture determines how society educates its people, as it consists of values and beliefs that influence practices. In the same way, Killen (2015) asserted that the different cultural groups have different experiences of the world both past or present and this leads to members of each group having distinctive cultural knowledge that should be acknowledged and

valued. Hence this study proposed that intervention programmes should play a role in the Grade 9 Physical Science curriculum in integrating, linking scientific concepts with the learners' local knowledge practices, as well as encouraging contextualised teaching and learning.

Based on the United Nations International Children Emergency Fund's (UNICEF) report for 2011 on improving quality and equity in Namibian education, the classroom lesson observations undertaken revealed that Namibian teachers have common weaknesses in ensuring quality teaching, as they are characterised by poor use of concrete objects to teach abstract concepts. The report further revealed that too often teachers relied on textbooks or worksheets to explain concepts without relevant teaching aids. Some schools are poorly resourced, but teachers also rarely make use of easily accessible everyday resources in their lessons.

Moreover, Breidlid and Botha (2015) believed that indigenous knowledge offers interesting possibilities for including alternative forms of cultural activity into our learning and teaching practice. Even more, the Namibian National Programme on Research, Science, Technology and Innovation (2014 - 2017), prioritised indigenous knowledge (IK) as a critical area of research that could address Namibia's social challenges. Yet, easily accessible resources could be in the form of resources used in indigenous practices as evidenced in the studies of Nikodemus (2017) and Asheela (2017), which they conducted in Namibia. Their findings were that many teachers were not exposed to the use of easily accessible materials and that workshops should be conducted with the teachers on the inclusion of local knowledge practices in teaching, to enhance learners' engagement, participation and sense-making of the concepts.

These scholars believed that integrating local knowledge in science lessons might improve the quality of teaching and learning. Furthermore, the findings of Physical Science classroom lesson observations for the Otjozondjupa Directorate of Education, Arts and Culture (2012) concluded that the majority of science teachers observed were facing pedagogical challenges in integrating learners' prior knowledge and that their teaching was more on theoretical aspects than practical aspects. Based on my research, these challenges might arise because science concepts and practical activities are presented more within a western context than in our local context.

Mukwambo, Ngcoza and Chikunda (2014) noted that there is the need for Africanisation of the school science curriculum, which has to do with introducing methods and approaches in teaching

and learning that can be adapted and made relevant to the African context. There is the need for inclusion of local context and cultural identities in science teaching. This is linked to Giddens' (2009) argument that students are more likely to engage in education that aligns with and includes their cultural identities. The inclusion of local knowledge in science teaching and learning may contribute to the relevance and sensitivity of students' cultural context (Cocks, Alexander, & Dold, 2012; Webb, 2013). Science teaching that acknowledges and values students' IK has been seen to increase their interest and participation (Brown, Muzirambi & Pabale, 2006).

As a Senior Education Officer for professional development in the region, I came up with an intervention that worked with the Grade 9 Physical Science teachers in the Otjiwarongo circuit, to investigate how teachers could be supported to integrate local knowledge in their Physical Science lessons. Physical Science is the subject that places strong emphasis on the understanding of the physical and biological world around us at the local, regional and international levels (Physical Science, Grade 8-9, 2015). It thus includes the application of scientific knowledge and attitudes to health are of special relevance for the individual, the family, and society at large. The major aim of the Namibian Grade 8-9 (2015) curriculum is to ensure knowledge with understanding by developing understanding, creativity, practical and experimental skills as a solid foundation for academic training, to prepare students for a creative and meaningful adult life. It also aims at helping the learners develop self-confidence, self-knowledge and understanding of the world in which they live, through meaningful scientific activities (Physical Science syllabus, Grade 8-9, 2015).

1.3 STATEMENT OF THE PROBLEM

The Namibian science teachers are expected to integrate local or indigenous knowledge in their science classrooms, but there are no clear instructions on how to go about doing it. Lack of innovation and essential laboratory resources limit practical activities that could be done in science subjects and therefore teachers need to improvise (Nghipandulwa, 2012). Although professional development activities are encouraged to update teachers on curriculum reform, and empower them to improve their teaching strategies, there is still the challenge of inadequate teachers' professional development (du Plessis & Muzaffar, 2010). It is against this backdrop that my study

sought to explore an impact of intervention on the integration of local knowledge in Grade 9 Physical Science lessons.

1.4 SIGNIFICANCE OF THE STUDY

The study is significant as it could help with the processes of mobilising and integrating local or indigenous knowledge in Grade 9 Physical Science lessons. Additionally, the findings of this study might inform Continuing Professional Development (CPD) and hence improve pedagogical content knowledge (PCK) of the teachers, in relation to the inclusion of the local or indigenous knowledge in science lessons. The study advanced my educational practices as a Senior Education Officer and enabled me to assist teachers in improving their teaching pedagogies, based on local or indigenous knowledge in science classrooms. The study improved PCK of the participants and collaborative skills of co-developing the lessons, Learning and Teaching Support Materials (LTSMs) for science teachers grounded in IK and local resources, rather than just relying on laboratory resources and textbooks to explain concepts when teaching.

1.5 THEORETICAL FRAMEWORK

Vygotsky's (1978) socio-cultural theory informed my study. The socio-cultural theory informed the study in terms of the learning, by looking at how teachers can learn in a social cultural context and relate socio-cultural knowledge to the subject content knowledge. The concepts that I used from this theory are the Zone of Proximal Development (ZPD), mediation, internalisation and self-regulation. Since socio-cultural theory does not explain explicitly how groups of people with a common goal learn, the research study was also informed by Wenger's Community of Practice (1998). Community of Practice (CoP) informed my study on how the group of individuals could participate in a social set-up within the community and share their knowledge, experiences and learn from each other. The concepts that I borrowed from CoP were participation, social learning and collaboration. The two frameworks were used to complement one another.

1.6 RESEARCH GOAL, OBJECTIVES AND QUESTIONS

The goal of my study was to explore an impact of intervention on the integration of local knowledge in Grade 9 Physical Science lessons. To achieve this goal, the following objectives guided the study:

1. (a) To determine Grade 9 Physical Science teachers' understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention;
- (b) To determine Grade 9 Physical Science teachers' attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention;
2. To collaboratively come up with examples of local knowledge that Grade 9 Physical Science teachers might consider for integration and then co-develop model lessons that integrate such knowledge;
3. To determine how the Grade 9 Physical Science teachers implemented the model lessons which integrated local knowledge in their classrooms; and
4. To ascertain if there was a shift in the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons that evolved as a result of their participation in the intervention.

The study was thus guided by the following research questions:

1. (a) What are Grade 9 Physical Science teachers' understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention;
- (b) What are Grade 9 Physical Science teachers' attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention;
2. In what ways can Grade 9 Physical Science teachers be supported to co-develop model lessons that integrate such knowledge;
3. How do Grade 9 Physical Science teachers mediate learning of the co-developed model lessons which integrated local knowledge in their classrooms; and
4. How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons shifted or evolved as a result of their participation in the intervention?

1.7 DEFINITION OF THE CONCEPTS

Indigenous Knowledge – The term given to the form of knowledge that seems to be more prominent in traditional societies, not documented and passed on from generation to generation.

Pedagogical Content Knowledge – Broad knowledge of subject matter, how to teach it effectively based on understanding of the students' needs and the nature of certain topics.

Local Knowledge - Skills and philosophies developed by societies with long histories of interaction with their natural surroundings.

Attitudes – Individual's tendency to respond positively or negatively to an object (person or group of people, institutions or events).

Westernised science – The knowledge system which relies on understanding the world through application of scientific methods, documented laws, theories and facts.

Practical Activities – Learning tasks whereby students are exposed to observations and manipulation of actual objects.

Culture – Sum of knowledge, experience, beliefs, values, attitudes, meanings, religion and possessions acquired by a group of people in a certain society that are transmitted from generation to generation.

Multi-Cultural Education – A social or educational theory educational strategists developed to assist teachers when responding to challenging issues in education which encourages interest in many cultures within a society rather than in only a mainstream culture.

Intervention – Combination of educational programmes or strategies designed to produce behaviour changes or improvement within the certain context.

Inclusion – The act of fighting against exclusion and all social discrimination secures opportunities for students with different needs to learn alongside and benefit in general education classrooms.

Inclusive Education – Creating conducive learning and teaching environments for all children in regular schools, regardless of differences in socio-economic background, (dis)ability, race, colour, sexual orientation, religion and ethnicity, among others.

Integration – To combine two or more variables within society or a group of people, with an intention of changing to suit their way of life in order to become more effective.

Learner Centred Education – Educational approach that moves students from passive receivers of information to active participants in their own discovery process. Teachers implement academic-support strategies based on what students learn, how they learn it and how their learning is assessed which is all driven by each individual student's needs and abilities.

Professional Development – Professional work of established collaborative teams of teachers, school leaders, and other administrative, instructional, and educational services staff members who commit to working together to accomplish common goals and who are engaged in a continuous cycle of professional improvement.

Collaborative Teaching – Educators working in tandem to plan and share resources for meaningful teaching.

Socio-Cultural Theory – Theory in psychology and sociology that helps one understand that society and culture make a significant contribution to an individual's development.

Community of Practice – Group of people with a common interest for something as they meet, interact regularly, share, and engage in dialogue relevant to their specific aspects to see how to bring about improvement.

1.8 THESIS OUTLINE

The study was conducted with four Grade 9 Physical Science teachers in the Otjiwarongo circuit of the Otjozondjupa Region. The thesis consists of seven chapters:

Chapter One: Presented the context of the study. This included the purpose, outline and structure of the study. The statement of the problem, theoretical framework, and significance of the study, research goal, objectives, questions and definition of the terms were specified.

Chapter Two: Discusses relevant literature for the study. It also provides an overview of the literature relating to the curriculum matters in Namibia, approaches to educational theories, indigenous vs western, hands-on practical activities, quality in science teaching and learning, multicultural and inclusive approaches to science teaching, challenges and benefits of integrating local knowledge, teachers' pedagogical development and their participation in professional development activities.

Chapter Three: Presents the description of the theoretical framework used in this study. It provides an overview and application of Vygotsky's (1978) socio-cultural theory, Wenger's (1998) Community of Practice (CoP) and theoretical concepts used.

Chapter Four: Provides an overview and justification of research methodologies used in the research. Firstly, it portrays the research orientation, research approaches, research objectives and research questions. Secondly, the research site, procedures of the study, data gathering techniques and the rationale behind their use are explained. Thirdly and finally, data analysis, data management, validity, trustworthiness and ethical considerations are presented.

Chapter Five: Provides Phase I of a narrative account of the data generated prior to the intervention. It begins with the outlines of qualitative data generated from orientation workshop discussions, semi-structured and document analysis, and the syllabus in particular.

Chapter Six: Presents data generated from the lesson observations and journal reflections.

Chapter Seven: This chapter provides a summary of the main findings, discussions, conclusions, recommendations and reflections.

1.9 CONCLUDING REMARKS

This chapter presented the contextual background of the study, statement of the problem, significance of the study, research goals and objectives, definition of the terms and thesis outline.

It was designed to guide the reader throughout the thesis. The next chapter presents relevant literature for the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In the previous chapter, I discussed the context of my study whose focus was exploring the integration of local knowledge in Physical Science lessons. In this chapter, I thus discuss the literature relevant to my study. Firstly, I unpack literature on curriculum issues related to the local knowledge in international and Namibian contexts. I then provide an overview of approaches to philosophies of education. Furthermore, I provide some insights of curriculum matters in relation to local knowledge. Secondly, I present the literature based on description of local knowledge, WS and practical activities in relation to local knowledge. I then proceed with the discussion on aspects and approaches that can bring about quality in teaching and learning of science. Thirdly, I deliberate on the benefits and challenges of integrating local knowledge. Finally, I present discussions grounded on the teachers' pedagogical development and their participation in professional development activities.

2.2 APPROACHES TO PHILOSOPHIES OF EDUCATION

Mukwambo et al. (2014) signposted that approaches to educational theories are categorised as either Eurocentric or Afrocentric (indigenous knowledge). Eurocentric are western educational theories that have been adopted both theoretically and practically within an African context while Afrocentric theories are those originated from within the African continent based on the principles of inclusivity, cultural specificity, critical and political awareness (Mukwambo et al., 2014). Odora Hoppers (2001) claimed that the African knowledge system experienced domination through Eurocentric colonialism and globalisation which devalued and negated African knowledge. Moreover, even though modern education deals with values, there is still marginalisation of African values in African education. This means that the African education system has failed to acknowledge the cultural preferences and practices of African people (Higgs & Smith, 2015). African philosophy has minimal influence in education because modern education is highly influenced by western values.

Although Namibia has been independent since 1990, the school curriculum remains Eurocentric and dominated by post-colonial education even though political power rests in the hands of African leaders (Matemba & Lilemba, 2015). One can say that the Namibian education reform did not fully adopt local knowledge as a significant form of knowing. Moreover, there is a struggle to reassert African values in education in order to establish African identity as Odora Hoppers explains (2001). Hence, there is the need for the revival of African values in the modern education system. Furthermore, many African scholars went through a western education system that indoctrinated them to view African indigenous knowledge and its scientific epistemologies and ontologies as irrelevant to ‘modernisation’, hence invalidated and irrelevant (Emeagwali & Shizha, 2016).

Having the background of these approaches to education, establishes the idea of what African education is all about and what should be done in order to bring about fairness and the revival of African values in the modern education system. In addition, Emeagwali and Sefa Dei (2014) acknowledged that academic scholarship has a duty to recognise the local cultural ways of knowing as legitimate sources of knowledge for a number of reasons; foremost though is to recognise African peoples as producers and creators of knowledge. Mukwambo et al. (2014) proposed Africanisation of the science curriculum, whereby the school system structures the learning activities based on the notion of ‘reaching what we know with what we have’. They further proposed that Africanisation processes require tools such as *ubuntu*, *indigenous knowledge* and *westernised science*. Likewise, Higgs and Smith (2015) brought a notion of *communality* within African traditional thinking.

Van Wyk (2014) developed seven fundamental constructs of an Afrocentric approach, namely, identity, Pan-Africanism, African culture and heritage, adoption and transmission of African values, Black Nationalism, community control with institution building, as well as education opposed to schooling. The tools for Africanisation are interrelated and that is the reason Mukwambo et al. (2014) are of the view that *ubuntu*, *IK* and *WS* are the tools available to science teachers and that the teacher should create powerful points of ‘pedagogical interconnectedness’ in the science curriculum. In this study, Afrocentricity is viewed as an inclusive approach to teaching and learning, whereby the teachers are expected to teach so that their learners see themselves represented in all aspects of the school system. In the context of this study, schools where science is taught are expected to develop the need to integrate African indigenous knowledge strategies

for teaching and learning into the science curriculum. This is what Mhakure and Otulaja (2017) refer to as culturally responsive pedagogy.

2.3 CURRICULUM MATTERS IN NAMIBIA

Curriculum is a complex social and educational construct that leads to broad and narrow definitions. A broad understanding is that curriculum is a systematically organised body of knowledge through which the goals of education can be achieved for the fulfilment of the needs and aspirations of any given society (Igbokwe, Mezieobi, & Callistus, 2014). On the other hand, a narrow definition of curriculum is that it is intended, and planned learning proposed by the school system and classroom teacher (Perso, 2012). Essentially, curriculum has to do with teaching and learning of knowledge, skills and attitudes which embrace issues such as subject-matter, pedagogy, evaluation, as well as related resources involved in the organisation, delivery and articulation of education programmes (Loreman, Deppeler & Harvey, 2010). Tyler (1959) identified knowledge, society and learners as sources of curriculum design whereby societal values should be considered in education; knowledge is to be regarded as the centre of a curriculum and should embrace the learners' knowledge. The Namibian National Curriculum for Basic Education (2015) defined a curriculum as an official policy for teaching, learning and assessment which gives direction to planning, organising, as well as implementing teaching and learning. It serves as an official reformed framework policy that guides schools on how to organise the teaching-learning processes.

Based on the reformed Namibian National Curriculum for Basic Education (2015), effective teaching should embrace the learners' prior everyday knowledge, local knowledge or IK in order to bring about a knowledge-based society. It stresses that Grade 8-9 Physical Science syllabi (2015, p. 2-4) require teachers to be inclusive in their teaching and that they are expected to:

Meet the needs of the learner through differentiation of teaching methods and materials; and understand that few learners might not be able to achieve all the specific objectives satisfactorily and must receive learning support through adapted teaching approaches, adapted materials, and assistance from peers. A small number of learners have special educational needs to a degree which requires greater individual attention, resources or assessment.

The question, however, is to what extent the integration of local knowledge has been taken into consideration by the Namibian reform curriculum, in relation to what the teachers are expected to do? The other question is whether teachers understand what the curriculum expects them to do in relation to the integration of local knowledge in their science classrooms. Moreover, teachers' attitudes towards the integration of local knowledge in science lessons might have an impact on the learners' learning (Perso, 2012). Hence, the Namibian Physical Science Curriculum for Grade 8-9 (2015) recommends the learner-centred education (LCE) approach as an appropriate pedagogy to use in teaching and learning. It is believed that learners learn best when they are actively involved in the learning process (Vygotsky, 1978; Sedláček & Sedova, 2017). At the same time, it should be recognised that each learner is an individual with his/her own needs, pace of learning, experiences and abilities. The teacher should be able to identify the needs of the learners and understand how to shape learning experiences accordingly. Thus, Mavuru and Ramnarain (2017) emphasised the importance of taking into consideration learners' socio-cultural backgrounds. Teaching strategies must therefore be varied and be flexible within well-structured sequences of lessons (Physical Science syllabus, Grade 8-9, 2015).

For learners to participate fully in the learning process, teachers need to apply Contextualized Teaching and Learning (CTL) pedagogies (Berns & Erickson, 2001). Berns and Erickson (2001) defined CTL as the teaching and learning strategy whereby the teacher teaches by relating the subject content to real life situations. When local knowledge is integrated in science classrooms, it has a potential to contextualise science. Mukwambo (2016) articulated that Contextualized Teaching and Learning Pedagogical Practices (CTLPP) bring a genuine context that helps the learners to see the relevance of science concepts that the teacher presents. He further articulated that sometimes teachers have challenges in addressing the social and physical context in an African context, as in some cases formal work environments are sometimes quite far from certain schools. In addition, a teacher might have difficulties in implementing the curriculum effectively in order to integrate local knowledge in their teaching.

A study was conducted by the Indonesian Curriculum Research Centre to monitor the implementation of the school-based curriculum in primary and secondary schools across the nation. It revealed that CTL had not been implemented effectively as intended in most of the schools due to some of the factors identified as hindrances such as, unequal distribution of information about the curriculum, inconsistency of information regarding the curriculum, lack of

teachers' understanding, lack of teaching and learning resources, as well as the lack of appropriate training (Puskur, 2007).

Another study regarding how teachers perceived new curriculum reforms was conducted by Bantwini (2010) in a school district in the Eastern Cape Province of South Africa and it revealed that teachers lacked understanding of the mandated curriculum. It also revealed that the new curriculum was viewed as a burden to teachers causing them to be overloaded. Consequently, some teachers were not implementing the reformed curriculum effectively. In the Namibian context, Tubaundule (2014) investigated the factors that influenced the implementation of the secondary school curriculum as intended by curriculum developers. The study revealed that the Namibian teachers' implementation of the national curriculum was negatively affected by many factors such as teachers' knowledge, attitudes and beliefs, as well as teachers' professional development. In this study, such factors are viewed as the teachers' barriers to effective curriculum implementation and integration of local knowledge in classrooms.

The NPRSTI (2014) aimed at ensuring that the Namibian local indigenous knowledge (IK) was properly documented. NPRSTI urged that Namibian school curricula should also include indigenous knowledge to enhance learning and teaching. De Beer and Whitlock (2009) indicated that by including IK in the curriculum, the social identity of learners are acknowledged which can turn learning into a more positive experience – especially for those learners who are resistant to studying the WS curriculum. Madjidi and Restoule (2008) suggested that curricula should include indigenous knowledge and indigenous ways of knowing as a means of appealing to the personal dignity of learners and the community, as well as providing opportunities to validate their lived experiences. Concurring, Mawere (2015) stressed that realisation of local knowledge can only be recognised if it is fully implemented in education curricula and its importance should then be popularised. Likewise, Thompson (2016) concluded that local knowledge needs to be integrated into the mainstream curriculum, by providing locally relevant ways and examples of learning about the environment, plants, animals, geography, and language that will give students self-confidence and a stronger sense of identity and community. The focus is on the potential role of local knowledge in motivating, raising interest and promoting both innovative thinking and a sense of self-consciousness in the students. The integration of IK in the curriculum can act as a powerful tool during the teaching and learning process (Srikantaiah, 2005).

Effective science learning environments help learners build on their IK by recognising their scientific cultural practices. It can be said that IK is part of a learners' prior knowledge and cultural capital. Integrating IK into an educational environment helps learners to take ownership of the knowledge they bring to the science class. Freire (1993) indicated that allowing the learners to have ownership of their knowledge is the same as respecting their culture, tradition and identity. Freire (1993) thus proposed a curriculum deeply rooted in the social, cultural and economic context of disadvantaged and oppressed communities. Hence, it could be argued that by integrating local knowledge and WS, resembles an inclusive education that affords learners an opportunity to understand the relevance and meaning of scientific knowledge they are being taught. Ornstein and Hunkins (2018) specified that learners should be active in their learning environments and that learning should not be separated from their lives, needs and interest. In other words, learners must be able to grasp knowledge from both local knowledge and WS perspectives.

2.4 LOCAL KNOWLEDGE VS WESTERNISED SCIENCE

MacKenzie (2011) specified that local knowledge is viewed as a knowledge that people have from local realities. Furthermore, local knowledge is the knowledge that a child or any individual learns from their birthplace in order to grow and understand the world. Local knowledge and indigenous knowledge are used interchangeably in literature and they are regarded as an entry point for effective teaching and learning.

Semali and Kincheloe (1999) defined indigenous knowledge (IK) as dynamic native ways of knowing which involve creativity of residents for a particular locality to understand themselves in relation to their natural environment to seek solutions to their daily problems. Boven and Morohashi (2002) extended the definition of indigenous knowledge by stating that it is the local knowledge that is unique to a given culture or society. It is the basis for local-level decision-making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural communities. De Beer and Whitlock (2009) and Mawere (2015) understood that IK is the sum of the total knowledge and skills which people in a particular area possess and which enables them to get the most out of their natural environment.

According to Emeagwali (2014), IK may be defined as the cumulative body of strategies, practices, techniques, tools, intellectual resources, explanations, beliefs, and values accumulated over time in a particular locality, without the interference and impositions of external hegemonic forces. Ogunniyi (2007a) indicated that IK is based on oral knowledge transmitted from generations in forms of stories, riddles, games, songs, dances, rituals, ceremonies, dreams and intuition. He further indicated that WS is a documented knowledge in libraries, text, publications as well as digitally, involving principles, laws, theories, axioms, concepts, fact, models, as well as representations such as graphs and pictures.

Westernised science (WS) is perceived as an intellectual activity designed to discover information about the natural world and to discover the ways in which this information can be organised into meaningful patterns that have been adopted as the rationale for teaching WS in schools (Shizha, 2008). However, Kibirige and Van Rooyen (2006) posited that IK is locally based on practical activities from trial and error, transmitted orally through imitation, repetition and demonstrations that are based on intuitive thinking modes that rely on spiritual and cultural facts. Le Grange (2007) argued that there is cognitive dissonance as IK has been ignored and its absence or silence in the science curriculum has created conflict between local existing knowledge and the science knowledge in the curriculum. This might be the cause of the failure and/or lack of interest in science subjects. Le Grange (2007) further argued that WS is viewed as superior to IK, as it is seen as universal and objective.

Westernised science and indigenous knowledge systems (IKS) systems have been questioned and critiqued by a number of scholars and politicians in both Africa and Asia, as well as in the West (Bredlid, 2009). Aikenhead and Ogawa (2007) protested that WS is a dominant knowledge system of the western world that originated in Europe and its values dominate those of indigenous people around the world. Mukwambo et al. (2014) implicitly stated that WS is Eurocentric and manifests itself strongly and powerfully in our ideas, culture and education. In the context of this study, WS and indigenous knowledge are both viewed as overlapping or intersecting ways of knowing and they both support teaching and learning of science as posited by Taylor and Cameron (2016). In addition, the inclusion of local knowledge in science teaching might encourage teachers to teach WS and local knowledge in a complimentary manner. Westernised science is regarded as offering a broader understanding of aspects beyond the local level, while IK offers depth of experience in

a local, culture-specific context (Abah, Mashebe & Denuga, 2015). This study advocated that effective science teaching and learning should be influenced by both scientific and cultural world views.

With the background of dominant WS and teachers' pedagogical challenges in curriculum implementation, this study developed professional activities as an intervention that promoted inclusion of local knowledge in science teaching in order to improve teachers' pedagogical skills and to contextualise teaching in Namibia. Based on the studies on teachers' and cultural science in the South African context, Ogunniyi (2007a) found that teachers opposed indigenisation and contextualisation of science due to the historical worldview that WS is better than IK. Similarly, teachers' beliefs and lack of knowledge determined teachers' pedagogical practices in their classrooms and this made teaching and learning of science unsuccessful because the subject was not linked to everyday life experiences of the learners and the language of instruction alienated them (Shizha, 2007, 2008). Furthermore, science teachers' understanding of IK lacks the methodological part of IK (Dziva, Mpofu & Kusure, 2011). This suggests that teachers are lacking creativity on how local knowledge can be integrated to promote hands-on practical activities in their lessons.

2.5 HANDS-ON PRACTICAL ACTIVITIES

Lunetta, Hofstein and Clough (2007) defined practical activities as the learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world. Practical activities in science have enormous potential for exciting students, giving first-hand knowledge which supports theory, in the form of demonstrations, class experiments, stimulations, role play, investigations or problem-solving activities (Wellington & Ireson, 2012). The motive for doing practical activities in science classrooms is to encourage accurate observation, teach specific skills and techniques making phenomena more real and to also arouse, as well as maintain, the interest of the students. The Physical Science syllabus of Grade 8-9 (2015) indicated that practical activities or demonstrations should be carried out in all the topics and it should be considered essential that all students be exposed to them, both during teaching and as preparation for assessment. Abah et al. (2015) stated that integration of IK in education is significant for an African child to learn meaningful practical application within his/her community.

Integration of local knowledge in Physical Science lessons may enable teachers to develop their students' understanding beyond memorisation of facts.

Hodson (1990) showed that practical activities do not contribute much to the students understanding of scientific facts as compared to other methods. Students should be helped to relate practical activities to their learning, understanding the process of discovery by the use of cheap resources in the environment (Asheela, 2017). There is thus the need for the teachers' content knowledge and pedagogical skills to be shaped through interventions in the professional development to bring about quality in their teaching.

2.6 QUALITY IN SCIENCE TEACHING AND LEARNING

Killen (2015) recommended the Quality Teaching Model (QTM) which characterises quality teaching practices into three dimensions, namely, intellectual quality, significance and quality learning environment. According to the South African Department of Education (2003) the intellectual quality dimension is based on the idea that higher quality student outcomes, results if learning is focused on intellectual work that is challenging, centred on significant concepts, ideas that requires substantial cognitive and academic engagement with deep knowledge.

Teachers should make learning significant to students by their cultural background knowledge, integrating knowledge to create connectedness as well as by being inclusive (Killen, 2015). That is to say that what the learners understand already has a very significant influence on whether and how well they learn something new (Bennett et al., 2004). QTM suggests that learners are more likely to develop deep understanding of whatever they are studying if teachers deliberately help them to make meaningful connections between different pieces of knowledge within or between subjects. This is what is called knowledge integration. Consequently learners can see the relevance in learning and make useful connections between what they are learning and the real world.

The third dimension of QTM is creation of a quality learning environment. Killen (2015) claimed that learning environment is more than just than just the physical space in which learning occurs, it also includes the interactions and relationships between the learners and the teachers as well as among the learners. Hattie (2009) further claimed that a conducive learning environment is one

where error is welcomed as a learning opportunity and where participants can feel safe to learn and re-learn and explore knowledge and understanding. To create a positive learning environment, teachers need to accommodate their learners' backgrounds and prior knowledge, and structure learning activities in a way that it is interesting, challenging and realistic.

King and Schielmann (2004) identified aspects that influenced quality indigenous education programmes namely: participation and decision-making, pedagogy and methodology, indigenous knowledge, curriculum, language instruction, teacher training and materials. The concept of *participation* has a strong influence in Community of Practice Theory (CoP) (Wenger, 1998; Lave & Wenger, 1991). Nevertheless, King and Schielmann (2004) understand that quality indigenous education should involve indigenous people to participate in the production, review and approval of educational materials to support implementation, as well as enhancing responsibility and ownership of indigenous people over educational practices and contents. The community around the school might be a significant source of knowledge, resources or materials for the schools as well as expertise in languages and cultural aspects that can be used to support teaching and learning (Namibian National Curriculum for Basic Education, 2015). This might help the teachers to shape their pedagogical skills.

Other quality aspects in indigenous education are *conceptions, disposition* or *attitudes* for both teachers and the students. Conception is influenced by an individual's knowledge, values, assumptions and views. On the other hand, attitudes or dispositions are groups of thoughts and actions that affect how we react to individuals and groups of people (Loreman et al., 2010, p. 47). In other words, attitudes are behaviours that people learn or are developed from social interactions as proposed by Vygotsky (1978) which enable them to make sense of the world.

The literature shows that research studies have been carried out to investigate teachers' knowledge, attitudes, perception and conception towards integration of IK in the science classroom. Dziva et al. (2011) carried out a research in Zimbabwe on teachers' conceptions of IK in the science curriculum, which revealed that in some cases teachers used IK resources to clarify scientific concepts or as illustrations of how scientific events happen. They further revealed that teachers stereotyped IK as being of lesser value as compared to school science because they felt that IK could not be subject to proof-testing. In this study, the knowledge of the subject matter for Grade

9 Physical Science and strategies for how subject matter is to be learnt or taught might be shaped though an intervention.

Quince (2012) reported that teachers are hesitant about integrating indigenous content as they feel that they do not have expertise to integrate. Michie (2002) recognised that teachers do not have much knowledge about indigenous science, lacking resources and poor access to professional development. However, in the Australian context, BurrIDGE and Evans (2012) showed that teachers' participation in professional learning communities increased teachers' inclusion of indigenous cultural knowledge in their teaching.

In the Canadian and Zimbabwean contexts, Aikenhead and Huntley (1999) and Shizha (2008) respectively revealed that teachers' understanding, beliefs and attitudes towards integrating WS and indigenous science was firstly, found to be *conceptual*, as teachers did not recognise the cultural nature of science. Secondly, it was *pedagogical*, in that teachers experience a lack of accommodation and understanding of IKS in relation to WS. Thirdly, teachers' attitude was found to be *cultural*, in that WS education affected teachers' interpretation of science negatively, that indigenous ways of knowing are not applicable in science teaching. Fourthly, it was *psychological*, as teachers had a feeling that indigenous knowledge was inferior as a result of colonial mentality that disadvantaged the integration of the indigenous perspective. Fifth and finally, teachers' attitudes were observed to be *practical* as it was based on unavailability of indigenous teaching materials and lack of institutional support which made teaching indigenous science impossible. In Aikenhead and Huntley (1999) and Shizha (2008) viewed the above as barriers to the teachers' instructional practices of science teaching. In addition, Alsalouli (2004) indicated that teachers' conceptions of and disposition towards their subjects influence their instructional practices. To reflect on these concepts, one has to understand that teachers should first develop a positive disposition towards their subjects and their instructional practices in relation to the inclusion of indigenous knowledge in order to build within their multicultural classrooms.

2.7 MULTI-CULTURAL AND INCLUSIVE APPROACHES TO SCIENCE TEACHING

United Nations Educational, Scientific, and Cultural Organisation (UNESCO) Action Plan (2001) for implementation of a universal declaration on cultural diversity specified that, where appropriate, traditional pedagogies need to be incorporated into the education process with a view to preserving and making use of culturally appropriate methods of communication and transmission of knowledge. Hence, UNESCO supports intercultural education as a means of promoting respect for cultural diversity. For one to have a reasonable knowledge of multicultural education, the concept of diversity should be understood. Van Heerden-Pieterse (2015) noted that diversity is a complex phenomenon of differences that are based on culture, race, personality, nature and nurture. According to the Calgary Board of Health (2008), diversity is defined as all ways in which we are unique and different from others. Educators need to acknowledge dimensions of diversity in their classroom in order to manage multicultural education. However, nowadays teachers are facing the challenges of teaching and managing students of unfamiliar cultures, social class, languages and backgrounds (Sotuku & Duku, 2015). To overcome this challenge, multicultural and inclusive approaches to teaching were introduced to acknowledge that all cultures are important and that they should be appreciated in the school context.

Inclusion is about developing comprehensive community and education systems and putting values in action (Booth & Ainscow, 2011). Loreman et al. (2010) understood inclusion as the full involvement of all students in all aspects of schooling, regardless of the presence of individual differences. Killen (2015) highlighted that inclusivity implies that all students should feel that they are being involved in classroom activities as their backgrounds, cultural differences, interests, insights and intelligences, as well as their contributions to the classroom, are valued and acknowledged. Inclusive education is the process of addressing and responding to the diversity of needs of all children, youth and adults through increasing participation, cultures and communities, and reducing and eliminating exclusion within and from the education system (UNESCO, 2009). Inclusive approach to education means ending segregation or the deliberate exclusion of individuals or groups on the grounds of academic performance, gender, race, culture, religion, lifestyle, health conditions or disability (Namibian Sector Policy on Inclusive Education, 2013). The role of an inclusive approach to science teaching is to shift the focus from blaming the child for difficulties in learning to the interaction between the learner and his/her environment.

The Namibian *Sector Policy on Inclusive Education* (2013) contributes to pedagogical and wider educational development and correlates with the policy directions of the *National Curriculum for Basic Education*. This suggests that inclusivity is a significant model that can bring about quality and equity in education. On the other hand, Drake (2014) stressed that the implementation of inclusive education faces challenges such as lack of funding and discrepancy between training and the demands of inclusive classroom.

It is recognised, however, that inclusion and integration are complex phenomena, as Loreman et al. (2010) summarised that teachers are concerned about training for inclusion, appropriate curriculum for all learners, available resources, as well as school and classroom structures that inhibit inclusion. This study thus intended to create an empowering environment for teachers to understand and embrace inclusive approaches to science teaching.

2.8 BENEFITS AND CHALLENGES OF INTEGRATING LOCAL KNOWLEDGE IN SCIENCE LESSONS

Attempts to integrate local knowledge in school curriculums have been made in different contexts. The state of Alaska in the United States initiated the Alaska Rural Systemic Initiative (AKRSI) and the Alaska Standards for Culturally Responsive Schools in 1999 and guidelines for respecting cultural knowledge as well as strengthening indigenous languages in 2000. A Resource Handbook for Culturally Responsive Science Curriculum was developed to provide practical examples on how to incorporate traditional knowledge curricula and integrate it with WS (AKRSI). Some of the changes and effects made through the AKRSI initiatives included involvement of state and other stakeholders to support such initiatives, production of science educational materials based on local language and cultural knowledge. The initiative also improved learners' achievement scores, decreased their drop-out rate, increased the number of rural learners attending colleges, and increased the number of native learners choosing to pursue studies in the field of science, mathematics and engineering (AKRSI).

In the Namibian context, a project that aimed at including indigenous knowledge and skills was implemented in 2003 with the Nama people in rural schools of the Kharas Region. In the Traditional Life Skills Project (TLSP), parents and grandparents taught children some of the

traditional life skills and knowledge of the Nama people such as various kinds of handicrafts, agricultural techniques and traditional medicine and cosmetics at the schools in the afternoons (Klein, 2011). The project was successful in some of the communities as it made a significant contribution to the conservation of the Nama culture and reduced both drop-out rates and disciplinary problems in some of the schools. It also contributed economically to the local societies through sales of products which they manufactured. However, in some of the communities the project did not succeed due to the fact that some local resources such as social capital were more than the actual level of IK found. It is recommended that such projects should be grounded even more strongly in the school system in order to overcome the lack of social capital and entrepreneurial skills in some of the communities.

Integrating IK in science lessons is not an easy task as there might be challenges that are based on educators' attitudes and pedagogical knowledge (Shizha, 2007). Shizha stressed that some teachers and parents undervalued the effectiveness of IK because it is not a documented fact. He further stressed that teachers relied on documented information, accepting it as legitimate knowledge and prescribed scientific knowledge.

Ogunniyi (2007a) speculated that the rationale behind integration is to identify valuable indigenous wisdom that has been lost due to colonialism King and Schielmann (2004) stressed that the challenge in indigenous education lies in establishing links between indigenous skills and national standard curricula. They further stressed that, in recognising these different yet equal and complementary systems of knowledge and world views, one needs to understand that the linkage is a gradual process that can be achieved by providing instruction in the indigenous community's values, traditions, language, and agricultural techniques. This prepares students with the practical skills they need to participate in national society, as well as emphasising the study of traditional life, culture in formal education systems and the advocacy of curricula that puts local heritage on an equal footing with standard subjects such as maths, science and natural history.

Nevertheless, Hattie (2012) felt that teachers experience the challenge of spending an undue amount of time on planning and resourcing lessons which affects effective teaching and learning. To overcome such challenges, Mednick (2004) provided a good guide for teachers to collaborate in terms of lesson planning, resource development and sharing. In the context of this study, the implementation and mediation of IK lessons was done based on a collaborative effort of planning

and teaching within a professional learning community structure; as Al-Shareef and Al-Qarni (2016) indicated, teamwork and collaboration are very important to teachers in order to improve their pedagogical practices.

2.9 KEY ISSUES FOR TEACHERS' PEDAGOGICAL DEVELOPMENT

Content knowledge (CK) is knowledge about the actual subject matter that is to be learned or taught while pedagogical knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning. This includes knowledge about techniques or methods to be used in the classroom, the nature of the target audience, and strategies for evaluating student understanding (Mishra & Koehler, 2006).

In the mid-eighties, a psychologist and scholar of teacher education developed the notion of Pedagogical Content Knowledge (PCK) as a response to what he saw as problematic distinction between the knowledge of the subject (content knowledge) and knowledge of teaching and education (pedagogical knowledge) (du Plessis & Muzaffar, 2010). Shulman (1987) maintained that effective teachers' education should go beyond the subject to be taught (content knowledge) and the set of strategies to deliver it (pedagogical knowledge). He then created the third domain of knowledge (Pedagogical Content Knowledge) that has to do with an idea on how to teach a particular subject based on how students view the subject, why some topics are easy or difficult, how to structure or present the topics in a manner in which students can make sense of what is taught. Shulman (1987) stressed that when subject content knowledge and pedagogical content knowledge are joined, they create a knowledge space referred to as Pedagogical Content Knowledge (PCK).

As a teacher, what you teach and how you teach matters equally and teachers need to use and reflect on a variety of teaching methods and adapt practices in their teaching. This is what du Plessis and Muzaffar (2010) referred to as teaching within a pedagogical milieu. With PCK, the teacher will be able to interpret the subject matter and find different strategies to represent it and make it understandable to students. Teachers will then be able to understand inclusion of indigenous knowledge in science teaching. Looking at the instructional practices of teachers, the literature revealed that there is a knowledge gap between what teachers are expected to do in

reformed education and their Pedagogical Content Knowledge (PCK). The evidence suggested that teachers' classrooms and pedagogical practices are not always aligned with methods promoted by the education system (Howey, 1996) such as a learner centred approach and inclusive education. This is the reason why teachers are encouraged to participate in professional learning communities in order to improve their teaching practices (Vescio, Ross, & Adams, 2007).

2.10 PROFESSIONAL DEVELOPMENT INTERVENTIONS

The state of education in Africa was not making a substantial impact on students' academic performance and that is why in 1990 in Jomtien, Thailand, leaders from around the world met to address challenges in education on a global level (UNESCO, 2009). The most significant outcome of the meeting was an agreement that all children should have access to basic education by the year 2000 through commitment to the policy of Education for All (EFA). EFA required students' performance improvement through improved teacher practice reforms based on Learner Centred Education (LCE).

To achieve these in the Namibian context, there was an increased demand for teachers' education based on five challenges (du Plessis & Muzaffar, 2010). The first challenge was that *teachers were teaching as they were taught*; memorising as well as recalling information at a lower level of cognitive skills; second, *there was a lack of sustained institutionalised professional development for teachers*; third, *poor institutional role in professional growth and development*; the fourth challenge was *cultural barriers to teachers to implement active pedagogy and pressure for the teachers to complete syllabus to cover examinations*. That is how Namibia shifted to teacher education reform within professional development based on these challenges in relation to several broad principles: access, equity, quality and democracy (Swarts, 2003).

Intervention within professional development is an activity that develops an individual's skills, knowledge, expertise and other characteristics as a teacher (Organisation for Economic Co-operation and Development, 2009). Teachers' continuous engagement in professional learning activities is critical for critical improvement of their knowledge instruction and student learning (Akiba & Liang, 2016). Professional development is regarded as a model and a way of supporting a paradigm shift to Professional Learning Communities (PLCs) (Vescio et al., 2007). According

to Tshiningayamwe (2016), teachers in PLCs shared successful teaching strategies, developed new approaches to shared problems and shared specific subject content knowledge. PLCs are linked to professional development and they are discussed under Communities of Practices in the theoretical framework chapter.

According to the decentralised model for Continuing Professional Development (CPD) for educators in Namibia (2012), CPD can be regarded as a tool for pursuing Vision 2030 and the Namibian National Professional Standards for Teachers (NNPST), by improving teaching and learning. In the Namibian context, the Ministry of Education, Arts and Culture facilitates intervention professional development activities through the National Institute for Educational Development (NIED), the Programmes for Quality Assurance division within Directorate of Education (PQA), and the University of Namibia, through its Faculty of Education. The Educational Quality Improvement Programme, is a teacher self-assessment system that provides tools for teachers to reflect on their classroom practices, after which they can participate in professional development activities within local and national reform frameworks (LeCzel & Gillies, 2004).

The objectives for interventions are to update individuals' knowledge of a subject in light of recent advances in the area, update individuals' skills, attitudes and approaches in light of the development of new teaching techniques, to exchange information and expertise among teachers and to help teachers become more effective (decentralised model for Continuing Professional Development CPD for Educators in Namibia, 2012). Literature showed that there is a relationship between professional development and teachers' instructional practices. Guskey (1986) formulated a model for professional development programmes which is viewed as a process linking changes in classroom practices to teachers' educational practices.

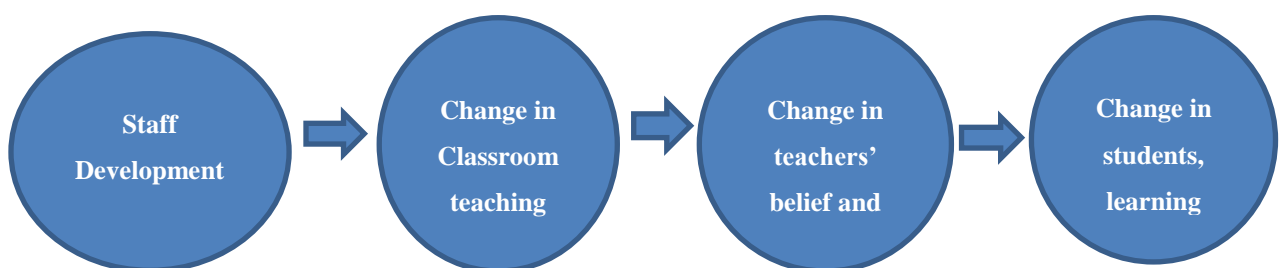


Figure 2.1: Shows a model of the process of teacher change (Guskey, 1986, p. 7)

According to Guskey (1986), the model shows that significant change in teachers' beliefs and attitudes are likely to take place only after changes in student learning outcomes are evidenced. This is because of specific changes teachers have made in their classroom practices, for example, a new instructional approach, the use of new materials or curricula, or simply some modification in teaching strategies. This framework emphasises the continuous implementation of professional development to get the desired change in classroom practices which will enhance students' achievements and finally change academic beliefs, as well as attitudes towards teaching (Shava, 2016). In other words, Guskey's (1986) model of teacher change expects teacher development programmes to result in changes in teaching approaches and achievement of the students. Huffman, Thomas and Lawrenz (2003) revealed that approaches to professional development such as collaborative work, curriculum implementation and others have been shown to affect positively teachers' knowledge, instructional practices and their knowledge of mathematics and science. Similarly, Akiba and Liang (2016) discovered that research driven activities within professional development and participation of the teachers were found to be associated with students' academic improvement and achievement growth in mathematics. This model does not explain or account for all of the variables that might be associated with the teacher change process and it acknowledged that a change is gradual and that there are complex processes that involve interrelationships of its components (Guskey, 1986).

In the context of my study, professional development is conceptualised as an intervention programme which will focus on embedded teachers' practices to guide improvement on their teaching pedagogies as proposed by Fraser, Carroll, McKinney and Reid (2006). Behera (2014) indicated that intervention programs are essential for teachers as they inculcate curiosity, motivation, and new ways of thinking. However, Barnett (2002) reported that inadequacy of follow-up intervention programs after in-service training courses was one of the most crucial problems of professional development programs. Barnett (2002) suggested follow-up activities since one or two day seminars are not sufficient to improve teacher knowledge and skills by themselves. Furthermore, my study will consider the possibilities of planning some follow-up activities after the study intervention.

2.11 CONCLUDING REMARKS

This chapter discussed the literature related curriculum issues, from local knowledge to international and Namibian contexts. It then provided an overview of approaches to philosophies of education. It provided an insight into curriculum matters in relation to local or indigenous knowledge. It then looked at the literature based description of IK, WS and practical activities in relation to local knowledge. It further looked at discussions on aspects and approaches that can bring about quality in teaching and learning of science. Finally, the literature deliberated on the benefits and challenges of integrating local knowledge, pedagogical development, as well as the participation of teachers in professional development activities. In the next chapter, I discuss the theoretical framework that informed this study.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.1 INTRODUCTION

A theoretical framework is an explanatory mechanism which serves as the lens that guides the research process. A theoretical framework determines things to be measured as well as to establish relationships and provide the study with an identity and also to position the discussion within the study based on its theoretical orientation (Okeke, Van Wyk, & Phasha, 2014). Vygotsky's (1978) socio-cultural theory and Wenger's (1998) Community of Practice (CoP) informed my study. The socio-cultural theory informed the study in terms of learning, by looking at how teachers can learn in a social cultural context and relate socio-cultural knowledge to the subject content knowledge. On the other hand, the CoP informed the study based on how the group of individuals participated in a social set-up within the community, to share their knowledge, experiences and learn from each other. Each of these two theories was not enough on its own to inform this study and the two frameworks complemented each other. Firstly, this chapter presents discussions on Vygotsky's (1978) socio-cultural theory and how it informed the study. Secondly and finally, the chapter discusses Wenger's (1998) Community of Practice and what it meant for my study.

3.2 SOCIO-CULTURAL THEORY

Socio-cultural theory was developed by a Russian psychologist Lev S. Vygotsky, around 1920. Vygotsky was interested in applying Marxist theory to individual psychology as his approach to cognitive development was "the socio-cultural aspect with an assumption that action is mediated and cannot be separated from the milieu in which it is carried out" (Wertsch, 1991, p. 18). The socio-cultural theory describes learning as a social process and the origination of human intelligence in society or culture and its major theme is that social interactions play a fundamental role in the development of cognition (Vygotsky, 1978). Vygotsky (1978) believes that everything is learned on two levels – through *interaction* with others, which is then *integrated into the individual's mental structure*. His theories of development differ from other social theoretical frameworks in the sense that he acknowledged social interaction as significant in the processes of

individual development and psychological functions. Socio-cultural theory has many concepts and I only focused on those that spoke to my study, namely, culture, language and mediation, internalisation, self-regulation, social interactions and Zone of Proximal Development (ZPD).

3.2.1 Culture, language and mediation

Culture is all about languages, customs, knowledge, beliefs, values and norms that combine to make up the way of life of any society (Beeden & Van Zyl, 2015). It provides basic orientations that construct the behavioural environment and the development of an individual. Language is the component of culture which is used in interaction as a means of communication. It is a major source of information for communication, a critical resource mechanism for people to understand the nature of culture and how cultural knowledge and beliefs are transmitted both from generation to generation and in everyday interaction (Schieffelin & Ochs, 1986). Without language, it would be impossible to socialise and interact because language is regarded as a vital tool through which learning and thinking is shaped. To Lantolf and Thorne (2006), language use, organisation and structure are the primary means of mediation.

Mediation is central to social interactions whereby individuals' mental processes are comprised of higher and lower mental functions. Vygotsky (1978) indicated that lower mental functions (*intramental psychological abilities*) are those that are genetically and natural mental abilities of an individual, while higher mental functions (*intermental psychological abilities*) are those developing through social interaction or culturally mediated activities. The concept of culture, language and mediation are interrelated and informed my study in the sense that the inclusion of local knowledge constitutes culture and this inclusion cannot be possible without language as a mediational tool. When mediation takes place, mental processes are involved to ensure the process of self-regulation and internalisation.

3.2.2 Self-regulation and internalisation

Harrison and Muthivhi (2013) state that self-regulation refers to a deep internal mechanism that underlies mindful, intentional and thoughtful behaviours of children and is the capacity to control one's impulses, both to stop doing something (even if one wants to continue doing it) and to start doing something (even if one does not want to do it). According to Vygotsky (1978) children's ability to regulate themselves is linked to social activity that enables them to explore and become

more independent learners and start regulating their own learning. In the context of this study, self-regulation was manifested in the teachers' reflections that after taking part in the intervention, they were able to regulate themselves by integrating local knowledge into their lessons. Internalisation is the process through which cultural artefacts, such as language, take on a psychological function within an individual (Lantolf & Thorne, 2006). Eun (2008) indicated that internalisation is one of the core concepts of socio-cultural theory which goes along with the process of mediation. Internalisation cannot take place without mediating tools (Vygotsky, 1987) and for it to take place effectively, teachers need to be given enough time to learn and reflect on the engagement of interventions within professional development programmes (Eun, 2008).

In the context of my study, mediating tools (in the process of internalisation) such as integration of local knowledge in the Physical Science classroom has the potential to alter teachers' psychological functions. In addition, there is an interrelationship of existing mental functions (intra-psychological planes) and newly created ones through social interaction (inter-psychological planes) which lead to new psychological systems. In order to achieve new psychological functions, mediation through social interaction should take place through organised social activities (Eun, 2008) such as the interventions that I had with the teachers, based on inclusion of local knowledge in their science lessons. The processes involved in internalisation bring about the Zone of Proximal Development.

3.2.3 Zone of Proximal Development (ZPD)

Zone of Proximal Development is the "distance between the actual developmental levels determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). The ZPD can also be understood as the difference between what an individual can do independently and what he or she is able to do with mediation. Lantolf and Thorne (2006) designated that the ZPD is characterised by cognitive development as a result of social interpersonal activities, as well as intrapersonal functioning. Lantolf and Thorne (2006) further designated that ZPD can be induced by activities of participation in organised cultural practices and also through collaborative efforts with others in order to shape development. However, there are some current literatures that approach the concept of ZPD with a new look and understanding.

Scott (2016) understood that the ZPD is not individual centred but developed through social interactions with others during a series of learning activities which depends on the active contribution of all the participants. Abtahi (2017) understood that Vygotsky's concept of development should be regarded as an end product of the learning process. Development and learning are two interrelated processes (Abtahi, 2017). In other words, for ZPD to be achieved a series of organised learning activities should be given and learning is regarded as the tool that brings about the ZPD. According to Wenger (2000), learning is interplay between social competence and personal experience which is a dynamic, two way relationships between people and the social learning systems in which they participate. Based on the neo-Vygotskian interpretation of ZPD, one cannot discuss the concept of ZPD without talking about the concept of learning simply because development cannot take place without learning.

In the context of my study, firstly, the concept of the ZPD is viewed as the *model of developmental process* for the teachers, whereby analysis was made to see how their pedagogical skills and content knowledge expanded (or not) by mediation of local knowledge. Secondly, ZPD is viewed as a *conceptual tool* that teachers used to understand how their students internalised certain concepts through integration of local knowledge in Physical Science lessons, which helped teachers to mediate learning within the ZPD of their students. Thirdly, the ZPD is viewed as a *diagnostic instrument* to create teaching and learning conditions that might raise cognitive development of their students.

In summary, the socio-cultural theory provided me with useful concepts that helped to understand and explain how learning can take place in socio-cultural contexts (Mavuru & Ramnarain, 2017). Since local knowledge is a component of culture, this theory seemed to be an appropriate lens to analyse how teachers can learn socially to improve their teaching practices, by integrating local knowledge into Physical Science lessons. However, socio-cultural theory alone was not enough to inform my study due to the fact that it did not clearly explain how a group of people who share common experiences such as educators can learn, and share ideas through interacting regularly. For this reason, I have also used Wenger's (1998) Community of Practice (CoP) in this study.

3.3 Community of Practice (CoP)

Community of Practice (CoP) was developed by Wenger (1998). This scholar defined CoP as groups of people who share a concern or a passion for something they do and learn how to do it

better as they interact regularly. Abigail (2016) defined CoP as a group of people who interact on an ongoing basis by sharing concerns and engaging in deepening their knowledge of and expertise in common practices. The construct of community of practice is grounded in socio-cultural theories of learning and development that Vygotsky (1978) and Engeström (1987) contend all human development is founded upon – social interaction in cultural and historical practices that are mediated by the use of cultural artefacts, tools and signs. Wenger (1998) and Lave and Wenger (2001) acknowledged that CoP theory is derived from the socio-cultural perspective, but its argument is that people construct and develop their identities and understandings through their active participation and engagement with others in cultural practices that are situated in a particular social community, such as teacher education programmes. Other CoPs would include Professional Learning Communities (PLCs) and critical friends' groups (Vescio et al., 2008).

CoP has three components, namely, domain, community and practices (Wenger, 2000). *Domain* determines common ground for sharing knowledge which Mhakure and Otulaja (2017) viewed as a shared goal of deepening understanding of the integration of IK and WS through argumentation. *Community* is the platform that creates social structure for interaction (Wenger, 2000). In the context of this study, community provided a platform for members to participate in workshops, research activities based on integration of local knowledge. *Practice* involves specific knowledge that is shared, developed and maintained by the community (Wenger, 2000). Wenger (2006) indicated that members of the community are practitioners as they develop shared repertoire resources such as experiences, lesson plans, teaching aids and ways of addressing challenges within their community. According to DuFour (2005), the concept of CoP embraces the social natural origins of an individual's development while recognising the importance of continuous, ongoing, school-based collaborations among all the members (such as principals, teachers, parents, students) of the teaching and learning process based on common goals. Although literature does not clearly state that CoP is a model for professional development, in this study, CoP is viewed as an exemplar of a professional development model, oriented by social learning and developmental theories.

Abigail (2016) stressed that in order to understand how CoPs work, one has to understand that a CoP is closely linked to situated learning theory which views knowledge as being situated in authentic contexts and where learning is influenced by the activity, context and culture. In addition, teachers in the context of my study were viewed as active participants who learned from and with community members. Wenger’s (2005) social learning theory specifically emphasises the process of learning based on the extent of social participation (Sedláček & Sedova, 2017). That is to say that participants are involved in a community (*belonging*), they engage in certain activities (*doing*), thus establishing their identity (*becoming*) to interpret the world around themselves (*experience*). According to Wenger’s (2005) CoP, as a theory it emphasises the subconscious process of learning through participation with the purpose of substantiating and legitimising individual actions. Wenger (2005, p. 5) summarises his framework for a social theory of learning, with four components that are “deeply interconnected and mutually defining” as in the following diagram.

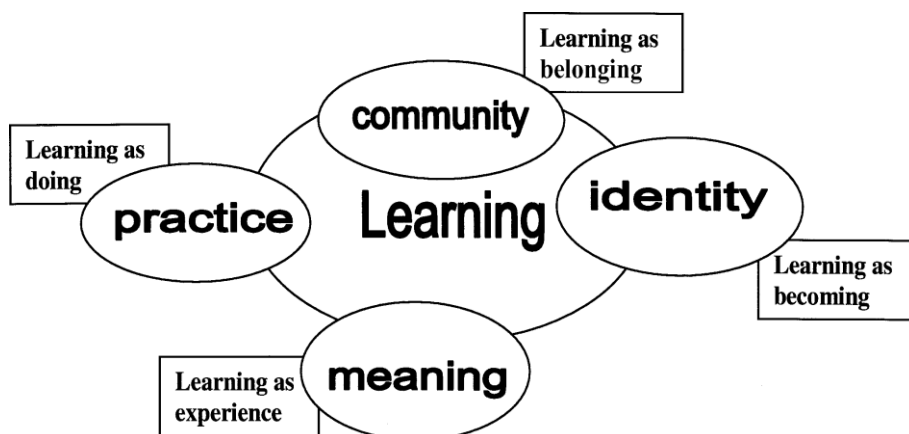


Figure 3.1: Wenger’s (1998, p. 5) components of social learning theory

- *Meaning* – the way of talking about our abilities to experience the world around us meaningfully;
- *Practice* – talking about shared historical and social resources, frameworks and perspectives that sustain mutual engagement in actions;
- *Community* – a social configuration in which our enterprise is defined, and participation is recognisable as competence; and
- *Identity* – defined as the way of talking about how learning changes who we are.

The four components of CoP are interrelated and are equally important in analysing how learning takes place in a social group. As I worked with the teachers, social interaction was created as each

individual from different contexts participated in the social group, shared experiences, and developed the meaning and understanding of the group identity. In this research, it is believed that from a CoP, teachers improved their understanding and attitudes towards integration of local knowledge. This was shown in the workshop discussions, lesson observations and reflections that are discussed in Chapter Five and Six.

In this study, the CoP members were four Physical Science teachers from four schools in the Otjiwarongo circuit, and me as a Senior Education Officer. The members thus shared a common interest that was centred on the integration of local knowledge in a multicultural science environment. CoP honours the knowledge and experience of the teachers and the theory generated by the researcher, through collaborative efforts (Vescio et al., 2008). In this study, CoP members explored new ideas, teaching materials development, and teachers' pedagogical practices in relation to integration of local knowledge in science lessons. We explored local knowledge, gained a history of specific local knowledge and identified some possible local knowledge practices that could be integrated into science. This developed a positive disposition to confidently adapt and share expertise of local knowledge through interaction and participation.

Concepts that I borrowed from CoP were *social learning*, *participation* and *collaboration*. When CoP members are interacting in a social set-up, they share experiences and learning takes place through participation. Participation is depicted as central to situated learning since it is through participation that identity and practices develop (Handley, Sturdy, Fincham, & Clark, 2006). Bodner and Orgill (2007) suggested that CoP enables one to study how shared knowledge evolves and how groups learn. In this study, CoP enabled me to develop an understanding and justification, by explaining the degree of participation within the learning environment of teachers, students and myself. In terms of data analysis, CoP helped me through interviews and workshop discussions to understand the individual points of view, rather than making generalisations about the behaviour of the group.

CoP values reflective practices of which du Plessis and Muzaffar (2010) believed is widely recognised as a way of creating valid and situated knowledge about the practice of teaching and strategies for its continual improvement. Even though there are many types of reflective practices for teachers' programmes, this study focuses on six categories defined by du Plessis and Muzaffar (2010) (Killion & Todnem, 1991). The first is *reflection for action*, which has to do with an

individual's (teacher) personal growth and actions in relation with his/her students. This type of reflection leads to self-awareness (based on attitudes, weaknesses, strengths and personal growth) to improve on any future actions. The second type of reflection is *reflection in action* which takes place during the lesson-based concepts, theories and approaches in science education. The third type of reflection is *reflection on action* that takes place after the lesson, based on the effectiveness of the lesson. The fourth type is *technical reflection* which refers to strictly rule-governed application of education-based research on the practice of teaching. It serves as an intervention for reflection on teaching skills and techniques. The fifth type is *personalistic reflection* which is concerned not just with learning, but life as a whole.

This is where a reflective practitioner would try to be inclusive enough and develop concern for the abilities of themselves and their students to live a good life as a whole. The sixth and final type is *critical reflection* which is an educative action that can help to transform and improve the conditions of life in a society as a whole. To understand suppressed Afrocentrism, the dominant Eurocentrism views in science education and emancipation approaches to education, critical reflection was embarked upon. In the context of this study, reflective discussions and journal witting was done based on all the types of reflections discussed in this chapter. Through reflection, I was able to determine whether CoP had an impact on the teachers' education practices or not.

Several studies have been carried out to investigate the impact of CoPs on teaching practices, as well as student learning. Their findings were relative, as the effectiveness of CoPs is determined by certain factors. For instance Vescio et al. (2008) revealed that the CoP model shifted the teachers' habits of mind and created cultures of teaching that engaged educators in enhancing teacher and student learning. Similarly, Abigail's (2016) study concluded that CoPs can make a difference to educators' practices by providing opportunities for actual application of knowledge, tools and social relationships. However, factors that influenced the effectiveness of CoPs included: *time* – required for planning, meetings, workshops, implementation, monitoring and evaluation practices; *personal factors* – such as members' interest, attitudes and readiness for lifelong learning; for instance the research found that the people in the CoP were sociable and developed the ability to form close and positive relationships; *key role played by all members of CoP* – such as a leader, facilitator or ordinary member; *environmental context* – such as the learning environment, social-emotional environment, technology, support, interaction, group structures and external forces (Abigail, 2016).

Despite the potential value and contribution that communities of practice offer to organisations, there are challenging issues and difficulties that are of concern. The first challenge is based on time demands and constraints, of which Kerno (2008) indicated that CoPs mostly have limited time to engage in their activities. Members need to meet regularly depending on the frequency of their choice (perhaps daily, weekly, monthly, quarterly and so on) and sometimes they are unable to meet due to other commitments. The second challenge is based on the notion that learning in a CoP is a voluntary transformational process that occurs through interaction and participation with the peers or other experts in the community (Wenger & Lave, 2001). The attitude of the members determines whether they want to learn or not and they cannot be forced, as learning take place on a voluntary basis. This is the reason why du Plessis and Muzaffar (2010) felt that is important for all members to develop and adhere to the norms of practice for that CoP. The third and final challenge is based on organisational hierarchies; as Kerno (2008, p. 74) argued that CoPs do not “possess any of the formally sanctioned powers manifest within the organisational chart as it is regarded as an informal structure and that is the reason why sometimes CoP efforts are not likely to produce substantive progress or benefits”. Future CoP studies need to design a framework for evaluations in order to promote and improve value creation in CoPs.

3.4 CONCLUDING REMARKS

This chapter discussed Vygotsky’s (1978) socio-cultural theory and Wenger’s (1998) Community of Practice (CoP) that looked at the theoretical orientation of my study. These two frameworks complemented each other. The next chapter presents the research design and methodologies that are used in the study.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

Research methodology is a critical component of the research that specifies approaches used in the research as well as the design of the study. It has to do with procedures and logic to be followed during the research process (Coe, Waring, Hedges, & Arthur, 2017). Firstly, this chapter presents the research orientation and approach of the study. Secondly, the research goal, objectives and research questions, research site, sampling, research procedures and data collection plan are discussed. Thirdly, the data collection analysis and validation and trustworthiness are presented. Fourthly, and finally, ethical considerations and positionality are discussed.

4.2 RESEARCH ORIENTATION

This study is located within an interpretive paradigm. According to Coe et al. (2017), a paradigm represents a persons' conception of the world, its nature and their position in it as well as a multitude of potential relationships with that world and its constituent parts. An interpretive paradigm was adopted in this study to grasp the subjective meaning of the social world of my participants. That is, the interpretive paradigm aims at developing a greater understanding of how people make sense of the context in which they live or work, whereby the researcher engages the situation from the viewpoint of the participants (Bertram & Christiansen, 2015). Based on ontological, epistemological and methodological assumptions, an investigator and object of investigation are assumed to be interactively linked to findings; the knower and the process of knowing cannot be separated from what is known; individual constructions can be prompted and refined only through interaction between investigators and respondents (Coe et al., 2017). Having the understanding of an interpretive paradigm from different orientations enabled me to be informed about the nature of the reality in the social world (*ontology*); how I could know about it (*epistemology*) and what procedures I could follow (*methodology*) to frame my study.

4.3 QUALITATIVE CASE STUDY

The study employed a qualitative case study approach in the form of an intervention. An intervention is a deliberate attempt to change the world in some way with a view to assess the impact of the intervention (Coe et al., 2017). Bryman, Bell, Hirschsohn, Dos Santos, Du Toit, Masenge Van Aardt and Wagner (2017) hold that qualitative studies emphasise words rather than quantification in the collection of and analysing of data. In their seminal work, Gubrium and Holstein (1997) focused on the traditions of qualitative research such as *naturalism*. To understand the nature of qualitative research in terms of naturalism my study was designed as a case study. My justification for a case study is that I wanted to have a deeper understanding on how to integrate local knowledge into the Physical Science classroom.

A case study allows a large amount of detail to be collected, which assures the researcher that the data collected is adequate, richer and of greater depth than can be found through other experimental designs (Cohen, Manion, & Morrison, 2018). The type of case study that was designed was a “*reflection*” case study of which Hamilton and Corbett-Whittier (2013) highlighted that in a reflective case study, the researcher is the focus of the study with data collection methods including reflective journals and audio-video recordings to encourage self-reflection. This reflective case study was conducted as an intervention that Coe et al. (2017) viewed as a deliberate attempt to change the world in some ways with the notion of assessing the impact of that intervention.

The reflective case study intervention was chosen as I considered a case study suitable for it allowed me to explore in detail teachers’ attitudes and understanding towards integration of local knowledge in their Physical Science lessons. Hence, my case in this study is the integration of IK to see whether the teachers’ attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons evolved or not as a result of their participation in the intervention.

4.4 RESEARCH GOAL, OBJECTIVES AND QUESTIONS

The main goal of my study was to explore an intervention on the integration of local knowledge in Grade 9 Physical Science lessons. To achieve this goal, the following objectives guided the study:

1. (a) To determine Grade 9 Physical Science teachers' understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention;
- (b) To determine Grade 9 Physical Science teachers' attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention;
2. To collaboratively come up with examples of local knowledge that Grade 9 Physical Science teachers might consider for integration and then co-develop model lessons that integrate such knowledge;
3. To ascertain how the Grade 9 Physical Science teachers mediate learning of the co-developed model lessons that integrate local knowledge in their classrooms; and
4. To determine if there was a shift in the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons that evolved as a result of their participation in the intervention.

The study was thus guided by the following research questions:

1. (a) What are Grade 9 Physical Science teachers' understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention:
- (b) What are Grade 9 Physical Science teachers' attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention?
2. In what ways can Grade 9 Physical Science teachers be supported to co-develop model lessons that integrate such knowledge?
3. How do Grade 9 Physical Science teachers mediate learning of the co-developed model lessons that integrate local knowledge in their classrooms? and
4. How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons shifted or evolved as a result of their participation in the intervention?

4.5 RESEARCH SITE, PARTICIPANTS AND SAMPLING

The location where the research was conducted, sampling techniques and research participants are presented below:

4.5.1 Research site

The research was carried out in the urban area of the Otjiwarongo circuit, for the Otjozondjupa Directorate of Education, Arts and Culture in Namibia. Otjiwarongo is situated in central-north Namibia on the Trans Namib railway. It is the biggest business centre for the Otjozondjupa Region located on the B1 road and it links between Windhoek, the Golden Triangle of Otavi, Tsumeb and Grootfontein, and Etosha National Park. The Herero people were the original settlers of this area, and they called the place Otjiwarongo, ‘meaning where fat cattle graze’. Around 1906, a few tribe members from the Oshiwambo and Damara tribes migrated to the town to settle. The following is a map of Namibia that shows the location of the region, and the town where the research was carried out.

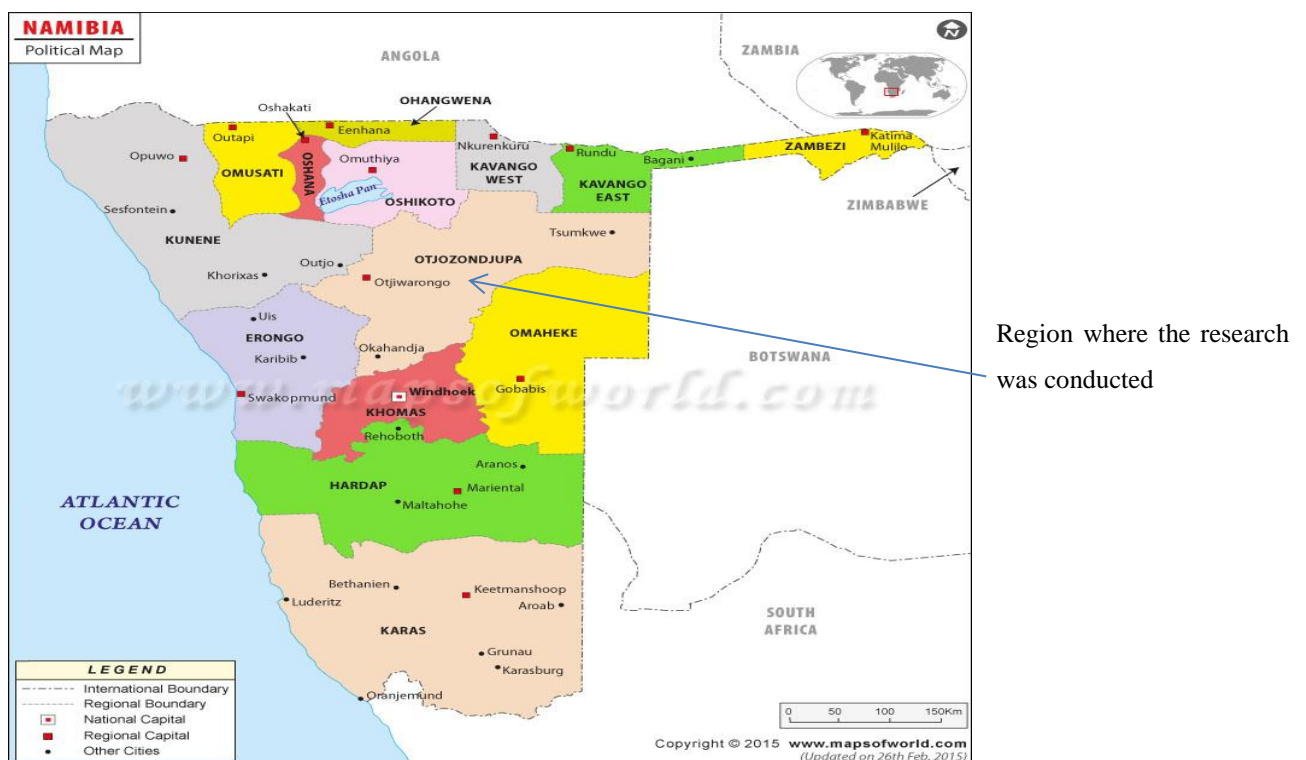


Figure 4.1: Map of Namibia

(<http://namibiaconsulate.co.za/wp-content/uploads/2015/03/namibia-regions-map.jpg>)

Currently, the town is mostly inhabited by three tribes, namely, Oshiwambo, Damara and Otjiherero. No studies on the integration of local knowledge (for the three tribes in the context of Otjiwarongo) in science were found by the researcher.

4.5.2 Participants and sampling

Three Grade 9 Physical Science teachers from four Junior Secondary schools and one from a Junior Primary school in the Otjiwarongo circuit were the participants in this study. Otjiwarongo town is my duty station and I found it more convenient to work with schools that were closer to me to save time and budget constraints to travel to other circuits. The choice of grade 9 was made based on the fact the transition of Namibian Basic Education curriculum revised was implemented in grade 9 in 2018. Essentially, I wanted to work with grade 9 teachers in order to see how they implement and integrate local knowledge within the revised curriculum. Two of the four schools are poorly resourced and the other two are moderately resourced. That is, I wanted to work with teachers from schools having different resources and I regarded four teachers as a reasonable number to work with.

The four participants were all full-time teachers having many other school commitments such as formal teaching, compensatory teaching, extra mural activities, administrative tasks and management tasks. As a result, it was not easy for all of us to meet regularly because of our tight schedules. Notwithstanding, in some cases, teachers sacrificed their time to even meet after hours to accommodate our community of practice (CoP) activities (see Section 3.3). Realistically also, teachers in a given school might not have the same workload. From the four teachers, therefore, I then requested those who were willing to be observed while mediating the model lessons that integrated local knowledge. Similarly to Bertram and Christiansen (2015), Cohen, Manion and Morrison (2018) refer to this as purposive sampling. Cohen et al. (2018) define *purposive sampling* as a sampling method whereby the researcher chooses a specific sample for a particular purpose. Two teachers willingly volunteered to mediate learning of the model lessons. We then co-developed model lessons that integrated local knowledge and thereafter I observed such lessons.

4.6 RESEARCH PROCESS

The study was conducted in four phases. The first phase was based on engagement with the literature around the topic of local knowledge in order to strengthen the background and the context of the study. This was followed by the second phase of workshops (analysis of syllabus and co-development of the lessons) and interviews that answered the first and second research questions. The third phase was based on implementation as co-developed lessons were taught and observed in order to answer the third research question. The fourth and final phase was reflections on the intervention and this was designed to answer the fourth research question.

4.7 DATA GATHERING TECHNIQUES

I used workshop discussions, semi-structured interviews, observations and journal reflections as data collection instruments in this study.

4.7.1 Workshop discussions

Workshop discussions were audio-recorded. Firstly, we had an orientation workshop whereby the objectives, expectations, research context and significance of the intervention were shared and discussed. Based on the participation of the teachers in the first session of workshop discussions, I discovered that their understanding was that local knowledge is regarded as home knowledge which they do not know how to integrate into classrooms. Teachers' expectations were that from such an intervention they would be able to know more about local knowledge and how to integrate it in order to make their science lessons interesting. In the second workshop we had a discussion based on a mini-demonstration for possible IK that could be integrated in the science classroom. Secondly, we had an analysis of the Physical Science syllabus, whereby topics such as Matters, Acids & Bases, and Physical & Chemical Changes were identified as possible topics for local knowledge integration. Among the possible topics, teachers agreed on acids and bases as the best topic as there were many possible local knowledge resources that could be used in the classrooms. We then co-developed two model lessons on testing acidity/alkalinity and neutralisation (see the practical lesson outlines in Chapter six). Thirdly, the two science teachers taught the lessons in their classrooms and I with another CoP member observed the lessons, where we observed the way the teachers integrated the local knowledge. Fourthly, we had discussions, reflecting on the lessons to find out how the lessons

went, what went well, as well as areas of improvement. We also reviewed the lesson plan, pre-tested experiments to see whether they were going to work and how best they could work. Time constraints were however a challenge, as the CoP members found it difficult to meet regularly due to other school commitments. Data generated from the workshop discussions were augmented with data from the semi-structured interviews.

4.7.2 Semi-structured interviews

An interview is a conversation between the researcher and the respondent, whereby the researcher sets the agenda to ask the respondent questions and obtain answers (Bertram & Christiansen, 2015). An interview is the best primary source of data whereby the researcher can access more in-depth information from each respondent by asking open questions, as well as follow-up questions (Bryman et al., 2017). I opted to interview the four teachers individually and this enabled me to gain data about their attitudes and knowledge of the teachers concerning the integrating of IK in the Physical Science classroom. Interviews were conducted for four days (one participant per day), audio-recorded, and participants finished the interviews within the range of 20 to 40 minutes. Interviews were conducted after school hours, at the schools where these teachers were teaching. As the CoP, we had decided to share responsibilities which meant that I would go to their schools for interviews and lesson observations, while they came to the Teachers' Resource Centre (where I was based) for workshops, demonstrations and discussions. When the participants were unable to understand some question or provided inadequate information, the interview allowed me to probe further. In addition, interviews helped me to gather more data and to learn from the participants' responses based on facial expressions and tone of voice. This helped me to gain a deeper understanding of what the respondents were saying. Interview data were not enough to answer all my research questions and this was the main reason for the observation technique that was used.

4.7.3 Observation

Observation is the use of body senses in order to learn and investigate something (Mweti & van Wyk, 2005). It is through observation that the researcher can carefully watch for certain details, notice what they are like, whether they change and how they change. Based on observation, I looked at how teachers integrated IK and their students' engagement during the local knowledge mediated lessons. One of the four CoP members played a role of being a critical friend to the teachers who presented the lessons. Since my research focused on the teachers, students were also involved in the

research especially in the lesson observation. I got informed consents from their parents. I observed four lessons in total, that is, two lessons per teacher.

Four model lessons that were co-developed were taught, observed and reflected on by the CoP members. The *first lesson* I observed was done after school hours and it took about two hours. Students were engaged in practical activities carried out in group work (it was time consuming). The practical activity was using red cabbage juice to test the acidity and alkalinity of substances. The teacher guided the students to carry out the test themselves. Although most of the students expressed interest, curiosity and active participation, I also observed that some were tired probably because it was a lot of learning activities for them.

The *second lesson* (next day and it took about two hours as well), was a practical activity using wood ash to teach the topic of neutralisation. The strategy of having the lessons as afternoon classes did not work very well in terms of attendance, as some students did not attend the second lesson perhaps because the previous lesson took so long. The teaching and learning activities were too much to fit into the two lessons. As the first two lessons took so long, the CoP decided to change the teaching strategies of group work and after school classes, to lesson demonstrations during normal school hours. The last two lessons took about one hour each and all the students were present for both of the lessons. The teacher and the critical friend guided the students to carry out the practical activities. More time is needed for planning and presentation of the lessons. The strategy of co-planning and co-teaching assisted as it saved time.

Some students from other Grade 9 Physical Science classes that were not part of the research wanted to be part of local knowledge mediated lessons and the teachers decided to teach the same lessons to all the Grade 9 classes. I did not observe the other classes that were taught as the students requested, as they were not part of the research.

4.7.4 Journal reflections

According to the Royal Melbourne institute of Technology, RMIT (2006), reflective journals are a personal record of an individual learning experience. Göker (2016) suggested that journal reflections are essential tools for teachers to develop self-awareness, evaluate their strengths, weaknesses, teaching methods used, problems encountered in teaching, and determine authenticity for aids and materials to be adapted, and analyse and change their practice when necessary. This

was used to generate data for the fourth research question. Teachers reflected on the lessons' delivery as well as on the entire intervention process. Through journal reflection, I got an idea of what worked well/not worked well and areas of improvement (as fully indicated on appendix M as well as in Chapter Six).

4.8 DATA ANALYSIS

Cohen et al. (2018) explained that data analysis involves organising, accounting for and explaining the data. That is, researchers try to make sense of what is happening and identify themes emerging from the data as the participants explain the situation. Generated data were in the form of interviews, workshop discussions, video-recorded observations and journal reflections. The first step taken to organise data was coding. Charmaz (2006) defined coding as the means of categorising segments of data with short names that simultaneously summarises and accounts for each piece of data. Data were labelled with codes whereby the categories, themes and patterns were formulated. The second step was to get a full description of data per participant based on unit analysis such as attitudes, pedagogical content knowledge, participation and opinions.

A sociocultural perspective was used to analyse the teachers' learning in social interactions, based on their experiences, knowledge, feelings, opinions and input. The base analysis for my study was the teachers' attitudes, practices and participation in intervention activities. Vygotsky's (1978) concept of ZPD was used as a lens to analyse my data. The key theoretical concepts related to interventions within professional development practices by Eun (2008), was deemed a suitable framework that I used to look at my data. I adapted this framework as I found it helpful in analysing the teachers' understanding, their attitudes, as well as their pedagogical knowledge.

Table 4.1: Key theoretical concepts related to the intervention within professional development practices (Adapted from Eun, 2008, p. 144)

Key theoretical concepts	Related professional development practices
Social interaction	Workshops, colloquia, seminars, mentoring, meetings, and/or study.
Internalisation	Individually guided activities (video self-assessment; journal writing).
Mediation	Continuous follow-up support that includes the three types of mediators: Tools (material resources); signs (newsletters and journals); and other people (professional networks).
Zone of Proximal Development	Learning and developmental space of knowledge within the teachers' practices, in terms of what the teachers were able to do before intervention and their abilities to integrate IK in their lessons on their own after intervention.
Psychological systems	Social interactions were encouraged through the development of professional development programmes within intervention. Activities within intervention were developed for the teachers to mediate and internalise within their ZPD. Expectation focus on changing teachers' attitudes as well as instructional practice.

The key theoretical concepts related to an intervention are: social interactions, internalisation, mediation, ZPD and psychological systems. I have adapted the five key theoretical concepts by adding the concept of ZPD. Shabani (2016) emphasised that there is a need for designing and implementing teachers' interventions by linking the developmental aspects of professional development to other developmental theories in order to derive theoretical implications for an effective realisation of professional development in teachers. Vygotsky's (1978) sociocultural theory was used, whereby the ZPD was used to analyse data and this helped me understand the teachers' attitudes and pedagogical content knowledge before the intervention and their participation in professional development activities of local knowledge.

I also adapted the model of educational reconstruction for teacher education developed by Komorek and Kattmann (2009). The model has three components that are interrelated that speak well to my intervention and it helped me to analyse the data from my research questions (see Figure 4.5 below).

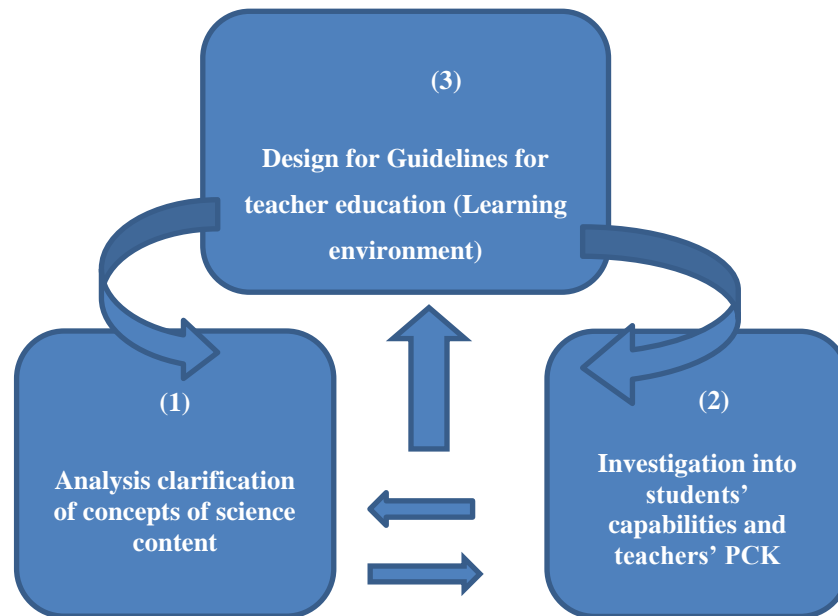


Figure 4.2: Model for Educational Reconstruction for teacher education (MER) (Adapted from Komorek & Kattmann, 2009, p.188)

Oeftering, Ngcoza and Kuhlana (2018) recommended that the three components or forms of knowledge are seen as relevant to creating more sustainable learning environments in the process of education. The *first* component of the model helped me to handle data that had to do with analysing Physical Science topics that are rich in local knowledge and see how best these topics could be presented to ensure effective teaching. Regarding the *second* component, CoP was to scrutinise the learners' abilities and syllabus specific competencies. The *third* component provided guidelines based on the teachers' instructional practices and the understanding that content structure to be taught has to be adjusted to student needs and contexts, in order to provide conducive learning opportunities that allow students to construct the knowledge. Data collected was analysed by linking teachers' pedagogical knowledge and content knowledge that formed a framework for intervention to guide teachers to develop Pedagogical Content Knowledge (PCK) within their teaching practices. The model enabled me to analyse my data in relation to what

subject matter knowledge teachers had, their pedagogical content knowledge, their attitudes towards intervention of subject matter representation and how it influenced (or not) their teaching practices.

4.9 DATA MANAGEMENT

I created a research data folder where I kept interview notes, journal reflections and any other evidence materials for effective data storage, making data storage accessible for verification as well as for usage by others. Good data management includes effective processes of consistency, collecting, recording and storing data securely (Peersman, 2014). I kept soft copies of each item as a back-up for the processed files to avoid losing data. Information was kept with confidentiality.

4.10 VALIDITY AND TRUSTWORTHINESS

Weiler (2003) defined validity and trustworthiness as follows;

- *Validity* is the degree to which an instrument accurately measures what it is intended to measure; and
- *Trustworthiness* means that the research collection methods work consistently in different contexts.

Taking validity and trustworthiness into account, my understanding was that there is no one instrument of data collection that is much more reliable than another, when trying to collect exactly the same data from different participants. Each instrument has its advantages and disadvantages. For instance, the interview process is influenced by interpersonal relationship which means that the responses can be partially constructed as some respondents adapt their answers according to factors such as: who asks the questions and the purpose of asking questions. Due to this, I also used observation that enabled me to watch and identify some of the aspects that interviews had missed. To make sure that collected data were accurate and truthful, I triangulated my data collection techniques. This meant that I used a combination of data collection instruments such as interviews, observations and journal reflections to ensure that research findings were valid and trustworthy.

Triangulation is when the researcher employs different approaches of collecting data to ensure validity and trustworthiness (Csikszentmihalyi & Larson, 2014; Cohen et al., 2018). I also piloted and pretested the tools that I used for improvement. I piloted my interview questions with my fellow Masters' students as well as with a few teachers and this helped me to improve my interview questions. Peersman (2014) stressed that it is important to conduct a pilot study to test the tools for effectiveness and improvements. I also conducted member checking with the participants to ensure that what I had transcribed was exactly what they had said. In terms of confirmability and transferability, I shared my interview transcripts, narrated workshop discussions, collated post lesson reflections and my research findings with my fellow Masters students. This was done to ensure transparency, dependability and validity of the results.

4.11 ETHICAL CONSIDERATION

When I carried out the research, I reviewed my actions to ensure that my participants' rights and welfare were protected. The first thing that I did was to present my proposal to Rhodes University's Ethical Department and I received an ethical clearance certificate (see Appendix A). From there, I asked permission in writing from the Regional Education Director to carry out the research within the schools in the region (see Appendix B). I also asked permission from the circuit inspector and school principals to allow me to work with their teachers (see Appendix D). Informed consent letters were sent to the teachers who participated in this research as well as to the parents of the students involved in the lessons observed (see Appendix G & H). Informed consent is the practical application of the principle of autonomy and respect for persons, whereby the researcher demonstrates his/her respect for each participant as a person who is capable of decision-making (Kruger, Ndebele, & Horn, 2014). In the context of my study, participants were subjected to the ethical obligation that they were allowed the opportunity to choose whether they were willing to participate or not.

I analysed my research context to see if there was any jeopardy and unveiled potential risks and benefits to the participants. I explained the goals and objectives of the study to them. In my role as primary investigator, I was mindful of my positionality as I served a dual role as both a senior to the teachers at the regional level and a researcher. As a Senior Education Officer for the Teachers' Resource Centre in the Otjozondjupa Region where the research was conducted, I had

to remain cognisant of interactions with participants who I had prior professional connections with in the region, as an advisor in teaching and learning resources. Power relations between the researcher and participants is acknowledged as a potential factor influencing the quality of data collected (Greene, 2014; Merriam, Johnson-Bailey, Kee, Ntseane & Muhamad, 2001). I did not misuse my position as a Senior Education Officer, but rather conducted my research in agreement with research principles.

As an insider researcher, I was also aware of insider knowledge I possessed regarding the professional practices of the participants within the context of my study that might have influenced objectivity of my conception. As a way to diminish subjectivity, during the data collection process, I was vigilant, and reminded the participants throughout that their honest perspectives were significant to the study and that they should not consider or allow my position to influence their responses. My role was to collect record and interpret the data in a non-judgemental manner. To provide reliable representation of the data, credibility, I transcribed interviews, workshop discussions and journal reflections accurately. In addition, I also applied my insider knowledge of the situational context and professional relationship of the participants in framing my interpretation of data. I conducted my research in accordance with the code of ethics of professional development within the education sector. I paid special attention to critical circumstances that included vulnerable participants (such as teachers from marginalised groups in the community). The research was conducted based on the principles of respect, integrity, dignity, transparency, honesty, accountability, responsibility and academic professionalism.

4.12 CONCLUDING REMARKS

This chapter presented the research orientation and approach of the study, the research goal, objectives and research questions, research site, sampling, research procedures and data collection plan was discussed. It further presented data collection analysis, validation and trustworthiness. It also discussed issues pertaining to ethical considerations and positionality. The next chapter presents the qualitative data from the orientation workshop discussions, semi-structured interviews as well as from discussions of the syllabus analysis.

CHAPTER FIVE

DATA PRESENTATION, ANALYSIS AND DISCUSSION

(PHASE I)

5.1 INTRODUCTION

The goal of my study was to explore an intervention on the integration of local knowledge in Grade 9 Physical Science lessons. In Chapter Four, I discussed the research design and methodology I used in this study and described how data were gathered to answer the research goal and research questions. In this chapter, I thus present a summary of the qualitative data from orientation workshop discussions, semi-structured interviews and document analysis (syllabus analysis). Phase I of my data presentation aims at answering the following research questions:

- What were the attitudes and understanding of Grade 9 Physical Science teachers on integration of local knowledge in their Physical Science lessons prior to the intervention?
- How can Grade 9 teachers be supported in developing model lessons that integrate local or indigenous knowledge?

Firstly, I present, analyse and discuss the data generated from the orientation workshop discussions and semi-structured interviews. The orientation workshop was intended to access participants' views and understanding on the integration of local knowledge in Physical Science lessons prior to the intervention. Informed by this data, I thereafter conducted one-on-one semi-structured interviews with four Grade 9 Physical Science teachers (see Section 4.7.1). Secondly, I present, analyse and discuss the data generated from Grade 9 Physical Science syllabus analysis that I conducted with four Grade 9 Physical Science teachers. The presentation, analysis and discussions are linked to literature and the theoretical framework.

5.2 TEACHERS' PROFILES

There are four teachers that were involved in Phase 1 and 2 of the study. They gave themselves pseudonyms but I preferred to call them T1-T4. The table below shows their profiles.

Table 5.1: Shows teachers' profiles

Description	Teachers			
	T1	T2	T3	T4
Pseudonyms				
Gender	Female	Male	Female	
Name of the school, circuit and the region	School A, Otjiwarongo circuit Otjozondjupa Directorate of Education	School B, Otjiwarongo circuit Otjozondjupa Directorate of Education	School C, Otjiwarongo circuit Otjozondjupa Directorate of Education	School D, Otjiwarongo circuit Otjozondjupa Directorate of Education
Area of specialisation	Mathematics and Natural science Grade 8 - 10	Science Education Grade 8 - 10	Mathematics and Natural science Grade 8 - 12	Science Education
Subject(s) currently teaching	Physical Science	Physical Science	Physical science and Mathematics	Physical Science
Years of Experience	8	10	5	9
Highest qualification	BED Hons	Advance Certificate in Education	BED Hons	Advance Certificate in Education
Role in the study	Mediating the lesson	Mediating the lesson	Critical friend to T1 and T2	Ordinary participant

5.3 ORIENTATION WORKSHOP DISCUSSIONS, SEMI-STRUCTURED INTERVIEWS AND DOCUMENT ANALYSIS

Qualitative data were generated from four teachers who were invited to attend the orientation workshop. The orientation workshop was the first gathering technique for all the participants and it was intended to familiarise them with the research context and process. Qualitative data from the four teachers' orientation workshop discussions and semi-structured interviews were colour coded, collated, analysed and discussed. The orientation workshop was held at the Otjiwarongo Teachers Resource Centre. During the workshop, a series of discussion activities emerged and they were developed into episodes as shown in Table 5.2.1 below.

Table 5.2: Shows episodes emerged from workshop discussions

Categories developed to form episodes	The role of episode
Workshop Introduction Welcoming remarks Ice Breaker	<ul style="list-style-type: none"> • To create a conducive workshop environment. • To strengthen the CoP by sharing some quotes that speaks about team work. These quotes are regarded as a motivation for people to learn through social interactions.
Familiarisation of the African/Namibian context of science education and research processes	<ul style="list-style-type: none"> • To acquaint the participants to the context of the study, statement of the problems and objectives.
Created a platform for the participants to share their experiences, contribute, discuss and ask questions	<ul style="list-style-type: none"> • To encourage social interaction by questioning and discussions.
Participants expectations	<ul style="list-style-type: none"> • For participants to set some common and uncommon targets within the domain of CoP.

Thereafter, I combined similar episodes; interpreted and related them to the literature, theoretical framework and research questions (see Table 5.3 below).

Table 5.3: Shows emerged episodes that support literature and theory

Research Question 1:			
<i>(a)What are Grade 9 Physical Science teachers’ understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention?</i>			
<i>(b)What are Grade 9 Physical Science teachers’ attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention?</i>			
Episodes	Interpretation	Literature	Conceptual/Theoretical
Workshop Introduction	Establishing a friendly and collaborative learning community	Wenger (2000); Abigail (2016)	In CoP members have passion to interact regularly and share experiences (Lave & Wenger, 1991) Eun (2008) Shabani (2016)
Familiarisation of African/Namibian context of science education and research processes	To develop meaning and identity	Vescio et al. (2008)	People construct meaning, develop their identities and understanding through their active participation or engagement with others in cultural practices (Wenger, 2001)
Open discussions	Social interaction by questioning and discussions	DuFour (2005)	All human development is founded upon social interaction in cultural and historical practices that are mediated (Vygotsky, 1978).
Participants’ research expectations	Participation	Sedláček & Sedova (2017); Handley et al. (2006); Bodner & Orgill (2007)	Participation has a strong influence in social interactions (Lave & Wenger 1991; Wenger, 1998)

The data analysis process was informed by Vygotsky's (1978) socio-cultural theory and Wenger's (1998) Community of Practice. I then came up with four episodes that I was able to interpret, and relate to literature, theory and research questions. It was strengthened by the fact that the Grade 8-9 Physical Science syllabuses (2015) require teachers to be inclusive in their teaching and that they are expected to:

- Meet the needs of the learners through differentiation of teaching methods and materials; and
- Understand that a few learners might not be able to achieve all the specific objectives satisfactorily and must receive learning support through adapted teaching approaches, adapted materials, and assistance from peers. A small number of learners have special educational needs to a degree which requires greater individual attention, resources or assessment.

Based on discussions of how the syllabus expects teachers to approach teaching, one teacher commented: *"I do not know if maybe I was not serious or maybe nobody explained well to me those approaches, I think it make sense to me now"* (T4).

From this reflective comment, it seems like from discussions, this teacher developed a better understanding of what the syllabus expects him to do in terms of an inclusive and learner centred approach. Furthermore, teachers highlighted that they had little knowledge on integration of local knowledge. During the workshop, expectations from the intervention were also discussed. Firstly, participants expected the intervention to enable them to gain a better understanding on how to integrate local knowledge in Physical Science lessons, improve their content and pedagogical knowledge and make their lessons interesting to encourage active participation among their learners. Secondly, participants expected to work together to come up with localised or indigenous teaching and learning materials that could assist their learners to master the specific competencies of Grade 9 Physical Science.

5.4 DATA FROM SEMI-STRUCTURED INTERVIEWS

Participants were asked to share their views on the inclusion of local or indigenous knowledge in Grade 9 Physical Science. Semi-structured interviews were answered well by the teachers and a short description of sub-themes and themes were developed. I collated the semi-structured interviews for the two interview transcripts. I then analysed data sets and developed emergent categories, some colour-coded categories were merged to form themes (see Appendix K). I was

directed by Vygotsky’s (1978) socio-cultural perspective to understand how teachers were expressing their views, experiences and input, in coming up with my analytical statements. Subsequently, I came up with themes that were further interpreted into six analytical statements.

Table 5.4: Shows the categories, sub-themes and themes that emerged from interviews

Research Question 1:		
<i>(a)What are Grade 9 Physical Science teachers’ understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention?</i>		
<i>(b)What are Grade 9 Physical Science teachers’ attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention?</i>		
Categories	Sub-Themes	Themes
Local knowledge is based on culture, language, originality, tribes and daily life activities within environment	Local knowledge is viewed as cultural knowledge grounded on tribes and ways of life	Understanding of local knowledge
Inclusion of local knowledge enhances better understanding, promotes sense-making, improves learners’ performance and links classroom situations to home background knowledge	Local knowledge enhances effective learning and promotes socio-cultural interaction	Socio-cultural views on the inclusion of local knowledge in Physical science lessons
<ul style="list-style-type: none"> • If correct training is provided inclusion of local knowledge will not be a problem • Teachers did not value the significance of incorporating IK in the lessons • Teachers incorporated IK in Physical Science lessons for the learners to make sense of concepts 	<p>Inclusion of local knowledge needs basic training</p> <p>Negative and positive attitudes that enable teachers include or exclude IK in their lesson</p>	Factors that influence the inclusion of local knowledge in Physical science lessons
Inclusion of indigenous knowledge was used to teach the concept of fermentation and distillation.	Inclusion of local knowledge at high schools and higher institutions	Effect of past educational experiences on inclusion of local knowledge

Local knowledge of geographical features were included to enhance learning	enabled teachers to promote IK in their lessons	on Physical Science instructional practices
Teachers were exposed to indigenous knowledge of using manure, compost, oshikundu, omalodu iilya, ombike, stomach ache, wood ash, animal dungs, decant, boiling, sieving, producing butter from milk and traditional songs	Exposure of indigenous knowledge of farming production, brewing of homemade drinks, acids and bases, water purification, separation of substances	Home background knowledge and experiences of local and IK
Inclusion of local knowledge creates a broader picture of teaching, learning activities, promotes comprehensive understanding, inquiry and discovery, learning of subject content within local context, stimulates active participation	Inclusion of local knowledge enhances improvement in teaching and learning, promotes learners to pursue indigenous careers	Advantages for local knowledge inclusion in the Physical Science lessons
In a multicultural set up, more time is needed for preparation and incorporation, financial implications for teachers to be trained, less impact on incorporating in one grade	Challenges associated with IK inclusion	Disadvantages for local knowledge inclusion in the Physical Science lessons

Table 5.5: Emerged themes linked to theory and literature

Research Question 1:			
<i>(a)What are Grade 9 Physical Science teachers’ understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention:</i>			
<i>(b)What are Grade 9 Physical Science teachers’ attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention?</i>			
Themes		Theory	
		Literature	Conceptual/Theoretical
Local knowledge is viewed and as a cultural knowledge grounded on tribes and ways of life	Understanding of the concept local knowledge	Semali & Kincheloe (1999), Boven & Morohashi (2002)	IK is locally-based (Kibirige & van Rooyen, 2006)
Local knowledge enhance effective learning and promote socio-cultural interaction	Socio-cultural views on the inclusion of local knowledge in Physical science lessons	Wertsch (1991), Cocks, Alexander & Dold (2012), Brown et al. (2006), Mavuru & Ramnarain (2017), de Beer & Whitlock (2009)	Learning as a social process from society or culture (Vygotsky, 1978) Contextualised teaching and learning helps learners to see the relevance of science concepts (Mukwambo, 2016)
Inclusion of local knowledge need a basic training Inclusion of local knowledge is affected by the teachers’ attitude and understanding	Factors that influence the inclusion of local knowledge in Physical science lessons	Shava (2016), Huffman et al. (2003), Akiba & Liang (2016), Bereha (2014), Vescio et al. (2007)	Teachers’ professional development programmes influence their instructional practices (Guskey, 1986). Interventions within professional development practices are needed (Eun, 2008).
Inclusion of local knowledge at high schools and higher institutions enable teachers promote IK in their lessons	Effect of past educational experiences on inclusion of local knowledge on Physical science on teachers’ instructional practices.	Michie (2003). Quince (2012), Burrige & Evans (2012), Aikenhead & Huntley (1999), Shizha (2008),	Teachers teach as they were taught (du Plessis & Muzaffar, 2010)
Exposure of IK on farming production, brewing of homemade drinks, acids and bases, water purification, separation of substances	Background experiences of local and IK	Oguniyi (2006) Senanayake (2006) Kimbell (2008)	IK is a cumulative body of strategies, practices and techniques (Emeagwali, 2014)
Enhance improvement in teaching and learning, Promote learners to pursue indigenous careers	Advantages for local knowledge inclusion in the Physical science	Klein (2011)	Alaska standards for culturally responsive guidelines initiatives improved students achievement (AKRSI, 1999)
Challenges associated with IK inclusion	Disadvantages for local knowledge inclusion in the Physical science	Hattie (2012), Mednick (2004), Shizha (2008), Aikenhead and Huntley (1999)	Teachers challenges of IK integration is based on teachers attitude and pedagogical knowledge (Shizha, 2007)

I now discuss each of these themes below.

5.5 DISCUSSION OF THEMES FROM SEMI-STRUCTURED INTERVIEWS

5.5.1 Theme 1: Understanding of the concept local knowledge

Teachers were asked to share their understanding of the concept of local or indigenous knowledge during the semi-structured interviews. It appeared that their responses showed that they had slightly different answers. For instance, T2 defined IK as:

I understand it like the knowledge based on your home language and what you understand from home, It has to do with local knowledge based on what is in within your area instead of you getting the knowledge of something abroad that you did not experience, so I think local or indigenous knowledge is more on things that are based in your daily life around you within your environment.

This is related to Semali and Kincheloe's (1999) definition of indigenous knowledge (IK) that it is a dynamic native way of knowing which involves creativity of residents for a particular locality to understand themselves in relation to their natural environment. T1 understood indigenous knowledge in the Namibian context as the:

Knowledge that is about the originality of Namibia, so meaning that it is talking about if we are having 13 tribes, all these tribes knowledge is incorporated to be called indigenous knowledge and it more like if we are in a specific town and we have got that specific and unique knowledge that we are using in that town.

This definition resonates with Boven and Morohashi' (2002) understanding that indigenous knowledge is the local knowledge that is unique to a given culture or society.

5.5.2 Theme 2: Socio-cultural views on the inclusion of local knowledge in Physical Science lessons

It emerged in this study that participants had positive socio-cultural views on the integration of local knowledge. For instance, they expressed that integration of local knowledge is a good practice that is linking everyday home background situations to classroom situations. These research findings seemed to suggest that integration of local knowledge has the potential to promote sense-making of science concepts. To this end, T1 commented that:

Inclusion of local knowledge promote better understanding as it does not only bound the learners in the classroom situations but for instance after school, the learner can go home and try to experience or experiment things they have done since they will be at their exposure which is their home and environment.

This revealed that this teacher's views on local knowledge was based on improving the learners' understanding by linking everyday home knowledge and school scientific knowledge, which is what Aikenhead and Jegede (1999) refer to as border crossing. Similarly, De Beer and Whitlock (2009) advocated that integration of indigenous knowledge into science classrooms make science more relevant to students, particularly in culturally diverse classrooms. T1 further commented that:

"It will make the teachers and the learners to make sense and have meanings of what they are teaching or learning".

In my view, it is for these reasons that Cocks et al. (2012) proposed integration of local knowledge in science teaching and learning as they believe that it contributes to the relevance and sensitivity of learners. science teaching; it also acknowledges and values students' IK which has been seen to increase their interest and participation (Brown et al., 2006; Sedláček & Sedova, 2017). In addition, Mavuru and Ramnarain (2017) emphasised that such integration would reflect the diverse cultural backgrounds of the learners and enhance their knowledge construction.

In view of the above, T2 expressed the opinion that *"if a basic correct training is given this might not really be a problem"*, which is not the case at the moment. Regarding this teacher' concern, Loreman et al. (2010, p. 7) summarised that teachers are concerned about training for inclusion, an appropriate curriculum for all students, available resources, as well as school and classroom structures that inhibit inclusion.

5.5.3 Theme 3: Effect of past educational experiences on inclusion of local knowledge

The teachers involved in this study shared their opinions regarding their past educational experiences on inclusion of local knowledge in Physical Science lessons. It seemed that their past educational experiences might have an influence on their current instructional practices. For instance, T1 highlighted that:

"When we were taught a topic on ethanol, the teacher was giving us an example of traditional drink that we brew that is ombike and this was opening up my knowledge".

Looking at the current instructional practices of this teacher, there is clear indication that she is integrating local knowledge in her lessons as she (T1) explained more about the topic of alcohol and fermentation:

I brought in oshikundu which is oshiwambo traditional drink that we make at home. Scientifically when you go deep into it oshikundu has to be ready once it has fermented. Fermentation is where alcohol is produced and I just brought it for the learners to have a better understanding of what I was talking about.

Du Plessis and Muzaffar (2010) comprehended that teachers were teaching as they were taught. For instance, T2's past educational experience was that:

We use to have science excursion, I had a local knowledge for example where they take us to a desert or to the ocean, that was mostly the case, that was really something good to us as learners but in most cases the other part of chapters of the lessons, aah, it was not really incorporated. So that was one of the most very good experience for us that it was more of local knowledge for us to understand within our area, it was very good. It really broadens and widens our mind about our local environment.

This teachers' local knowledge was integrated when he was a learner and he can still remember how it helped him to develop a broader understanding of his environment.

5.5.4 Theme 4: Home background knowledge and experiences of local knowledge

Teachers shared their home background knowledge and experiences of local knowledge.

Table 5.6: Home background knowledge and experience of Local knowledge

Knowledge Dimension	Description	Application
Farming production	Animal manure, <i>iihenguti</i>	To make the soil more fertile
Brewing of home-made drinks	Oshikundu, ombike, omalodu iilya	Home-made cultural drinks
Acids and bases	Wood ash, mahangu flour, coca cola fizzy drink with salt, animal dungs	Neutralise soil and stomach acids
Water purification	Decanting, boiling, filtering	Make water safer for human consumption
Separation of substances	Ongalo, omushalo, ondjupa	Separating flour from mahangu/maize grains, separating butter from milk
Traditional songs	Wedding, funeral, initiation, etc	Songs for different ceremonies

It appeared that the teachers involved in this study had exposure to indigenous knowledge of farming production, brewing of homemade drinks, acids and bases, water purification, separation of substances, as well as traditional songs. But what we do not know is whether or not they applied this knowledge in their classrooms. Classroom observation is regarded as an effective tool to measure the professional growth of teachers by identifying their strengths, weaknesses, other great enriching experiences and suggestive measures in their teaching (Zaidi, 2017). This warrants the importance of classroom observations.

5.5.5 Theme 5: Aspects that influenced teachers' attitudes not to incorporate IK in their lessons

It emerged from this study that teachers involved seemed to integrate IK in their Physical Science lessons for the learners to make sense of concepts. Mukwambo (2016) articulated that integration of local knowledge helps the students to see the relevance of science concepts that the teacher presents. T1 indicated:

The topic was about alcohol and fermentation, I brought in oshikundu which is oshiwambo traditional drink that we make at home. I just brought it for the learners to have a better understanding of what I was talking about.

This teacher's attitude is influenced by teaching the learners to make sense of what she teaches. On the other hand, it was also revealed that some teachers do not integrate local knowledge in their lessons. To this end, T2 commented that:

To be honest I have never done it with the very simple reason that I am teaching a multilingual or multicultural class and if I incorporate, it might sound unfair to others. The other thing is that, I did not value the importance of incorporating local knowledge in science lessons but now I see the significance and I think this is the starting point.

Aikenhead and Huntley (1999) and Shizha (2008) revealed that teachers' understanding, beliefs and attitudes towards integrating WS and indigenous science was found to be *conceptual*; as teachers did not recognise the cultural nature of science. It was also *pedagogical*, in that teachers are experiencing a lack of accommodation and understanding of IKSs in relation to WS. Furthermore, teachers' attitudes were found to be *cultural*, that WS education affected teachers' interpretation of science negatively and that indigenous ways of knowing are not applicable in science teaching.

5.5.6 Theme 6: Advantages and disadvantages for local knowledge inclusion in science lessons

The study establishes that inclusion of local knowledge may promote learners to pursue indigenous careers. Nevertheless, the research findings noted that inclusion of local knowledge in Physical Science lessons can be a challenging exercise particularly in a multicultural set-up; some learners may feel excluded if the inclusion is not based on their tribes. At the same time the research findings indicated that some teachers had negative attitudes towards inclusion of local knowledge. By the same token, Shizha (2007) stressed those educators' attitudes and pedagogical knowledge undervalued the effectiveness of IK because it was not a documented fact. Besides that, the research findings pointed out that there might be financial implications for teachers to be trained on how to incorporate indigenous knowledge and also that time is needed for preparation and incorporation. Finally the findings argued that integrating local knowledge in one grade would not make a great impact unless it was done across all the grades.

As de Beer and Whitlock (2009) advocated, integration of indigenous knowledge into science classrooms might make science more relevant to students, particularly in culturally diverse classrooms. This research finding suggests that integrating local knowledge in science develops a broader picture of teaching and learning activities and enhances effective learning. Furthermore, these scholars believed that IK promotes comprehensive understanding, inquiry and discovery, the learning of subject content within local context and stimulates active participation.

5.6 OUTLINE OF SYLLABUS ANALYSIS DISCUSSIONS

Discussions based on the syllabus took place once a week for four consecutive weeks in the afternoons at the Otjiwarongo Teachers Resource Centre. The aim of syllabus analysis was to collaboratively come up with examples of local knowledge that Grade 9 Physical Science teachers could consider for integration and then co-develop model lessons that integrated such knowledge. The research question was: How can Grade 9 Physical Science teachers be supported in developing model lessons that integrate local or indigenous knowledge? During the syllabus analysis, a series of discussion activities emerged and they were developed into episodes as indicated in Table 5.4.1 below.

Table 5.7: Shows episodes from the syllabus analysis

Categories Developed to form Episodes	Role of Episode
Syllabus analysis introduction	To strengthen the domain, community and practices of the CoP
Identifying possible topics for integration	To collaborate, identify and develop meanings
Link the identified topics to specific competencies from grade 9 Physical Science syllabus	To develop practices that lead change in instructional attitudes
Reflections	For individual(s) personal growth in relation to his/her students.
Selected topics and guideline for integration	To come up with guidelines for teachers' instructional practices for IK integration
Further activities	Co-developing the lessons and pre-testing

I then combined similar episodes, interpreted them, linked them to the literature, theoretical framework and research question (see Table 5.8 below).

Table 5.8: Shows episodes supporting literature and theory

Research Question 2: In what ways can Grade 9 Physical Science teachers be supported to co-develop model lessons that integrate such knowledge?			
Episodes	Interpretation	Literature	Conceptual/Theoretical
Identifying possible topics for integration	Clarification of concepts of educational structuring	cf. Duit et al. (2012) Komorek & Kattmann (2009)	Model for Educational Reconstruction for Teacher (cf. Duit et al. 2012)
Link the identified topics to specific competencies for grade 9 Physical science syllabus and develop pedagogical knowledge	Align subject content knowledge with the classroom pedagogical practices	Vescio et al. (2007), Howey (1996) cf. Duit et al. (2012)	(Shulman, 1987)
Selected topics and guideline for integration	Guidelines for teachers education/Design of learning environment	Mishra & Koehler (2006) cf. Duit et al. (2012)	Teaching within pedagogical milieu (du Plessis & Muzaffar, 2010)
Reflections	Reflective practices	Killion & Todnem, (1991)	CoP values reflective practices (du Plessis & Muzaffar, 2010)

We managed in our community of practice (CoP) to analyse the Grade 9 syllabus and what emerged was that four possible topics were considered: these were combustion reactions, physical and chemical changes, separation of mixtures and acids and bases. The choice was made on the two topics under acids and bases, as participants agreed that there are more local and indigenous practical applications that can be incorporated in the Physical Science lessons. The two topics were: using wood ash to teach the concept of neutralisation and using red cabbage juice indicator solution to test acidity and alkalinity of substances.

It emerged that participants were very eager to discuss and analyse the syllabus topics, link them to local knowledge and also to specific competencies. Reflecting on the analysis, T4 discovered that, *“Nowadays kids are lucky to be taught by incorporating local knowledge in science lessons, us, we were never taught with this IK incorporation”*.

After the syllabus analysis, CoP members met again and the co-development of the model lessons was undertaken. Participants agreed to adopt the regional template for lesson planning. This regional template was developed by the Otjondjupa Regional Directorate of Education (where the research was conducted), Professional Development Division for Performance Improvement Plan (PIP). PIP was introduced to improve the quality of teaching and learning by assisting teachers to interpret and implement the syllabus correctly. The two selected topics were then planned based on the regional PIP.

Finally, the pre-testing was conducted. The samples of dirty cups and glasses were cleaned with wood ash. Sample chemicals like vinegar and sodium hydroxide were tested using a red cabbage indicator. Pre-testing was done by the participants prior to the lesson presentation to see whether what was planned would work out or not.

5.7 CONCLUDING REMARKS

In this chapter, I presented qualitative data from the orientation workshop discussions, semi-structured interviews, as well as from syllabus analysis discussions. The qualitative data from workshop discussions, syllabus analysis and interviews were analysed, linked to the literature and the theoretical framework to find a connection. This qualitative data showed that the teachers involved in this study seemed to have some understanding of the concept of local knowledge. The findings also showed that teachers had different home background knowledge of IK ,of which some indicated that they integrated it in their lessons, while others did not.

In the next chapter, I present, analyse and discuss data generated from lesson observations and journal reflections.

CHAPTER SIX

DATA PRESENTATION, ANALYSIS AND DISCUSSION

(PHASE II)

6.1 INTRODUCTION

In the previous chapter, I presented qualitative data from the orientation workshop discussions, semi-structured interviews, as well as from syllabus analysis discussions. In this chapter, I thus present, analyse and discuss qualitative data generated from implementation of the intervention which is lesson observations and journal reflections. The purpose of the intervention was to observe how the participants mediate model lessons that integrated local knowledge. I observed two Physical Science teachers (two lessons per teacher) on how they implemented and mediated lessons that integrated local knowledge. Data collected and presented in this phase was aimed at answering the following research questions:

- How do Grade 9 Physical Science teachers mediate learning of the co-developed model lessons that integrate local knowledge in their classrooms?
- How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in Science lessons shifted or evolved as a result of their participation in the intervention?

6.2 QUALITATIVE DATA GATHERED FROM LESSON OBSERVATIONS

Observation was the main technique used to collect data in this study. Practical activity lessons were observed by looking at how the teachers mediated learning of the model lessons that integrated local knowledge, as well as the social interactions between the teachers and the learners. Of the three teachers, only two were observed teaching. In line with CoP, the third teacher in both Schools A and B played the role of a critical friend. Four practical activity lessons (two per teacher) were conducted whereby two teachers were observed. The lessons were video-recorded, transcribed, and analysed for similarities and differences. Lessons were narrated by means of story writing whereby the series of lesson activities were developed into episodes that were interpreted, and linked to literature and theory. The lessons are deliberated below.

6.3 PRACTICAL ACTIVITY 1: T1 AND T2

6.3.1 Topic: Using wood ashes to teach the concept of neutralisation

This practical activity lesson was conducted by both T1 and T2. The table below shows the outline for the lesson.

Table 6.1: Lesson one outline

THEME: Acids and Alkalis (Bases)		TOPIC/SKILLS: Neutralisation	
Practical activity: Using wood ashes to teach the concept of neutralisation			
Learning And Teaching Support Materials (LTSMs) used		Wood ash, red cabbage juice indicator, test tube, glasses, dishes, water, stove with fatty acids stain	
<p>1. SPECIFIC COMPETENCIES/OBJECTIVES: (Refer to Syllabus) Learners should be able to:</p> <p>Understanding neutralisation as a reaction between acids and bases, Describe the application of neutralisation reactions in everyday life, Write down the word equations for neutralisation reactions</p>			
2. Presentation of subject content and learning tasks:			
Competencies/objectives (Teacher)		Competencies/objectives (Students)	
<p>a) Ask the learners' understanding of neutralisation</p> <p>b) Properties of wood ashes</p> <p>c) Uses of wood ashes: Cleaning agent, neutralise the soil, pest control, ice melt, odour control, food/tomatoes & seed preservation, soap making, sunscreen, antacids, purifying water etc.</p> <p>d) Instructs the learners to use wood ashes to clean glasses, dishes and stove.</p> <p>e) Open Discussions: Clarification, questions and answers; what makes the wood ashes to have a major role in the process neutralisation</p> <p>f) Concluding the lesson</p> <p>g) Presenting assessment activities to the learners: project-Wood ashes soap making.</p>		<p>a) Learners shows their understanding of neutralisation</p> <p>b) Learners' demonstrate their prior knowledge on the uses of wood ashes.</p> <p>c) Use the wood ashes to clean glasses, windows, dishes and the stove.</p> <p>d) Open Discussions: Clarification, questions and answers.</p>	

This practical activity was the first intervention lesson of the study. The lesson was about the inclusion of local and indigenous material (wood ash) to teach neutralisation reactions. Based on observations, it seemed the learners had more prior knowledge of wood ash. Learners were able to recall and recap teaching and learning activities from the previous lesson. In addition, the learners' understanding of the concept, the role of neutralisation and the uses of wood ash were also tested. What emerged has been summarised in the following tables.

Table 6.2: Shows learners' prior knowledge of neutralisation

Understanding the concept of neutralisation	The role of neutralisation
<ul style="list-style-type: none"> • Reaction between acids and bases' • A reaction that involve a base and an acid' 	<ul style="list-style-type: none"> • Baking soda to remove fatty stains on the stove (girl) • Vinegar to remove scales on electrical kettles. (boy) • Coke to remove rust on metals. (girl) • Add salt to coke, drink to neutralise stomach acid (boy) • Add water in Mahangu flour to neutralise stomach acid. (boy) • Roots of some trees (boy) Omushelele, you take the root, crush it dissolve it in water and drink. • Drink cooking oil to relieve heartburn. (boy) • Use wood ash to clean
Learners' prior knowledge on wood ashes	
<ul style="list-style-type: none"> • Relaxing the hair • Used at the farm in the animal's kraal to kill bacteria • Cleaning pots • Use it as a fertiliser in the field • Polishing jewelry • Smear it on the pot to avoid it to turn black. • If one pours water outside the house during the night, you have to put wood ash (otjiherero culture). • To fasten the ripening process of fruits once the fruits are kept under the wood ash even for three days (kavango culture). • Seed preservation , prevent insects (Oshiwambo culture) • Vegetable medicine storage medium. • If you had a bad dream when you wake up in the morning you apply wood ash on your head and the face (Otjiherero culture) • If you are building a wall with bricks, you can mix wood ash and the sand to make Omunoko (cement) to make it hard (otjiherero and oshiwambo culture) • Apply wood ash on the face of the new born baby. • Kills pests in the chicken. (girl) • Purify waters sedimentation. (boy) • Wood ash is removing fats. 	

The two teachers introduced the practical activities to the learners: using wood ash to clean household items. T1's lesson incorporated a stove, dishes, spoons, glasses and test tubes, while in T2's lesson; it was a microwave, dishes, coffee mugs and glasses. T1 instructed the learners to use wood ash to clean the stove, dishes, spoons, glasses, and test tubes and see if it could remove the dirt or not. In contrast, T2 asked his learners to predict what would happen before they started cleaning clean the microwave, dishes, coffee mugs and glasses. The diagrams below show the items before the cleaning.

Figure 6.1: Shows household utensils before the cleaning



Learners started the cleaning process as depicted in the following diagrams:



Figure 6.2: Shows learners carrying out practical activity, using wood ash to clean household utensils

Both teachers arranged their learners so that they could carry out their hands-on practical activities in a manner where they shared cleaning activities amongst themselves. With T1, the practical activity was an out of the classroom activity, and learners were actively involved, and some came up with some observations while the cleaning was going on. As a result, some of them commented that: *“Wood ash is removing fats”* and *“Wood ash is making a chemical reaction”*. With T2’s lesson, learners shared the responsibilities of cleaning within the classroom as some boys were cleaning the microwave while the girls were cleaning the plates. Within 20 minutes learners were done with the cleaning and all the items were properly cleaned and they were really shining. The teacher asked: *“What do you say about this?”*

Learners’ responses: *“Wood ash can clean just like dish wash and Vim that we use at home”*. The cleaned items were displayed as demonstrated in the diagram below:



Figure 6.3: Cleaned items

When the learners were done with the cleaning, they arranged the cleaned materials in the front of the class for the teachers to conclude the lesson. T2 stressed that fats on the plates and the microwave are acids, while wood ash is the base. He asked: “*What does a base do to acids?*” Learners: “*It neutralises acids*”.

T1 concluded: “*As we were cleaning the stove, plates, glasses, spoons and the test tubes, that whole process of wood ash removing dirty substances is a neutralisation reaction.*” She asked: “*What did you learn from the practice of using wood ash to clean?*” And some learners responded that:

“*It is good to me because I never knew that a wood ash is a base that neutralises acids*”. (L1)

“*I feel good because I did not know wood ash can do greater things, but we still need to discover more about things around us*”. (L2)

“*I could not believe with what my eyes saw, that wood ash can be used to clean materials. I would like this people to come back again so that we do/touch other topics as well*”. (L3)

Finally, learners came up with some reflective comments. At this time, some learners were still observing the cleaned items, some expressed surprise as perhaps it was their first time seeing wood ash as a cleaning substance.

6.4. PRACTICAL ACTIVITY 2: T1 AND T2

6.4.1 Topic: Using the red cabbage indicator solution to test acidity and alkalinity of substances

This practical activity lesson was conducted by both T1 and T2. The table below shows the outline for the lesson.

Table 6.3: Shows lesson two outlines

THEME: Acids and Alkalis (Bases)	
TOPIC/SKILLS: Practical Activity: Using Red Cabbage Juice to test Acidity and Alkalinity of Substances	
LEARNING AND TEACHING SUPPORT MATERIALS (LTSMs) TO BE USED	Materials for preparing indicator: Red cabbage, Red cabbage juice, knife, cutting board, water, filter paper, beakers, test tubes, droppers, Bunsen burner, Substances to be tested: Sodium Hydroxide, Baking soda (Sodium bicarbonate, NaHCO_3), Wood Ash, Vim, Lemon juice, Coffee, Fresh milk, Sour milk, Bleach, Vinegar (acetic acid, CH_3COOH), Fizzy drink (Carbonic acid, H_2CO_3), Window cleaner, Methylated spirit, Hydrochloric acid (HCl), or Table Salt (Sodium Chloride, NaCl), Tea, Baking Soda, Lemon juice
3. SPECIFIC COMPETENCIES/OBJECTIVES: (Refer to Syllabus) Learners should be able to: <ol style="list-style-type: none"> Outline that an indicator is a chemical that changes colour when an acid or alkali is added to it, that indicators can be used to detect acids and bases. Measure/Test the pH of a variety of solutions. Distinguish between weak acids/bases and strong acids/bases using an indicator and by referring to pH scale. Classify variety substances as weak/strong acids or bases. 	
4. Presentation of subject content and learning tasks:	
Specific competencies/objectives (Teacher)	Specific competencies/objectives (Students)
<ol style="list-style-type: none"> Ask the learners' understanding of an indicator Demonstrate how red cabbage juice (indicator) is prepared Aim of experiment and procedures Monitor and guide the learners on how to measure the pH of variety of solutions Open Discussions: Clarification, questions and answers Concluding the lesson Presenting assessment activities to the learners 	<ol style="list-style-type: none"> Learners shows their understanding of an indicator Observation on how red cabbage juice (indicator) is prepared Listen attentively on the aim and procedures experiment Measure/Test the pH of variety of solutions and record their observation. Open Discussions: Clarification, questions and answers.

Both the teachers started their lessons by acknowledging the learners' prior knowledge regarding the testing of acidity and alkalinity of substances. At school A, the lesson was conducted in the science laboratory while at school B the lesson was conducted in a classroom. Both teachers explained that they gave learners some handouts for procedures/guidelines on how to carry out the hands-on practical activities. Furthermore, they demonstrated to their learners how to do the testing so that they could master doing the testing themselves. The teachers and the critical friend played the role of facilitator to guide, monitor and assist the learners. Figure 6.4 shows how the red cabbage indicator was prepared.



Figure 6.4.: Shows preparation of red cabbage indicator at school B

From there, a sample of red cabbage indicator solution was prepared by the teachers together with the learners just to show the learners how to prepare the indicator solution. The handout for experiment procedures assisted the learners to better understand their roles in the experiment. Figure 6.5 below shows how they were doing the testing themselves, making and recording their observations. Teachers arranged the teaching and learning activities in a way that the learners were assisting each other to test and make observations. This is shown in the following in figure 6.5.

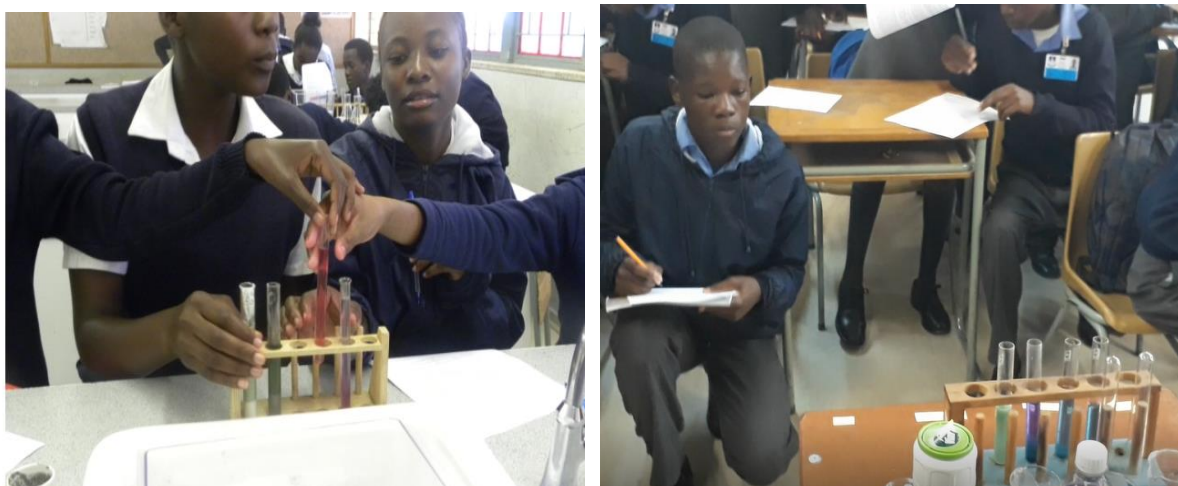


Figure 6.5: Shows learners doing the testing and recording observations

Teachers from both schools gave their learners assessment activities to test whether the learners had met the specific lesson competencies or not. The teachers concluded the lessons by thanking the learners for availing themselves to be part of the study. Both the teachers asked their learners to reflect on the lessons. According to the teachers, the purpose of the learners' reflections were to find out whether the integration of local knowledge in the lesson enhanced (or not) learners to make sense of testing acidity and alkalinity of substances.

Although my research focus was not on the learners, some of the reflective comments that strengthened the integration of local knowledge emerged during the lesson. For example, one learner commented that:

It was really amazing, because I never knew that the red cabbage that we usually use as food at home can be also used as an indicator. It is easy to prepare and I can even do experiments at home. (L1)

L1's reflection is connected to Vygotsky's (1978) notion of mediation and self-regulation. The teacher mediated a self-regulatory process by using local knowledge on red cabbage as an indicator. It seemed like learner 1 developed a sense of awareness of red cabbage as an indicator and self-regulation as he/she wanted to conduct that experiment at home. It appeared that intervention could enable learners to develop scientific skills. Wellington and Ireson (2012) asserted that the aim of practical work is to promote common sense, scientific methods of thought and develop manipulative skills. Learners became more independent and started regulating their own learning processes (Young & Tan, 2013). Two other learners commented: *"I learnt more on*

testing, colour changes, strong chemicals like hydrochloric acid that we should not touch with our bare hands, taste or smell” (L2). “The lesson improved my skills as I now know how to deal with experiments” (L3).

Based on L1’s and L2’s comments, it appeared that local knowledge in the mediated lesson enabled them to develop some skills such as laboratory rules and regulations. Practical activity can serve an important purpose to develop and teach specific skills and techniques as proposed by Wellington and Ireson (2012) in their study. “The lesson was good because I learnt something new that I never knew and now I got a chance to go out in my environment and explore new things” (L4).

This excerpt resonates with Killen’s (2015) assertion that if the learners can see direct and useful connections between what they are learning and their real world, the learning will be valued to have meaning beyond the instructional setting.

As I observed the lessons’ activities, episodes emerged, interpreted into themes that were related to literature and theory. I was directed by the socio-cultural perspective (Vygotsky, 1978) to understand how teachers were mediating the lessons. I then came up with sub-themes that were further interpreted into four themes.

Table 6.4: Shows episodes and themes

Research Question 3: How do Grade 9 Physical Science teachers mediate learning of the co-developed model lessons that integrate local knowledge?			
Episodes	Themes	Literature	Conceptual/Theoretical
<ul style="list-style-type: none"> Teacher greeted the learners 	Establishing a friendly and conducive learning environment	Meaningful learning environment is not just about physical space in which learning occurs, it also include creating and strengthening positive interactions between learners and the teacher (Killen, 2015)	Vygotsky (1978) Design of learning environments (Duit et al., 2012)

<ul style="list-style-type: none"> • Teacher asked questions, provided local materials • Learners to participated in the lesson activities, curious to observe and ask questions • Groups work and shared responsibilities Learners were able to do experiments themselves • Learners mastered scientific skills 	Active participation	<p>Learning and development is a social collaborative activity (Landsberg, Kruger & Swart, 2016).</p> <p>Classroom activity should be a reality based and applicable to the real world (Landsberg et al., 2016) Wellington & Ireson, (2012)</p> <p>Hodson (1990)</p>	<p>Vygotsky (1978)</p> <p>Lave & Wenger (1991)</p> <p>Learner Centred Education</p> <p>Mastering skills</p> <p>Contextualised Teaching and Learning</p> <p>Collaborative teaching</p>
<ul style="list-style-type: none"> • The teacher and the critical friend worked together to assist the learners 	Collaborative teaching		
<ul style="list-style-type: none"> • Teacher guiding, instructing and monitoring the learners towards the learning activities 	Teacher as a facilitator for teaching and learning activities	Teacher played a role as a facilitator who provides challenges to the learners to achieve more (Pritchard (2013)	<p>ZPD</p> <p>Mediation</p> <p>Internalisation</p> <p>Self-regulation</p>

In order to answer my research question four, the following themes were developed from the observations of the first and second practical activity:

- Establishing a friendly and conducive learning environment;
- Active participation;
- Teacher as a facilitator for teaching and learning activities;
- Collaborative teaching;
- Practical Activity.

I now discuss each of these themes below.

6.5 THEMES DEVELOPED FROM OBSERVATIONS OF ACTIVITY 1 AND 2

6.5.1 Theme 1: Establishing a friendly and conducive learning environment

As I discussed in Section 2.6, creating a quality learning environment is a significant aspect that contributes to quality teaching and learning. Both the teachers created a conducive learning environment by strengthening a good relationship with their learners through greeting them. It appeared that when the learners were greeted, they expressed the sense of being respected and accommodated by the teachers and this showed a good interaction with their learners, especially when T1 called them by their names. In my view, a meaningful learning environment is not just about physical space in which learning occurs; it also includes creating and strengthening positive interactions between learners and the teacher (Killen, 2015). Based on du Toit et al.'s (2012) Model for Educational Reconstruction (MER), the design of a learning environment is regarded as an important aspect that contributes to a sustainable learning environment.

6.5.2 Theme 2: Active participation

During the classroom observations for T1 and T2, a series of social interaction activities were conducted. Learning and Teaching Support Materials (LTSMs) that the teachers used were locally-based. These were the indicator solution (red cabbage), wood ash, Vim, lemon juice, coffee, fresh milk, sour milk, bleach, vinegar, fizzy drinks, window cleaner, methylated table salt, tea and baking soda. These are the materials that learners knew from their homesteads and communities. In addition learners' prior knowledge of red cabbage was tested and acknowledged by the teacher. Classroom activities should be reality-based and applicable to the real world (Landsberg et al., 2016).

T1 arranged her learners in groups to interact with one another and share responsibilities. During the group work activities learners were able to carry out experiments themselves, make and record their observations. T2 and the critical friend on the other hand, arranged the lesson in a manner that they were doing the testing while the learners were observing and recording their observations. The following diagrams show classroom social interactions that resulted in active participation of the learners.



Figure 6.6: Shows learners' active participation

Through this active participation, learners from both schools were curious and they were stimulated to ask questions such as: *“Ms., when hydrochloric acid was added to the red cabbage indicator solution, the test tube became warm, why?”* *“Sir, where can I get that red cabbage?”*

Based on the learning activities from both classrooms, there is a connection with what Landsberg et al., (2016) said that learning and development is a socially collaborative activity. There was a high degree of teacher to learner as well as learner to learner interactions.

6.5.3 Theme 3: Teacher as a facilitator during teaching and learning activities

Teachers play a role as facilitators who provide challenges for the learners to achieve. Teachers play a role of guiding, teaching, instructing, probing, promoting discovery, learning and critical thinking (Pritchard, 2013). Both the teachers understood that the learners were children to be monitored and protected, as they helped them with the last three strong chemicals, to avoid danger/injuries during the experiments. Hydrochloric Acid, Ammonia and Sodium Hydroxide were not given to the learners to test on their own, as their teacher explained to them that they were

strong chemicals; T1 indicated that: *“Class, you have to be very careful, pay attention and wait until I give you these chemicals and instruct you on how to handle them safely”*.

6.5.4 Theme 4: Collaborative teaching

Implementation and mediation of IK lessons were done based on the collaborative effort of planning and teaching within professional learning community structures, as Al-Shareef and Al-Qarni (2016) indicated that teamwork and collaboration are very important to teachers in order to improve their teaching practices. CoP honours the knowledge and experience of the teachers and the theory generated by the researcher, through a collaborative effort (Vescio et al., 2008). Teachers engaged in a participatory and collaborative approach to teaching with a critical friend who was also a CoP member and research participant. Through collaborative efforts, teachers shared teaching activities.

6.5.5 Theme 5: Practical activity

Inclusion of local knowledge in the classroom promoted the teaching of practical activities in Physical Science that encouraged active participation of the learners. T1’s lesson was more learners centered in its approach by involving the learners in carrying out the experiment themselves unlike T2, whose practical activities/experiments were based more on a teacher centred approach. Abah et al. (2015) stated that integration of IK in education is significant for an African child to learn meaningful practical application within his/her community.

6.6 DATA COLLECTED FROM TEACHERS POST-LESSON OBSERVATION REFLECTIONS

During the post-reflective session, two teachers and the critical friend were asked to reflect on the model lessons that integrated local knowledge that were observed and also on the overall intervention. Their reflections were based on what effect the local mediated lessons could have on the learners, whether the lessons were successful or not. They also reflected on the overall intervention of local knowledge mediated lessons, areas of improvement and recommendations. The first step was to collate teachers’ journal reflections to come up with general categories as depicted in the following table. After analysis of general sub-themes, seven themes emerged as shown below.

Table 6.5: Preliminary categories and sub-themes from journal reflection

Research Question 4: How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons shifted or evolved as a result of their participation in the intervention?		
Description of marked text	Sub-themes	Code
Local knowledge enhances learners better understanding, Learners apply what they learnt at school in their everyday life, Use of local knowledge enables learners to recall what they learn, Help the learners to understand better the usefulness of what is around them.	Enhance effective learning	T1 T2
Learners used their local knowledge that made them ask questions, Learners recall their daily activities and link it to classroom science, Learners showed understanding and relate the lesson to their everyday lives.	Promotes learners prior knowledge	
Learners and the teachers aimed new knowledge and experiences from surroundings, Experienced new knowledge rather than just from the textbooks, Lesson enlightened teachers and the learners on neutralisation.	Development of new knowledge	
Enables the learners to do practical activities, Enables the learners to do experiments on their own, Learners master the skills easier and faster.	Promote the teaching of practical activities	
Local knowledge makes the learners more curious, Learners input amazed the teachers.	Active participation	
Participating in professional development activities, knowledge of locality.	Professional development activities promoted local knowledge.	
Time constraints	Challenges	

Table 6.6: Shows themes that emerged from the lesson observations

Research Question 4: How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons shifted or evolved as a result of their participation in the intervention?		
Themes	Theory	
	Literature	Conceptual/Theoretical
Use of local knowledge enhance effective learning and teaching	Mukwambo (2016), Botha (2012), Mavuru & Ramnarain (2017) Killen (2015)	Contextualised Teaching and Learning (Berns & Erickson, 2001)
Development of new knowledge	Behera (2014)	
Promote the teaching of practical activities	Wellington & Ireson (2012)	
Promote learners' prior knowledge and active participation	Cocks et al. (2012), Brown et al. (2006), Mhakure & Otulaja (2017), Coetzee & van Niekerk (2015) Wellington & Ireson (2012)	Without necessary background knowledge, students cannot learn new things (Killen, 2015) Learning is a socially mediated process (Vygotsky, 1978)
Participation in professional activities	Kozleski & Smith (2009) Akiba & Liang (2016)	Community of Practice (Lave & Wenger, 1991)
Challenges of local knowledge mediated lessons	Mednick (2004), Ogunniyi (2007a), King & Schielmann (2004)	Challenges associated with local knowledge mediated lessons is based on time, planning and implementation (Hattie, 2012)

I now discuss each of these themes below.

6.6.1 Theme 1: Use of local knowledge enhance effective learning and teaching

Both the teachers reflected that as they participated in an intervention, they developed an understanding that the use of local knowledge in their lessons had the potential to enhance effective teaching and learning. For instance, T1 reflected that:

Local knowledge and indigenous intervention help learners to master the work quickly since they are already using those substances in their everyday life. It actually allowed my learners to connect the relationship they have to the subject content and understand it better.

It could be hypothesised that this teacher's understanding of local knowledge shifted to another dimension to viewing it as a mediational tool that can bring about effective learning. To this end, Killen (2015) recommended that teachers should make connections by basing the learning around the learner's personal experiences and the real world, in order to give the learners the opportunity to share their work beyond the classroom.

6.6.2 Theme 2: Development of new knowledge

The teachers' reflections revealed that their participation in this intervention enabled them to gain new knowledge. For instance, the critical friend highlighted that she gained new knowledge that teachers can teach science even without a science laboratory but with local substances to meet the competencies for the learners to make sense of science. This concurs with what T2 and T1 stressed:

I gained new knowledge, experience and how useful our surrounding can about to us. I have also gained new knowledge that red cabbage that it can be used as an indicator. (T2)

I have learnt not to focus only on chemical in laboratory but rather use more local knowledge to implement our teaching and make learners understand. (T1)

Behera (2014) indicated that intervention programmes are essential for teachers as they inculcate curiosity, motivation, and new ways of thinking. It could be deduced that the impact that participation has on the development of new knowledge is not only manifested in the teachers but also in the learners as discussed in Chapter Six (see Section 6.3.1).

6.6.3 Theme 3: Promote the teaching of practical activities

In terms of content knowledge and pedagogical skills, teachers reflected that their Pedagogical Content Knowledge (PCK) improved as a result of their participation in the intervention. The locally or IK mediated lessons promoted the teaching of hands-on practical activities as T1 commented that:

Using the wood ash to clean the glass and the stove enabled the learners to carry out a practical activity and at the same time trying to prove what they knew in theory through practice. The role of the teacher as a facilitator enabled the learners to do accurate measurement and take responsibility when it comes to safety in a laboratory.

It seems like having teachers participating in the intervention of locally or IK mediated lessons empowered them to develop or promote positive attitudes on how best they could make use of practical activities. Wellington and Irreson (2012) viewed practical activity as the teaching strategy that enables learners to develop scientific skills such as using a Bunsen burner, taking measurements and learning about safety hazards.

6.6.4 Theme 4: Promote learners' prior knowledge and active participation

The findings of this study showed that the teachers' participation in this intervention influenced their views and attitudes in relation to the consideration of learners' prior knowledge in science teaching. For instance, T1 reflected that her learners were able to use their local knowledge which made them even more curious to ask more questions, recall their everyday knowledge and link it to the lesson activities. Correspondingly, T2 noted that: *"I was surprised by the input from the learners and it shows that there is still more that we need to know locally"*.

Coetzee and van Niekerk (2015) advocated that a teacher should create a learning environment that supports positive cultural connections by ensuring that learning activities are related to the learners' socio-cultural background. Similarly, Mhakure and Otulaja (2017) and Mavuru and Ramnarain (2017) believed that teachers should implement culturally responsive pedagogy by using materials and practices that integrate learners' socio-cultural background knowledge. Hence, it emerged that local mediated lessons enabled the teachers to realise the significance of learners' prior knowledge in teaching and learning.

6.6.5 Theme 5: Participation in professional activities

It appeared that this intervention falls within the area of professional development and teachers' participation resulted in the evolvement of teachers' attitudes, views, understanding and pedagogical skills. From T3's point of view:

I am now able to teach acid and bases in an interesting way due to the fact that I got better/depth knowledge on the topic. Nowadays laboratory materials are getting scare due to economic crises, so red cabbage is cheaper to buy and it can even be grown in our gardens for school or home.

Teachers' continuous engagement in professional learning activities is critical for improvement of their knowledge instruction and learners' learning (Akiba & Liang, 2014). Before the intervention, the teacher (T3) may have had some challenges in teaching acids and bases but after the intervention she acquired some skills or experiences that enabled her to handle the topic of acids and bases on her own (independently). Local knowledge was therefore a mediating tool that was used in the intervention to bring about the Zone of Proximal Development (ZPD) (Vygotsky, 1978).

6.6.6 Theme 6: Challenges of locally or IK mediated lessons

It emerged that mediating local knowledge lessons was restricted by a lack of time. More time is needed for researching local knowledge practices and the preparation and presentation of the lessons.

6.7 CONCLUDING REMARKS

In this chapter I started with a presentation of the qualitative data from classroom observations and journal reflections. From the classroom observations, it was clear that teachers were able to mediate lessons that integrated local knowledge. It was observed that the inclusion of local knowledge had a positive impact on the teaching and learning as it enhanced learning, promoted the teaching of practical activities and active participation. Journal reflection data revealed that the teachers' attitudes, views, understanding and pedagogical skills evolved gradually due to their participation in the intervention. Both classroom observations and journal reflections revealed that inclusion of local knowledge in Physical Science lessons has challenges, such as lack of proper training and time. In the next chapter, I present a summary of my findings, recommendations and conclusions.

CHAPTER SEVEN

SUMMARY OF FINDINGS, RECOMMENDATIONS, CONCLUSION AND REFLECTIONS

7.1 INTRODUCTION

The goal of my study was to explore an intervention on the integration of local knowledge in Grade 9 Physical Science lessons. It looked at teachers' attitudes and understanding towards integration of local or IK and how Grade 9 teachers could be supported in developing model lessons that integrate local or indigenous knowledge. It has been advocated that integration of IK into science classrooms might make science more relevant to students, particularly in culturally diverse classrooms (de Beer & Whitlock, 2009). It is believed that such integration would reflect the diverse cultural backgrounds of the students and enhance their knowledge construction (Botha, 2012; Mavuru & Ramnarain, 2017). As a result, the Namibian Grade 9 Physical Science curriculum expects teachers to integrate learners' prior knowledge (of which local knowledge is a part), but there are no clear instructions on how to go about doing this. These ideals prompted me to carry out a research investigating the effect of an intervention on integrating local or indigenous knowledge in Physical Science lessons.

The study employed an interpretive, qualitative, intervention case study to generate data (see 4.2). Vygotsky's (1978) socio-cultural theory and Wenger's (1998) Community of Practice (CoP) informed my study. Data were collected by means of semi-structured interviews, workshop discussions, classroom observations and journal reflections. Qualitative data were inductively analysed whereby episodes and themes were developed.

In this chapter, I thus present a summary of my findings of my data in relation to my research questions. Moreover, implications and recommendations, limitations, and the conclusion are also presented. The chapter ends with some personal reflective discussions on the research process.

7.2 SUMMARY OF FINDINGS

Data generated were analysed to answer my four research questions and I thus present the summary in relation to these research questions.

7.2.1 Research Question 1:

(a) What are Grade 9 Physical Science teachers' understanding of the integration of local knowledge in their Physical Science lessons prior to the intervention?

(b) What are Grade 9 Physical Science teachers' attitudes towards the integration of local knowledge in their Physical Science lessons prior to the intervention?

The data which responded to the above research question are presented in Chapter Five (see Sections 5.3 and 5.4). During the orientation workshop, it appeared that teachers had little understanding on integration of local knowledge. Consequently, their expectations from the intervention were to gain a better understanding on the usage of local knowledge materials within the Physical Science curriculum content; gain some local knowledge that could be used in the classroom and improve their teaching methods; and to acquire knowledge that could make the lessons more interesting to the learners and encourage the learners to participate more in the class due to the indigenised and localised learning materials. Teachers developed positive attitudes toward what the Grade 8-9 Physical Science syllabi expected of them with regards to their approach to teaching and learning.

Data from the interviews revealed that teachers' understanding of local knowledge was based on culture, tribes and the everyday way of life. For example, T2 understood local knowledge as: *"The knowledge based on your home language and what you understand from home"*. Furthermore, the data revealed that the integration of local knowledge can enhance learning and socio-cultural interactions in the classroom. It emerged that the teachers involved in this seemed to have background experience on indigenous knowledge related to farming production, brewing of homemade drinks, acids and bases, water purification and separation of substances. It emerged that there are factors that influence integration of local knowledge such as basic training, attitudes and background experiences. It also appeared that the teachers' educational experiences on local knowledge integrated into the mainstream curriculum, by providing locally relevant ways and examples of learning about the environment, plants, animals, geography, and language that would in turn give students self-confidence and a stronger sense of identity and community. Finally, the research findings seem to support the claim made by Hattie (2012) that more time is needed for preparation and integration of local knowledge. Participants felt that integration of local knowledge in one grade would not make a great impact unless it is done across all the grades.

7.2.2 Research Question 2

In what ways can Grade 9 Physical Science teachers be supported in co-developing model lessons that integrate local knowledge?

Qualitative results from document (syllabus) analysis (see Chapter Five, 5.6) confirmed that participants met as a community of practice to analyse the Grade 9 Physical Science syllabus. The analysis was guided by the three components of Komorek and Kattmann's (2009) Model of Educational Reconstruction. Firstly, analysis and clarification of the Physical Science content was made based on four possible topics, identified as: combustion reactions, physical and chemical changes, acids and bases, as well as separation of mixtures. Secondly, the investigation into the students' capabilities were based on consideration of their prior knowledge, understanding and specific competencies.

Thirdly, the design and evaluation of the teaching and learning environment, was also made taking into consideration the availability of possible local materials, learners' needs and syllabus expectations. The choice of the topics that were to be integrated (the two topics under acids and bases) was made and agreed upon as participants agreed upon that there are more local and indigenous practical applications that can be integrated in the Physical Science lessons. The other reason for the choice was that those topics accommodated the learners' needs, prior knowledge syllabuses specific learning competencies. The two topics were:

- Using wood ash to teach the concept of neutralisation.
- Using a red cabbage juice indicator solution to test acidity and alkalinity of substances; and
- Finally, co-development of model lessons and implementation of such lessons was conducted.

7.2.3 Research Question 3

How do Grade 9 Physical Science teachers mediate learning of the co-developed model lessons that integrate local knowledge in their classrooms?

The lessons were mediated with a collaborative effort of teachers and a critical friend. This strategy is supported and highlighted by Mednick (2004) that it is a good guide for teachers to collaborate in terms of lesson planning, presentation and resource development. Similarly, Al-Shareef and Al-

Qarni (2016) highlighted that sharing teamwork and collaboration are very important to teachers in order to improve their teaching practices. It emerged that participants considered and acknowledged the learners' prior knowledge and this resonated with Madjidi and Restoule's (2008) suggestion that curriculum should include indigenous knowledge and indigenous ways of knowing as a means for appealing to the personal dignity of students and community, as well as providing opportunities to validate their lived experiences. Finally, it can be concluded that mediation of locally mediated lessons needs teachers' better understanding, positive attitudes toward local knowledge, collaborative effort and acknowledgement of the learners'.

7.2.4 Research Question 4

How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local knowledge in science lessons shifted or evolved as a result of their participation in the intervention?

It emerged that the teachers' attitudes and understanding evolved in the sense that they developed positive attitudes towards improving their instructional practices. That is to say that they realised how important it is to value and acknowledge the learners' prior knowledge in lessons, as well as in the teaching of practical activities. This is similar to Guskey (1986), who said that participation in professional development activities creates a new instructional approach, the use of new materials or curricula, or simply some modification in teaching strategies.

The findings of the study recognised that the teachers' content knowledge pedagogical skills had shifted as a result of their participation in the intervention. These findings corroborated the findings of Tshiningayamwe (2016), who said that teachers in PLCs share successful teaching strategies, develop new approaches to shared problems and share specific subject content knowledge. These teachers expressed that they developed new knowledge on the red cabbage indicator as, indigenous technological innovations of wood ash and possibilities of science projects that are grounded on local knowledge.

The findings established further conclusions, based on the rational understanding that inclusion of local knowledge was not only used to mediate subject content aspects but also used to strengthen Education for Sustainable Development (ESD). It appeared that integrating local knowledge of wood ash into the lesson to teach the concept of neutralisation, unpacked the possibilities for more exploration on the uses of wood ash as indicated in Section 6.3.2. Relating the application of wood

ash to scientific concepts appeared to open another new knowledge dimension within my research context which could address some of the social challenges within ESD. This finding resonates with the requirement of the Namibian Physical Science curriculum (2015) that ESD is one of the cross-curricular issues that should be dealt with across all phases and in every subject where the topics overlap with the content of that subject, so that learners can understand how they can play a part in addressing these risks and challenges in their own school and local community.

7.3 RECOMMENDATIONS

This study highlighted the significance of integrating local knowledge in the teaching and learning of Physical Science. In addition, this intervention study has engendered further research prospects. The following recommendations are proposed in order to reinforce the integration of local knowledge in science lessons.

- **Curriculum expectations:** Based on the expectations of the Namibian Grade 8-9 Physical Science syllabus, teachers are expected to integrate local or indigenous knowledge in their science classrooms, but with no clear instructions on how to go about doing it. The suggestion is to have clear guidelines underlining the possibilities for integrating local and indigenous knowledge.
- **Provision of locally Learning and Teaching Support Materials (LTSMs):** There is a need to mobilise the provision of indigenised LTSMs and local examples should be made available in the curriculum documents, textbooks, assessment activities and posters. This can bring about Contextualised Teaching and Learning.
- **Continuous professional development:** Teachers should be empowered to create study groups, participate in professional learning communities, attend workshops and share ideas on how they can improve their content and pedagogical knowledge. Through such platforms, teachers can discuss the possibilities for local knowledge inclusion.
- **Ministry of Education, Arts and Culture (MoEAC):** Through NIED, MoEAC is urged to strengthen local and indigenous ways of knowing as part of science content.
- **Further research:** It might be useful to conduct more research studies based on integration of local knowledge in science lessons, particularly on the relationship between teachers' instructional practices and learners' performance. The focus should be particularly on the area of investigating the acknowledgement of the learners' socio-cultural prior knowledge and their attitudes, interest and/or performance.

7.4 LIMITATIONS OF THE STUDY

The limitations of the study include the fact that the findings of this case study are not generalisable to all teachers or all schools in Namibia. This is because the study was limited by the size of the sample. Only four teachers from four schools in the Otjiwarongo circuit participated in the research. Out of the four teachers, only two were observed. Notwithstanding, the study illustrated some possibilities for the integration of local knowledge in science lessons.

The other limitation was the issue of positionality which could have influenced the responses of the participants. At the time of the study, I served as both a Senior Education Officer (for the Teachers' Resource Centre in the Otjozondjupa Region where the research was conducted) to the teachers at a regional level and also as a researcher. I had to remain conscious of my interactions with participants and ensured that I explained to them that they should not consider or allow my position to influence their responses and that they could withdraw from the research at any time. On a final note, if I were to do this study again, I would conduct some mini-workshops to raise awareness among teachers, so that they could develop a more positive attitude towards participating in educational researches in order to improve their teaching practices.

7.5 REFLECTIONS

It was not an easy exercise for me to become a Master student. I started my studies with Rhodes University in 2015 with a BEd (Hons), Science Education. My intention in studying was just to acquire my BEd (Hons) and that was my target. At the end of the BEd Hons course in 2016, two of my lecturers encouraged me to apply to do my Master's. I did not want to apply and told them that I was not interested and that I would never apply. Ms Kuhlane was very disappointed but she kept on trying to convince me to apply. In the same way, Prof Ken Ngcoza convinced me to apply.

I finally changed my mind and decided to continue with my Master's for the academic years 2017/2018. Being a part-time Master's student is not an easy thing due to other crucial commitments such as work, family, friends and many others. For me to be able to make any progress during this time, I had to spend some sleepless nights, limit the time spent with my family, friends and others. Despite some family members, friends and relatives that were not happy that I

had little or no time for them, I was not discouraged as I needed to be focused and create more time to focus on my studies.

After completing my research proposal, I started negotiating with the local teachers to participate in my study. I struggled as it took me more than a month to just find four teachers. Although I explained the benefits of doing research *with* rather than doing research *on* the participants, the majority of the teachers that I approached showed their negative attitudes toward intervention as they felt that the research was only going to benefit the researcher and they would just be used as subjects. Some teachers withdrew from the research and this delayed the process of data collection.

It was not easy to get research participants as most of the teachers that I approached were not willing to participate in the research as they thought that I was doing research on them. Some participants withdrew from the research and this delayed the data collection process. In future research I will raise awareness among the teachers on the importance of doing research with people. Based on parents' consent letters, a few parents phoned me as they could not properly understand the contents of the consent letter and I had to explain it more fully to them (telephonically). I think I was supposed to translate the consent letter into local languages that parents understood well. Lessons observed were planned for an hour for each and they ended up taking two hours. In future research the learning and teaching activities will be reduced.

I kept on approaching the teachers and luckily, I found teachers that were willing to learn and work within the community of practice (CoP), as they demonstrated dedication and good attendance. One thing that I learnt during my studies with Rhodes University is that in every challenging situation, there is always a way out. I worked with these teachers in a very positive way as they regarded the research and value of educational researches as significant to teaching and learning. I have learnt so much in many different ways such as, my research skills, my research area (integration of local knowledge in science lessons), how to work in a CoP, how to write journal article papers and other academic writings. As a Senior Education Officer, I also further learnt how to work with teachers as a CoP to improve their pedagogical skills. The Namibian National Programme on Research, Science, Technology and Innovation (2014 - 2017) prioritised Indigenous Knowledge (IK) as a critical area of research that can address Namibia's social challenges. Likewise, I am willing to respond to this, take up the challenge of earning my PhD to learn more in this field of local knowledge.

7.6 CONCLUSION

The study highlighted the significance of an intervention aimed at exploring the impact of integrating the local knowledge in Physical Science lessons. This intervention was in the form of workshops aimed at developing positive attitudes and understanding towards integration of local knowledge in their science lessons. The study revealed that teachers can mediate lessons that integrate local knowledge. It emerged that such integration enhances learning; promotes the teaching of hands-on practical activities as well as their learners' prior knowledge. The study has established that teachers' participation in professional activities within an intervention enabled them to learn on how they can improve instructional practices. This requires teachers to be empowered professionally as Guskey' (1986) model of the teacher change expects teachers' development programmes to result in changes in teaching approaches and achievement of the learners.

The study thus recommends that the Namibian Science curriculum should give explicit guidelines on how local knowledge could be integrated during teaching and learning. That is, teachers should be afforded opportunities and spaces to participate in professional development activities to share ideas on how to integrate local knowledge in their lessons. It is recognised, however, that there is a need for more research to be conducted on how the teaching and learning of science could be improved by tapping into local and indigenous knowledge. Finally, this study, albeit at a small scale, has provided some insights on how to go about integrating local or indigenous knowledge in science classroom

REFERENCES

- Abigail, L. K. M. (2016). Do communities of practice enhance faculty development? *Health Professions Education*, 2(2), 61-74.
- Abtahi, N. (2017). More knowledgeable other: A necessity in the zone of proximal development? *For the Learning of Mathematics*, 37(1), 20-24.
- Aikenhead, G. S., & Huntley, B. (1999). Teachers' views on Aboriginal students learning western and Aboriginal science. *Canadian Journal for Native Education*, 23, 159-175.
- Aikenhead, G. S., & Ogawa, M. (2007). Indigenous knowledge and science revisited. *Cultural Studies of Science Education*, 2(3), 539-620.
- Alsoulouli, M. (2004). Preservice teachers' beliefs and conceptions about mathematics teaching and learning. In *Annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, Toronto, Canada*. Retrieved online from <http://web.Ebscohost.com/ehost/pdfviewer/pdfviewer>.
- Al-Shareef, S. Y., & Al-Qarni, R. A. (2016). The effectiveness of using teacher-teacher wikis in collaborative lesson planning and its impact on teacher's classroom performance. *English Language Teaching*, 9(4), 186.
- Abah, J., Mashebe, P., & Denuga, D. D. (2015). Prospect of integrating African indigenous knowledge systems into the teaching of sciences in Africa. *American Journal of Educational Research*, 3(6), 668-673.
- Akiba, M., & Liang, G. (2016). Effects of teacher professional learning activities on student achievement growth. *The Journal of Educational Research*, 109(1), 99-110.
- Asheela, E. N. (2017). *An intervention on how using easily accessible resources to carry out hands-on practical activities influences science teachers' conceptual development and disposition towards use of practical activities in science*. Unpublished master's thesis, Education Department, Rhodes University, Grahamstown.
- Atallah, F., Bryant, S. L., & Dada, R. (2010). A research framework for studying conceptions and dispositions of mathematics: A dialogue to help students learn. *Research in Higher Education Journal*, 7, 1.
- Bantwini, B. D. (2010). How teachers perceive the new curriculum reform: Lessons from a school district in the Eastern Cape Province, South Africa. *International Journal of Educational Development*, 30, 83-90.

- Barnett, M. (2002). *Issues and trends concerning electronic networking technologies for teacher professional development: A critical review of the literature*. Paper presented at the American Educational Research Association, Indiana University, New Orleans, LA.
- Beeden, A., & Van Zyl, M. (2015). *The sociology book: Big ideas simply explained*. London: Dorling Kindersley Limited.
- Bennett, A., Bridglall, B. L., Cauce, A. M., Everson, H. T., Gordon, E. W., Lee, C. D., & Stewart, J. K. (2004). All students reaching the top: Strategies for closing academic achievement gaps. a report of the national study group for the affirmative development of academic ability. *North Central Regional Educational Laboratory*.
- Berns, R. G., & Erickson, P. M., (2001). Contextual teaching and learning, preparing students for the new economy. *The Highlight Zone: Research@ Work*, 5, 2-9.
- Bertram, C., & Christiansen, I. (2015). *Understanding research: An introductory to reading research*. Pretoria: Van Schaik publisher.
- Bodner, G. M., & Orgill, M. (2007). *Theoretical frameworks for research in chemistry/science education*. United State of America: Pearson Prentice Hall.
- Botha, L. R. (2012). Using expansive learning to include indigenous knowledge. *International Journal of Inclusive Education*, 16(1), 57-70.
- Brown, J. C., Muzirambi, J. M., & Pabale, M. F. (2006). *Integrating indigenous knowledge systems (iks) in the teaching and learning of science, a case study of Zimbabwean form 3 biology students and South African grade 10 physics students*. Proceedings of the 14th Annual SAARMSTE Conference, University of Pretoria (pp. 212-218). Pretoria.
- Bryman, A., Bell, E., Hirschsohn, P., du Toit, J., dos Santos, A., Wagner, C., van Aardt, I., & Masenge, A. (2014). *Research Methodology. Business and management contexts*. Cape Town: Oxford University Press.
- Booth, T., & Ainscow, M. (2011). *Index for Inclusion: developing learning and participation in schools* (3rd ed.). Bristol: Centre for Studies in Inclusive Education (CSIE).
- Boven, K., & Morohashi, J. (2002). Best practices using indigenous knowledge: *A Joint Publication by: Nuffic, The Hague, The Netherlands, and UNESCO/MOST, Paris, France*.
- Breidlid, A. (2009). Culture, indigenous knowledge systems and sustainable development: A critical view of education in an African context. *International Journal of Educational Development*, 29(2), 140-148.

- Breidlid, A., & Botha, L. R. (2015). Indigenous knowledges in education: Anticolonial struggles in a monocultural arena with reference to cases from the global south. In *Indigenous Education* (pp. 319-339). Dordrecht: Springer.
- Burridge, N., & Evans, C. (2012). Carmine school. In N. Burridge, F. Whalan & K. Vaughn (Eds.), *Indigenous education: A learning journey for teachers, schools and communities* (pp. 77-86). Rotterdam: Sense Publishers.
- Calgary Board of Health. (2008). *Healthy Diverse Population*. Retrieved 13 February 2009 from www.calgaryhealthyregion.ca/programs/diversity/diversity-resources/definitions/definitions-main.htm.
- Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative research*. London: Sage Publications.
- Cocks, M. L., Alexander, J., & Dold, T. (2012). Inkubeko Nendalo: A bio-cultural diversity schools education project in South Africa and its implications for inclusive indigenous knowledge systems (IKS) Sustainability. *Journal of Education for Sustainable Development*, 6(2), 241-252.
- Coe, R., Waring, M., Hedges, L. V., & Arthur, J. (Eds.). (2017). *Research methods and methodologies in education*. Sage.
- Cohen, L., Manion, L., & Morrison, K. (2018). *Planning educational research: Research methods in education* (8th ed.). New York: Routledge.
- Csikszentmihalyi, M., & Larson, R. (2014). Validity and reliability of the experience-sampling method. In *flow and the foundations of positive psychology* (pp. 35-54). Netherlands: Springer.
- De Beer, J., & Whitlock, E. (2009). Indigenous knowledge in the life sciences classroom: Put on your Bono Hats! *The American Biology Teacher*, 71(4), 209-216.
- Dziva, D., Mpofu, V., & Kusure, L. (2011). Teachers' conception of indigenous knowledge in science curriculum in the context of Mberengwa district, Zimbabwe. *African Journal of Education and Technology*, 1(3), 88-102
- Drake, M. (2014). Historical development of inclusive education in South Africa. In C. Okeke, M. van Wyk & N. Phasha (Eds.), *Schooling, society and inclusive education: An African perspective* (pp. 65-80). Cape Town, South Africa: Oxford University Press.
- DuFour, R. (2005). What is a professional learning community? In R. DuFour, R. Eaker & R. DuFour (Eds.), *On common ground: The power of professional learning communities* (pp. 31-43). Bloomington, IN: Solution Tree.

- Du Plessis, J., & Muzaffar, I. (2010). *Professional Learning Communities in the Teachers' College: A Resource for Teacher Educators. EQUIP1.*
- Emeagwali, G. (2014). Intersections between Africa's Indigenous Knowledge Systems and History 1, In G. Emeagwali & G. J. Sefa Dei (Eds.), *African indigenous knowledge and the discipline* (pp.). Rotterdam: Sense Publisher.
- Emeagwali, G., & Sefa Dei G., J. (2014). *African Indigenous Knowledge and the Discipline*, (eds), Rotterdam: Sense Publisher.
- Emeagwali, G. & Shizha, E. (2016). African Indigenous Knowledge and the Sciences: *Journeys into the Past and Present*, Rotterdam: Sense Publisher.
- Engeström, M. Y. (1987) *Learning by expanding: An activity-theoretical approach to developmental research.*
- Eun, B. (2008). Making connections: Grounding professional development in the developmental theories of Vygotsky. *The Teacher Educator*, 43(2), 134-155.
- Fraser, C., Carroll, M., McKinney, S., & Reid, L. (2006). Teachers continuing professional development (CPD): contested concepts, understandings and models. Paper presented at the British Educational Research Association Annual Conference, University of Warwick, 6-9 September 2006.
- Freire, P. (Ed.) (1993). *Pedagogy of the oppressed*. New York: Continuum.
- Giddens, A. (2009). *Sociology* (6th ed.). Cambridge: Polity Press.
- Göker, S. D. (2016). Use of reflective journals in development of teachers' leadership and teaching skills. *Universal Journal of Educational Research*, 4(12A), 63-70.
- Greene, M. J. (2014). On the inside looking in: Methodological insights and challenges in conducting qualitative insider research. *The Qualitative Report*, 19(29), 1-13.
- Gubrium, J. F., & Holstein, J. A. (1997). *The new language of qualitative method*. New York: Oxford University Press.
- Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher*, 15(5), 5-12.
- Handley, K., Sturdy, A., Fincham, R., & Clark, T. (2006). Within and beyond communities of practice: Making sense of learning through participation, identity and practice. *Journal of Management Studies*, 43(3), 641-653.

- Harrison, G., & Muthivhi, A. (2013). Mediating self-regulation in kindergarten classrooms: An exploratory case study of early childhood education in South Africa. *Journal of Education*, 57, 79-102.
- Hattie, J. (2009). *Visible learning: A synthesis of meta-analyses in education*. London: Routledge.
- Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. London: Routledge.
- Higgs, P., & Smith, J. (Eds.). *Philosophy of education today. An introduction*. Cape Town: Juta.
- Hodson, D. (1990). A critical look at practical work in school science. *School Science Review*, 70(256), 33-40
- Howey, K. R. (1996). Revisiting the purposes of professional development schools. *Contemporary Education*, 67(4), 180.
- Huffman, D., Thomas, K., & Lawrenz, F. (2012). Relationship between professional development, teachers' instructional practices, and the achievement of students in science and mathematics. *School Science and Mathematics*, 103, 378-387. doi:10.1111/j.1949-8594.2003.tb18123.x
- Igbokwe, U., L., Mezieobi, D., I., & Eke, C. (2014). Teachers attitude to curriculum change: implications for inclusive education in Nigeria. *Journal on Research on Humanities and Social Sciences*, 4(11).
- Katjavivi, P. H. (2016). Education transformation in Namibia: At the Forum of the Commonwealth Council of Education, Commonwealth Parliamentary Association: London United Kingdom.
- Kerno, S. J. (2008). Limitations of communities of practice: a consideration of unresolved issues and difficulties in the approach. *Journal of Leadership & Organizational Studies*, 15(1), 69-78.
- Kibirige, I., & Van Rooyen, H. (2006). Enriching science teaching through the inclusion of indigenous knowledge. In J. de Beers & H. Van Rooyen (Eds.), *Teaching science in the OBE classroom*. Bloemfontein: Macmillan.
- Killen, R. (2015). *Teaching strategies for quality teaching and learning* (2nd ed.). Lansdowne: Juta and Company Ltd.
- Killion, J. P., & Todnem, G. R. (1991). A process for personal theory building. *Educational leadership*, 48(6), 14-16.

- Kim, E. J. A. (2015). Neo-colonialism in our schools: Representations of indigenous perspectives in Ontario science curricula. *McGill Journal of Education/Revue des sciences de l'éducation de McGill*, 50(1), 119-143.
- King, L., & Schielmann, S. (2004). *The challenge of indigenous education: practice and perspectives*. UNESCO.
- Klein, J. (2011). Indigenous knowledge and education – the case of the Nama people in Namibia. *Education as Change*, 15, 81-94.
- Komorek, M., & Kattmann, U. (2009). The model of educational reconstruction. In S. Mikelskis-Seifert, U. Ringelband & M. Brückmann (Eds.), *Four decades of research in science education – From curriculum development to quality improvement* (pp. 171-188). Münster, Germany: Waxmann.
- Kruger, M., Ndebele, P., & Horn, L. (Eds.). (2014). *Research ethics in Africa: a resource for research ethics committees*. African Sun Media.
- Landsberg, E., Kruger, D., & Swart, E. (Eds.). (2016). *Addressing barriers to learning: A South African perspective* (3rd ed.). Pretoria: Van Schaik Publishers.
- Lantolf, J. P., & Thorne, S. L. (2006). Sociocultural theory and L2: State of the art. *Studies in Second Language Acquisition*, 28(1), 67-109.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- LeCzel, D. K., & Gillies, J. (2004). *From policy to practice: The teacher's role in policy implementation in Namibia*. Washington, DC: USAID/EQUIP2 Policy Brief (draft).
- Le Grange, L. (2007). Integrating western and indigenous knowledge systems: The basis for effective science education in South Africa? *International Review of Education*, 53(5-6), 577-591.
- Loreman, T., Deppeler, J., & Harvey, D. (2010). *Inclusive education: Supporting diversity in the classroom*. New York: Allen & Unwin.
- Lunetta, V. N., Hofstein, A., & Clough, M. P. (2007). Learning and teaching in the school science laboratory: An analysis of research, theory, and practice. *Handbook of research on science education*, 393-441. United State of America: Lawrence Erlbaum Associates Publishers.
- MacKenzie, R. C. (2009-2011). *Indigenous knowledge and the local curriculum in basic education in Mozambique – with a focus on two case study schools in Manica Province: Mozambique*. London: Institute of Education University of London.

- Madjidi, K., & Restoule, J. P. (2008). Comparative indigenous ways of knowing and learning. *Comparative and international education: Issues for teachers*, 77-106.
- Matemba, Y. H., & Lilemba, J. M. (2015). Reclaiming indigenous knowledge in Namibia's postcolonial curriculum: The case of the Mafwe people. In K. C. Chinsebu, A. Cheikhyoussef, D., Mumbengegwi, M., Kandawa-Schulz & L. Kazembe (Eds.), *Indigenous knowledge of Namibia* (pp. 283-310). Namibia: UNAM Publishers.
- Mavuru, L., & Ramnarain, U. (2017). Teachers' knowledge and views on the use of students' socio-cultural background in teaching natural sciences in grade 9 township classes. *African Journal of Research in Mathematics, Science and Technology Education*, 1-11.
- Mawere, M. (2015). Indigenous knowledge and public education in sub-Saharan Africa. *Africa Spectrum*, 50(2), 57-71.
- Mbeki, T. (1998). *Africa the time has come: Selected speeches*. Johannesburg, South Africa. Cape Town: Mafube Publishers.
- Mednick, A. (2004). Teachers working together to improve instruction. *Conversations*, 4(2), 1-12.
- Merriam, S. B., Johnson-Bailey, J., Lee, M. Y., Kee, Y., Ntseane, G., & Muhamad, M. (2001). Power and positionality: Negotiating insider/outsider status within and across cultures. *International Journal of Lifelong Education*, 20(5), 405-416.
- Mhakure, D., & Otulaja, F. S. (2017). Culturally-responsive pedagogy in science education. In *The World of Science Education* (pp. 81-100). Sense Publishers, Rotterdam.
- Mills, C. W. (2000). *The sociological imagination*. New York: Oxford University Press.
- Ministry of Education, Arts and Culture. (2012). *Otjozondjupa Regional School Visits*. Otjozondjupa Directorate of Education, Arts and Culture: Otjiwarongo.
- Ministry of Education, Arts and Culture. (2013). *Sector Policy on Inclusion Education*. Windhoek: Directorate of Programmes and Quality Assurance (PQA).
- Ministry of Education, Arts and Culture (2014). *The National Programme on Research, Science, Technology and Innovation*: Windhoek.
- Ministry of Education, Arts and Culture. (2015). *Physical Science, Grade 8-9. Syllabus*. Okahandja: NIED.
- Mishra, P., & Koehler M. J. (2006). *Technological pedagogical content knowledge: a framework for teacher knowledge*. Teachers College Record Volume 108, Number 6, June 2006, pp. 1017-1054. Copyright © by Teachers College, Columbia University 0161-4681.

- Michie, M. (n.d.). *Where are indigenous peoples and their knowledge in the reforming of learning, curriculum and pedagogy?* Retrieved 03 26, 2005, from <http://members.ozemail.com.com.au/2mmichie/aceid.html>
- Mukwambo, M., Ngcoza, K., & Chikunda, C. (2014). Africanisation, ubuntu and IKS: A learner centred approach. In C. Okeke, M. van Wyk & N. Phasha (Eds.), *Schooling, society and inclusive education: An African perspective* (pp. 65-80). Cape Town, South Africa: Oxford University Press.
- Mukwambo, M. (2016). Trainee teachers' experiences using contextual teaching and learning: Implications for incorporation of indigenous knowledge in instructional design. *Pedagogical Research*, 1(1), 3-12.
- Nghipandulwa, L. L. (2012). *Secondary school teachers' perceptions of practical work in biology in the Oshana education region*: University of South Africa.
- Mweti, I., & van Wyk, H. (2014). *Development studies*. New York: Cambridge University Press.
- Nikodemus, K. S. (2017). *Exploring how Grade 11 Physical Science Students make sense of the concept of rates of reactions through the inclusion of the indigenous practice of making oshikundu: A Namibian case study*. Unpublished master's thesis, Education Department, Rhodes University, Grahamstown.
- Odora Hoppers, C. (2001). Indigenous knowledge systems and academic institutions in South Africa. *Perspectives in Education*, 19(1):73-85
- Oeftering, Ngcoza and Kuhlana (2018). Citizenship education in South Africa and Germany – insights in a binational research project. In L. Mollers & S. Manzel (Hg.) *Populismus und Politische Bildung*, Schriftenreihe der GPJE (pp 163-170). Frankfurt: Wochenschau verlag.
- Ogunniyi, M. B. (2007a). Teachers' stances and practical arguments regarding a science-indigenous knowledge curriculum: Part 1. *International Journal of Science Education*, 29(8), 963-986.
- Okeke, C., Van Wyk, M., & Phasha, N. (Eds.). (2014). *Schooling, society and inclusive education: an Afrocentric perspective*. Cape Town: Oxford University Press.
- Ornstein, A. C., & Hunkins, F. P. (2018). *Curriculum: Foundations, principles and issues*. Harlow: Pearson.
- Perso, T. F. (2012). Cultural responsiveness and school education: With particular focus on Australia's first peoples – A review and synthesis of the literature. *Darwin Northern Territory: Menzies School of Health Research, Centre for Child Development and Education*.

- Peersman, G. (2014). Overview: Data collection and analysis methods in impact evaluation, *Methodological Briefs: Impact Evaluation 10*, UNICEF Office of Research, Florence.
- Pritchard, A. (2013). *Ways of learning: Learning theories and learning styles in the classroom*. Hoboken, NJ: Routledge.
- Puskur. (2007). A Report on monitoring findings on the implementation of *Content Standard and Graduate Competency Standard*. Research and Development Board, Department of National Education: Jakarta.
- Quince, S. (2012). Coral secondary school. In N. Burrige, F. Whalan & K. Vaughn (Eds.), *Indigenous education: A learning journey for teachers, schools and communities* (pp. 49-62). Rotterdam: Sense Publishers.
- Richerson, P. J., & Boyd, R. (2005). *Not by genes alone: How culture transformed human evolution*. London: University of Chicago Press.
- RMIT University, Study and Learning Centre, Melbourne, Australia. (2006). *Reflective journals*. http://www.dlsweb.rmit.edu.au/lsu/content/2_AssessmentTasks/assessment_tasks/reflective%20journal_LL/index.html
- SADC. (1997). *Protocol on education and training. Blantyre, 8 September 1997*. Retrieved from: http://www.sadc.int/english/protocols/p_education_and_training.html.
- Schieffelin, B. B., & Ochs, E. (1986). Language socialization. *Annual Review of Anthropology*, 15(1), 163-191.
- Scott, D. (2016). Making sense of ZPD: An organising framework for mathematics education research. *African Journal of Research in Mathematics, Science and Technology Education* 65(3), 191-212.
- Sedláček, M., & Sedova, K. (2017). How many are talking? The role of collectivity in dialogic teaching. *International Journal of Education Research*, 85, 99-108.
- Semali, L. M., & Kincheloe, J. L. (1999). Introduction: What Is Indigenous Knowledge and Why Should We Study It: What Is Indigenous Knowledge? Voices from the Academy (pp. 1-28). New York: Falmer Press.
- Shabani, K. (2016). *Teacher education & development: applications of Vygotsky's sociocultural approach for teachers' professional development*. Allameh Mohaddes Nouri University: Iran.
- Shava, G. N. Enhancing learner achievement through professional development: The Zimbabwean experience. *South African Journal of Higher Education*, 30(6), 56-72.

- Shizha, E. (2007). Critical analysis of problems encountered in incorporating indigenous knowledge in science teaching by primary school teachers in Zimbabwe. *Alberta Journal of Educational Research*, 53(3), 302-319.
- Shizha, E. (2008). Indigenous? What is indigenous knowledge? Beliefs and attitudes of rural primary school teachers towards indigenous knowledge in the science curriculum in Zimbabwe. *The Australian Journal of Indigenous Education*, 37(01), 80-90.
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22.
- Sotuku, N., & Duku, N. S. (2014). Indigenous African theories in multicultural education. In C. Okeke, M. van Wyk & N. Pasha (Eds.), *Schooling, society and inclusive education* (pp. 17-38). Cape Town: Oxford University Press.
- Srikantaiah, D. (2005). Education: Building on Indigenous Knowledge. Indigenous Knowledge (IK) Notes; No. 87. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/10747> License: CC BY 3.0 IGO.
- Swarts, (2003). Learner Centred Education in the Namibian Context: A Conceptual Framework, Okahandja, NIED.
- Thompson, E. J. C. (2016). Gitga'at plant project: bridging the gap between generations. In G. Snively & L. Williams (Eds.), *Knowing home: braiding indigenous science with westernised science* (pp. 233-245). Canada: University of Victoria.
- Tubaundule, G., M. (2014). *Evaluative research for the implemented secondary school curriculum: A Namibian case study*. Unpublished master's thesis, Education Department, University of Free State, Bloemfontein.
- Tshiningayamwe, S. A. N. (2015). *Exploring functionings and conversion factors in biodiversity teacher professional learning communities*. Unpublished PhD thesis, Rhodes University, Grahamstown.
- Tyler, R. W. (1959). *Basic principles of curriculum and instruction: Syllabus for Education 305*. Chicago: University of Chicago Press.
- UNICEF. (2011). *Improving quality, and equity in education in Namibia; A trend and gap analysis*. Windhoek: UNICEF.
- UNESCO. (2009). *Policy guidelines on inclusion in education*. Montreal: UNESCO Institute for Statistics.
- UNESCO. (2001). *Universal declaration on cultural diversity*. World Summit on Sustainable Development, Johannesburg, 26 August- 4 September 2002.

- Vescio, V., Ross, D., & Adams, A. (2008). Teaching and teacher education. *An International Journal of Research and Studies*, 24(1), 80-91.
- Wangola, P. (2002). Mpambo, the African multiversity: A philosophy to rekindle the African spirit. In G. S. Dei, B. Hall & D. Rosenberg (Eds.), *Indigenous knowledge in global contexts* (pp. 265-277). London, GB: University of Toronto.
- Webb, P. (2013). Xhosa Indigenous Knowledge: Stakeholder awareness, value, and choice. *International Journal of Science & Mathematics Education*, 11(1), 89-110.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.
- Wenger, E. (2000). Communities of practice and social learning systems. *Organization* 7, 2, 225-246.
- Wellington, J. J., & Ireson, G. (2012). *Science teaching. Science learning* (3rd ed.). New York: Routledge.
- Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Hemel Hempstead: Harvester Wheatsheaf.
- Weiler, J. (2003). *Educational action research CDS guide* (2nd ed.). Harare: Skilled Press.
- Van Heerden-Pieterse, E. (2015). *Life skills: My journey, my destiny* (2nd ed.). Pretoria: Van Schaik Publishers.
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological process*. Cambridge, MA: Harvard University Press.
- Young, M. F., & Tan, B. H. (2013). The use of reflective journal in a postgraduate research methodology course: Student experiences. *Pertanika Journal of Social Sciences and Humanities*, 2, 41-56.
- Zaidi, Z. (2017). Formal classroom observations: Factors that affect their success. *English Language Teaching*, 10(6), 83-92.

APPENDICES

Appendix A: Ethical clearance approval



RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

EDUCATION FACULTY • PO Box 94, Grahamstown, 6140
Tel: (046) 603 8385 / (046) 603 8393 • Fax: (046) 622 8028 • e-mail: d.wilmot@ru.ac.za

PROPOSAL AND ETHICAL CLEARANCE APPROVAL

Ethical clearance number 2017.12.08.15

The minute of the EHDC meeting of 05 December 2017 reflect the following:

**2017.12.8 CLASS B RESTRICTED MATTERS
MASTER OF EDUCATION RESEARCH PROPOSALS**

To consider the following research proposal for the degree of Master of Education in the Faculty of Education:

Ms Rauha Mika (15M8769)

Topic: An intervention on the integration of local or Indigenous Knowledge (IK) in Grade 9 Physical Science lessons.

Supervisor: Professor K Ngcoza

Decision: *Approved*

This letter confirms the approval of the above proposal at a meeting of the Faculty of Education Higher Degrees' Committee on the 5 December 2017.

The proposal demonstrates an awareness of ethical responsibilities and a commitment to ethical research processes. The approval of the proposal by the committee thus constitutes ethical clearance.

Sincerely

A handwritten signature in black ink, appearing to read 'Zisanda'.

Ms Zisanda Sanda
Secretariat of the EHDC, Rhodes University
8th December 2017

Appendix B: Request Permission Director

From: Ms Rauha T. Mika

Cell 0813244931

P O Box 1129

Otjiwarongo

12 December 2017

To: Regional Education Director

Directorate of Education, Arts and Culture

Otjozondjupa Regional Council

Subject: Request for Permission to Conduct Educational Research in Otjozondjupa Region

Dear Mr Tsuseb

My name is Rauha Tufilonghenda Mika, currently registered as a part-time Master's (full thesis) Science Education student (student number: 15M8769) at Rhodes University, and a Senior Education Officer for the Otjozondjupa' Teachers' Resource Centres based at Otjiwarongo TRC. I hereby request permission to conduct a research study at [REDACTED] JP during the period of February and March of 2018.

My research focus of interest is to explore a shift in teacher practices after going through an intervention on the integration of local knowledge in grade 9 Physical Science lessons. Research findings have shown that Namibian teachers are experiencing challenges on ensuring quality teaching as they are characterised by poor use of concrete objects to teach abstract concepts. Some schools are poorly resourced, and this means that teachers rely heavily on textbooks, or worksheets and have to explain concepts without relevant teaching aids. On the other hand, literature has shown that students are likely to engage better in education that aligns with and includes their cultural identities. The literature has further shown that local and indigenous knowledge is not well acknowledged in the science classrooms.

The challenges that I have mentioned earlier in this letter prompted me to carry out a research by looking at the ways to indigenise and contextualise Physical Science lessons, to see if it can mediate effective teaching. The research will be conducted in three stages. Firstly, I will conduct an interview with *four* Grade 9 Physical Science teachers; two of whom will be purposively selected to co-develop model lessons that integrate local or indigenous knowledge that are relevant in Physical Science teaching. At this stage, the participants will be exposed to possible local or indigenous knowledge. Secondly, the participants will analyse the Grade 9 Physical Science syllabus, identifying topics that are rich in local or indigenous knowledge and then co-develop the model lessons. Thirdly, implementation will be done whereby two teachers will teach the planned lessons voluntarily and I will observe the lessons. Thereafter, we will reflect on the lessons.

Should I be granted permission, I will apply the principles of research ethics by respecting participants' views or contributions with confidentiality and anonymity. Upon completion of the study, I undertake to provide you and the participants with access to the research findings. Attached kindly see the clearance certificate from Rhodes University and permission letter from the Director. If you require any further information, please do not hesitate to contact me at 0813244931 or rihalwa@gmail.com





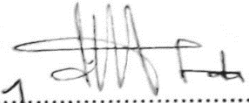
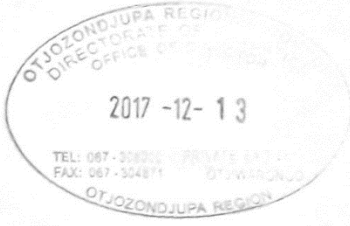
I hope this request will receive your favourable consideration and I am looking forward to hearing from you.

Yours sincerely

Ms Rauha T. Mika

MEd in Science Education Student: Rhodes University

Appendix C: Permission from Directorate

	REPUBLIC OF NAMIBIA OTJOZONDJUPA REGIONAL COUNCIL	
<hr/> DIRECTORATE OF EDUCATION, ARTS AND CULTURE <hr/>		
<i>"Committed and Dedicated For Quality Education"</i>		
Tel no: 264 67 308000 Fax no: 264 67 304871 Enq:		Private Bag 2618 Erf. 280, Sonweg Street Otjiwarongo NAMIBIA
To: Ms. Rauha Mika P.O. Box 2618 Otjiwarongo		
 PERMISSION TO CONDUCT EDUCATIONAL RESEARCH IN THE OTJIWARONGO CIRCUIT SCHOOLS		
Your letter dated 12 December 2017 forwarded to our office bears reference and is hereby acknowledged.		
Permission is hereby granted for you to conduct your educational research in the Otjozondjupa Region.		
Consult with the Principals at schools and present this letter. No school activities must be interrupted during execution of this exercise.		
Thanking you in anticipation.		
 Mr. Simon Tsuseb DIRECTOR Otjozondjupa Region		
<hr/>		

Appendix D: Request Permission Principals

From: Ms Rauha T. Mika

Cell 0813244931

P O Box 1129

Otjiwarongo

12 December 2017

To: The Principal

██████████

Otjiwarongo Circuit

Subject: Request for Permission to Conduct Educational Research at ██████████

Dear ██████████

My name is Rauha Tufilonghenda Mika, currently registered as a part-time Master's (full thesis) Science Education student (student number: 15M8769) at Rhodes University, and a Senior Education Officer for the Otjozondjupa' Teachers' Resource Centres based at Otjiwarongo TRC. I hereby request permission to conduct a research study at ██████████ during the period of February and March of 2018.

My research focus of interest *to explore a shift in teacher practices after going through an intervention on the integration of local knowledge in grade 9 Physical Science lessons*. Research findings have shown that Namibian teachers are experiencing challenges on ensuring quality teaching as they are characterised by poor use of concrete objects to teach abstract concepts. Some schools are poorly resourced, and this means that teachers rely heavily on textbooks, or worksheets and have to explain concepts without relevant teaching aids. On the other hand, literature has shown that students are likely to engage better in education that aligns with and includes their cultural identities. The literature has further shown that local and indigenous knowledge is not well acknowledged in the science classrooms.

The challenges that I have mentioned earlier in this letter prompted me to carry out a research by looking at the ways to indigenise and contextualise Physical Science lessons, to see if it can mediate effective teaching. The research will be conducted in three stages. Firstly, I will conduct an interview with *four* Grade 9 Physical Science teachers; two of whom will be purposively selected to co-develop model lessons that integrate local or indigenous knowledge that are relevant in Physical Science teaching. At this stage, the participants will be exposed to possible local or indigenous knowledge. Secondly, the participants will analyse the Grade 9 Physical Science syllabus, identifying topics that are rich in local or indigenous knowledge and then co-develop the model lessons. Thirdly, implementation will be done whereby two teachers will teach the planned lessons voluntarily and I will observe the lessons. Thereafter, we will reflect on the lessons.

Should I be granted permission, I will apply the principles of research ethics by respecting participants' views or contributions with confidentiality and anonymity. Upon completion of the study, I undertake to provide you and the participants with access to the research findings. Attached kindly see the clearance certificate from Rhodes University and permission letter from the Director. If you require any further information, please do not hesitate to contact me at 0813244931 or rihalwa@gmail.com

I hope this request will receive your favourable consideration and I am looking forward to hearing from you soon.

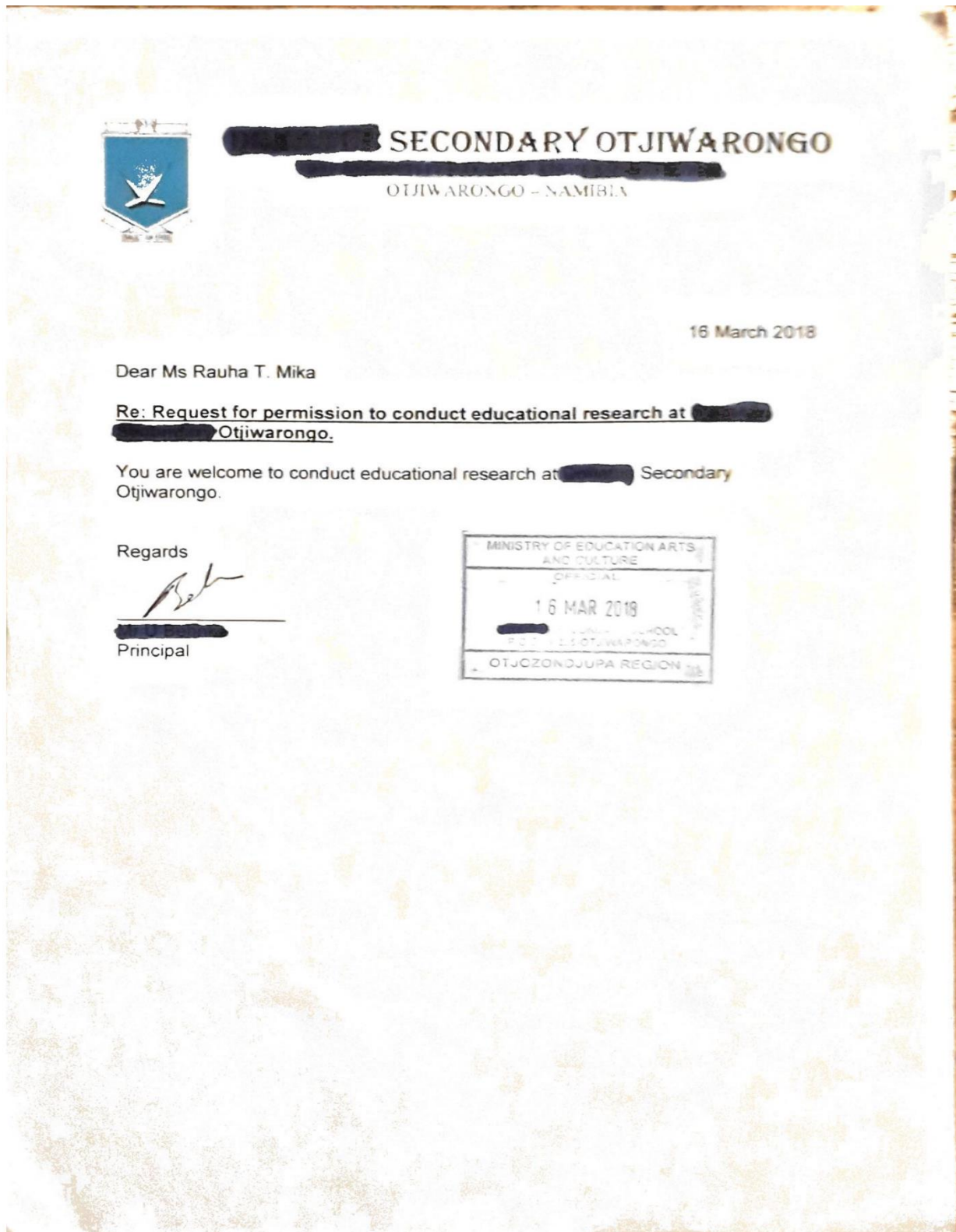
Yours sincerely

A handwritten signature in black ink, appearing to read 'RAUHA T. MIKA', written over a light blue rectangular background.

Ms Rauha T. Mika

MEd in Science Education Student: Rhodes University

Appendix E: Permission from the principal



Appendix F: Informed Consent Participants

Ms Rauha T. Mika

Cell 0813244931

P O Box 1129

Otjiwarongo

15 January 2018

Participant

[REDACTED]

Subject: Invitation to participate in an educational research study

Dear Teacher

My name is Rauha Tufilonghenda Mika, currently registered as a part-time Master's (full thesis) Science Education student (student number: 15M8769) at Rhodes University, and a Senior Education Officer for the Otjozondjupa' Teachers' Resource Centres based at Otjiwarongo TRC. I am hereby kindly requesting your participation in an educational research study in Otjiwarongo circuit during the period of February and March 2018.

The aim of this research is to *to explore a shift in teacher practices after going through an intervention on the integration of local knowledge in grade 9 Physical Science lessons*. The Namibian Physical Science Curriculum for Grade 8/9 (2015) recommends a Learner Centred Education (LCE) approach as an appropriate pedagogy to use in teaching and learning. It further encourages the teachers to be flexible and use all knowledge sources in teaching and learning. Your participation is important as the study hopes to provide an opportunity to develop Learning and Teaching Support Materials (LTMSs) based on local or indigenous knowledge resources, rather than just relying on laboratory equipment and textbooks as a source of knowledge when teaching. In this way, I believe that teaching and learning may improve.

The research will be conducted in three stages. Firstly, I will conduct an interview with *four* Physical Science teachers; two of whom will be purposively selected to co-develop model lessons that integrate local or indigenous knowledge that are relevant in Physical Science teaching. At this stage, the participants will be exposed to possible local or indigenous knowledge. Secondly, the participants will analyse the Grade 9 Physical Science syllabus, identify topics that are rich in local or indigenous knowledge and co-develop the model lessons. Thirdly, implementation will be done

whereby two teachers will teach the planned lessons voluntarily. I will observe the lessons and we will reflect on them together.

If you agree to participate, I will explain in more detail what would be expected of you, and provide you with the information you need to understand the research. Participation in this research is voluntary and you have the right to withdraw at any given time during the study. Your identity and opinions will be treated with confidentiality and anonymity.

Thank you for your time and I hope that you will respond favourably to our request.

Yours sincerely



Ms Rauha T. Mika

Rhodes University: MEd in Science Education Student

Reply slip

I agree to participate in the research on condition that I can withdraw at any time.

Name _____

Signature _____

Contact number _____

INFORMED CONSENT FORM

Research Project Title:	To explore a shift in teacher practices after going through an intervention on the integration of local knowledge in grade 9 Physical Science lessons
Researcher:	Ms Rauha T. Mika
Supervisor:	Prof Kenneth Ngcoza

Participation Information

- I understand the purpose of the research study and my involvement in it;
- I understand the risks and benefits of participating in this research study;
- I understand that I may withdraw from the research study at any stage without any penalty;
- I understand that participation in this research study is done on a voluntary basis;
- I understand that while information gained during the study may be published, I will remain anonymous and no reference will be made to me by my name or student number;
- I understand that data collection requirements particularly to this research, (e.g. test results, personal information, video recording) may be used;
- I understand and agree that the interviews will be recorded electronically;
- I understand that I will be given the opportunity to read and comment on the transcribed interview notes;
- I confirm that I am not participating in this study for financial gain.

Information Explanation

The above information was explained to me by: Rauha T. Mika (Researcher)

The above information was explained to me in English and I am in command of this language:

Voluntary Consent

I,

Hereby voluntarily consent to participate in the above-mentioned research.

Signature: _____

Date: / /

Researcher' Declaration


I, Rauha Tufilonghenda Mika, declare that I have explained all the participant information to the participants and have truthfully answered all questions that ask me about the participants.

Signature:

Date: 15 / 01 / 2018



The research will be conducted in three stages. Firstly, I will conduct an interview with *four* Physical Science teachers; two of whom will be purposively selected to co-develop model lessons that integrate local or indigenous knowledge that are relevant in Physical Science teaching. At this stage, the participants will be exposed to possible local or indigenous knowledge. Secondly, the participants will analyse the Grade 9 Physical Science syllabus, identify topics that are rich in local or indigenous knowledge and co-develop the model lessons. Thirdly, implementation will be done whereby two teachers will teach the planned lessons voluntarily. I will observe the lessons and we will reflect on them together.

If you agree to participate, I will explain in more detail what would be expected of you, and provide you with the information you need to understand the research. Participation in this research is voluntary and you have the right to withdraw at any given time during the study. Your identity and  opinions will be treated with confidentiality and anonymity.

Thank you for your time and I hope that you will respond favourably to our request.

Yours sincerely

Ms Rauha T. Mika

Rhodes University: MEd in Science Education Student

Reply slip

I agree to participate in the research on condition that I can withdraw at any time.

Name  _____

Signature  _____

Contact number  _____

INFORMED CONSENT FORM

Research Project Title:	Explore a shift in teacher practices after going through an intervention on the integration of local knowledge in grade 9 Physical Science lessons
Researcher:	Ms Rauha T. Mika
Supervisor:	Prof Kenneth Ngcoza

Participation Information

- I understand the purpose of the research study and my involvement in it;
- I understand the risks and benefits of participating in this research study;
- I understand that I may withdraw from the research study at any stage without any penalty;
- I understand that participation in this research study is done on a voluntary basis;
- I understand that while information gained during the study may be published, I will remain anonymous and no reference will be made to me by my name or student number;
- I understand that data collection requirements particularly to this research, (e.g. test results, personal information, video recording) may be used;
- I understand and agree that the interviews will be recorded electronically;
- I understand that I will be given the opportunity to read and comment on the transcribed interview notes;
- I confirm that I am not participating in this study for financial gain.

Information Explanation

Appendix H: Informed Consent Parents

Ms Rauha T. Mika

Cell 0813244931


P O Box 1129

Otjiwarongo

15 January 2018

Dear Parent

My name is Rauha Tufilonghenda Mika, currently registered as a part-time Master's (full thesis) Science Education student (student number: 15M8769) at Rhodes University, and a Senior Education Officer for the Otjozondjupa' Teachers' Resource Centres based at Otjiwarongo TRC. I am carrying out a research study together with Physical Science teachers in the Otjiwarongo circuit, in which we will work on the inclusion of local or indigenous knowledge into the science lessons. Your child's Physical Science teacher is participating in this study during the period of February and March 2018. I am going to visit this teacher's Physical Science lessons twice in this year, to *investigate the effect of an intervention on the integration of local or indigenous knowledge (IK) can influence (or not) Grade 9 Physical Science lessons.*

I kindly ask you to grant me permission for your child to be included in the research during my presence at the science lessons; I will take notes on the teaching, for example, on conversations between learners and  teacher, on the teacher's explanations or on learners' contributions. Possibly, some of the science lessons will be audio recorded.

All information will be treated confidentially: Nobody except myself and the group of four participating teachers will access the information. After finalising my Master's thesis (planned for 2019) the audio recordings will be deleted and the written materials will be made anonymous. I will write several journal articles about my research. Whenever mentioning my observations from the classrooms or my conversations with the students, I guarantee that your child's particulars will not be revealed. I will use pseudonyms and no information will be given by your child could be identified.

The aim of the research project is to make Grade 9 Physical Science lessons more interesting and familiar with the learners' local or indigenous knowledge. There is no foreseeable risk involved in your child participating in the research activities named above. Please note that all participation is voluntary. If you or your child does not wish that he/she be part of the research, I will not include him/her. Also, you are free to withdraw your permission at any time without giving a reason. A decision not to participate in the study will not have any effect on your child's participation in the science lessons.



If you have any question(s) about the research, please feel free to contact me on 0813244931, rihalwa@gmail.com or Prof. Ken Ngcoza (k.ngcoza@ru.ac.za) at the Education Department. Thank you for taking time to read this letter. If you agree for your child to participate in this research, please complete the consent form below.

Yours sincerely

Ms Rauha T. Mika

Rhodes University: MEd in Science Education Student

I _____ (full name of parent/guardian), the father/mother/guardian of _____ (full name of child) hereby confirm that I understand the content of this document and the nature of the research, and I consent to my child participating in the research study. I also understand that my child is at liberty to withdraw from participating at any time without any disadvantage.

Reply slip for Parent's/Guardian's

I agree and authorise my child to participate in the research and I understand that my child can withdraw from participation without any effect.

Parent's/Guardian's Full Name _____

Parent's/Guardian's Signature _____ **Date** _____

Contact numbers _____

Appendix I: Narrative stories from workshop discussions

WORKSHOP 1

ORIENTATION WORKSHOP (51 MINS: 54 SECONDS)

Research questions;

- What are the attitudes and understandings of grade 9 Physical Science teachers on integration of local or Indigenous Knowledge (IK) in the Physical science lessons prior to the intervention?
- How can Grade 9 teachers be supported in developing model lessons that integrate local or indigenous knowledge?

Codes

T1 – T4: Teacher one up to Teacher four

Colour Codes	Categories
Blue	Workshop Introduction
Orange	Familiarisation of the African/Namibian context of science education
Yellow	Encourage social interaction by discussions and questioning
Green	
Grey	Participants research expectations
Purple	Conclusions

The workshop aimed at presenting:

- a) Research goal, Objectives and Research questions
- b) Interventions/CoP Rationale
- c) Participants knowledge, understanding and expectations towards inclusion of local or IK
- d) Statement of the problem
- e) Structure and processes involved in the research.

To start off workshop the facilitator welcomed the participants by thanking them for their attendance. She introduced all the five CoP members and then presented the ice breaker to the participants which was based on some quotes she thought they were important on how people do things and how the way people do things affect their performance or productivity ;

- a) “Alone we do little. Together we do so much.” (*Helen Keller, 27/06/1880 – 01/06/1968*)

- b) You can do what I cannot do. I do what you cannot do. Together we can do greater things” (*Mother Theresa*, 26/08/1910 - 05/09/1997)
- c) “Do what you can, with what you have, where you are.” (*Theodore Roosevelt*, 27/10/1858 – 06/01/1919)
- d) “If you always do what you have always done, you will always get what you have always got.” (*Henry Ford*, 30/07/1863 – 07/04/1947)

The facilitator highlighted that those were some of the quotes that motivate her in her work and she thought it was a good thing to share them with the CoP members.

At this point the facilitator presented contextual background of the Namibian science teachers:

- The science that is taught in Africa does not carry African identity and that indigenous ways of knowing are not well recognised (Views of African educators)
- Namibian science teachers teach their learners within the foreign context/language that they are not familiar with. It is known whether this is the reason for poor performance and lack of interest in science subjects.
- Namibia teachers do not use concrete materials to teach, they highly depend on textbooks (UNICEF, 2011)
- The majority of science teachers in the (region where the study was conducted) have challenges for integrating learners prior knowledge and they present concepts more theoretical than practical (Ministry of Education Arts and Culture, Otjozondjupa Region).
- National Programme on Research, Science, Technology and Innovation (NNRSTI), 2014-2017 priorities identified the need for educators to focus on researching IK to address some of on social challenges in Namibia.
- Grade 8-9 physical science syllabus (2015, p. 2) advocate inclusive education and Learner Centred Education (LCE). She asked; T1, can you read on page 2 to tell us on what the Grade 9 Physical science syllabus says about inclusive approach to science education?
T1 read:
“The Physical Science teacher in the Junior Secondary phase should therefore accommodate learners with special educational needs by adapting this syllabus to the needs of the learner through differentiation of teaching methods and materials”

The facilitator asked: T2, can you read on page 4 Physical science syllabus grades 8-9 says about LCE? Mr. TB read:

“The starting point for teaching and learning is the fact that the learner brings to the school a wealth of knowledge and experience gained continually from the family, the community, and through interaction with the environment. Learning in school must involve, build on, extend and challenge the learner’s prior knowledge and experience. Learners learn best when they are actively involved in the learning process through a high degree of participation, contribution and production. At the same time, each learner is an individual with his/her own needs, pace of learning, experiences and abilities. The teacher must be able to identify the needs of the learners and the learning that still needs to take place, and know how to shape learning experiences accordingly. Teaching strategies must therefore be varied and flexible within well-structured sequences of lessons”.

Facilitator further asked: what does syllabus says about the learners that are unable to achieve basic competencies? T3 responded and read:

“A few learners might not be able to achieve all the specific objectives satisfactorily and must receive learning support through adapted teaching approaches, adapted materials, and assistance from peers. A small number of learners have special educational needs to a degree which requires greater individual attention, resources or assessment”.

Participants were given opportunity to discuss grade 8-9 syllabus in relation to its aims, rationale, inclusive science teaching learner Centred Approach for them to familiarise themselves with the approaches that they should consider in science teaching and learning.

Afterwards the facilitator also highlighted that the syllabus; Physical science grade 8-9 expects and recommends teachers to be inclusive by accommodating academic needs for their learners. LCE approach is encouraged by acknowledging the learners prior knowledge. At this point participants/CoP members were already introduced to and familiarised with the Namibian context of science education. The facilitator was able to present the statements of problem as she highlighted that the grade 8-9 Physical science curriculum expects teachers to integrate learner's prior knowledge of which local or IK are part of but there are no clear instructions on how to go about it. She further emphasised that the CoP would like to find out whether the study can assist on how to go about this.

The facilitators moved to the other part by asking the participants; Why are we doing this research? What are the aims and objectives of the study? She presented and explained the goals and objectives and research questions. Afterwards that facilitator gave an open opportunity for teachers to ask questions in case there is anything they did not understand. Some participants asked questions based on clarification of objectives. In terms of inclusive approach and learner centred approach to teaching and learning, some teachers reflected that they developed a better understanding, T4 reflected that:

“I do not know if maybe I was not serious or maybe nobody explained well to me those approaches, I think it make sense to me now”.

Some participants indicated with a concern that they have little knowledge about integration of local or IK in the science lessons

The Facilitator moved to the other part as she asked; what are your expectations of this research study? What do you expect this CoP to bring about to you as a teacher?

Participants were given opportunity to come up with their expectations of the study;

- a) To get better understanding when using local contextualised and integrate with the Physical science curriculum content.
- b) To gain some local knowledge that can be used in the classroom and improve the teaching methods.
- c) Acquire knowledge that can make the lessons more interesting to the learners and encourage the learners to participate more in the class due to the indigenised and localized learning materials.
- d) Make the teachers to be rich of materials that the learners could use to meet the competencies that are taught.
- e) To work together as a team to come up with the best strategies that can improve physical science teaching methods.
- f) Expect the understanding of the learners to improve based on subject content and practical application within and outside the classroom.

g) Based on Otjondjupa Regional classroom observation (2012) that teachers are presenting concepts more on theoretical than practical. The research is expected to assist teachers to develop some skills on how to do contextualised practical activities with their learners.

The facilitator also shared with teachers her expectations:

Active, honest participation of the teachers and that her position as a Senior Education Officer should not influence the participants. She added that participants should express themselves freely and fairly. Afterwards the facilitators gave an open platform for the participants to contribute or ask questions regarding anything that they did not understand. Participants asked for them to know the time and the date for the next session, the venue, date and time was agreed upon by all the CoP members: Next session – Mini IK or local knowledge demonstration.

Moving close to the end of the workshop, the facilitator presented the task to the participants:

To start thinking of possible physical science topics that is rich in local or indigenous knowledge. The facilitator asked the participants to reflect on the session but they felt that it was too early as they prefer to reflect in the next session. The facilitator thanked all the participants for their participation. Participants also thanked the facilitator for working with them.

The facilitator:

- ❖ Strengthen the CoP by sharing some quotes that speak about team work (power of social interactions).
- ❖ Since it was the first session, the facilitator spend more time, to explain, describe the context of the study, statement of the problems and objectives of the study to the participants.

WORKSHOP TWO

SYLLABUS ANALYSIS (1 HR, 19 MIN, 57 SEC)

Research objective: To collaboratively come up with examples of local or indigenous knowledge (IK) that grade 9 physical Science teachers can consider for integration and then co-develop the model lesson that incorporate such knowledge.

Research question: How can Grade 9 teachers be supported in developing model lessons that integrate local or indigenous knowledge?

Codes

T1 – T4: Teachers one up to Teacher four

Colour Codes	Categories
	Syllabus analysis introduction
	Identifying possible topics for integration
	Specific competencies from syllabus
	Reflections

	Selected topics for integration
	Further activities

The session was planned for the CoP members to identify and analyse possible topics that are rich in local or IK to be considered for integration. To start the session the facilitator welcomed all the participants and opened the platform for discussions and analysis of Physical science, grade 9 Syllabus. Recap from the previous sessions were made by all the participants. From there, CoP Members came up with possible topics for IK or local knowledge for integration on grade 8 – 9 Physical science syllabus:

1. T1 started the discussions: Page 34, 2.6, combustion reaction competencies that can be achieved by incorporating local or indigenous knowledge:

- Suggest examples of combustion from everyday life e.g. traditional way of making a fire without using a match. Test the learner's prior knowledge on combustion reactions in their everyday lives and see which once are more applicable for incorporation.
- Discuss examples of the combustion of elements which require heat to initiate the reaction and predict the products of combustion. In addition Mr C. asked: Traditionally, elders blow on the fire and participants should research to find out why?

2. T3. Page 33, physical changes and chemical changes.

Participants indicated that there are so many practical activities that learners may they perform at home that constitute physical and chemical changes, some felt that some activities that are performed traditionally such as cooking, preserving food like drying meat and spinach might confuse the learners in term of indicating whether they are physical or chemical changes
Syllabus competences:

- Describe the process of a chemical and compare it to a physical change.
- Describe experiments to illustrate the difference between a physical changes and chemical changes.

3. T4: Matter building blocks: page 30, 2.1

Syllabus Competencies:

- Outline that mixtures can be separated by a physical process while compounds only by a chemical process
- Investigate mass and volume in relation to identify densities of substances and to determine floating and sinking of objects

Mixtures: separation of mixtures like when brewing *Otombo*, oshikundu, *Omalodu iilya*.

- There is a separation of substances that is in involved in the brewing process.
- People use *omushalo* (sieve) and also *Ongalo* to separate substances.
- Separation of fats (butter) from milk *Ondjupa* is used to shake the milk produce butter.
- In separation of milk and fats the concept of density (sinking floating) can be also taught.

Some participants started reflecting on the analysis of the syllabus that:

“Nowadays kids are lucky to be taught by incorporating local or IK in science lesson, us, we were never taught with this IK incorporation”. (T4)

4. Acids and bases: Neutralization

Syllabus Competencies

- Identify and name examples of acids in everyday life, discuss that acids are common in food particularly fruits that they have sour taste
- Identify and name examples of bases used in everyday life, recognise that base are common Cleaning materials and that they have a bitter taste and a soapy feel when rubbed between fingers
- Page 39 specified that teachers should carry out practical activities of making a simple indicator from flowers to test acidity/alkalinity.

Consideration:

- ❖ Use traditional food and substances to classify then acids or bases as either *Oshilugulu / Oshimumu* to clean teeth.
- ❖ Traditional cleaning materials
- ❖ Wood ashes instead of hand wash, washing powder
- ❖ Salt – odour control
- ❖ Coke/cool drink cleans a toilet pot
- ❖ Fermentation of traditional drinks: *Epwaka, Otombo, Omangongo, Okatokele, Oshikundu*, etc. indigenous. Participants realised that there are more practical applications that can be incorporate in the physical science lessons.

Decision was made on the two topics under acids and bases:

1. Neutralization – using wood ash
2. Testing acidity/ alkalinity – using Red cabbage juice

After two weeks the CoP members met again and the following activities were undertaken:

- ❖ Co-planning
- ❖ Pre-testing to see whether what was planned can work or not.

Appendix J: Empty Interview Questions

Research goals and objectives

Research goal: To explore a shift in teacher practices after going through an intervention on the integration of local knowledge in grade 9 Physical Science lessons

Research question: To find out the attitudes and understanding of Grade 9 Physical Science teachers on the integration of local or Indigenous Knowledge (IK) in their Physical Science lessons prior to the

Interview Questions:

1. In your view what do you understand by the term ‘local knowledge’ or ‘indigenous knowledge’?
2. What are your views on inclusion of local or IK in Grade 9 Physical Science lessons?
3. What were your past experiences on the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons?
 - a) When you were taught as a learner at school?
 - b) When you were taught as a student at tertiary level (College, Technikon or University)?
4. Describe any local knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:
 - a) Farming production
 - b) Brewing of homemade drinks or beers?
 - c) Acids and Bases
 - d) Water Purification
 - e) Separation of Substances
 - f) Others
5. As a Physical Science teacher, have you ever used local or indigenous knowledge) in your teaching or not? Please explain.
6. What do you think could be the advantages and disadvantages of including local or indigenous knowledge in Physical Science lessons?
7. What else would you like to share with me regarding the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?

Appendix K: Semi-structured interview Transcript (T1 and T2)

Research questions:

What are the attitudes of Grade 9 Physical Science teachers on integration of local or Indigenous Knowledge (IK) in their Physical Science lessons prior to the intervention?

What is the and understanding of Grade 9 Physical Science teachers on integration of local or Indigenous Knowledge (IK) in their Physical Science lessons prior to the intervention?

Code	Questions and Responses	Stories/Summary of data captured
1. What do you understand by the term, 'Indigenous Knowledge' or Local knowledge'?		
T1	<p>I view it is the knowledge that is based on bigger area which is specific like in this instance, I am a Namibian so indigenous knowledge is the knowledge that is about the originality of Namibia, so meaning that it is talking about if we are having 13 tribes, all these tribes knowledge is incorporated to be called indigenous knowledge. It more like if we are in a specific town and we have got that specific and unique knowledge that we are using in that town. It is more like local, something that we are coming across everyday as we are living and that is more I will call it as local knowledge.</p> <p>Me: Ok. Thank you and let us go to the second question.</p>	<ul style="list-style-type: none"> • Understanding is based on the context, culturally and language. • Originality and tribes daily life activities within environment is also attached
T2	<p>T2: Indigenous knowledge for me I understand it like the knowledge based on your home language and what you understand from home. It has to do with local knowledge based on what is in within your area instead of you getting the knowledge of something abroad that you did not experience, so I think local or indigenous knowledge is more on things that are based in your daily life around you within your environment.</p>	

	<p>Me: Mhhh, Thank you</p>	
<p>2. What are your views on inclusion of local or indigenous knowledge in grade 9 Physical Science lessons?</p>		
<p>T1</p>	<p>Ok. I think if indigenous knowledge is incorporated in grade 9 Physical science lessons, it will make the teachers and the learners to make sense and have meanings of what they are teaching or learning because these are things that they are always using in everyday life. At the same time if the teachers have meaning of what they are teaching, it will also give the platform to the learners to have clear picture on what they are taught, which will also promote better understanding at the end of the lesson. It does not only bound the learners in the classroom situations but for instance after school, the learner can go home and try to experience or experiment things they have done since they will be at their exposure which is their home and environment. So it is very important for this inclusion of indigenous knowledge to be part of Physical science lessons.</p> <p>Me: Ok. Thank you for your response to question two. Let's go to question three.</p>	<ul style="list-style-type: none"> • Promote sense-making in everyday life activities • Improve the performance of the learners • Enhance better understanding • Link classroom situations to home background knowledge • If training is provided it can work
<p>T2</p>	<p>T2: You know this sound very new not only to me but it will sound new to many people, but if a basic correct training is given this might not really be a problem, but only now as I can see, Physical Science is not really a complicated subject. You might experience words that might not appear in our local languages, so my view is only if correct basic training is given all will be OK.</p> <p>Me, Follow up: Mhh, but now how do you feel about this inclusion, is it a good thing, But what are your views, what do you say about this inclusion?</p> <p>T2: My overall views for this one as I see it, it will bring a lot of improvement on performance on understanding the subject content. So for me is something good because most areas in the subject covered in the subject learners are going to improve.</p>	

<p>3. What were your past experiences on the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons when you were taught as a learner at school and as a student at tertiary level (College, Technikon or University)?</p>		
<p>T1</p>	<p>The experience that I had as a learner at school, when the teacher brings in knowledge which I am aware of at home or back now in our environment, it made more sense to me than and I was able to remember these things because these are things that come across on everyday basis and at the end of the day it made me to perform better in those areas whereby the teacher was using examples and referring to indigenous knowledge.</p> <p>Me, Follow up: Maybe can you remember some of those examples and how those teachers use to teach you?</p> <p>T1: I remember examples of when we were taught a topic on ethanol, the teacher was giving us an example of traditional drink that we brew that is <i>ombike</i>, and he was referring to that before we do <i>ombike</i>, we have to boil <i>oombe</i> which is traditional fruits and that one I was aware of it and we were also referred to as for <i>ombike</i> to be pure, we had to be referred to..... and then we were coming up with answers that we use to let it boil, let the water evaporate out, giving the substances which is then what we call <i>ombike</i>, then in that way it was opening up my knowledge, these are thing that.....</p> <p>Me, Follow up: So ombike was given as an example when you were taught in school?</p> <p>T1: Yes</p> <p>Me, Follow up: With this experience, how was your understanding?</p> <p>T1: The experience, I understood it in a better way because that is something that I know previous at home then now it was brought in the class, so I got a better understanding, so I got a better understanding it.</p> <p>Me: OK, What were your past experiences When you were taught as a student at tertiary level (College, Technikon or University)?</p> <p>T1: OK, My views on that I can say that there was less of indigenous knowledge, we were more on scientific knowledge and some of the things we could not really understand it better because now here we are using bigger terms and yes here and there I was able to make sense of the things that I was taught with a referral of indigenous knowledge when I was at elementary school but most of things at tertiary level, they were a bit taught for me because it was more on terms and things that I never come across.</p>	

	<p>Me, Follow up: Mhh, so you are saying that your experience when you were taught at tertiary institution, the inclusion of indigenous or local knowledge was not reflected well? Is that what are you saying?</p> <p>T1: Yes, I can in that sense that maybe because when I was at the tertiary level, there was no involvement of indigenous knowledge but I can always remember what I was always referred to during the school, and at tertiary education it was making more sense because then my knowledge has broaden. But I would also say if maybe I could have been taught more with this indigenous knowledge, at the school level, I think at my tertiary level I wouldn't have struggled much because then again it could make sense that these are the things that I am coming across everyday but due to tertiary level, the knowledge was really a bit like new because many terms I would not relate so much to indigenous knowledge.</p> <p>Me: Thank you</p>	
<p>T2</p>	<p>T2: I will not say really say it was incorporated that much, yea, but when it comes to science to science, I had a local knowledge for example where they take us to a desert or to the ocean, that was mostly the case, that was really something good to us as learners but in most cases the other part of chapters of the lessons, aah, it was not really incorporated.</p> <p>Me, Follow up: You mentioned about you being taken to the ocean, what was your experience there?</p> <p>T2: You know, for me what I have learnt best there instead of us..... Lets say we are talking about Tsunami, we are talking of earthquake, we are talking of what.....people have not experienced but if you talk of the sea, you talk of desert, mountain, it was quite interesting and amazing for someone coming from the northern part of Namibia, for instance he has never seen a desert. So that was one of the most very good experience for us that it was more of local knowledge for us to understand within our area, it was very good.</p> <p>Me, Follow up: At High school?</p> <p>T2: No, this was at tertiary level</p> <p>Me, Follow up: At university?</p> <p>T2: At College, it was very....., we use to have science excursion. Most of the people even if they go to Swakop but not going to experience how the desert, how animals are surviving, how they are living in the desert, things like that, but this happened while we at the college. It really broadens and widen our mind our mind about our local environment.</p> <p>Me. Follow up: so you are saying, when you were taught as a learner at high school it was not really reflected that much and inclusion was not that much and now at the college teachers were taking you to places linked to the topic of mountains and oceans.</p>	<ul style="list-style-type: none"> • Inclusion of indigenous knowledge was made to teach the concept of fermentation and distillation • Excursion: local knowledge of geographical features like oceans, mountains • Inclusion enhanced learning and strengthened indigenous language

	<p>TB: Yea, but here at school as well you know apart from the subject Agriculture, we use to go for the gardening and it was so explained that if the tool is In English, the you have to put in your own language.</p> <p>Me, Follow up: So teachers were also using vernacular language for certain terminologies?</p> <p>T2: Yea, exactly.</p> <p>Me, Follow up: How helpful was this?</p> <p>T2: You know not all of us were interested in farming, but you can see it most helpful for those that were into farming being into crop or animals farming they were really jumping to answers or they were very curious, they are just letting you, this person was quiet due to that he did not understand it locally but when it was brought on a local knowledge most of those of learners were eager to study the subject itself.</p> <p>Me: Thank you.</p>	
<p>4. Describe any local knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:</p> <ol style="list-style-type: none"> Farming production Brewing of homemade drinks or beers Acids and Bases Water Purification Separation of Substances Any other local knowledge (indigenous knowledge) you have been exposed to at your home/community 		
<p>a) Farming production</p>		
<p>T1</p>	<p>What I can say is that we use to work in the field to produce mahangu for the family and we use to take manure from the kraal and spread them onto the soil with the main aim of making the soil fertile before we start with the ploughing. And also what we use to do concerning this farming production, we also use to let what we call..... I I don't know how to call it in English</p> <p>Me, follow up: You can say in vernacular</p> <p>T1: <i>iihenguti</i>, these are the remaining sticks after the harvesting of the previous, we take them and spread and we also cut and spread them onto the soil so when we come and plough, these sticks or remaining, they put under the soil, it remains to decompose and make the soil more fertile. That is farming production.</p>	<ul style="list-style-type: none"> • Use animal manure to make the soil more fertile • Cut <i>iihenguti</i>, spread onto the soil to form up the compost

T2	Aah, Eish, No, No, I am not of farming.	
b) Brewing of homemade drinks or beers		
T1	<p>OK. With Mahangu that we produce from the field we use to make oshikundu which is a traditional drink. We mix mahangu flour with hot water and steer it. For that oshikundu to get ready quickly, we sometimes dilute it and put it on the sun.</p> <p>Me, Follow up: What was the purpose for putting it on the sun?</p> <p>T1: We put it on the sun because the sun is hot, so we know that reaction of chemical processes or reactions of any process that must take place scientifically needs heat. So for oshikundu to get ready, put it on the sun for the process of fermentation to take place very quickly and that oshikundu is ready to be taken as a drink.</p>	<ul style="list-style-type: none"> • Oshikundu, oshiwambo cultural soft drink prepared with mahangu flour • Omalodu iilya less alcoholic drink prepared with sorghum flour • Ombike is a traditional brandy highly alcoholic, prepared with natural dried fruits through fermentation and distillation
T2	<p>Yaa! Yaa! I think when it comes to home-made drinks we have what we call <i>omalodu iilya</i>, it is a traditional drink in our culture (oshiwambo) and I don't even know how to say it in English as there might not be a word for it. There is also <i>ombike</i> which is also oshiwambo traditional drink a kind of gin.</p> <p>TBB: Should I explain how it is made or?</p> <p>Me, Follow up: yes, briefly</p> <p>T2: Ok in the case of <i>omalodu iilya</i>, we have what we call millets or sorghum flour that we take and put it in the pot, I am not really sure but in most cases I just see the end product which is a drink.</p> <p>Me, Follow up: Is it alcoholic?</p> <p>T2: Yes it is quite alcoholic, depending on the level of your intake, how high have you taken it or low because it can be enjoyable by any even minors can enjoy it but not too much, you know sometimes after brewing it supposed to be or lets say best before a day or so. You cannot keep it for a longer time because it becomes sour and the more sour it is it becomes the more drunk it can make you.</p>	

	<p>Me, Follow up: what were variables that the people consider for <i>omalodu iilya</i> to get ready?</p> <p>T2: It depends on the weather, where they store it because you cannot just store it in any container as it may take time, even the room but I think best is at the room temperature is playing a role.</p> <p>Me, Follow up: For ombike?</p> <p>For ombike we have different types of ombike made different ingredients but I love is the one that they are normally do naturally from fruits. You put these fruits together and they put in water keep it for some days to ferment. Once the mixture it has fermented it is then boiled in the big pot and the steam is condensed and form little droplets of alcohol which is collected in another container. It is a slow process, I meant like if you want to produce a volume of litre you can spend 3 or 4 hours. Ombike can be also made from unhealthy materials like rubbish</p>	
c) Acids and Bases		
T1	<p>Yes acids and bases I can recall the time I had a running stomach from the school, I told my mother and then then she said I should take mahangu flour in the cup add a bit of water, stir and drink the mixture. After drinking the mixture, my running stomach was stabilising and since that it was not severe as it was. So I think that, now I am grown up I have realised this way maybe to neutralise the acids in the stomach because normally when you have diarrhoea, it means that your stomach acid became too much. So mahangu was a kind of neutraliser to neutralise the pH level in the stomach.</p> <p>Me, Follow up: Any other experiences on acids and bases?</p> <p>T1: OK we also have traditional toilets, whereby we only use it for urination purpose. This is just the urinating spot that is constructed behind the sleeping room and when we urinate more and more sometimes the smell becomes unbearable or uncondusive. So we take wood ash, pour it on top of urinating spot and the smell becomes better or minimised.</p>	<ul style="list-style-type: none"> • Mahangu flour mixed with water to neutralise stomach acids • Wood ash as odour control agent at urinating spot • Stomach ache treated with coca cola cooldrink mixed with salt • Animal dung to treat bee sting

	<p>Me, Follow up: What does the ash do the urinating spot?</p> <p>T1: I think in the sense also, is the way to neutralise the pH level because urine is a very strong waste products as it come from our bodies, getting rid of many bacteria, is just a way to neutralise the soil with urine at that specific area.</p>	
T2	<p>T2: In this case, the only practice that I have experienced or seen is that when a person has a stomach ach, you take a cooldrink, coke specifically you add a bit of salt into it and it will bubble off and immediately after bubbles you drink and it can stop stomach cramps. I also heard that if someone is stinged by the bees you apply animal dungs at the stinged spot but I do not know whether it can heal a person or not.</p>	
d) Water Purification		
T1	<p>Growing up in a village we use to collect water from the well because there was no taps. If they were there they were a bit far. Web collect water from the dams and the water sometimes use to contain grass on it and also mud. So what we do sometimes if the water is salty or sour, we keep it still in the bucket, we then first remove the grass on top with the cup then once it has settled at once. We then remove the remaining grass with hands that are clean before they touch that water. And then about the mud, we keep the water and the water settle at the bottom of the bucket and what we do, we decant the water off into another bucket leaving the mud behind. This makes the water more consumable and then at the same time if we see that the water is still not safe, we then purify it further by boiling it to kill bacteria, let it cool down for us to consume that water and that is how we purify water in indigenous way.</p>	<ul style="list-style-type: none"> • Decant • Boiling • Use water purifying tablets
T2	<p>From the area where I came from, we can say maybe we are lucky with water, we take underground and we just drink it as it is. We don't experience any sickness up to now. We also boil water or to get water purifying tablets at the nearest clinic.</p>	
e) Separation of Substances		

<p>T1</p>	<p>Separation of substance, we as I said, we are more into farming so when we cook for example beans I remember very well there comes a stage where you maybe pour too much water and then now it happens that the beans has been cooked and it is ready but there is still more water, so what we use to do is to avoid overcooking of those beans, we take the lid of the pot, at the same time we tilt the pot. We decant, block the bigger substances which is beans to remain behind in the pot and the smaller molecules which is water to flow out. In that way we are separating the water from the beans and at the end of the day we get the beans ready.</p> <p>Me: OK</p>	<ul style="list-style-type: none"> • Decant • Filtering • Use <i>omushalo</i> to sieve
<p>TBB</p>	<p>We have for example some of liquids mixed with certain seeds like when they are brewing omalodu iilya, there is this brown bag that is used to separate once the mixture is poured on it. The liquid substance pass through the bag and the residue of sorghum flour remain in the bag. The other one is <i>omushalo</i> (sieve) and we use it when we are sieving to get maize or mahangu flour from the whole production of it.</p>	
<p>f) Any other local knowledge (indigenous knowledge) you have been exposed to at your home/community</p>		
<p>T1</p>	<p>When it comes to milk that we get from the cows or goats, we know that milk is very nutritious food. After milking the cows we take the milk in a certain container we call it <i>ondjupa</i> where we keep milk, we let it settle for few days. We tie <i>ondjupa</i> with the rope on the neck and hang it and start shaking. The main reason is that we want to get the fats from the milk for us not just to consume only milk but also fat to use it for cooking our meals and traditional spinach. So we shake <i>ondjupa</i> more enough until the fat substances appear on top of milk. We remove the fat on top of milk with the cup and put it on a separate container. We then cook and boil fat for the water molecules to evaporate and leave behind and that is how we get cooking oil from the milk.</p>	<ul style="list-style-type: none"> • Producing fats from milk • Traditional songs in indigenous language

	Me: Thank you	
T2	T2: There is quite a lot for examples traditional dances and songs that we only do in indigenous language during the ceremonies such as weddings, funerals and so on.	
5. As a Physical Science teacher, have you ever used local or indigenous knowledge) in your teaching or not? Please explain		
T1	<p>Yes, here and there I use it.</p> <p>Me, Follow up: what was the topic?</p> <p>T1: the topic was about alcohol and fermentation, I brought in <i>oshikundu</i> which is oshiwambo traditional drink that we make at home. Scientifically when you go deep into it oshikundu has to be ready once it has fermented. Fermentation is where alcohol is produced and I just brought it for the learners to have a better understanding of what I was talking about.</p> <p>Me, Follow up: So you brought oshikundu to explain the concept of fermentation and alcohol.</p> <p>T1: Yes</p> <p>Me: OK</p>	<ul style="list-style-type: none"> • IK incorporated whereby oshikundu was used for the learners to make sense of alcohol and fermentation • Not incorporated due to challenge of multiculturalism
T2	<p>To be honest I have never done it with the very simple reason that I am teaching a multilingual or multicultural class and if I incorporate, it might sound unfair to others. The other thing is that, I did not value the importance of incorporating local or IK in science lessons but now I see the significance and I think this is the starting point.</p>	
6. What do you think could be the advantages and disadvantages of including local or indigenous knowledge in Physical Science lessons?		

<p>T1</p>	<p>Advantages</p> <ul style="list-style-type: none"> • The teacher will have insight the broader picture of they are going to teach if brings local or indigenous materials to the class, the kids clearly see and they have a better understanding of the lesson. • It makes the learners to explore further on things that might have a gap in the and have better reasoning and research skills. • It makes the learners to explore further on things that might have a gap in the and have better reasoning and research skills. 	<ul style="list-style-type: none"> • Broader picture of teaching learning activities • Enhance effective learning • Promote comprehensive understanding, inquiry and discovery learning of subject content within local context
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<p>T2</p>	<p>Advantages</p> <ul style="list-style-type: none"> • It will be of the greatest advantages because the person can understand the subject content in his/her origin. • There will be more participation from the learners thinking back home and they figure out with what the teacher is talking about during the lessons. • Learners can have the sense like what they have experienced today at home, as the teacher was talking about classification and I put my toothbrush and I put my shoes and other things but not mix up things anyhow. • It will reduce the learners to daydream in the class. I mean for example when talking about the steam, how do the learners understand the concept 'steam' they might not have an actual picture and understanding • Local knowledge does not have many confusing terminologies unlike foreign languages like English • In terms of career, currently, we did not yet identify our indigenous talented and intelligent learners because their talents are still hiding behind a certain foreign language that is imposed on them. If we incorporate local or indigenous knowledge, the intelligence and talents of the learners will be promoted maybe even up to tertiary institutions. We will end up having our own indigenous Entrepreneurs, Doctors, Engineers, Mechanics and so on. 	<ul style="list-style-type: none"> • Stimulate active participation • Promote learners to pursue indigenous career • In a multicultural set up, some learners may feel excluded if the inclusion is not based on their tribes • More time is needed for preparation and incorporation • Financial implications for teachers to be trained on how to incorporate. • Incorporate in one grade will not make a greater impact unless it is done across all the grades
<p>T1</p>	<p>Disadvantages</p> <ul style="list-style-type: none"> • It might be a challenge in multicultural classrooms because if you focus on one tribe you might omit or exclude other learners of other tribes in terms of language barriers and cultural differences • It takes up a lot of time for the teachers to be fair enough and cater the multicultural group as you need to do a research for all cultural diversities in the class to benefit. 	
<p>T2</p>	<p>Disadvantages</p> <ul style="list-style-type: none"> • It might take time as we need to identify some linguistic people that can really translate indigenous language. • It might be costly because people should start with the basic training on how to apply and incorporate indigenous knowledge in the science classrooms. • Teaching learners from different tribes will make it difficult for the other learners to understand other people's culture 	

	<ul style="list-style-type: none"> • Incorporating local or indigenous knowledge in one grade will not make a grade and I think it should start from primary school goes to secondary school and higher learning institutions 	
<p>7. What else would you like to share with me regarding the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?</p>		
<p>T1</p>	<p>I think for Physical Science lessons to have impact on our learners, we can come up with vocabulary concerning the local or indigenous knowledge and that I mean by coming up with dictionaries designed or published with the local and IK terminologies for different tribes. I strongly feel that local knowledge and IK will open up an understanding of the learners (where I referred to the past question), motivate them and have interest in science. Learners who would want to study further to become scientist are now limited somehow to get to that level in terms of English, the culture is English, it does not really makes sense to some of the a learners. Some learners are studying further in the field of science are struggling because when they were in school there was no proper foundation of linking science to their cultural background.</p> <p>Me, Concluding: Ms A, thank you very much for your time and for your detailed responses. We have come to the end of our interview session</p> <p>T1: Thank you too Ms.</p>	<ul style="list-style-type: none"> • More publication on indigenous terminologies • Inclusion to be implemented across all the grades up to tertiary level • Media, namely: posters, TVs, radios, product manuals to be used to promote indigenous practices and local language.
<p>TBBI</p>	<p>All I can say is that if this has to be implemented, learning and teaching are processes and I think we have different ways to enhance learning through local or indigenous knowledge. If a media like posters are to be printed in our indigenous languages, computer language to be in our local languages it will be ok. Even instructions or directions on the products that we buy in shops to be also presented in local languages, our cultural</p>	

	practices to be presented more and promoted on our televisions and radios. This will make the process of inclusions easier and faster.	
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Me, Concluding: Thank you very much Mr B for your time and for your detailed responses. We have come to the end of our interview session

T2: you are welcome

Appendix L: Narrative story for lesson observation

Duration : 2 hours

Teacher' code: T1

Topic: Using a wood ash to teach the topic of neutralization.

Research question: How do grade 9 Physical teachers meditate learning of lessons which incorporate local or indigenous Knowledge (IK).

The lesson was a practical activity for using a wood ash to teach the topic of neutralization. The teacher started the lesson by greeting the learners: Good afternoon class! The learners responded: Afternoon Ms!

The teacher made a recap from the previous lesson by asking the learners:

What is an indicator? Learners responses:

- Is a substance that changes colour depending on the pH on the solution
- Is a dye

The teacher responded, ok very good!!

The teacher strengthen that an indicator is a chemical that change colour once an acid or base is added on it. The teacher continued yesterday we were testing different substances; can you tell me some of these substances? Learners responses: Vinegar, cooldrink, coke, baking soda, Jik, Hand wash

The teacher responded, very good, how did we test? Learner responses:

- 'We took a red cabbage indicator and mix it with vinegar and it turned pink. The teachers strengthen that the pink colour tells you that vinegar is a weak acid. Teacher asked further: What about base? Any base that we have tested yesterday? Learners responses (Boys)
- 'Hand wash and it turned green'. The teacher emphasised that green colour in red cabbage indicator means a base and different indicator have different colour effect, but if we use universal indicator, the green colour tells you about neutral solutions. You have to understand these differences.

The teachers introduced the topic lesson:

Today we need to proceed to the topic of today which is neutralisation reaction. What is neutralisation reaction? One learner (Girl) answered: 'A reaction that involve a base and an acid'. The teacher asked further: Can you tell me some examples of neutralisation reaction in our everyday lives?

Learner responses:

- We use baking soda to remove fatty stains on the stove.
- Vinegar to remove scales on electrical kettles. (boy)
- Coke to remove rust on metals. (girl)
- Add salt to coke, drink to neutralise stomach acid. (boy)
- Add water in Mahangu flour, should be loose drink flour to neutralise stomach acid. (boy)
- Roots of some trees but I don't know the name in English: teacher say in Oshiwambo: (boy) Omushelele, you take the root, crush it dissolve it in water and drink.
- When you have a heartburn, you can drink cooking oil. (boy)
- We use wood ash to clean. (girl)

The teachers added that to neutralise stomach acid we use antacids such as ENO, she was more interested on the wood ash and she asked the learner to state physical properties of wood ash:

Learner responses:

- It is powdery. (girl)
- Black or grey. (boy)

Teachers strengthened that it depends to the type of wood or substance that were burn.

She indicated that wood ash is made up of Potassium Carbonate, Calcium Carbonate, Phosphate iron, Manganese, etc. She asked the learners: What are the uses of wood ash?

- Relax the hair. (girl)
- We use it at the farm in the animal's kraal to kill bacteria. (boy)
- Cleaning pots. (boy)
- We use it as a fertilizer in the field. (girl)
- Polishing jewelry. (girl)
- Smear it on the pot to avoid it to turn black. (girl)
- In otjiherero culture, if you pour water outside the house during the night, you have to put wood ash.
- In kavango culture it hastens the ripening process of fruits once the fruits are kept under the wood ash even for three days.
- Seed preservation , prevent insects Oshiwambo culture
- Vegetable medicine storage.

One learner told the teacher that her grandmothers told he that wood ash can be used to store tomatoes even for more than two weeks. The teacher brought six tomatoes three were placed under wood ash and the other were kept outside for two weeks. This was done by the learners.

- Kills pests in the chicken. (girl)
- Purify waters sedimentation. (boy)

The teacher demonstrated wood ash and Vim to explain some similarities in sense that both have the components of Potassium Carbonate and they play the same role in cleaning process.

The teacher instructed the learners to use wood ash to clean off the fatty acid stains on the stove, plates, spoons and test tubes. This was an outdoor activity. Learners shared cleaning activities amongst themselves and they were actively involved and here are some of their observations.

- "Wood ash is removing fats.
- "Wood ash is making a chemical reaction.

When the learners were done with the cleaning, they took the stove, plates, spoons and test tube back to the class for the teachers to conclude the lesson.

The teacher asked: What did you learn from the practice of using wood ash to clean?

Learners' responses:

- Motivate people at home to use wood ash to clean. (boy)
- I learnt that uses of wood ash that I did not know. (girl)
- The lesson was worth because like doing practical helps you to remember things even in question papers, like testing acidity/alkalinity and cleaning an oven. (girl)

- I learnt a lot of things like how to test but not to taste acids , bases and I also learnt how to do or deal with an experiment

Teacher probed: **What do you mean deal with experiment? In what way?** Response;

Like which indicators to use when doing experiment like testing vinegar as I can now use red cabbage indicator.

- I also want to thank Ms. Mika and other teachers who participated, and I would like to say they should do it again with us.
- I think the lesson was good because some can actually remember things when they see them.
- I learnt that wood ash is a cleaning agent.
- It opened our mind for us to know more than what we know.
- I could not believe with what my eyes saw, that wood ash can be used to clean materials. I would like this people to come back again so that we do/touch other topics as well.

Thank you very much, that is the end of our lesson.

Summary/teachers:

- Applied the approached of learners centered in the lesson as all the learners were actively participating in the lesson
- Was patient, kind, flexible with her learners and gave them enough time to demonstrate and explain their prior knowledge of wood ash.
- Promoted classroom interaction by asking questions (thought provoking) and probing Encouraged Social interaction of the making the lesson more interesting practical information.
- Promoted the use of local\indigenous materials (wood ash) that the learners are familiar with to practice contextualised teaching and learning hence the concept neutralization was presented in the local context.

Narrative story for lesson observation

Duration : 1 hours, 30 minutes

Teacher' code : T2

Topic: Using the red cabbage indicator solution to test acidity and alkalinity of substances

Research Question:

How do grade 9 Physical Science teachers meditate learning of lessons which integrate local knowledge?

The lesson was a practical activity for using a red cabbage indicator solution to test acidity and alkalinity of substances. The teacher greeted the learners and started the lesson: yesterday we discussed the properties of acids and base but today we are going to talk about indicators. He asked the learners: what are indicators? Learners responded: Is a substance that is used to show whether a substance or an object is an acid or a base.

Teacher asked further: How does it show? One learner responded: By changing the colour.

Teachers: Which indicators do we use to test acids or bases were the learners' responses:

Universal indicator

Litmus paper

The teacher strengthened on the colour changes of indicators and made it clear that litmus paper can just indicate acidity and alkalinity while universal indicator determine the strength of acidity and alkalinity of the substances. Learners showed an expression of being curious about the new indicator.

He introduced the lesson to the learners: By showing a red Cabbage head. Today we are going to look at this very new indicator

The teacher asked while holding the red Cabbage head; Are you familiar with this? What do you use it for? One learner responded (girls) we use it in the kitchen to make salad. The teacher indicated to the learners that they are going to use the red Cabbage indicator to test acidity and alkalinity of substances. The teacher introduced his critical friend T3 (Pseudonym) and also a CoP member and research participant and also a Physical science teacher at neighbouring school to the learners.

T3 greeted the learners and told the learners: Today we are going to use the red cabbage as an indicator solution to test acids and bases. She asked one learner to volunteer himself/herself to come and chop the red Cabbage. T3 indicated that a red onion used as an indicator. Thank you very much, grade 9, 7 also learnt a lot from you. One girl comes out to assist T3 chop and boil prepare the red Cabbage indicator solution. While T3 and the learner were preparing the red cabbage indicator solution, T2 was explaining to the learners the procedures for testing alkalinity and acidity with red Cabbage indicator. In fact the red Cabbage indicator was already prepared in advance and the one that was prepared in class was just made to demonstrate to the learners on how the indicator is prepared. While the indicator was prepared the teachers was further explaining procedures involved in testing to the learners. At the same time learners were listening attentively and observe how red cabbage indicator is prepared. At this point the T2 and T3 prepared all the chemicals to be tested, pasted the name tags to all the chemicals to be tested. They also placed red cabbage indicator solution in all the test tubes where the drops chemicals will be added.

Thereafter, the teacher demonstrated the chemicals to be tested: Baking soda (sodium bicarbonate, NaHCO_3), Vim, Wood ash, bicarbonate of soda (NaHCO_3), Bleach, lemon juice (citric acid, $\text{C}_6\text{H}_8\text{O}_7$), mouth wash, coffee, fresh milk, vinegar (acetic acid, CH_3COOH), carbonic acid (H_2CO_3), sour milk, fizzy drink, hand wash, Hydrochloric acid (HCl), scale remover, table salt (Sodium Chloride, NaCl_2), tap water sodium Hydroxide (NaOH). Learners were arranged in groups of five and they were listening attentively to all the procedures involved in the using the red cabbage juice to test acidity and alkalinity of substances.

The teacher explained that red cabbage solution is an indicator and indicators are chemicals that change colours when an acid or alkali is added to it. She further explained that different indicators have different effects and colour change in acids and bases. He also explained the colour changes of the red cabbage juice:

Pink colour: Strong acids, pH 1 to 2;

Dark red colour: Weak acids, pH 3 to 4;

Violet colour: Very weak acids, pH 5 to 7;

Blue colour: Very weak base, pH 8;

Blue-green colour: Weak base, pH 9 to 10;

Green-yellow colour: Weak base pH 11 to 12;

Green colour: Very strong base pH 13 to 14;

Pink, dark red solutions are acidic; and

Violet are either acidic or neutral.

Blue, blue-green, green yellow and green solutions are alkaline

This lesson was conducted during the school hours. The teachers were doing the testing while the learners were observing and record their observation in the table.

The last two chemicals that were tested were: Sodium hydroxide and Hydrochloric acid. The teacher strengthened that NaOH and HCl are strong chemicals and they are corrosive as the learners should be very careful with such chemicals. Some learners where able give the uses of these strong chemicals as they indicated:

“We use Hydrochloric acid at home to remove the scales in the toilet pot”

“Sodium hydroxide is used to clean”

One learner asked: Sir where can I get the red cabbage? The teacher told the learners that red cabbage is a local vegetable that one can buy in supermarkets and it can even be planted at home. The teacher strengthened that learners can even prepare it themselves and does the testing of acids and bases at home. Although learners wanted to interact with the teachers, they could not ask many questions because they were busy completing the table and to answer the practical assessment questions in the paper that they have to give the teachers before the next lesson.

The teachers concluded that learners need to start thinking critically as young scientists to find out and discover some other plants that can be also used to test acids and bases. This practical activities was just to awaken your knowledge in local and indigenous materials that can be used to learn and make Physical science easier.

Finally the teacher encouraged the learners to start engaging in inquiry and discovery approach to learn physical science. He acknowledged that he also learnt from the learners when they were testing wood ash (uses of wood ash – cleaning Pots). The critical friend, T3 concluded by asking the learners: Did you the lesson? Have you learnt something as young scientists? Learners reflected:

- I learnt that we can use red cabbage as an indicator to test acids and bases
- The lesson was good because I learnt something new that I never knew and now I got a chance to go out in my environment and explore new things.

- The aspect of the lesson that I enjoyed the most is where the cabbage indicator changed to pink when Hydrochloric acid was added. I did not know these things and it was very great experiences.
- It was really amazing, because I never knew that the red cabbage that we usually use as food at home can be also used as an indicator. It is easy to prepare and I can even do experiments at home.
- I learnt more on testing, colour changes, strong chemicals like hydrochloric acid that we should not touch with our bare hands, taste or smell
- The part that I did not like in this lesson was that some chemicals had unpleasant smell that disturbed me and I want to say that if we are to do more experiments it should be in the science lab, where we will be dressed protective clothes.

Summary, the teacher:

1. Engaged in participatory / collaborative approach to teaching with a critical friend who is also a CoP member and research participants.
2. Learning and teaching activities were shared mostly by the teachers and few learners.
3. Practical activities/ experiments were based on teacher centred approach.
4. Learner's prior knowledge of red Cabbage was tested and acknowledged.

Appendix M: Collated journal Reflection (T1 and T2)

Topic 1: Using wood to teach the topic of neutralisation

Research questions:

- What are the attitudes of Grade 9 Physical Science teachers on integration of local or Indigenous Knowledge (IK) in their Physical Science lessons prior to the intervention?
- What is the understanding of Grade 9 Physical Science teachers on integration of local or Indigenous Knowledge (IK) in their Physical Science lessons prior to the intervention?
- How have the Grade 9 Physical Science teachers' attitudes, understanding, content knowledge and pedagogical skills towards integration of local or Indigenous Knowledge (IK) in Science lessons evolved as a result of their participation in the intervention?

Colour Codes	Categories/Themes
	Enhance effective learning
	Promotes learners prior knowledge
	Development of new knowledge
	Enable learners to do practical activities
	Stimulate learners to ask questions and participate actively
	Challenges
	Recommendations

Code	Questions and Responses
	1. What have you gained from this lesson?
T1	Able to use more local knowledge to implement our teaching activities and make the learners understand better the content and to be able to carry along or apply what they were taught at school in their everyday lives
T2	I have gained new knowledge, experience and how useful our surrounding can be to us.
	2. In general, have you found the lesson useful to you or not? Explain why
T1	The lesson was very useful because my learners were using their local knowledge that made them even more curious to ask more questions and recall their daily activities and link it the classroom science.
T2	Very useful as I experienced something new that I never knew before. In other words neutralisation process is not only as we see it written in the textbooks. There are more substances that can be used.
	3. Which aspect (s) of the lesson did you find most helpful to teach acids and bases and why?
TAAJR	Using wood ash to clean the glasses and the stove, as the learners were more carrying out a practical activity and at the same time trying to prove what they knew in theory through practice.
T2	In general the whole lesson was helpful. The lesson opened up our mind of many other things that can be used for neutralisation

	4. How do you describe the lesson? Was it successful or unsuccessful? Explain why.
T1	It was successful because the learners were able to meet most of the learning objective and till to date, they could still recall what they did not able to explain the process of neutralisation.
T2	The lesson was successful because I could see that learners gain new knowledge
	5. Was there any aspect (s) of this lesson that you do not like? Explain why.
T1	Could not think of any since the learning objectives were met during the lesson and most learners showed understanding and rely the lesson to their everyday life
T2	Time Management was of a problem. Time could not allow classes to see the preparations
	6. If we happen to present another Local or indigenous mediated lesson, on which area do you think we need to improve?
T1	Engaging learners in doing things on their own with the teacher's guide since some learners are very slow in adding or following instructions and in the same way it actually use up the most of the time and the conclusion might not be effective due to time.
T2	The best way is to teach this type of lessons after school, whereby there will be enough time for the lesson preparation and presentation.
	7. How do you feel about Ms Mika working with you, engaging in professional activities within CoP?
T1	I regard her as my mentor. I learnt a lot through working with her and I will definitely involve her in every step of my professionalism
T2	Ms Mika knows how to work with people. She proved her leadership to be professional. I did not encounter any conflict with her. Ms Mika is friendly, helpful and mostly understanding.
	8. What are your views on the overall intervention of integrating indigenous or local knowledge in grade 9 Physical science?
T1	It is actually a motivative way of learning, since it enable learners to learn through what they know and engage in everyday life and put it in practice and learning. More need to be done to engage all topics to motivate learners and encourage the teaching and learning.

T2	I was surprised by the input of the learners and it shows that there is still more that we need to know locally.

Collated journal Reflection (T1 and T2)

Topic 2: Use the red cabbage indicator solution to test acidity and alkalinity of substances

Code	Questions and Responses
	1. What have you gained from this lesson?
T1	Not to focus only on chemical substances in a laboratory but rather apply our local substances as well as to carry on effective teaching and learning
T2	I have gained new knowledge, about red cabbage that it can be used as an indicator
	2. In general, have you found the lesson useful to you or not? Explain why
T1	It was useful because learners could tell how the indicator was prepared and it causes the colour change to show acidity and alkalinity
T2	The lesson was very useful as it leads to learners to be eager to find out more about other substances that can be used an indicator.
	3. Which aspect (s) of the lesson did you find most helpful to teach acids and bases and why?
T1	Learners carrying on the practical on their own and the teacher being the facilitator. This enabled the learners to do accurate measurements and take responsibilities when it comes to safety in the laboratory
T2	When testing substances with indicators as in science we are not allowed to taste with our tongues. Having a red cabbage indicator is a wonderful.
	4. How do you describe the lesson? Was it successful or unsuccessful? Explain why.
T1	Yes it was successful as learners were able to identify acidity and alkalinity of solutions as well as identifying strong ones. This enabled my learners to test substances in future even at their houses.
T2	Very successful but only that more should be done especially on preparation.
	5. Was there any aspect (s) of this lesson that you do not like? Explain why.
T1	None so far, only that some learners were not following instructions and waited for the teacher' guidance
T2	Time was not on our side and boiling and prepare red cabbage took more time

6. If we happen to present another Local or indigenous mediated lesson, on which area do you think we need to improve?	
T1	Learners not handling substances since not all of them followed the instructions, that one day might end up mixing wrong substances. For better improvement the teacher must engage in handling substances instead of the learners
T2	Mostly more time is needed to present the lessons. It also need more technics to involve learners physically.
7. How do you feel about Ms Mika working with you, engaging in professional activities within CoP?	
T1	I regard her as my mentor. I learnt a lot through working with her and I will definitely involve her in every step of my professionalism
T2	Ms Mika handled the whole process professionally. She has understanding of subject content and she is confident in what she is doing. I had no conflict with her.
8. What are your views on the overall intervention of integrating indigenous or local knowledge in grade 9 Physical science?	
T1	Local knowledge and indigenous intervention help learners to must the work quickly since they are already using those substances in their everyday life. It actually allows them to connect the relationship they have to the subject content and understand better.
T2	I think local knowledge should be taken up to another level. It will help our learners to understand more and what is useful around them. Our region should really consider this inclusion

Appendix N: Practical activity 1

~~Barossa~~ Secondary School

Name _____
Subject : Physical Science, Grade 9
Theme : Acids and Alkalis (Bases)
Concept : Red Cabbage Juice pH Indicator
Lesson : Practical Activity 1
Date : 04 July 2018

Total Marks: 15

Background: A number of plants change colour in different pHs, e.g. the purple dye from pansy flowers changes from scarlet in strong acid to lime green in strong base. Red cabbage contains a pigment called flavonoids/Flavin (Anthocyanin). This pigment is also found in red onion, red poppies, blue cornflowers, grapes, and apple skin. Depending on the pH of the fruit or plant the pigment will give a different color. This pigment can be used to indicate pH of substances. Like all vegetables when you cook them, the water is soluble chemicals leak into the cooking water as the heat breaks the plasma membranes of the cells. Red cabbage juice will change to a variety of colours when added to solutions of various pH. You are going to use Red cabbage as pH indicator to test acidity and alkalinity of solutions.

Materials: Red cabbage, knife, cutting board, water, filter paper, coffee filters work well, beakers, test tubes droppers.

Chemicals substances to be tested:

Ammonium Hydroxide, Baking soda (sodium bicarbonate, NaHCO_3), Wood Ash, Vim, Lemon juice, Coffee, Fresh milk, Sour milk, Bleach, Vinegar (acetic acid, CH_3COOH), Fizzy drink (Carbonic acid, H_2CO_3), Window cleaner, Methylated spirit, Hydrochloric acid (HCl), Table Salt (Sodium Chloride NaCl), Tea, Baking Soda, Lemon juice.

Procedures:

1. Chop cabbage into small pieces.
2. Boil chopped red cabbage in tap water. You only need to boil long enough to extract some of the red colour into the water. Save the coloured water for the experiments.
3. For each experiment, you will need only use a small amount of the cabbage water.
4. Rinse the test tube out with tap water between experiments.
5. Hold the test tube against a white background or hold it up to the window when viewing the colour. If you have problems seeing the colours in a test tube, try a white plastic spoon.
6. Add 1 – 2 drops of vinegar to a small amount of red cabbage water.
Does the colour change? Record in the table on the next page.
7. Add a pinch of baking soda to a small amount of red cabbage water.
Does the colour change or disappear? Record in the table.
8. Add 1 – 3 drops of vinegar. Does it have any effect on the colour? Wait a couple of minutes – now what is the colour? Record in the table.

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