

**Exploring the effect of the indigenous technology of oil extraction
on Grade 10 Biology learners' perspectives and sense making of
enzymes**



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By

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Declaration of Originality

I, Martha Ndeyatila Nyamakuti (17N8166) hereby declare that this thesis is my own original work and has not been previously submitted in any form for assessment or degree in any other higher education institution. All ideas, quotations and other materials used in the study derived from the work of other people have been acknowledged using complete references according to Rhodes University Education Department guideline



Signature

Date: February 2021

Dedication

This thesis is dedicated to my godmother, Martha Nehoya Johannes and my mother Petrina Nandjila Ndeshimona who raised me up, teaching me the principles of life to be the independent dreamchaser type of a woman I am today. I further dedicate the thesis to my children Iyaloo, Ndinomwameni, and Nasimane and my husband Johannes Nyamakuti who took care of our children while I embarked on my academic journey, and gave me moral support to prove to myself that I can be a multifaceted being. This motivated me to work harder and reach for the stars.

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Abstract

The current status quo is that African learners' local indigenous knowledge (IK) and experiences from home (cultural heritage) are not considered in science classrooms. In the context of Namibia, it seems that the Namibian curriculum policies do little or nothing to decolonise and address the issues of equity and social injustice in Namibian schools. For instance, although the Namibian National Curriculum for Basic Education (NCBE) claims that it "embraces traditional knowledge", it does not specify how this should be done in schools. As a result, little or no integration of IK is enacted in many of our schools in Namibia. Resultantly, learners seem to find science inaccessible and irrelevant to their everyday lives. It is against this background that in this study I sought to explore how the mobilisation of the indigenous technology of oil extraction (*okuyenga*) from marula nuts and melon seeds influences (or not) Grade 10 Biology learners' conceptions, dispositions and sense making of the topic of enzymes.

The study was located within the interpretive and indigenous research paradigms. Central to the interpretive paradigm is the development of a greater understanding of how people make sense of the contexts in which they live and work. On the other hand, central to indigenous research paradigms are belief systems based on the lived experiences, values, and histories of the participants. The Ubuntu perspective or approach in which respect and humble togetherness is emphasised is critical in indigenous research paradigms especially when researchers are working *with* and *in* communities as I did in this study.

The study was conducted in an under resourced school in Walvis Bay, Namibia. A qualitative case study approach was used and data were derived from a focus group interview, participatory classroom observations, learners' reflections, and a stimulated recall interview. Vygotsky's socio-cultural theory was employed as a theoretical framework. Within the socio-cultural theory, mediation of learning, social interactions, and the zone of proximal development (ZPD) were used as analytical lenses. The conceptual framework comprised of perspectives (conceptions, dispositions) and sense making of enzymes by the learners. Criteria were also adapted from Atallah, Bryant, and Dada to analyse learners' perspectives. A thematic approach to analysis was employed to come up with categories and sub-themes and thereafter, common sub-themes were combined to form themes.

The findings of the study revealed that the presentations on the indigenous technology of oil extraction by the expert community members influenced learners' conceptions, dispositions, and sense making of enzymes and other associated science concepts. This was noticed when learners extracted emerging science concepts from the indigenous technology of oil extraction. The implication of this study is that there is a need for science teachers to consider learners' cultural heritage and integrate local IK in their Biology classrooms in order to make science accessible and relevant to learners. Moreover, the integration of local IK is critical for learners to embrace and respect their cultural heritage. This study thus recommends that teachers should make efforts to collaborate with expert community members who are the custodians of local IK and tap into their cultural heritage and wisdom to enrich teaching in their science classrooms.

Keywords: Biology, enzymes, culture, indigenous technology, oil extraction, indigenous knowledge, conceptions, dispositions, sense making, indigenous research paradigm, socio-cultural theory, contiguity argumentative theory

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List of Abbreviations and/or Acronyms

BEd:	Bachelor of Education
CAT:	Contiguity Argumentation Theory
CBL:	Case Based Learning
CRN:	Constitution of Republic of Namibia
DBE:	Department of Basic Education
IK:	Indigenous Knowledge
IKS:	Indigenous Knowledge System
IT:	Indigenous Technology
LoTL:	Language of Teaching and Learning
MEAS:	Ministry of Education, Arts and Culture
MEd:	Master of Education
MKO:	More Knowledgeable Other
MoE:	Ministry of Education
NCBE:	National Curriculum for Basic Education
PEEOE:	Predict, Explain, Explore, Observe, Explain
SCT:	Socio-Cultural Theory
TEK:	Traditional Ecological Knowledge
TMESD:	Transformational Model of Education for Sustainable Development
WS:	Western Science
ZPD:	Zone of Proximal Development
ZPL:	Zone of Proximal Learning

CHAPTER ONE: SITUATING THE STUDY

1.1 Introduction

Although the Namibian curriculum recommends that different teaching approaches should be enacted, the approaches to teaching and learning of science used seem to still privilege Westernised ways of teaching science. The African politicians, policy makers, and administrators still seem to neglect and undermine the use of indigenous knowledge systems (IKS) because the Western education they themselves attained developed a colonised mindset that still persists today (Shizha, 2013). This shows the intensity of the damage caused by the apartheid regime in segregating, oppressing, and suppressing African ontology and epistemology.

In most African countries including Namibia, the knowledge that Black children brought from home is considered irrelevant in the classroom (Taylor & Cameron, 2016). The fact that learners' home experiences are not considered in science classrooms creates a gap in knowledge reconstruction whereby learners cannot relate to what they are taught. Yet, if learners' home experiences are considered, they will be able to make the connection between indigenous and Westernised Science (WS) which will subsequently help them retain their values and their practices of Ubuntu (Ogunniyi, 2007a; Seehawer, 2018; Taylor & Cameron, 2016).

It is against this backdrop that the main goal of this study was to explore how the mobilisation of the indigenous technology of oil extraction (*okuyenga*/ *khamtui oli*¹) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of enzymes.

In this chapter, I therefore discuss the background of the study followed by the statement of the problem. The rationale and the significance of the study is also provided and research goals

¹Okuyenga/ *khamtui oli* is an indigenous practice of extracting oil in Aawambo and Damara cultures respectively.

and questions that guided my study are highlighted. Lastly, the data gathering methods are described, key concepts used in the study are defined and the outline of the thesis is provided. The chapter ends with a chapter summary.

1.2 Background of the Study

Namibia, like many African countries, has a long history of colonisation and apartheid ideology. The colonisation's hangover resulted in inequalities and inconsistencies in the education system, affecting the country's multicultural diversity in terms of access, equality, curriculum, and resources. To address this, since 1990 Namibia has made substantial advances in ensuring an inclusive and equitable education system. For instance, the Constitution of the Republic of Namibia (CRN) article (20) states that "all persons shall have the right to basic education, that primary education shall be compulsory and that all state shall provide reasonable facilities to render effective this right to residence in Namibia" (Namibia. CRN, 1998, p. 14). The basic education which is mandated by article 20 of the CRN is further guided by the Namibian National Curriculum for Basic Education as an official policy document (NCBE).

This official policy document guides teaching and learning in schools on how to organise the teaching-learning process and ensure coherence and consistency in the delivery of the curriculum in Namibia (Ministry of Education, Arts & Culture [MEAC], 2016). The NCBE (2016) replaced the NCBE (2010) to ensure continuous foundation principles of the Namibia education system. In an attempt to realise quality education delivery, the Namibian education system has undergone extensive restructuring in order to transit from a literate to a knowledge-based society as per the national benchmark Vision 2030 (Namibia. MEAC, 2018). This includes addressing the challenge of national curriculum that is based on Western ideas and models, ignoring the IK of the marginalised in the African classroom. I am of the opinion, however, that some learners' perceptions could be related to the ambiguous nature of Western ways of teaching pedagogies of Mathematics and Science, which is out of touch with learners' cultural heritage (indigenous knowledge).

The current status quo in the field of science worldwide, calls for integration and fusion of diversity of knowledge in the science classrooms such as Traditional Ecological Knowledge (TEK), Aboriginal, and indigenous, just to mention a few (Hodson, 2009). There have been calls to integrate other forms of knowledge to improve teaching pedagogies and learners'

understanding of school curricula around the world in countries such as Canada (Aikenhead, 2006; New Zealand (Ministry of Education, 1993; Roberts, 1998) and South Africa's Department of Basic Education (2011) to mention just a few. These scholars advocate for introducing teaching pedagogies that can be incorporated to accommodate learners from an African context. Notably, there is a great need to make school science relevant to African learners.

Similarly, scholars such as Erinoshio (2013), Nyika (2017), Kibirige and Van Rooyen (2006), Ogunniyi (2008), and Shizha (2007) believe that the integration of IK has the potential to make science more relevant to learners. Further, Mhakure and Otulaja (2017), Mutanho (2016), Nikodemus (2017) and Shinana (2019) suggest that drawing from learners' cultural heritage makes learning of science relevant and improves learners' understanding of science. To Mukwambo, Ngcoza, and Chikunda (2014), neglecting indigenous practices of African people makes science abstract to African learners.

Kuhlane (2011) asserts that the beginning of each stage of the learning process is the learners' existing knowledge. Hence, learners require their cultural heritage background to make sense of science knowledge. Admittedly, learners effectively assimilate newly acquired knowledge if they can link it to their everyday experiences. This might afford learners from different cultural backgrounds equal opportunities to succeed at school (Mavuru & Ramnarain, 2020; Tonbuloglu, Aslan, & Aydin, 2016). In addition, learners should be able to negotiate meaning across IK and WS and integrate them (Ogunniyi, 2007a).

Furthermore, scholars such as Roschelle (1995) and Kuhlane (2011) suggest that learning starts from prior knowledge and only later from presented ideas. Additionally, learners learn better when they negotiate emerging conflicting and contradictory ideas where Western and IK co-exist (Ogunniyi, 2007a; Ogunniyi & Hewson, 2008). Knowing these benefits but failing to consider the integration of IK may create racism, segregation and alienation in the education system. Therefore, placing emphasis on learners' socio-cultural background and the integrating of IK can be an alternative approach to mediate learning of science (Mavuru & Ramnarain, 2017; Naidoo & Vithal, 2014). In light of this, the value of indigenous knowledge is accorded status as one of the seven principles underpinning the South African curricula (South Africa. Department of Basic Education [DBE], 2011). This is also the case in Namibia.

In this regard, the curriculum document advises the use of IK and embracing all local cultures in different societies. The issues of acknowledging and embracing multicultural values are guaranteed by article 19 of the CRN (1998) which states “that every person shall be entitled to enjoy, practice, profess, maintain and promote any culture, language and tradition subject to the term of this constitution” (p. 8). As alluded to earlier, the Namibian school curriculum calls for home and community to actively support the holistic development of learners which aligns well with the concept of Ubuntu – which translates to “I am because of others” (Seehawer, 2018). The curriculum seems to validate that acquiring new knowledge and skills takes place when people interact with one another. This notion resonates with Vygotsky (1978) who attests that knowledge can be constructed in social set ups with More Knowledgeable Others (MKOs) and through interaction with the environment.

Additionally, the curriculum warns against the danger of ignoring learners’ cultural heritage as it explains that teaching which does not build on learners’ prior knowledge might limit their thinking. Consequently, they might not see the connection between the world outside the school and what is taught and learnt in the school (Aikenhead & Jegede, 1999; Kuhlane, 2011). This suggests that there is a need to consider learners’ home experiences during teaching repertoires.

1.3 Nature of the Namibian Science Curriculum

Natural Science is one of the compulsory fields offered at secondary schools in Namibia across the curriculum: Life Science and Biology are some of the subjects in this field of Natural Science. One of the aims of teaching Science is to provide worthwhile educational experiences, for all learners to become confident citizens in the technological world and develop an informed interest in matters of scientific importance (Namibia. Ministry of Education [MoE], 2017). Therefore, interest in Science could be stimulated when learners’ prior knowledge is considered in the teaching and learning of Science and in particular Biology in the context of this study. Based on the new curriculum, Biology is now an optional subject at Grade 10 level and no longer a compulsory subject to all learners from Grade 11 as was the case in the curriculum that was phased out (Namibia. MEAC, 2017).

In my view, the fact that Biology is an optional subject could contribute to science career limitations at university level since those learners who did not opt for Biology might not be admitted to science courses which require Biology as a prerequisite. The grades mentioned above are foundation phase for Biology, thus they necessitate learners to be equipped with all

knowledge that is related to their prior knowledge and experiences (Kuhlane, 2011) for them to cope with Biology that will be offered as a subject in Grade 12 at the Advanced Subsidiary level.

Furthermore, the teaching of enzymes in Namibian schools seems to be a challenge (Namibia, MoE, 2015-2018). This situation seems to deter learners from taking up careers in the field of biological sciences. Grade 10 Biology introduces the topic of biological molecules. In light of this, teachers are thus expected to have a good foundation of the role of enzymes in chemical reactions and teach it effectively, so that learners may ultimately take up careers in the field of science. The field of science is one educational area of focus which will pave the way for the realisation of Namibia's benchmark of Vision 2030.

This Vision 2030 calls for exploring the field of science curriculum to produce an innovative, educated, and self-sustained society by the year 2030. The current new curriculum does not include cultural knowledge as a possible area of instruction to be integrated across the science curriculum yet it advocates for integration of IK and assumes that teachers know how to do that. The fact that the curriculum has changed and content is more complex than in the old curriculum, might make it more of a challenge for teachers to make science relevant to learners (Davidowitz & Rollnick, 2011). This suggests teachers should adapt to methodology which learners could relate to in order to understand science concepts as proposed by Mavuru and Ramnarain (2020). Therefore, drawing from my experience and findings from the examination reports, I found it fit to explore integrating IK in the teaching of enzymes which might perhaps help my learners make sense of the concept of enzymes.

There have already been a number of studies of integrating IK into science in Namibia and South Africa under Rhodes University's umbrella research programme, specifically in Biology or Life Science or Physical Science. In Namibia, for example, Nakale's (2012) study focused on how teachers mediate learning of biological language and concepts. Nakale's study revealed the kind of representations teachers use to help students or learners make sense of the topic of enzymes. In his study, Nikodemus (2017) mobilised the indigenous technology of making

²*Oshikundu* to mediate learning of rates of reactions in a Physical Science classroom. His study revealed that the integration of IK positively influences learners' sense making, conceptions, and dispositions towards science. Similarly, Shinana (2019) conducted an interventionist study on the indigenous technology of making *Oshikundu* as an inquiry method to support Grade 8 Life Science teachers in mediating learning of enzymes. Both Nikodemus and Shinana's findings indicate that the integration of IK positively influences learners' sense making, conceptions, and dispositions towards science.

However, a gap I identified in both Nakale's (2012) and Shinana's (2019) studies is that their studies did not focus on learners in multicultural classrooms in the Namibian context. Moreover, both Nakale's and Shinana's studies focused on teachers. Hence, these are the knowledge gaps that my study sought to close. Essentially, my study focused on how to mobilise the indigenous technology of oil extraction (*okuyenga/!khamtui oli-/*) to mediate learning of the concept of enzymes focusing on Grade10 Biology learners in a multicultural classroom. It is recognised, however, that a researcher's personal life and upbringing as well educational background might have an influence on how research is conducted.

1.4 My Personal Experiences

My experience of education, from kindergarten to graduate school, was one of coping with someone else's agenda, curriculum, and pedagogy, someone who was neither interested in my well-being as a kwezens, nor interested in my connection to my homeland, my language or history, nor my Nishnaabeg intelligence. No one ever asked me what I was interested in nor did they ask for my consent to participate in their system. My experience of education was of continually being measured against a set of principles that required surrender to an assimilative colonial agenda in order to fulfil those principles. (Simpson, 2014, p. 6)

Similarly to Simpson's (2014) education highlighted in the quote above, my home experience and upbringing was completely different from my school experience. Put differently, my home experience was not in any way relevant to what I learnt at school. At home, for instance, I remember that during the day my grandmother used to look at the sun or her shadow to mark time. The elders would tell us that once you notice your shadow it is a sign that it was midday. In some cases, our elders in the community would look at the clouds or the sound of a

² *Oshikundu* is a non-alcoholic traditional beverage which is made from fermenting three flours, namely, *ongundo*, *Uushutu* and *Mahangu*. It is a staple drink for Namibian tribes mostly the Aawambo people and is rich in carbohydrates, proteins, vitamins as well as minerals (Shinana, 2019).

thunderstorm to predict the direction of where it was raining heavily. The elders would also use the appearance of birds and insects to predict flood or drought. This suggests that elders studied the environment to make sense of the world (Mosimege & Onwu, 2004).

Regarding food habits, my grandmother would always collect a white plant like an umbrella called *Owawa* and cook it for lunch and it actually tasted like chicken. I later learnt that this was actually mushroom. In addition, she also used to cook us wild spinach as relish called *Ombidi* in Oshiwambo. *Ombidi* can be prepared fresh or can be dried and preserved in dry wooden ashes for killing and preventing pests from spoiling it or covered in maize meal for more than two years. *Ombidi* is used for other various purposes such as medicine and served as a traditional starter meal at any traditional event (Hashondili, 2020). None of this was mentioned during my primary schooling, yet I do not blame my teachers as such since it is how they themselves were taught.

During my high school years I was introduced to Life Science where we had to learn about animal and plant kingdoms. I noticed that certain pictures from both the plant and fungi kingdoms looked similar and I struggled to tell the difference between organisms in these kingdoms. Since the teacher never made an effort to link my everyday knowledge to what was taught at school, I just resorted to rote learning without understanding. Such rote learning made me dislike Life Science because my prior everyday knowledge learnt at home was not considered (Kuhlana, 2011) hence, I could not relate to the knowledge imparted.

It was only at college when I asked for examples of organisms found in the fungi kingdom. It was only when I asked my lecturer what fungi was called in my vernacular and where it could be found that I discovered that mushroom is an example of fungi and is the same as *Owawa* which my grandmother used to cook for us. Had my teacher drawn from our socio-cultural experiences to mediate learning as reiterated by Mavuru and Ramnarain (2020) in their study, I believe I could have understood things better and probably engaged more in my learning as reiterated by Sedlacek and Sedova (2017). Moreover, during my secondary school we were asked to come up with science fair projects to present at the circuit level.

In the year 2000, as a Grade 9 learner my science project was titled: *Extraction of Marula oil at home*. However, when the judges came to my project, they were not keen to observe my entire practical and explanation of the extraction of oil. Instead, some of the judges walked away to observe other projects while I was still explaining. This was an embarrassing

experience which led me to believe that home experiences had nothing to do with science we learnt at school.

During my 10 years of teaching grades 11 and 12 Biology, I have always favoured the use of hands-on practical activities in most of my lessons as emphasised by Asheela (2017) as well as Asheela, Ngcoza and Sewry (2021) to mention a few. Similarly to Asheela et al. (2021), I have always viewed hands-on practical activities as a method of promoting the ‘hands-on, minds-on and words-on’ approach. Learners always looked forward to the hands-on practical activities whereby they had to manipulate apparatus and think of the likely results. Learners actively participated during hands-on practical activities compared to other theory-based lessons. Essentially, the inclusion of hands-on practical activities seemed to improve learners’ understanding of Biology and made it more enjoyable.

In spite of the fact that learners seemed to understand and enjoy the subject, the formal and summative assessments results for grades 11 and 12 did not correlate with the effort I put in to mediate learning through these hands-on practical activities. For instance, only 40% received the quality symbols from A-C and the rest, 60%, received D-E symbols. This was so discouraging because I thought I had done everything I could to make my learners understand and make sense of the content which meant they should have attained quality symbols. Moreover, I assumed that I always provided clear outlined steps for all hands-on practical activities that were done by learners where they had to observe and explain their findings.

On reflection, however, the practical activities did not make provision for the Predict–Explain–Explore–Observe–Explain (PEEOE) approach as stipulated by Asheela et al. (2021). The practical steps were also clearly outlined more like a recipe book style – something that has been criticised by Hodson (1993). At that time, I could not see anything ‘wrong’ with my practice because based on my observation, learners seemed to be enjoying and learning well simultaneously. I did not notice that the amount of knowledge gained from hands-on practical activities was limited. In addition, I was not able to carry out all hands-on practical activities specified in the syllabus due to lack of resources in our township school.

In 2017-2018, I enrolled for the BEd honours with Rhodes University. During my science elective I was exposed to Asheela’s (2017) study on the use of easily accessible resources to conduct hands-on practical activities. I also observed Asheela’s practical demonstration on how *oshikundu* can be used to improvise when there is a lack of resources to carry out practicals to

mediate learning. In addition, in 2019 I was exposed to a practical demonstration of making ³*umqombothi* by Mama Noling – an ⁴expert community member at Rhodes University. Her presentation was conducted in a multicultural lecture session. Notably, she made her presentation in isiXhosa (her home language) and another master's student translated into English so that we could all understand. It could be argued that during her presentation, isiXhosa as a language was used as a resource as emphasised by scholars such as Msimanga and Lelliot (2014), Mavuru and Ramnarain (2017), Ngcoza (2019), and Nhase (2019).

In summary, the presentation by the expert community member was an eye-opener for me to realise that IK has the potential to be used to mediate learning of science concepts. It is from this background that I discovered how IK could be integrated in school science to mediate learning. In my earlier years of teaching, I regret not knowing that IK can be used as a foundation on which new knowledge can be built as proposed by Roschelle (1995) and other scholars.

1.5 Statement of the Problem

The new Namibian curriculum advocates for integration of IK in science teaching. However, it fails to indicate explicitly how it should be enacted during science teaching. Yet, it is believed that integrating IK in science teaching enriches learning and makes science relevant to learners (Gwekwerere, 2016; Kibirige & Van Rooyen, 2006; Mavuru & Ramnarain, 2020; Tzou, Meixi, Suárez, Bells, LaBonte, Starks, & Bang, 2019). The assumption is that when science is accessible and relevant to learners this might improve their understanding of science concepts.

To acquaint myself with learners' past performances on the concept of enzymes, I managed to read through the national and regional examiners' reports for 2015-2020 and found out that most learners could not answer examination questions based on the topic of enzymes which is both in the Grade 10 and 11 syllabuses. I also noted general comments relating to Grade 12, that "generally 65% of learners could not distinguish between inactive and denaturation stages of enzymes" (Namibia. MoE, 2015-2020). It seems that lack of integration of IK in part hinders understanding of enzymes. Furthermore, this could be caused by the teaching of science which

³ *Umqombothi* is a traditional alcoholic beverage with about 3% alcohol content made by many families in South Africa.

⁴ *Expert community members* are referred to as experts in this study since they are the custodians of traditional knowledge and are recognised for their funds of knowledge and wisdom.

tends to alienate non-African learners as they are generally out of touch with the reality of the learners' world (Aikenhead & Jegede, 1999; Erinosh, 2013). This interventionist study therefore sought to explore the mobilisation of the indigenous technology of oil extraction (*okuyenga/khamtui oli-*) from Marula nuts and Kalahari melon seeds respectively to mediate learning of the topic of enzymes in a Grade 10 Biology class in a township⁵ school.

1.6 Rationale and Significance of the Study

There have been a number of studies on the integration of IK into science teaching in South Africa and Namibia under the Rhodes University's umbrella research programme. My study forms part of this research umbrella. Its main purpose was to integrate IK in a Biology lesson in a multicultural class in particular. This was achieved through the presentations on oil extraction (*okuyenga/khamtui oli-*) by the expert community members and my focus was particularly on the topic of enzymes. Although local knowledge, traditional knowledge, traditional ecological knowledge or indigenous knowledge are used interchangeably in literature, in this study I will use local indigenous knowledge (IK) throughout this thesis.

I would like to emphasise upfront that the word 'integration' of indigenous knowledge in this thesis is not used synonymously with inclusion or incorporation as I was interested in commonalities between IK and westernised science. That is, these knowledges (IK and westernised science) were regarded as equal and co-existing as reiterated by Ogunniyi's (2002a) equipollent cognitive state. Moreover, these knowledges were regarded as being in dialogue with each other rather than being oppositional as emphasised by Seehawer (2021) in her study. In my view, therefore, the problem with the use of 'inclusion' and 'incorporation' seems to give the impression that IK's role is restricted to being a vehicle for the promotion of westernised science, hence my reluctance to use these terms.

Notably, is that this study builds on previous studies conducted by Hashondili (2020) and Shinana (2019) in Namibia, on how to integrate IK in science teaching with a view to making it relevant and accessible to learners. Essentially, the study strove to help learners to discover,

⁵ Township school – the school in a disadvantaged community in terms of socio-economic resources.

embrace, and appreciate their IK, values, and cultural practices (Mavuru & Ramnarain, 2020; Tzou et al., 2019), which are embedded in Westernised science.

Therefore, using easily accessible resources (Asheela et al., 2021) such as the indigenous technology of extracting oil would contextualise and make science more accessible to the learners. Furthermore, the findings of this study might potentially provide opportunities in the form of interventions to mobilise and illustrate how IK of community experts could be involved in imparting IK, skills, and wisdom which could be integrated into science teaching to enrich mediation of learning.

That is, bringing the community into the science classroom and *vice versa* which might afford an opportunity to document this knowledge and make it available for use in local schools. As a result of the interaction between learners and community members, it might alleviate the cultural aspect whereby children are not supposed to question adults. That is, it was hoped that some cultural stereotypes would be challenged in this study. In addition, it might also be useful to me as a teacher to improve my teaching pedagogy in terms of integrating IK, lesson preparation, and also ultimately improving my learners' sense making science concepts. It might also retain and sustain the notion of Ubuntu/Unhu which could result in the advancement of the culture and dignity of indigenous people (Cocks, Alexander & Dold, 2012; Ogunniyi, 2007a; Seehawer, 2018; Taylor & Cameron, 2016). Cocks et al. (2012) refer to this as cultural revitalisation.

1.7 Research Goal and Research Questions

The main goal of this study was to explore how the mobilisation of the indigenous technology oil extraction (*okuyenga*/ *khamtui oli*-) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of enzymes.

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

1. What are Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?
2. How do Grade 10 Biology learners interact, participate, and learn (or not) during the presentations on the indigenous technology of oil extraction by the expert community members?

3. How do Grade 10 Biology learners' conceptions, dispositions, and sense making shift/ evolve (or not) as a result of the presentations on the indigenous technology of oil extraction by the expert community members?

1.8 Theoretical Framework

The theoretical framework is a significant component of any research study. The theoretical framework for this study was drawn from Vygotsky's socio-cultural theory (SCT). Vygotsky (1978) believes that "human activities that take place in cultural contexts, are mediated by language and other symbol systems, and can be understood when investigated in their historical development" (p. 191). Based on this cultural theory, meaningful learning takes place through social interaction between learners and those with more experience (More Knowledgeable Others). Substantially, it draws more on the significance of social contexts and culture in learning. Within this theory, I focused on the following concepts: mediation of learning, social interaction, and assistance with higher order cognitive skills within individual student's zone of proximal development (ZPD). I augmented the socio-cultural theory with Ogunniyi's (2007a) Contiguity Argumentative Theory (CAT), which I used as my analytical framework. According to Ogunniyi, CAT consists of five cognitive states, viz., dominant, assimilation, suppressed, emergent and equipollent.

1.9 Data gathering Methods

- Focus group interviews;
- Participatory observation;
- Stimulated recall interviews; and
- Journal reflections.

1.10 Definition of Key Concepts Used in this Thesis

Some key concepts are frequently referred to in this thesis. These are Biology, enzymes, culture, indigenous knowledge, indigenous technology, prior knowledge, conceptions, disposition, sense making, socio-cultural theory, social interaction, visualisation, multicultural, hands-on practical activities, learner engagement, and language usage. These are hence defined as follows:

Biology: The study of living organisms, divided into many specialised fields.

Enzymes: Biological catalysts that speed up biochemical reactions in living organisms (Robinson, 2015).

Culture: The set of rules according to how communities behave.

Indigenous knowledge: IK is an all-inclusive knowledge that covers technologies and practices that have been and are still used by indigenous and local people for their existence, survival, and environmental adaptations (Mosimege & Onwu, 2004).

Indigenous technology: Emeagwali and Shizha (2016) define indigenous technology as practices used by indigenous peoples from time immemorial to solve their problems that affected the communities.

Traditional technological knowledge: A body of knowledge, practices, and beliefs about the relationship of living beings with one another and with their environment which is culturally passed on from one generation to another.

Prior knowledge: Any form of pre-existing experiences or information which learners bring with them to school.

Conceptions: The views of learners about the subject (Atallah et al., 2010).

Dispositions: Social influences which contribute to the shaping of the person's personality (Bourdieu, 1993).

Sense making: It involves turning a circumstance into a situation that is comprehended explicitly in words and that serves as a springboard into action (Nikodemus, 2017).

Socio-cultural theory: A social learning theory which advances that all human thinking processes are interdependent with social contexts and culture (Vygotsky, 1978).

Social interaction: The process of engaging and interacting with one another.

Visualisation: The process of using concrete materials to bring reality into the classroom to improve understanding.

Translanguaging: The use of more than one language in a classroom (Garcia, Skutnabb-Kangas, & Torres-Guzman, 2006).

Multicultural: Inclusion of people from all spheres of life without any discrimination.

Practical activities: Any teaching or learning activity in which the learners work in a group or as individuals to observe and manipulate instruments.

Language usage: A mediating tool which facilitates communication in a socio-cultural set up.

1.11 Thesis Outline

The study was conducted at Iyaloo Secondary School (pseudonym), a rural school in Erongo region, Walvis Bay in Namibia. The thesis consists of six chapters:

Chapter One:

This chapter provided the background of the study and highlighted the reason for carrying out the study. The context was informed by the challenges of teaching science at international and national levels. The statement of the problem was explained such as the gap in Namibian curriculum implementation. In addition, the potential value and the significance of my study was explained in relation to the indigenous technology of oil extraction with a view to making science relevant to learners as well as cultural revitalisation. The theoretical framework informing my study was briefly discussed. Lastly, the research goal and research questions, key concepts, and thesis outline were provided.

Chapter Two:

In this chapter, I presented literature relevant to the study to illuminate what has been researched already. The literature shed some light on the concept of enzymes, curriculum requirement and the integration of indigenous knowledge (IK) in teaching science. In addition literature on conceptual, theoretical and analytical framework that underpinned this study were also discussed in this chapter.

Chapter Three:

This chapter provides an overview of the research methodology used in this study. Firstly, it presents the research paradigm and the research design. Within the research design, a case study approach, research goals and research questions are presented. Secondly, the research sites, data gathering methods and the rationale behind their use is explained. Lastly, data analysis, data management, validity, trustworthiness, ethical consideration and positionality are presented.

Chapter Four:

In this chapter, I presented data, analysis and discussion from the focus group interview and participatory observations. The analysed data were about how grade 10 learners interact and participate and learn (or not) during presentation on the indigenous technology of oil extraction by the expert community members are discussed in this chapter.

Chapter Five:

Data presentation, analysis and discussion about Grade 10 learners' conception, dispositions shift (or not) as a result of the presentations on the indigenous technology of extraction oil by the expert community members are discussed.

Chapter Six:

This chapter summarises the findings of the study and this is done in relation to my research questions. It also presents some recommendations and limitations of the study. Areas for further research are discussed in this chapter, and it also provides a summary of my reflections. This chapter ends with some conclusions.

1.12 Chapter Summary

This chapter set the stage for introducing the reader to the study. Literature from various studies together with the curriculum, were discussed, which provided insight into the need and importance of carrying out this study. The statement of the problem and rationale of my study were discussed with relevant literature to this study. Additionally, methodology and data analysis were also highlighted. Lastly, the research goal and research question for this study

were also discussed in this chapter. In the next chapter, I discussed relevant literature in this study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The main goal of this study was to explore how the mobilisation of the indigenous technology of oil extraction (*okuyenga*/! *khamtui oli*-⁶) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of enzymes. It was triggered and motivated by the need to make science relevant and accessible to learners as well as cultural revitalisation in a multicultural classroom.

In this chapter, I thus discuss literature relevant to my study, namely, the topic of enzymes in the Grade 10 Biology syllabus, what indigenous knowledge is, indigenous knowledge embedded on the indigenous technology of oil extraction, literature around benefits and challenges of integration of indigenous knowledge, use of language, and lastly, I discuss the literature around teaching in a multicultural classroom.

2.2 Teaching the Concept of Enzymes

The concept of enzymes is defined in various ways by different authors. For example, Thomassen, Larsen, Mikkelsen, and Meyer (2011) defined enzymes as proteins catalysts that increase the rate of specific reactions by converting substrates into products. On the other hand, Ramirez-Paz, Ortiz-Andrade, Griebenow, and Diaz-Vazques (2017) defined an enzyme as a protein and sometimes ribonucleic acid (RNA) that catalyses biological reactions and as a result accelerates chemical reactions occurring in living systems. Moreover, the topic of biological molecules where enzymes are discussed falls under the unit of chemical digestion. Although the topic deals with chemical reactions in the formation of biological molecules, it is imperative that Grade 10 learners understand the role of enzymes in the formation of molecules. This

⁶*Okuyenga*/! *khamtui oli*-/ is an indigenous practice of extracting oil in Aawambo and Damara cultures, respectively.

would make it easier for learners to understand how enzymes lower the activation energy during chemical reactions (catalyst).

Several research studies carried out on the conceptions of the topic of chemical reactions found that rates of chemical reactions is one of the most difficult topics to teach in chemistry. For example, Yalcinkaya, Tastan-Kirik, Boys, and Yildiran (2012) concluded that it is one of the difficult topics to teach both at secondary and university levels. Hence, their study recommends case-based learning (CBL) which is a method of teaching learners based on their everyday life scenarios. Yalcinkaya et al. (2012) suggested that “since cases were generally based on the analogies associated with real-life events, this would help to link students’ prior knowledge with new information” (p. 166). In a study conducted by Nikodemus (2017) in Namibia exploring how physical science learners make sense of the concept of rates of reactions, the findings revealed that learners make better sense of science concepts through the integration of everyday experience or indigenous practices.

Moreover, the concept of enzymes has been investigated before. Some studies were conducted at universities (House, Meades, & Linenberger, 2016). One of these studies by Orgill, Bussey, and Bodner (2015) indicated that the comparison of a hand glove accommodating a finger was used to resemble enzymes and substrates. Although this seemed to contribute to learners’ understanding of the concept of enzymes, Tibell and Rundgie (2010) suggested that it makes learners’ understanding cumbersome, because the concept of enzymes is abstract and unobservable. Hence, the focus of this study was to use indigenous knowledge to mediate learning of enzymes.

Other scholars such as Nakale (2012) and Shinana (2019) researched the topic of enzymes at secondary schools. Nakale’s (2012) study focused on how teachers scaffold learners to mediate biological concepts when using English. Nakale found that teachers made use of prior knowledge and storytelling as analogies to teach the concept of enzymes. Based on Nakale’s study, the use of prior knowledge and storytelling afforded the learners an opportunity to learn in relation to home experiences (Nakale, 2012). This way of teaching was espoused by Abah, Mashebe, and Denunga (2015), making the subject matter and knowledge relevant to learners rather than learners absorbing ideas spoken by the teacher. Besides that, Nakale’s findings were that, although learners’ prior knowledge was considered and observed in lessons, visualisation in all these lessons was limited as was the use of hands-on practical activities (Nakale, 2012).

Similarly, Shinana (2019) carried out a study using a scientific inquiry approach as a pedagogy to mediate learning of enzymes. Some findings from Shinana's study also indicate that poor subject matter knowledge (Shulman, 1987) may influence how the concept of enzymes is presented to learners and that making of *Oshikundu* as a practical investigation was appropriate to support teachers to acquire knowledge on the concept of enzymes. Nakale's and Shinana's studies revealed that the concept of enzymes is quite challenging to teach as attested to by Tibell and Rundgre (2010). These scholars further suggested the use of other teaching pedagogies to teach the concept of enzymes. The gap in both Shinana's and Nakale's studies is that both studies only focus on teachers and not on learners. Additionally, another gap in Shinana's study is that it was done with participants in a monoculture set up. Thus, for the above mentioned reasons, the current study made use of the indigenous practice of oil extraction and was conducted in collaboration with the expert community members to help mediate the concept of enzymes in a multicultural classroom.

The Grade 10 Biology discipline introduces the topic of enzymes. In Grade 8, this topic is embedded in the topic of chemical digestion but is not covered in the Grade 9 Life Science syllabus. This creates a knowledge gap between the two grades making it difficult to conceptualise the concept of enzymes in Grade 10 Biology lessons. For learners to understand the role of enzymes, they first need to know what an enzyme is and what its functions are. Yet, while the learning of enzymes is important in Grade 10 Biology classrooms, it seems the objective which requires teaching of enzymes is presented implicitly or is silent in the syllabus, for example, "explain enzymes' action with reference to the active site, enzyme-substrate complex, substrate and product" (Namibia. MEAC, 2017, p. 13). In my view, for this learning objective to be taught and learnt well, it should be considered and informed by learners' previous knowledge on enzymes. That is, the beginning of each stage of a learning process is the learner's existing knowledge, skills, interests, and understanding, derived from previous experience in and out of the school environment (Kuhlane, 2011). It is recognised, therefore, that learners' previous experiences from home or community could potentially constitute their prior knowledge.

2.3 Prior Knowledge

Prior knowledge could be defined as learners' home and everyday experiences which learners bring from their homes or community to school. To help learners make the most of a new

experience, teachers need to understand how prior knowledge affects learning (Kuhlane, 2011; Roschelle, 1995). In support of the use of prior knowledge, Kuhlane (2011) and Roschelle (1995) argued that new knowledge begins with the selection of ideas from everyday experiences. However, Roschelle reiterated that the new knowledge does not replace prior knowledge, instead it re-uses it, resulting in prior knowledge being refined. This study further postulates that learning starts firstly from prior knowledge, and only later from presented materials.

Concurring, Mavuru and Ramnarian (2017) accentuated that meaningful teaching recognises the role of learners' prior knowledge. These scholars further elaborate that learners' experiences from home are made up of socio-cultural practices and their everyday experiences and such experiences tend to influence what is learned at school and vice versa (Mavuru & Ramnarian, 2017). In the context of my study, learners' prior knowledge refers to traditional knowledge which learners bring from home or the community.

However, Tylor (1999) cautioned that not all everyday knowledge provides suitable entry points in the classroom. He further asserts that if prior knowledge is not properly enacted, it might create misunderstandings rather than making learners' everyday knowledge relevant to the learnt knowledge. In light of this, it should be noted that prior knowledge serves as a foundation for acquisition of new knowledge.

2.4 What is Indigenous Knowledge?

According to Mosimege and Onwu (2004), indigenous knowledge (IK) is an all-inclusive knowledge that covers technologies and practices that have been and are still used by indigenous and local people for their existence, survival, and environmental adaptations. Agreeing, Odora-Hoppers (2005) defined IK as "knowledge that is characterised by its embedded-ness in the cultural web and history of people including civilisation and forms the backbone of social, economic, scientific and technological identity of such people" (p. 74). In concurrence, Ogunniyi and Hewson (2008) view IK in the African context, as the knowledge that existed before the colonial masters settled in Africa. It should be acknowledged, however, that the Western settlers brought their own knowledge which possibly could be described as 'indigenous' as well.

Therefore, I found it befitting to say that IK existed and still prevails in both the Western and African world and that different IK may still exist among varied African cultures because of tribal and ethnic diversity. For local people, IK forms part of their everyday ways of reasoning. Henceforth, IK is embedded within social interactions (Vygotsky, 1978), education, language, system of classification, resources, and use of practice (Dziva, Mpofu, & Kasure, 2011).

Current literature recognise IK knowledge as indigenous technology (Snively & Corsiglia, (2001); traditional ecological knowledge (Turner, Ignace, & Ignace, 2000); and indigenous/native science (Aikenhead, 2006). Sharing similar sentiments, Garcia et al. (2006) defined IK “as people cognitive and wise legacy as a result of interaction with nature and common territory” (p. 62). This legacy of knowledge is passed on from one generation to another (Kibirige & Van Rooyen, 2006; Simpson, 2014) and the practice of IK is unique to a particular culture (Kibirige & Van Rooyen, 2006; Mukwambo et al., 2014).

Nyika (2017) elaborated that IK includes cultural songs, storytelling, rituals, beliefs, community law, local language, and much more (Afonso-Nhalevilo, 2013; Iseke, 2013; Smith, 2012; Simpson, 2014; Tzou et al., 2019). To Nyika, the community makes use of this knowledge each and every day to make decisions about their livelihood. This means that IK is lived and experienced through interactions as a way of living. In addition, IK is all-inclusive and based on collective knowledge rather than expectations and investigations (Shizha, 2007). Moreover, IK manifests through the community elders through, among other things, language, beliefs, values, customs, artefacts, and rituals (Klein, 2011; Simpson, 2014). Simpson (2014) reminisces and reminds us of:

... the Elders who resisted colonial educational practices and live out their commitment to teaching others, the vast majority of the time in the absence of compensation or deep reciprocity, and outside of the provincial education and post-secondary education system. Not one time has an Elder ever told me to go to school to learn Indigenous Knowledge. Not one time has an Elder told me to go and get a degree so that I can pass Indigenous Knowledge down to my children. Yet, we place tremendous pressure on our youth to gain western academic credentials. (Simpson, 2014, p. 14)

Despite many scholars' contributions to the definition of IK, Battiste and Henderson (2000) suggested that defining IK is inappropriate because such efforts are about comparing knowledge of which there are no valid existing methods to make such comparisons. Therefore, instead of defining IK, we should rather try to understand and be open to accepting different

realities. This means that there are different world views with different realities. Walker (2004) suggests that the term ‘world’ in worldview tends to describe the Eurocentric context and ignores the indigenous people’s worldviews. It is, therefore, the marginalisation of IK that continues to be used as a “major tool of colonization” (Walker, 2004, p. 531).

In light of this form of oppression and suppression, Kirmayer, Brass, and Tait (2000) and Hart (2003) suggested that there is need to rethink applicable research interventions which recognise the view of indigenous people. These research interventions must consider the perspective of local community’s values and aspirations, recognising that indigenous culture matters to the indigenous people (Hart, 2010). Admittedly, Higgs (2008) insisted that all critical and transformative educators in Africa must embrace and integrate indigenous African world views. Hence, it is in response to this state of affairs that this study collaborated with community elders as MKOs (Vygotsky, 1978). It was hoped that such collaboration would lead me to take advantage of a missed opportunity to document IK for future utilisation and reference. It was also hoped that the integration of IK might change the narrative of viewing an African child-learner not as a “bundle of Pavlovian reflexes, but as human being who is culturally and cosmologically located in authentic valued systems” (Higgs, 2010, p. 447). Moreover, Shinana, Ngcoza and Mavhunga (2021) also suggested that the intergration of indigenous technology can be an altenative way of mediating learning of scientific skills through practical activities. It is against this backdrop that this study focused on integrating the indigenous practice of oil extraction to mediate learning of enzymes.

2.5 The Indigenous Technology of Extraction of Marula Oil

Namibia is a country with vast cultural diversity. Different ethnic groups have different traditional practices. For example, one of the common practices of the Aawambo people is the extraction of marula oil from marula nuts called *okuyenga*. The traditional art of oil extraction is orally transmitted from generation to generation (Cheikhyyoussef & Embashu, 2013; Kibirige & Van Rooyen, 2006; Simpson, 2014). In light of this, it was hoped in this study that the current learners in my school would be familiar with this traditional practice.

Cheikhyyoussef and Embashu (2013), however, cautioned that this knowledge is a valuable local people’s capital and if not preserved or documented, it may be lost forever. Thus, integrating it with WS as a teaching pedagogy might be a way of revitalising and retaining it

in our society. Moreover, using this knowledge to mediate science concepts might present logical and meaningful science lessons, which will contribute to improving learners' understanding as espoused by Abah et al. (2015). This is consistent with the notion of cultural border crossing from home or community to school science (Aikenhead & Jegede, 1999). In this regard, the science embedded in the cultural practice of *okuyenga* could be utilised in teaching of science to mediate learning of science concepts beyond rote learning.

There is a body literature on marula's oil extraction *okuyenga* (Cheikhoussef, 2018; Cheikhoussef, Kanawa- Schulz, & Böck, 2015). For instance, Cheikhoussef's (2018) study focused on extraction methods of indigenous seed oils which involve enzymatic hydrolysis of marula oil. She describes the marula (*Scelerocarya birrea*) as belonging to Anacardiaceae the family of mango tree. The marula tree is locally known as *Omungongo* in Oshiwambo and is of great *social, cultural* and *economic* importance to rural communities of Southern Africa and in particular to Aawambo communities in the northern part of Namibia.



Figure 2.1: Marula tree



Figure 2.2: Leaves and fruits

The fruits from the Marula tree start to appear between January and May and become yellow when ripe. The fruits are harvested on the ground from February to June and the fruit flesh is removed to make a certain beverage called *omagongo*. The intact seeds of kernels are left to dry in the sun for oil extraction at a later stage. The process of drying is known as osmosis (Nangolo, 2018). Based on *Travel News Namibia* (2012), the intact seed kernels are left to dry and are stored for a year before nuts containing oil are removed from the kernel and this process is called decortification.

2.5.1 Decortification prior to oil extraction (*okuyenga*)

An axe and wooden stick is used to crack open the marula kernel and then a sharp needle-like object is used to remove the nut (*omahuku*) from the kernel. A wooden object with a hole in the middle is used for pounding of nuts. Based on Cheikhyyoussef's (2018) study, the extracted nuts are poured into the hole in the middle of the wooden object known as the mortar and pounded and crushed with a heavy wooden stick called a pestle. During the process of pounding to increase the surface area, a small amount of lukewarm water is added and marula oil (*odjove*) is then squeezed out of the crushed nuts. The seed cake is skilfully removed and the marula oil is scooped from the mortar into a bowl. Cheikhyyoussef and Embashu's (2013) study whose focus was on the significance of indigenous or traditional fruits revealed that marula oil is very nutritious and has antioxidant properties. It can also be added to food, cosmetics, and used for curing ear infections.



Figure 2.3: Shows marula kernel decortified

These studies provide literature on the concept of oil extraction and marula oil. This information plays a crucial role in this study, as it helped to find scientific reasons behind the traditional practice of oil extraction which could serve as learners' prior knowledge. Moreover, the indigenous technology of oil extraction also has the potential to afford learners the experience of hands-on practical activities, hence being able to visualise the science concepts embedded in it.

2.5.2 Hands-on practical activities and visualisation

Practical work in any science teaching and learning is an activity in which learners work individually or in groups and handle or observe the object they are studying (Millar, 2010). In light of this, in Namibia, the Biology curriculum recommends hands-on practical activities in

each topic whereby learners can observe and develop their scientific skills (Nhase, 2019; Ramnarain, 2021). Millar (2010) argued that practical activities of observing and intervening are important for promoting understanding. Asheela et al. (2021) also echoed the same sentiment that hands-on practical activities help learners' conceptual understanding of science concepts as they are encouraged to predict, explain, explore, observe, and explain when carrying out practical activities. Such assertions are supported by Woodley (2009) and Asheela et al. (2021) who postulated that the purpose of quality hands-on practical activities is to help learners develop their understanding of scientific concepts and make sense of them. This is in line with Suarez, Specht, Prinsen, Kalz, and Tenier (2018) who asserted that practical presentations stimulate learners' curiosity to learn science.

Although hands-on practical activities hold much potential, some scholars question their effectiveness in the science classroom and in learning. Hodson (1990), for instance, contended that practical work is misunderstood, confused, and does not produce desired outcomes in learners. Responding to this, Asheela et al. (2021) cautioned that hands-on practical activities should not only be about learners using their hands to manipulate the materials but instead learners should use their minds, record scientific concepts which they can use to develop mind maps, and further develop concept maps.

Asheela (2017) asserted that poor use of hands-on practical activities might be as a result of unavailability of resources and laboratory apparatus. To address this problem, Asheela et al. (2021) advocate for teachers to make use of easily accessible materials when doing hands-on practical activities. These scholars believe that the use of easily accessible materials has a potential to stimulate social interactions amongst learners. For instance, Nikodemus's (2017) study conducted in Namibia revealed that hands-on practical activities contribute to sense making of science concepts. Nikodemus (2017) recommended that relevant indigenous knowledge and practices should be incorporated during hands-on practical activities to help learners to cross smoothly between cultural science and school science (Aikenhead & Jegede, 1999).

Similarly, Shinana's (2019) study also revealed that hands-on practical activities are useful in the teaching of science and thus she recommends that teachers should be involved in authentic practical investigations by making use of local and low cost resources such as *oshikundu* to mediate learning. It should be recognised also that hands-on practical activities are a form of

visual presentation. As a result, the presentations by community members in this study have great potential to mediate learning of science concepts through visual representations.

Arcavi (2003) asserted that visual representations are tools of communication which are vital to our biological and socio-cultural existence. Similarly, Lioyd (2015) defined visualisation as a “a language of image” (p. 5). The images are shapes, colour, forms, lines, patterns, objects, people, and numbers (ibid.). To Rundgren and Yao (2014), visualisation in science education is a cognitive domain that has the role of making invisible ideas visible and more importantly illustrating abstract concepts and making them explicit. For example, Eilks, Witteck, and Pietzner (2012) investigated the role of visualisation when learning about sub-microscopic explanations in chemistry education. The investigation revealed that visual representations help learners to understand and support learning by evoking effective reactions.

In the context of this study, the practical presentations by community members are viewed as visual representations that could mediate learning of the concept of enzymes to Grade 10 Biology classes. This coheres with Muvhunga and Rollnick (2013) who stated that representations play a significant role as they serve as teaching aids which could assist learners to make sense of what is being taught. This suggests that visual representations play an important role in how learners make sense of science concepts.

2.6 Advantages of Integrating Indigenous Knowledge

Some scholars such as Erinosho (2013), Le Grange (2007), Nyika (2017), and Shizha (2007) are in support of integration of IK in the teaching of science. All these scholars agree that IK benefits learners in learning science. Furthermore, it may increase learners’ participation (Sedlacek & Sedova, 2017) and it allows cultural border crossing from home or community to school science (Aikenhead & Jegede, 1999). Arguably, Abah et al. (2015) stated that under proper integration of IK science, teachers will be able to present logical and meaningful science lessons which will contribute to improving learners’ understanding beyond rote learning of critical concepts.

Integration of indigenous knowledge into science lessons is seen as a platform to afford discussions on interaction between Western and indigenous worldviews (Mushanyika & Ogunniyi, 2011). Kibirige and van Rooyen (2006) posited that science teaching becomes effective when IK is considered as prior knowledge and as a starting point of learning. These

authors further indicate that IK promotes communication skills. Thus, it is a guiding tool of facilitating the bridge of what learners already know which makes teaching effective (Nikodemus, 2017).

Similarly, Ogunniyi and Ogawa (2008) attested that IK builds a strong link to everyday experience, leading to learners actively participating in lessons. Sharing these sentiments is Brayboy and Castagno (2008) who posited that integration of IK does not only bridge science to IK but provokes learners' thinking, which leads to critical thinking skills (Magwentshu, 2020). To Shizha (2007), learners tend to engage more when they learn what they relate to. Moreover, Le Grange (2007) and Mukwambo et al. (2014) advocated for integration of IK arguing that it paves the way for authentic Africanisation in teaching and learning. Cementing this, Le Grange (2007) and Mukwambo et al. (2014) proffered that IK integration could make remarkable strides in contributing to the cultural revaluing of IK. Similarly, Seehawer (2021) also averred that the integration of IK should be viewed as a strategic mechanism of finding solutions to today's educational realities.

Furthermore, the findings of a study carried out by Erinosho (2013) were related to difficulty in science because of irrelevancy in understanding science subjects, resulting in poor performance. The research also found that the fact that learners could not relate school science to their everyday life worlds was because their cultural heritage was not considered. Similarly, a senior professor in Mkhanda engaged a community member in a lecture by inviting her to give a demonstration on the making of *umqombothi* (sorghum beer). The demonstration was done to expose the students to IK which can be incorporated in science classrooms. This is an indication that educators have started to pay attention to IK rather than focusing only on Western based science (Cocks, Alexander, & Dold, 2012).

According to Shizha (2007), IK was misunderstood and misinterpreted as unscientific by the colonial masters. In other words, it was not accepted that IK represents '*real science*' in the Western world. This is regarded as ignorance of other types of knowledge (Shizha, 2007). On the other hand, many schools are integrating activities which include community elders so as to engage or cultivate youths' observational skills in order to support sense making and collective continuance of cultural practices (Klein, 2011). The collective continuance concept is similar to the notion of Ubuntu/Unhu. The notion of Ubuntu is a "spirit which sees human needs, interests and dignity as fundamental importance and concern" (Higgs, 2008, p. 453).

Thus Ubuntu translates to “I am because of others” which advocates for collective efforts to serve humanity. I, therefore, believe that integration of IK will liberate learners and teachers to learn and teach within their cultural contexts (Mavuru & Ramnarain, 2017). Mhakure and Otulaja (2017) referred to this as culturally responsive pedagogies.

The role of integrating indigenous knowledge in the science classroom can be well explained by adapting Chikamori, Tanimura, and Ueno’s (2019) Transformation Model of Education for Sustainable Development (TMESD) framework. To Chikamori et al. (2019), the TMESD framework comprises of three learning processes: ‘knowing the present’, ‘past-present relationship’ (focusing on dependence of the present on the past), and the ‘future-present’. These scholars refer to the process of studying the past-present relationship as *retroduction* and future present relationship as *retrodiction* (see Figure 2.4 below). In the context of my study, the TMESD diagram below illustrates how learning of enzymes through the integration of IK can take place in three sub-processes.

The first sub-process of ‘knowing the present’ illustrates that because it is known in the past that the topic of enzymes is a challenge to learners, at present it is known that WS poses a considerable challenge to learners. Hence, the curriculum can be transformed by sharing cultural knowledge in the science classroom to mediate the concept of enzymes in order to make sense of the aforementioned. The integration of IK plays a role in the ‘retroductive learning’ process which is the second process of TMESD.

During this process, for instance, the community members share the cultural heritage on oil extraction to make learning of enzymes accessible to learners. When the community members share their cultural knowledge on oil extraction, learners will link the concept to their prior knowledge (linking the past) in order to understand the concept of enzymes (thinking of the present). This is due to the fact that Chikamori et al. (2019) averred that learners deliberately consider the present, learnt from the first learning process, in connection with what they know from the past. When learners comprehend the concept of enzymes from ‘*retroductive learning*’, they will go through a *retrodictive* learning process. Learners will likely understand most of what is related to enzymes and will be encouraged to make use of their IK to help them understand and make sense of enzymes in the future. Similar to Hashondili’s (2020) study, this process is thus summarised below in the Figure 2.4.

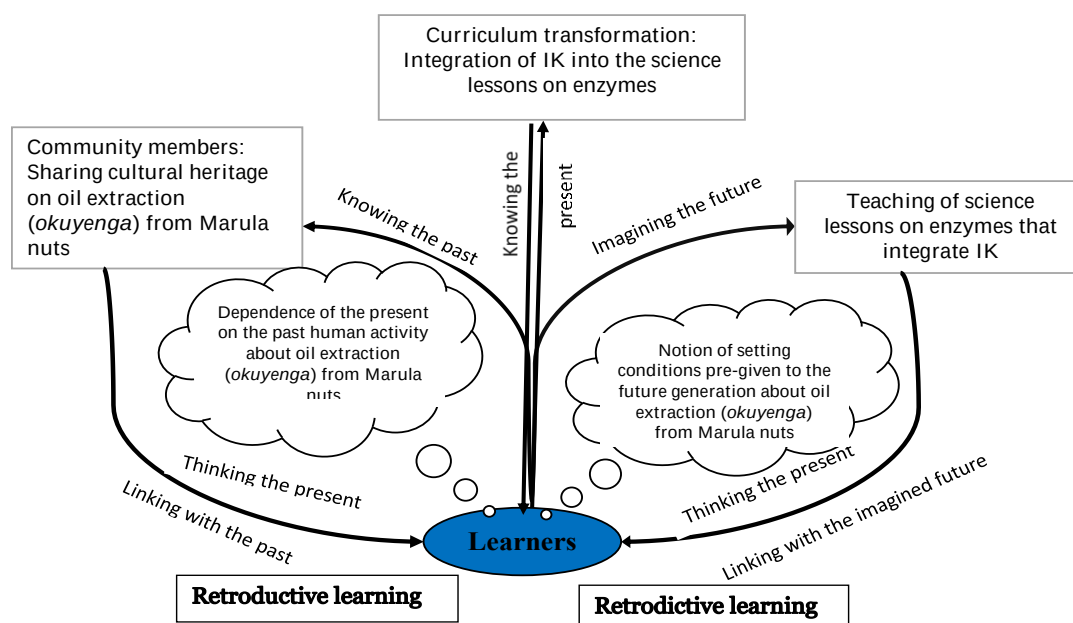


Figure 2.4: Shows the role of integrating indigenous knowledge in the science classroom (adapted from Chikamori et al., 2019, p. 9)

Furthermore, Jegede's (1999) theory of *collateral learning* posits that duality of thought is created in the memory of schemata of indigenous learners when they learn WS. This suggests that when learners are challenged by the two worldviews of science (Ogunniyi, 2007a), learning occurs in many forms. Jegede identifies four types of learning: parallel, simultaneous, dependent, and secured. He posits that collateral learning is not disparate but rather is a continuous way of learning.

On the contrary, Ogunniyi (2007a) critique's Jegede's theories, arguing that they tend to dichotomise knowledge and proposed the Contiguity Argumentative Theory (CAT). CAT is a dialogical framework to solve conflicts emerging from competing and contradictory ideas and thought systems in the context where IK and WS need to co-exist (Govender, 2014; Ogunniyi, 2007a; Ogunniyi & Hewson, 2008). According to Ogunniyi (2007a), learners should be able to negotiate the meaning across the two distinct thought systems and integrate them. Ogunniyi's idea of distinct knowledge systems is supported by Mpofu (2016) who posited that although IK and WS are different bodies of science, they can complement one another for a common goal. Simply put, both IK and WS contribute equally to ways of knowing.

Although learners bring different ranges of ideas and experiences from their cultural backgrounds, some teachers are not keen to tap into their IK because they believe that WS is

more genuine than indigenous science. Snively and Corsiglia (2008) pointed out that there are many issues that make it difficult to integrate indigenous science into a Western scientific framework. One of the main reasons is the fact that scientists and science educators continue to view the contribution of IK as significant, but not worthy to be integrated with ‘real science’. Yet, IK forms a great part of learners’ cultural heritage and hence educators should make efforts to harmonise the use of both WS and IK in the teaching and learning of science in their classrooms. Importantly, we are not suggesting that IK is the only way of knowing, rather we are suggesting that there are many ways of knowing (Hart, 2010).

2.7 Challenges of Integrating Indigenous Knowledge in Science Classrooms

As much as scholars advocate for the integration of IK in the science curriculum, some scholars such as Cobern and Loving (2001) and Horsthemke and Schafer (2007) criticised the integration of IK in science lessons. These scholars argue that IK and Westernised knowledge should be treated separately. For instance, Horsthemke and Schafer (2007) rejected the ownership of knowledge as IK as this cultural ownership is misleading and merely reinforces further marginalisation of other knowledge systems. They further posit that we should not look at the integration of IK as the only valid knowledge system and shut out modern science (Cobern & Loving, 2001). In other words, devaluing WS and favouring indigenous knowledge does not solve the main problem of making science relevant to an African child. Horsthemke and Schafer (2007) further stated that integrating IK carries some burdens as it is a challenge to locate and identify the scientific skills embedded in the cultural practices and that some skills are not culturally bound.

In contrast to Cobern and Loving (2001) and Horsthemke and Schafer (2007), Hodson (2009) is for the plurality of knowledges. He argued that choosing to exclude some forms of knowledge from the curriculum will create barriers and deny access to science. In this regard, he is quick to point out that although there are valid and sound pedagogical arguments for the inclusion of IK, there is a need to be cautious not to include “anything and everything in the curriculum under the banner of science” (p. 118).

Similarly, Klein (2011) cautioned that “IK should not be presented as the answer to all problems and short comings in Africa” (p. 82). In fact, romanticising IK (Afonso-Nhelevilo, 2013; Keane, Khuphe, & Muza, 2016; Le Grange, 2007; Mhakure & Otulaja, 2017; Ogunniyi,

2007a) might lead to another form of discriminatory system which could derail the pace of development and sustainability. To Le Grange (2007), integrating IK may cause conflicts between the scientific language and everyday language. Simply put, some words in English do not have the same meaning in the mother tongue hence the confusion and cognitive dissonance.

2.8 Teaching in Multicultural Classrooms

Tonbuloglu et al. (2016) defined multicultural education as a comprehensive school reform process that aims at providing standard education for all learners. That is, all learners are afforded an equal opportunity to access and succeed in school irrespective of their different socio-cultural and socio-economic backgrounds. Multicultural education rejects racism and all types of segregation in schools and accepts diversity (Okoye-Johnson, 2011). Scholars such as Tonbuloglu et al. (2016) and Mhakure and Otulaja (2017) suggested that for effective delivering of multicultural education, teachers need to be culturally sensitive in their conduct and ensure equal opportunities to all the learners.

Cultural sensitivity means acknowledging learners' diverse cultural heritage from home (Banks, 1995), knowing and respecting learners' cultures and analysing how their cultures influence their conduct in the classroom. For instance, most learners often hold back from asking questions and engaging in science lessons as they perceive this to be disrespectful to their teachers (Mavuru & Ramnarain, 2017). This could be attributed to the cultural barriers which dictate that asking an adult is a sign of disrespect. Hence, I encouraged my learners to talk and engage more to overcome such cultural barriers in this study.

Furthermore, teachers could become more culturally sensitive if they are well oriented about multicultural education when they are trained as teachers. It is against this backdrop that the University of Cyril and Methodius in Skopje, Mercerdonia held a conference to prepare future education professionals for work in a multicultural environment (Atanasoska, Cvetkova, & Trajkovska, 2015). Some of the suggestions from this conference were that teachers could implement multicultural education in their schools by integrating diverse reading lists that demonstrate the human experience which promotes cultural diversity, and encouraging community participation and social activism (Atanasoska et al., 2015). These suggestions relate well to this study on the understanding of the conceptions and dispositions of learners when IK is integrated in a multicultural context.

2.9 Role of Home Language in Science Classrooms

Language is by far the most important element of culture in the survival of indigenous people (Snively & Williams, 2008). It is through language that the tradition and moral values of the indigenous people are communicated. As highlighted by Gibbons (2003), language plays a very important role in communication and development of scientific ideas in science. Consequently, Ntsaone (2005) called for the promotion and protection of indigenous African languages. Although WS gives the impression that science is in the culture of the dominant group, the reality is that every culture has its own perspective on science based on their own cultural context (Shizha, 2007). Simply put, culture influences a particular kind of science. It is therefore this lack indigenous languages (home languages) which makes it difficult for learners to understand and make sense of science.

Mavuru and Ramnarian (2019) alluded that it is through language that learners can construct knowledge and make sense of science. The rationale is that using learners' home language when teaching science tends to empower learners as they are able to express their thoughts fluently and eloquently (Nhase, 2019; Nieto, 2004). In this way the language becomes a cultural resource which can make science relevant. It must therefore be recognised that the use of indigenous languages mediates learning of science. In spite of the benefits of the use of indigenous languages, Lo, Lin, and Cheung (2018) suggested that the strategy of using mother tongue to scaffold learners during the integration of IK in science, might be a challenge if teachers lack pedagogical tools to navigate around making scientific concepts understandable. In this study, the Khoekhoegowab language teacher and I had to translate from the expert community members' languages into English by means of translanguaging.

The literature in the field of translanguaging is relatively new, but studies into its related themes of code switching, bilingualism, and multilingualism are well documented (Baker, 2006; Blackledge & Creese, 2010; Garcia, 2009; Martin, 2005; Probyn, 2009; Williams, 1996). Originally, the term 'translanguaging' derives from Collin Bakers' translation of the Welsh term *trawsieithu*, which refers to the pedagogical practice of students reading in one language and writing in another. Similarly, Garcia et al. (2006) defined translanguaging as the use of more than one language in a classroom. Garcia (2009) further described translanguaging as the "language practices of bilinguals from the perspective of the users themselves (p. 45). Hence, translanguaging serves as a foundation that lends a theoretical strength to a multilingual

pedagogical stance that accepts all resourceful linguistic inventions of teachers and students (Wang, 2019). It is a language ideology that respects multilingual and diverse social conditions and takes multilingual practices as the norm, hence, aligns to the Namibian classroom realities. Although there are many descriptions and definitions of translanguaging, in this study translanguaging refers to the use of more than one language in a single speech when translating from English to Oshiwambo/Khoekhoegowab during the presentations by the expert community members.

2.10 Concepts Related to Learning

Concepts related to learning have to do with assumptions, expectations, and beliefs that together provide and support understanding (Maxwell, 2013). In this study, my concepts related to learning were: conceptions, dispositions, and sense making. I now discuss each of these below.

2.10.1 Conceptions

Atallah et al. (2010) posited that conceptions are the views that learners hold towards the subject and what they believe makes sense and is required of them to learn. Concurring, Chan (2011) referred to conceptions as understanding of knowledge and changes in personal opinions through learning. Simply put, the degree of learners' interest and effort invested in the subject depends on the perceptions of learners towards science. In this regard, Perkin (2008) and Richard (2011) posited that there are two types of conceptional approaches.

The first approach in which learners construct meaning based on ideas and evidence is called the deep approach and the second one is where learners reproduce learning materials for them to be assessed (Richardson, 2011). In the context of this study, conception is defined as learners' opinions, beliefs, and ideas about the indigenous technology of oil extraction and how it is relevant to science (Mateus & Ngcoza, 2019). Thus, the intention was to expose the learners to a practical presentation on oil extraction and explore whether or not such exposure had any influence on their conceptions of science. However, it should be recognised that conceptions are linked to dispositions.

2.10.2 Dispositions

To Graven (2012), disposition is a habitual predisposition to act in particular way when an opportunity presents itself. Similarly, Atallah et al. (2010) highlighted that dispositions are beliefs that are exhibited by frequent and conscious behaviours towards learning. Crik and Goldspink (2014) suggested that dispositions can be maintained in and through learners' engagement with their environment. In the context of this study, the learners' environment is the classroom context in the school community.

Agreeing to this Agunbiade, Ngcoza, Jawahar, and Sewry (2017) averred that learners could develop positive dispositions towards science in a science related environment and demonstrate their dispositions during activities as well as other science related activities which is in line with my study. This scholar avers that dispositions and attitudes can be used interchangeably as they both reveal one's mentality in a given context. In my study, I have opted to use disposition throughout my thesis. I also adapted Atallah et al.'s (2010) criteria to understand learners' conceptions and dispositions towards science. Thus, I was interested to see whether or not there was a shift in learners' dispositions regarding learning in the lesson in which traditional knowledge which formed part of their socio-cultural setting, was integrated (Mavuru & Ramnaian, 2020). It is recognised, however, that both conceptions and dispositions have an influence on sense making.

2.10.3 Sense making

Sense making refers to when learners are able to make sense of what they are taught. According to Ash (2004), reflective scientific sense making creates a platform for dialogue to take place while carrying out certain tasks. Ash's findings emphasised the importance of physical interaction with scientific phenomena. He advocates the view that physical activities (doing) and dialogic processes (talking) are both necessary to lead to increased learner understanding. Ash's research further maintains that it is significant to consider the ideas and ways of talking and knowing that children from diverse communities bring to science classrooms, between everyday and scientific ways of knowing and talking (Ash, 2004). This is done through interactions as suggested by Vygotsky (1978) when learners construct new knowledge and link it to their real world or lived experiences.

Moreover, Weick, Sutcliffe, and Obstfeld (2005) argued that sense making entails turning circumstances into situations that are understood clearly in words. Agreeing to this, Warren, Ballenger, Ogonowski, Roseberg, and Hudicott-Barnes (2001) posited that children's ways of knowing can take place effectively and efficiently if they are happening in their own language. Essentially, as espoused by Vygotsky (1978), language is a mediational cultural tool for sense making. Concurring, Nikodemus (2017) emphasised that sense making is when meaning materialises, which is a crucial part of language, talking, and communication. The practical demonstration of the traditional practice of oil extraction was presented in the local languages, as Msimanga and Lelliot (2014) and Mavuru and Ramnarian (2017) posited that home language helps learners to understand and make sense of scientific concepts. I now turn to discuss the theoretical and analytical frameworks which underpinned this study.

2.11 Theoretical and Analytical Frameworks

The theoretical framework is a significant component of any research study. According to Bertram and Christiansen (2020), a study is informed by a theory which affects how the data collected should be analysed. The theoretical framework for this study is drawn from Vygotsky's socio-cultural theory. However, I augmented the socio-cultural theory with Ogunniyi's (2007a) Contiguity Argumentative Theory (CAT), which I used as my analytical framework. I now discuss these below.

2.11.1 Theoretical framework: Vygotsky's socio-cultural theory

Vygotsky's (1978) socio-cultural theory is a learning theory that realises the link between social interactions and human development. To Vygotsky (1978), socio-cultural theory puts emphasis on the collaborative nature of learning through which reality is believed to be constructed through human activity. McRobbie and Tobin (1997) submitted that Vygotsky emphasises the concept of 'human activities' that take place in the cultural context and are mediated by language and other symbol systems. In other words, meaningful learning occurs during social interactions.

Furthermore, Vygotsky focused more on the social aspects of learners gaining information within the environment (Liu & Mathews, 2005). Moreover, learning requires that individual knowledge construction mostly occurs through social interactions to negotiate meaning of new experiences (Arends, 1997; Cobern, 1993; Palincsar, 1998). Vygotsky further maintained that

there are two levels of knowledge development, viz., the level of actual and the level of potential development. The level of actual is the level that learners have already reached when they are capable of solving problem themselves. On the other hand, potential development is where the problem solving is done under the guidance of the teacher or in collaboration with MKOs.

Thus, learners learn best when working together with others during joint collaborations (Goos, 2004). It is through such collaborative endeavours with a more skilled person (MKO) that learners learn and internalise new concepts, psychological tools, and skills.

The sociocultural theory informed this study in terms of learning by taking a look at how community members as MKOs, a teacher, and learners interacted and learnt in a socio-cultural set up. To Vygotsky (1978), learning is inherently social with high mental functions rooted in activities mediated by psychological tools, with materials from learners' cultures as tools. This suggests that all human thinking processes are interdependent with the social set up of a given society and its culture. Socio-cultural theory has many concepts. However, in this study I only used three concepts, namely, mediation of learning, social interaction, and the zone of proximal development (ZPD).

I used the three concepts as lenses to determine how learners learn through social interactions amongst themselves and with the expert community members and how learning prevailed during such a social cultural context (Mavuru & Ramnarain, 2017). I now discuss each of these concepts which formed my analytical framework.

Mediation of learning

Vygotsky (1978) explained mediation as a tool such as cultural artefacts used in cognitive change. Human activities, according to Vygotsky (1978), take place in cultural, social, institutional, and historical contexts and are mediated by language and other symbolic systems. Thus, language is an important characteristic and tool of any formal school learning system. In the context of my study, the expert community members are considered as more knowledgeable others (Vygotsky, 1978). Hence, teachers should carefully consider the language use through which they communicate ideas and concepts to learners during interactions.

Vygotsky's (1978) cognitive development is an indirect result of activity. This means that for cognitive development to occur, there must be interactions amongst or with learners using mediatory tools to facilitate learning. Kozulin (2003) classified mediatory tools into three categories: a) human mediator (the more knowledgeable other); b) psychological or symbolic mediator (the system and skills moulded by the more knowledgeable others with less knowledgeable during a social interaction); and c) the external mediator (the technical tools that are involved the process of social interaction).

Essentially, it was during the practical demonstration of *okuyenga* where mediation of learning took place. In this regard, the demonstrators (expert community members) as MKOs demonstrated and explained how to extract oil from marula nuts and melon seeds (a process known as *okuyenga* in Oshiwambo and *lhamtui oli-e* in Khoekhoegowab) to a less knowledgeable teacher and learners in the field of IK. That created an opportunity to use culture embedded in the knowledge from the demonstrations and relate it to science concepts. This is echoed by Snively and Corsiglia (2001), who asserted that science is embedded in our culture, hence it should be incorporated in the classroom like other sciences. Furthermore, the use of psychological tools such as Oshiwambo, Khoekhoegowab (indigenous languages), increased the level of participation (Naidoo, 2009; Sedlacek & Sedova, 2017).

The diagram below shows how cultural artefacts used by the expert community members mediated learning in order to achieve leaning objectives.

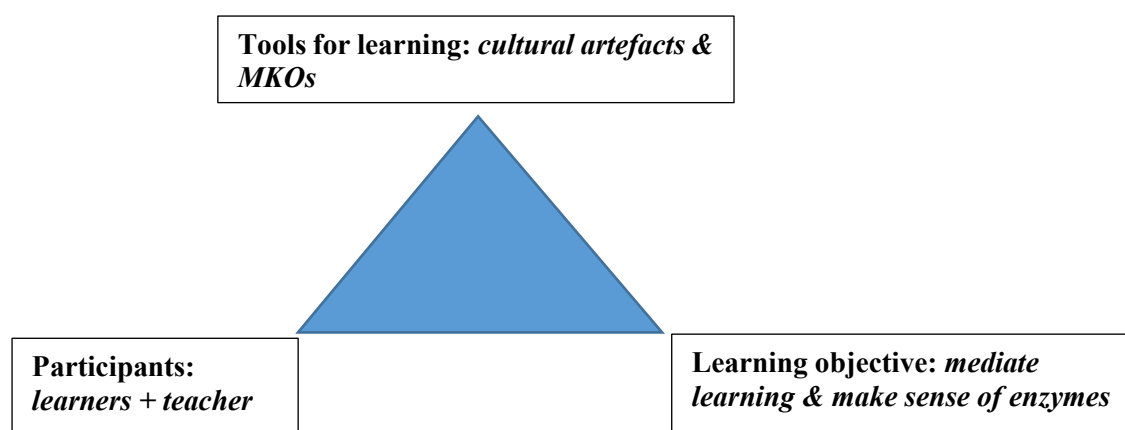


Figure 2.5: Shows mediation triad linking (adapted from Vygotsky, 1978, p. 54)

In this study, two expert community members demonstrated and presented extraction of oil from (marula nuts and melon seeds) in their mother tongue to mediate learning. In addition, the MKOs also used cultural artefacts to facilitate the demonstrations. Therefore, the use of mother tongue and other artefacts were used as mediatory artefacts (Lantolf & Thorne, 2006) and social interactions took place during mediation of learning.

Social interactions

To Vygotsky (1978), social interaction is the foundation of learning and development. It involves exchanging of ideas in a natural setting either with peers or more knowledgeable significant others (parents, teachers, or learners). He further explained that social interactions can be studied between groups of social groups, by interacting with other people and communicating shared expectations on different situations either within or outside the social setting. Building on Vygotsky's seminal work, Lave (1988) alluded that social interaction and collaboration are components of situated learning. Notably, learning takes place when people in a community interact and work together. This suggests that it is through collaborative activities with more knowledgeable persons that meaningful learning takes place. Similarly, McRobbie and Tobin (1997) asserted that "the perspective of learning environments that emerges from social constructivist semantics views classrooms as cultures and seeks to make sense of what is happening in terms of the actions of participants" (p. 206). It is through social interactions that learners navigate to make meaning and link what they know to what is new to them. In this study, learners, the community members and I interacted during the presentations by expert community members.

Furthermore, in the context of this study, a classroom is a social unit which contained learners, the teacher, and the community members who demonstrated oil extraction. My assumption was that when the community members who were from outside the science classroom setting (more knowledgeable others), explain and demonstrate how *okuyenga/ l'khamtui oli-e* is culturally carried out, they are likely to contribute to learning experiences amongst the learners and the teacher. Vygotsky (1978) believed that learners learn much better from their peers as they are free with one another and feel less challenged by their peers. For this reason, social interactions might contribute to an improvement of the zone of proximal development (ZPD) of the participants.

Zone of Proximal Development

Vygotsky (1978) defined the zone of proximal development (ZPD) as “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). That is, the ZPD is understood by Vygotsky as the current level of development of learners through mediating tools and capable adults or peer inputs. The idea is that after completing tasks jointly, the learner will likely be able to complete the task individually on their own the next time. That is, as the learner accomplishes the task, their ZPD or the gap between what they can do on their own and what they can only accomplish with assistance shrinks (Shabani, Katib, & Ebadi, 2010). Vygotsky (1978) presented the concept of ZPD to indicate the loopholes in traditional testing that only reflect the current level of learners’ achievement, rather than potential for future development. This means that the current level of learners’ development only reflects what they already know now and not what they are likely to achieve in future (Vygotsky, 1978).

Drawing on Vygotsky seminal work, Bruning, Shraw, Norby, and Ronning (2004) described the ZPD as a space between learners’ current level of capability and the level at which learners are assisted by the more knowledgeable person. Additionally, Stott (2016) asserted that there is no ZPD before learning activities take place. Therefore, she called ZPD the zone of proximal learning (ZPL) which is created during social interaction. Vygotsky (1978) also suggested that the magnitude of ZPD is dependent on the number of people in a given group. Simply put, the bigger the group, the higher the ZPD of each individual compared to smaller groups. Stott (2016) further argued that it is not only the learners who benefit in the zone of proximal development but all participants including adults. In this study, the expert community members might assist learners and the teacher to move into the most proximal level of development, as they consolidate the science concepts emerging from the demonstrations of oil extraction. Similarly, the expert community members might experience a shift in their ZPD as they learn that their expertise and traditional practice of oil extraction is recognised and has the potential to be integrated into science lessons.

The model (Figure 2.6) below is adapted from Shabani et al. (2010, p. 242) to show how ZPD is affected by influential factors.

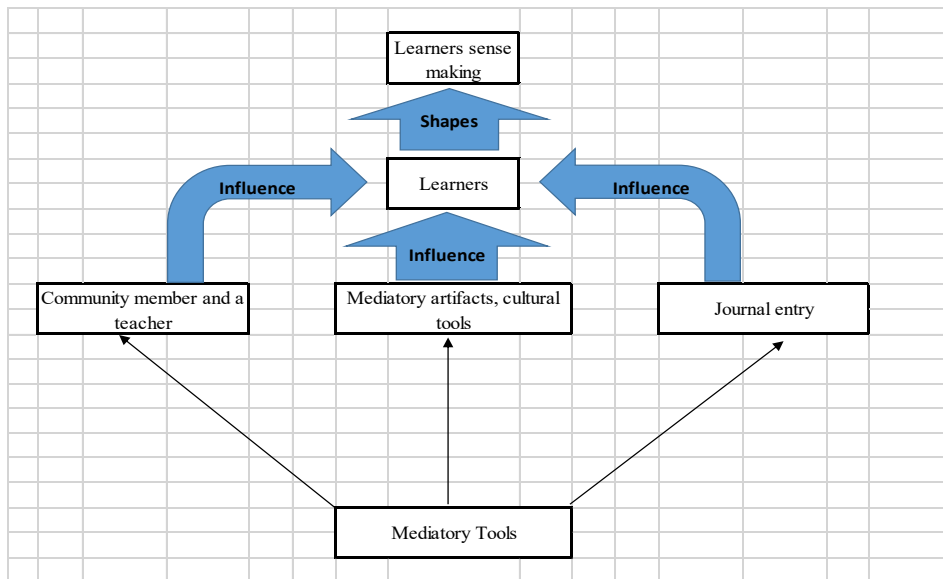


Figure 2.6: Shows how ZPD is affected by influential factors (adapted from Shabani et al., 2010, p. 242)

From this model, the mediatory tools were used to show how they influenced ZPD in this study. The nature of this study was to integrate IK through interactions with each other and the MKOs (the local experts). The cultural tools used by the community members to demonstrate extraction of oil acted as mediatory artefacts which mediated learning. These tools influenced the learners, teacher, and community members' ZPD as they discussed and asked questions based on the presentations. Arends (1997) argued that through the guidance of the teacher (the community member), learners may progress to a higher level of understanding. In this study, the presentations did not necessarily teaching them how to extract oil but rather exposed them to emerging scientific concepts. This may have shifted the participants' level of actual to the level of development (Vygotsky, 1978).

2.11.2 Analytical framework: Contiguity argumentative theory

In this study, to augment Vygotsky's socio-cultural theory I also used the Contiguity Argumentation Theory (CAT) as my analytical framework. According to Ogunniyi (2007a), CAT deals with two cultures or thought systems that co-exist or collide, for example, IK and WS. Essentially, CAT explains possible ways in which conflicts arising from clashing ideas such as in IK and WS can be resolved to reach meaningful understanding (Ogunniyi & Hewson, 2008).

To Ogunniyi (2007a), CAT consists of five components or cognitive states, namely (1) dominant – in which a more powerful idea seems to explain facts and events in a convincing and plausible way which resonate with acceptable social norm that afford an individual a sense of identity; (2) suppressed – an idea becomes suppressed in the face of more valid evidence; (3) assimilated – a less powerful idea might be consumed into a more powerful one which is able to explain facts and events convincingly; (4) emergent – this occurs in circumstances when there is no prior knowledge or preconceived ideas that exist and hence new knowledge has to be acquired or developed; and (5) equipollent – this cognitive state occurs when two competing ideas have comparably equal intellectual force. That is, the ideas tend to co-exist without necessarily resulting in a conflict (Govender, 2014; Ogunniyi & Hewson, 2008). In the context of this study, it was hoped that the above mentioned CAT's five cognitive states would help me to understand both my learners' and community members' thoughts on the integration of IK in the science lessons on the topic of enzymes in particular.

Moreover, since I was teaching a multicultural class, it was hoped that learners from diverse socio-cultural backgrounds might come with different stories about the cultural practice of *okuyenga*. For example, some might see *okuyenga* as the sole responsibility of women while others might argue that it is a cultural practice which should be inculcated in both genders. It was anticipated that such diverse views from learners and expert community members would nurture argumentation amongst participants. Ogunniyi (2007a) postulated that the CAT transpires when two different cultures coincide or collide and that it is only possible through mental shifts to recognise, accept, and accommodate each other.

Govender (2014) reminded us that in most cases African learners' cultural or indigenous experiences seem to not be taken into consideration in some science classrooms. Such exclusion of learners' cultural or indigenous experiences makes learning science difficult, resulting in them not making connections or sense of what is being taught (Govender, 2014). In is against this caveat that scholars such as Le Grange (2007), Mukwambo et al. (2014), Mhakure and Otulaja (2017) and others suggested that there is a need to employ culturally sensitive strategies that integrate WS and IK. Such a proposal has affinity with Ogunniyi's (2007a) equipollent state where IK and WS are regarded as co-existing and in harmony.

This school of thought triggered my interest in using Ogunniyi's (2007a) CAT as an analytical framework to analyse ideas that emerged during social interactions as suggested by Vygotsky

(1978). It was hoped that CAT might provide valuable theoretical underpinning to analyse internal dialogues that happen due to conflicting ideas on different cultural beliefs on the traditional practice of oil extraction and opposing ideas about science and IK. For instance, some learners might not see a problem with only females being allowed to take part in *okuyenga* while on the other hand, some might challenge why it is prohibited for males to take part in *okuyenga*.

In summation, I believed that CAT and socio-cultural theory would be great complementary analytical lenses that would help me as a researcher to observe the influence of indigenous knowledge on learners during social interactions brought about by presentations by expert community members in a multicultural classroom.

2.12 Chapter Summary

In this chapter, I discussed literature relevant to this study. Firstly, I started the chapter by discussing the gaps on the integration of IK and teaching of enzymes in Grade 10 Biology classrooms in the Namibian context and explained how the current study sought to address these gaps. I also provided a brief description of the concept of enzymes, definition of local or indigenous knowledge, the significance and challenges of integrating indigenous knowledge in the science classroom, and the role of language in science. Thirdly, I discussed the conceptual framework with the focus on conceptions, dispositions, and sense making towards the integration of indigenous knowledge in teaching science. Lastly, I discussed the theoretical, analytical as well as conceptual framework which guided this study.

In the next chapter, I discuss the research methodology employed in this study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The main goal of this study was to explore how the mobilisation of the indigenous technology of oil extraction (*okuyenga*/ *khamtui oli*-) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of enzymes.

The intention was to make science accessible and relevant to my learners' life worlds and experiences (Gwekwerere, 2016). To achieve my goal, I needed to establish a methodology with an appropriate research design. In this chapter, I thus present the methodology and research design used in this study. The chapter further discusses validity and trustworthiness and issues regarding ethical considerations in this study and I end the chapter with a chapter summary.

3.2 Research Paradigm

According to Chilisa (2012, p. 35), a research paradigm is a “way of describing a world that is informed by philosophical assumptions about the nature of social reality (ontology), ways of knowing (epistemology) and ethics and values (axiology)”. In consequence, theoretical assumptions regarding the research process and methodology used are invariably related to the chosen paradigm. The term ‘paradigm’ refers to ways of viewing the world and guiding research (Bertram & Christiansen, 2015). These authors posited that “a research paradigm represents a particular world view that defines, for the researchers who hold view that is acceptable to researcher and how this should be done” (Bertram & Christiansen, 2015, p. 22).

In the context of this study, a combination of the interpretive and indigenous paradigms were used to study how learners make sense of the concept of enzymes during the presentations on the indigenous technology of oil extraction from marula nuts and melon seeds by the two expert community members. That is, learners and I had an opportunity to interact with expert community members, to interpret and understand the science embedded in the indigenous technology of oil extraction. I now discuss these below.

3.2.1 Interpretive paradigm

According to Bertram and Christiansen (2020), an interpretive paradigm seeks to describe and understand how people make sense of their world, and how they make meaning of their particular actions in their contexts. Sharing similar views, Thomas (2013) elaborates that the key to interpretivism is to make sense of the understandings that people we are talking to have about the world and how we can in turn interpret and understand it. Based on this perspective, this paradigm seemed to be well-suited for this study that focused on human experience, behaviours, and attitudes (Bertram & Christiansen, 2020). Central to this study was to understand the experiences, behaviours, and views of the participants about the use of the indigenous technology of oil extraction, prior to and during the intervention (Cohen, Manion, & Morrison, 2018).

However, the interpretive paradigm has been critiqued in the sense that the researcher might make an interpretation of their own experiences rather than of the people directly involved (Creswell, 2007). Perhaps, it is this viewpoint of the researcher's biases that makes it descriptive at the expense of explanations from the worldview of participants. As an attempt to address this limitation, I complemented the interpretive paradigm with the indigenous research paradigm (Chilisa, 2012; Seehawer, 2021).

3.2.2 Indigenous research paradigm

To Chilisa (2012), central to the indigenous research paradigm are belief systems that take into cognisance peoples' lived experiences, values, and their historical contexts. Moreover, the indigenous research paradigm is informed and guided by relational ontologies, epistemologies, and axiologies. In this regard, Seehawer (2021) suggested that it is imperative for indigenous research to be aligned with the approaches and ethics of the local context. For example, the local context in my study was Namibia in Southern Africa. In my study, I used the Ubuntu perspective or approach.

The use of the Ubuntu perspective in this study was also in accordance with a call from scholars such as Chilisa and Ntseane (2010), Chilisa (2012), Smith (1999), Seehawer (2018) and Mbembe (2021) to mention a few, who suggested that indigenous researchers should start viewing indigenous research through the lens of a postcolonial indigenous paradigm rather than in an interpretive way. Wilson (2008) defined a postcolonial indigenous paradigm as a means

of hearing non-western voices and emancipating the voice of the formerly oppressed generations. Wilson (2008, p. 56) further explained the indigenous research paradigm as follows:

An indigenous paradigm comes from the fundamental beliefs that knowledge is relational. Knowledge is shared within all creation. It is not just interpersonal relationships, or just with the research subject I may be working with, but it is a relationship with all creation. It is cosmos; it is with animals, with plants, with earth that we share this knowledge. It goes beyond the individual's knowledge to the concept of relational knowledge ... you are answerable to all your relations when you are doing research.

It is, therefore, clear that the postcolonial indigenous paradigm's emphasis on I/we relationships is opposed to the Western I/you relationships whose emphasis is on individual interests (Chilisa & Ntseane, 2010). The notion of I/we is the view of Ubuntu which translates in English as "I am because we are" amongst African communities as alluded to earlier in this thesis.

Ubuntu is a "philosophy that is a collective effort characterised by the spirit of togetherness which sees human needs, interests, and dignity as of fundamental importance and concern" (Higgs, 2008, p. 453). In other words, Ubuntu is concerned with the welfare of the whole community as opposed to individual needs and interests. Simply put, it is the spirit of togetherness (Seehawer, 2021) and will to the community (Mbembe, 2021). Seehawer (2018) posited that in an Ubuntu paradigm, the knowledge is generated and validated through discussions with the concerned community. In other words, views and opinions of members of the community are equally valued and considered important to the validation of different knowledges emerging from the communal discussion. Goduka (2005) averred that African research should be done in a respectful way that is rooted in the indigenous way of knowing.

In this regard, Mkabela (2015) averred that the Ubuntu perspective befits African research activities as it focuses on African indigenous knowledge systems. Concurring, Khupe and Keane (2017) postulated that African research needs to be aligned with lived experiences and value the culture of participants. Similarly, Seehawer (2018) accentuated that there should be mutual respect between the researcher and participants. That means that researchers should respect the indigenous people and the communities where they are carrying out their research. However, Le Grange (2012) pointed out that the use of Ubuntu is not about wanting to live in the past but rather it is a way of harnessing togetherness and living in harmony. On the other

hand, Mangena (2015) emphasised that it is not a problem to appreciate and use an Ubuntu approach in African research, yet the problem comes when one thinks that research approaches such as Ubuntu in non-Western cultures cannot stand without the blessing of Western thinkers. Therefore, it should be noted that Ubuntu is not entirely a unique concept and that there might be other similar concepts in other contexts.

As a matter of fact, Chilisa (2012) reminded us that decolonisation is situated within Ubuntu and is facilitated by dialogue between epistemologies (Seehawer, 2021) – indigenous knowledge and westernised knowledge in the context of my study.

In the context of my study, using an interpretive paradigm coupled with the lens of Ubuntu afforded me an opportunity to explore, observe, and understand learners' conceptions and dispositions when the traditional practice of oil extraction was integrated into my science lesson. Chilisa (2012) referred to this as restoration and development of cultural practices and central to the decolonisation process.

Indeed, Chilisa's understanding and conceptualisation of decolonisation has affinity with calls on indigenisation or Africanisation of the science curriculum as well as the education system (Mbembe, 2021; Mukwambo et al., 2014; Mutanho, 2021; Seehawer, 2021). This suggests that there is a need for constructive co-existence and dialogue of different epistemologies and worldviews. In the context of my study, it was hoped, therefore, that these paradigms would enable me to understand the situation and to interpret meanings within the social and cultural contexts of this research study. Within the interpretive and indigenous paradigms, this study employed a case study research design.

3.3 Research Design

This section provides a discussion about case study, and the research goal and research questions of the study. Within the interpretive and Ubuntu paradigms, a qualitative case study research design was adopted in this study.

3.3.1 Qualitative case study research design

Bertram and Christiansen (2015) proffered that case study allows for deep exploration to provide thorough understanding of lived experience of participants. Concurring, Merriam and Tisdell (2016) explained that qualitative research is characterised by focusing on the search for meaning and understanding. When conducting this study, I was interested in establishing the

influence of practical demonstrations of oil extraction (*okuyenga/!khamtui oli-e*) on the learners' conceptions, dispositions, and sense making on the concept of enzymes. One of the advantages of qualitative study is that the researcher can expand their understanding through verbal and non-verbal communication (Merriam & Tisdell, 2016). In this regard, I accessed information from observations and the reflections that learners provided (Eisner, 2017; Mayana, 2020). This further gave me opportunities to follow-up and probe more deeply. Therefore, this study fulfilled the requirements of a case study as it examined a single case developed from the perspective of the influence of integration of an indigenous practice in the science classroom.

The case in this study was the Grade 10 Biology class from a township in the Erongo region in Walvis Bay in Namibia. One of the characteristics of studies is that they are bounded (Creswell, 2014). For instance, 30 Grade 10 learners, two expert community members, and a ⁷critical friend who is a chemistry teacher at my school were involved in this study. My focus was specifically on the indigenous practice of oil extraction with the view to making sense of the concept of enzymes. My unit of analysis, therefore, was the social interaction, participation, and learning experiences during presentations by the community members. The reason for this research approach was to do research on how mobilisation of the indigenous practice of oil extraction from knowledge gained from community members influences (or not) Biology learners' conceptions, dispositions, and sense making of the concept of enzymes.

3.3.2 Research goal and, research questions

The goal of this study outlines what the study was aiming to achieve. In order to achieve that goal, one has to have questions that are directed at achieving the goal of the study. Below I present the goals of this study and the research questions which guided this study.

3.3.2.1 Research goal

The main goal of this study was to explore how the mobilisation of the indigenous technology of oil extraction (*okuyenga/!khamtui oli-*) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of enzymes.

⁷ A *critical friend* is a trusted person who provided me with a different perspective on my research study.

3.3.2.2 Research questions

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

1. What are Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?
2. How do Grade 10 Biology learners interact, participate, and learn (or not) during the presentations on the indigenous technology of oil extraction by the expert community members?
3. How do Grade 10 learners' conceptions, dispositions, and sense making shift/evolve (or not) as a result of the presentations on the indigenous technology of oil extraction by the expert community members?

3.3.3 Research site

This study was conducted at a government secondary school in a township in Walvis Bay, in the Erongo region in Namibia. The school accommodates learners from Grade 8-12 from diverse socio-cultural backgrounds (Mavuru & Ramnarain, 2020). That is, learners who attend this school speak different languages such as Afrikaans, Damara/Nama, Lozi, Oshiwambo, and Otjiherero. Therefore, even though the school uses English as the medium of instruction learners struggle to communicate in English as the language of teaching and learning (LoTL). The Namibian Basic Education and Culture policy makes it mandatory that English should be the language of instruction in all schools (Namibia. MoE, 2015).

The school is made of brick and has many classes. At the time of this study, it had an enrolment of 920 learners, 520 females and 400 males. The school consists of 32 staff members, three heads of department (HODs) and a headmaster. Therefore, the teacher-learner ratio is 1:40. The three HODs mentioned above are responsible for the Department of Mathematics and Science, Social Sciences, and Commence. In terms of facilities, the school has two science laboratories but they are not well equipped to carry out any practical investigations. In addition, this school does not have a library nor sports fields. In terms of results, since its inception in 2015, this school has never reached its academic performance's target of 50% at regional or national level. It is against this backdrop that I became interested in conducting my study at this school to explore the indigenous practice of oil extraction to influence (or not) learners'

conceptions, dispositions, and sense making of the concept of enzymes in my Grade 10 Biology class.

The Erongo region is located in the western part of Namibia (see Figure 3.1 below). It has a shoreline on the Atlantic Ocean and on land borders with the Kunene, Otjozondjupa, Khomas, and Hardap regions. It has a population of over 400 000 people. This region is renowned for its large, flourishing fishing sector, and the Namibian Port Authority (NAMPORT) which is the biggest port in Southern Africa. This region has one of the largest Rossing Uranium mines producing 10% of uranium worldwide, ranked as the 4th largest producer. Notably, this region has been the most highly affected by the COVID-19 pandemic as approximately 90% of Namibian COVID-19 cases have been registered in this region. The high rate of COVID-19 is partly as a result of high industrial activities of the fishing and mining sectors. The increase of the Coronavirus cases led to the complete lockdown of the Erongo region from the rest of the country. Since this region is regarded as Namibia's economic fountain, the prolonged lockdown has negatively affected the stability of the Namibian economy.

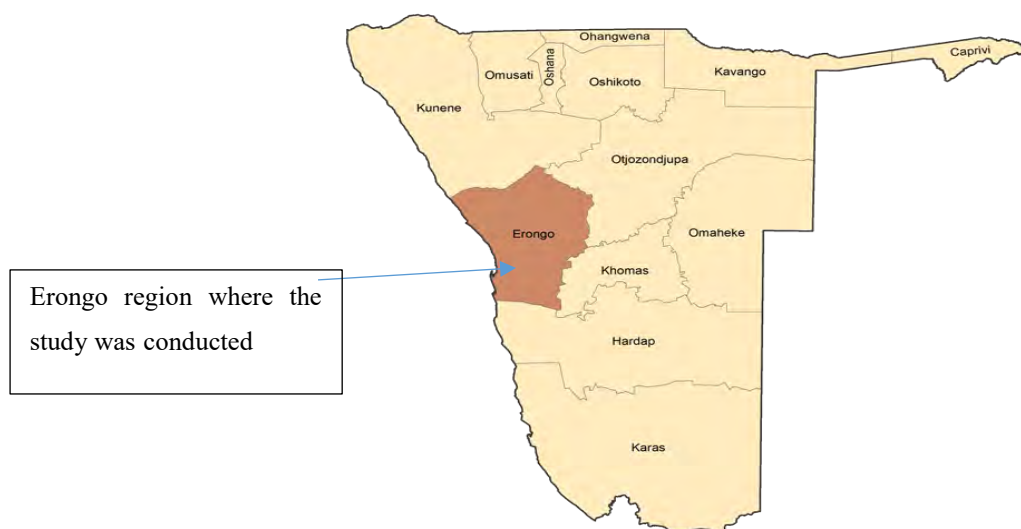


Figure 3.1: The Namibian map with different regions

3.3.4 Sampling and participants

Sampling has to do with identifying and selecting participants to be involved in a study. Thus, my learners that I was teaching at the time of this study, a teacher, and two expert community members voluntarily participated in this study. I now discuss them below.

3.3.4.1 Learners and teacher

Bertram and Christiansen (2015) defined the type of sampling that the researcher makes as specific choices about which people or group to include in the sample for a particular purpose. The study was thus conducted in a multicultural class with 30 Grade 10 Biology learners consisting of 15 boys and 15 girls with a good representation of cultural diversity (Mhakure & Otujala, 2017).

The choice of these learners was also on the basis of them studying Biology in Grade 10. The choice of the Grade 10 class was made based on the fact that it is the entry point of the senior secondary phase. I therefore purposively chose to carry out this study with a Grade 10 class because the focus topic of enzymes which is stipulated in the new curriculum syllabus has proven to be difficult to comprehend.

Additionally, an Oshiwambo speaking chemistry teacher played the role of a critical friend in this study. The teacher was purposively selected because she is also responsible for one of the Grade 10 Biology classes. Although the teacher has been teaching for nine years, she admitted that she was not knowledgeable about the integration of indigenous practices into science lessons and she reflected that:

I have never seen or heard of indigenous knowledge brought into the science classroom, I look forward to the community members' presentations.

She therefore positioned herself with me, as a co-learner in this study. My critical friend provided me with a different perspective as we reflected together on presentations by the expert community members. In fact, she saw the experience as an opportunity for her to make science lessons culturally responsive to learners as reiterated by Mhakure and Otulaja (2007) and Shizha (2007). Shizha (2007) further averred that culturally responsive lessons are a great step in liberating learners and teachers, so that they can learn and teach within their cultural contexts by not adopting a hegemonic system which is alien to them. At the end of the presentations, all

participants gained knowledge from the experienced and more knowledgeable ⁸expert community members.

3.3.4.2 Two expert community members

Two expert community members (women) from the community around the school, one Oshiwambo and one /Damara, were also involved in this study. Although there are five different cultural ethnic groups of learners in the class, the community members were from Damara>Nama and Aawambo ethnic groups, selected on a voluntary basis. The community members were purposively selected by looking at their richness of preserved cultural knowledge as well as their willingness to demonstrate it to the learners. The presentations were made in Khoekhoegowab and Oshiwambo which are home languages of the expert community members.

Both presentations were translated to make sure that all learners from the other ethnic groups understood what was presented; a Biology teacher was willing to translate into English for other non-Oshiwambo speaking learners and a Khoekhoegowab language teacher translated into English. I should admit upfront that the translating of mother tongue into English might have dissolved the value of IK, making it an artefact instead of a subject (Shizha, 2007). The expert community members are the custodians of the cultural heritage who are knowledgeable about the local knowledge as reiterated by Vygotsky (1978) and I present their profiles in Table 3.1 below.

Table 3.1: Profiles of the two expert community members

Biography information	Category	Community member
Age	70	Meme Fiina
	59	Meme Jaco
Gender	Females	

⁸ The community members are referred to in this study as ‘experts’ because they are the custodians of the indigenous practice of oil extraction.

Cultural background	Oshiwambo	Meme Fiina
	Damara/Nama	Meme Jaco
Home language	Oshiwambo	Meme Fiina
	Khoekhoegowab	Meme Jaco
Highest standard passed	Standard 4	Meme Fiina
	Standard 5	Meme Jaco

In Table 3.1 above I presented the profile of the two expert community members who were invited to demonstrate extraction of oil from marula nuts and from wild melon seeds. The presentations were aimed at affording the expert community members the opportunity to share their cultural heritage and expertise on oil extraction. The indigenous knowledge from the expert community members' presentations was subsequently used to mediate learning of the topic of enzymes.

The two expert community members preferred to use their real names, Mama Fiina Nakandunga and Mama Jaco Awases. The community members explained that they preferred to use their real names because they said they wanted their names printed in this research study as a way of motivating and mobilising other community elders to work with schools and pass on the traditional knowledge. This suggests that anonymising the expert community members as is often required ethically, would be against their will (Smith, 2012).

Mama Fiina Nakandunga is a Church elder and a traditional midwife in her community in Walvis Bay. She also prefers to be called by her ⁹clan name *Mkwankala*. Although she had aspired to be a nurse, she could only manage to complete her Standard 4 as she had to leave school to join the Namibian liberation struggle in Angola. On the other hand, Mama Jaco Awases also known by her clan name as *Gaiodaman*, is from the Damara culture. She aspired to be a teacher but she also only completed her Standard 5 as it was the highest educational

⁹ Clan names are important in the African context. Clan names are used to show respect for research participants and is consistent with the Ubuntu paradigm in this study (Mkabela, 2015; Ogunniyi, 2007a; Seehawer, 2018).

level a black person, especially women, was allowed to complete during the colonial era. She is a traditional community marriage counsellor and an institutional worker at a local school. Notably, both presentations by Mama Fiina and Mama Jaco kept most learners attentive and engaged with them as they were curious to see if science was really embedded in the indigenous practice. With the permission of the participants, the presentations by learners and community members were videotaped and used with data generation techniques in this study to help with data triangulation.

3.3.5 My Positionality in the Study

Since I conducted the study in my own classroom, I anticipated that the issue of positionality and power relations might arise. Thomas (2013) argues that interpretive researchers (like me) have an undeniable position in the research process and this position affects the nature of the observations and interpretations that they make. This suggests that the issue of positionality, power, and representation play a role in conducting research.

Essentially, at the time when I conducted this study I was an acting head of department as well as a master's student at Rhodes University, which I believe might have affected the study in terms of positionality. I, therefore, addressed the issue of positionality by ensuring that all the participants in this study knew and understood that their participation in this study was voluntary and that they were free to withdraw from participating in the research at any time they felt like doing so. Since the culture of participants was guided by the spirit of Ubuntu, all participants looked forward to the communal discourse where every person's opinion would be equally valued with no exemption of superiority (Seehawer, 2018). I also communicated to the learners that I was a co-learner during the presentations by the expert community members who are knowledgeable about the traditional practice of oil extraction. This suggests that I conducted this research *with* my learners rather than *on* them as they were involved in the construction of knowledge (Ngcoza & Southwood, 2015).

I also acknowledged that the expert community members were custodians of the cultural heritage of traditional oil extraction and were therefore regarded as a more knowledgeable others as proposed by Vygotsky (1978). Put differently, the MKO's inputs would broaden my understanding of an indigenous practice in relation to the concept of enzymes embedded in the cultural practice.

3.3.6 Data gathering methods

In this study, I used multiple methods of answering my research questions, namely, focus group interviews, stimulated recall interviews (audiotaped), participatory observation (videotaped lessons), and reflection journals. I video recorded these interactions with the permission of the expert community members and the learners. Written permission for all recordings was sought from learners' parents or guardians, learners themselves, and expert community members. As I explained earlier, my critical friend was a Biology and chemistry teacher and she was part of this study from beginning to end. All comments and suggestion she made were valued and appreciated.

Cohen, Manion, and Morrison (2018) argued that the aim for using a variety of data generation techniques is known as triangulation, which ensures trustworthiness, validity, and reliability. The data gathering process was done in three phases. In the first phase, I audio recorded a one hour focus group interview which was done to acquaint myself with learners' understanding of their conceptions and dispositions towards the use of indigenous knowledge.

In the second phase, I was a participant observer during the presentations on oil extraction by the expert community members. That is, I participated and at the same time observed the interactions and engagement of learners with the expert community members, teacher, and interactions amongst learners. This whole activity of Phase 2 was to learn how the indigenous practice of oil extraction influenced (or not) learners' conceptions and dispositions and how learners interacted with expert community members and amongst themselves. This activity was video recorded with the permission of the participants by the critical friend.

During the third phase, I carried out a stimulated recall interview. In Phase 3, the critical friend and learners who took part in the first phase of the focus group interview watched the video that was recorded during Phase 2. This was done to establish if there were any shifts or not in learners' conceptions and dispositions as a result of the presentations on the traditional practice of oil extraction by the expert community members. This was done by probing learners on their interactions and participation during the presentations by the expert community members. Throughout this research process, I also requested learners to write their reflections in their journals. I now tabulate data gathering methods and discuss each method below (see Table 3.2).

Table 3.2: Different data collection methods used to collect data in this study

Phases	Method of collecting data	Purpose	Target research question(s)	Time of data collection
1.	Focus group interview (sharing circle)	To acquire learners' understanding, conceptions, and dispositions towards the use of indigenous knowledge	1	This was done for the duration of one hour, before the presentations of the indigenous practice of oil extraction by the community members
2.	Participatory video-taped observation	How learners interact, participate, and learn during the presentations by expert community members. Scientific concepts were deduced from the community members	2	Took place for two hours, during the presentations of the indigenous practice of oil extraction by the community members
3.	Stimulated recall interview	To obtain data on any shifts in conception, disposition, and sense making in learning the concept of enzymes	3.	Took place for one hour, after the presentation of the indigenous practice of oil extraction
	Learners' reflective journals	Obtain insight into learners' experiences and perspectives on the integration of IK; constraints and enhancement of IK in enzymes.	1, 2 and 3	After the stimulated recall interview

I now discuss each of the data gathering techniques below.

3.3.6.1 Focus group interview

To Kitzinger (1996), a focus group interview is a semi-structured group discussion usually conducted in an informal setting intended to gather participants' understandings, experiences, attitudes, and beliefs on a topic by exchanging views in a group discussion. Additionally, Johnson and Christensen (2004) argued that a focus group interview facilitates discussions with a few people on how they feel about a situation. To Nieuwenhuis (2007), focus group interviews produce wider responses, trigger forgotten experiences, and contribute to data generation. Creswell (2008, p. 226) stated that "those participants who are hesitant to share information might do so in a focus group interview" as participants are generally more relaxed in a group than they would be in individual interviews which was certainly true for my interview with the learners. Nieuwenhuis further explained that participants can elaborate on

each other's ideas and comments, contributing to the richness of the data which would not happen during individual interviews. In support, Cohen et al. (2018) accentuated that focus groups are a contrived setting that brings together a specifically chosen sector of the population to discuss a given topic, where the interaction with the group leads to data and outcomes.

I choose to use the focus group in this study to find out learners' understanding of their conceptions and dispositions towards the use of IK. Learners were asked to group themselves in groups of six (using pseudonyms), with boys and girls from different ethnic groups ensuring ethnic diversity and gender balance. From each group of six, learners had to choose one learner to represent them in the focus group interview. Therefore the focus group interview was made up of six learners only, selected by their group members from the first formed focus group. In the focus group interview, an interview schedule was used as a guiding tool and audio-recorded (see Appendix H). In addition, with the use of the interview schedule, the six selected learners were allowed to go back to their original focus group in order to discuss the responses that emerged from the interview questions. This was done to equip the selected learners with the knowledge of how to represent the *voices* of the original group well.

I hoped that the focus group interview would be useful in creating a relaxed environment for learners to interact with each other. Indeed learners were relaxed during the interview and all participated well. However, some learners were quick to answer questions and some were hesitant at the beginning but started engaging as I encouraged them and gave them enough time. Since the focus group interview was done in a multicultural class, the questions were in English to accommodate all learners. The fact that questions were in English could have contributed to some learners being hesitant as they struggled with English but they all tried their level best. I am however mindful of some limitations of the focus group interview. For instance, some vocal participants can dominate other members which could result in less vocal participants conforming to the ideas of dominating members. Even in this study, learners who were more conversant in English were more vocal than others and as a result, those who were less conversant in English were quick to agree with them. I addressed this by making sure that all learners involved in the focus group took turns in giving answers. I also encouraged them to express themselves freely without fear of being judged in their English proficiency. The critical friend was not present when I conducted this interview and that allowed some learners

who were shy to express themselves freely. The interview took about 60 minutes and was tape recorded. It took place in the afternoon at the school.

3.3.6.2 Participatory observation

Observation means that the researcher goes to the site of the study which may be the school, a classroom, a staff room, community or meeting space, and observes what is actually taking place (Cohen et al., 2011). Observation gives the researcher an opportunity to become immersed and get a grasp of the whole scene (Bertram & Christiansen, 2015). Simply put, the researcher is afforded an opportunity to gain first-hand information of what happens at the scene. In this study, participatory observation was used to get a holistic picture of learners' and the community members' interactions and sense making.

Participatory observation took place after the focus group interview. Participatory observation was deployed to observe how learners interacted, participated, learnt (or not) during the presentations on the indigenous practice of oil extraction by the community members. Since it was a participatory observation where I had to be fully immersed, with the permission of the expert community members I asked one of my colleagues (critical friend) to videotape all presentations. I needed to split my time so that I could both concentrate on observing and gathering data from the discussions. What I observed during the presentations and interactions was that learners were joyful, attentive, and curious and seemed to be enjoying the presentations by the community members. At some point in the presentations, learners had to predict and explain what they had observed (Asheela et al., 2021) and I looked particularly to see how learners interacted, participated, and learnt (or not). However, I observed that learners were a bit hesitant to ask questions of the community members as it is culturally considered as disrespectful to ask questions of elders. To counteract this, I motivated learners to break this cultural barrier and ask more in order to know more.

Although one of the strengths of observation is that it is a powerful tool to gain insight into a situation, it has the challenge of being potentially invasive (Bertram & Christiansen, 2015). For example, the presence of the researcher may make participants behave in unnatural ways and that is known as the Hawthorne effect (Kawulich, 2005). I therefore declared my role as a researcher at the start of the research study and encouraged learners to participate and voice their opinions freely as I was a co-learner. That is, I explained that we were all learning from

the expert community members and they really enjoyed hearing this, as L1 commented: “*So the community members is going to be our teacher today? Mmmh, now I get it Mam when you always says that you don’t know it all*”. Participatory observation was deemed useful in this study since it enabled me to look afresh at everyday behaviours that otherwise might be taken for granted. To enhance data obtained from participatory observation, I used stimulated recall interview.

3.3.6.3 Stimulated recall interview

A stimulated recall interview (SRI) is a collaborative inquiry between research participants and the researcher, with the dialogue focused on the practice through video or audio recall (Lyle, 2003). After presentations by the expert community members, I first played a recorded video of the presentations for the learners in order to recall and refresh their ideas and thinking as Cohen et al. (2018) suggested. The video was watched with the critical friend and the selected learners who participated in the focus group interview before the whole class. This was done to probe learners’ understanding about what transpired during the presentations by community members. For instance looking at the scientific concepts that emerged from the presentations, interactions between participants, and if there were any shifts or not in the learners’ conceptions, dispositions, and sense making towards the integration of IK. Learners were thrilled to see themselves on TV. Subsequently, L4 commented: “*Wow!, is it really us, I never dreamed of seeing myself one day on TV, now I believe that anything is possible, thank you Mam*”. I used a stimulated recall interview to complement and triangulate data generated from the participatory observation.

3.3.6.4 Learners’ reflection journals

Since reflections are part of our daily homework, during my data generation process I asked my learners to reflect in their journals at the end of the entire research process. Similarly to Mayana (2020), I provided them with four guiding questions as to make reflections clear and straight to point (see Appendix K). McMillan and Schumacher (2014) posited that journals are a personal account of the learning experienced. Before the actual reflection on this study, learners were given guidance on how to go about reflecting. To prepare my learners on journal writing, at the beginning of 2018 I started with promoting the culture of writing reflections based on my lessons. That is, similar to Mayana (2020), learners were encouraged to write

reflections after every lesson and read out what they had written to their classmates the following day. This was done so that by the time I conducted the research they would be used to reflecting. As well as writing lesson reflections, I encouraged them to write down their experiences of COVID-19. This assisted learners greatly in terms of writing this research-driven reflection. In the context of this study, learners' journal reflections were collected as part of the data. I believed that the journals might give me more insights and highlight how the indigenous knowledge presentations had changed learners' conceptions, dispositions, and sense making towards the integrations of IK in the learning of science concepts.

3.3.7 Data analysis

Data analysis is the process of making sense of and finding meaning in the data, interpreting what has been seen, and what has been said (Gay, Mills, & Airasian, 2006). In this study, a qualitative data analysis was used whereby data from the focus group interviews, participatory observation, stimulated recall interviews, and learners' reflections were coded and compared or contrasted. I used the strategy of writing narrative stories from the episodes (Nhase, 2019; Sedlacek & Sedova, 2017) of the interactions between learners and community members. This was intended to enable internalisation and to make sense of my data. As a result, I had to watch the video of the expert community members' presentations at least three times and subsequently wrote narrative stories.

Sedlacek and Sedova (2017) as well as Nhase (2019) supported writing narrative stories since from them, episodes can emerge. The narrative stories were coded inductively and then analysed into categories and themes. That is, an inductive coding approach was used whereby themes emerged from the data collected. Merriam (2009) suggested that coding is a way of assigning some sort of short-hand notes so that data can be easily retrieved.

Constructs from the socio-cultural theory such as social interaction, mediation of learning, and ZPD were used to analyse the data generated to establish whether integration of IK influenced (or not) learners' conceptions, dispositions, and sense making of the concept of enzymes. Additionally, criteria adapted from Atallah et al. (2010) were used to analyse learners' conceptions and dispositions.

Table 3.3: The process of data analysis

Steps	Processes
1.	Data generation: • Data were collected from within the research site. • I conducted a focus group interview and participatory observation. A stimulated recall interview was done after observation. • Lastly, the learners' reflective journal was administered.
2.	Data analysis: • Data were transcribed from audio recorded focus group and learners' reflective journals were collected for analysis.
3.	Coding and Categories: • I read data which I collected to get a general idea and made sure that I understood all data. • For an example, I transcribed the focus group interview in order to colour code. • I then identified the categories, themes, and sub-themes which I used to analyse my data. • To analyse the participatory observation, I wrote a story from the video and identified episodes which I placed in categories and themes.
4.	Discovering patterns: • After categorising my data, I studied them and found the relationship between data in different categories and themes. • I then merged similar themes with similar data and came up with the main theme.
5.	Writing the report: • Finally, presentation and data analysis. Writing up findings, discussions, and summary. • I also concluded with some tables, graphs and visual structures.

3.3.8 Validity, trustworthiness and reliability

Validity refers to the extent to which the study reflects that which it intended to measure (Graven, 2012). In support, Shenton (2004) highlighted that the validity ensures that the researcher's findings of the study are actual findings rather than being the impression of the researcher. Moreover, Creswell (2014) also viewed validation as a distinct strength of a qualitative research in that the accounts made throughout the time spent in carrying out the research study, the description of the study, and the relationship between the researcher and participants all add up to the value and accuracy of a study. Furthermore, the researcher needs to make sure the data gathering tools are systematic, credible, and transparent (Bertram &

Christiansen, 2020). In this study, I used multiple data gathering methods such as a focus group interview, observation, a stimulated recall interview, and journal reflections. I piloted my focus group questions with my MEd classmates in order to be critiqued before carrying out the focus group interview. I also video recorded the participatory observation and audio recorded the focus group interview and then transcribed the videos verbatim to retain data.

During the SRI, the videos were watched together with learners who took part in the focus group interview before the whole class, so that they could engage, discuss, and reflect on what transpired during the presentation by the expert community members. In addition, the two community members and the critical friend were afforded an opportunity to discuss and reflect on what transpired during their presentations. All this was done for triangulation purposes. Triangulation refers to collecting data from a number of sources (Bertram & Christiansen, 2020). The audio recording of the interview and video recording of the observation were transcribed and analysed with a colleague, who was my critical friend in the same subject discipline, to reduce inconsistencies that may have arose through the process of collecting data. I made sure the ethical standards of respect and dignity, transparency and honesty, accountability and responsibility, integrity and academic professionalism were always taken into consideration.

3.3.9 Ethical considerations

From indigenous perspectives, ethical codes of conduct serve partly the same purpose as the protocols which govern our relationship with each other and with the environment. The term 'respect' is consistently used by indigenous peoples to underscore the significance of our relationships and humanity. Through respect the place of everyone and everything in the universe is kept in balance and harmony. Respect is a reciprocal, shared, constantly interchanging principle which is expressed through all aspects of social conduct. (Smith, 2012, p. 120)

The importance of ethics in research cannot be compromised. Mkabela (2015) suggested that researchers should show respect for individuals, their privacy, and confidentiality. In this regard respect of human rights and dignity was at the core of this study as emphasised by Smith (2012) in the quote above. For instance, participants' autonomy, non-maleficence, and beneficence were considered throughout the research process (Bertram & Christiansen, 2015). Therefore, before I conducted this research study I followed the procedures shown in Figure 3.2 below:



Figure 3.2: The procedures followed to work towards attaining ethical considerations

I now discuss each of these in detail below.

3.3.9.1 Respect and dignity

First, I made a thorough explanation of the study, its aims, and how it would benefit the participants. For instance, the community members felt honoured and overwhelmed with contentment at the fact that their indigenous knowledge would be preserved and passed on to the future generation. The human rights and dignity of the participants were respected in this study. In light of the above, the community members opted to use their real names as a way of motivating and mobilising other community elders to work with schools and pass on the traditional knowledge. I made sure that anything I wrote in this thesis did not compromise the dignity of participants. Their welfare, anonymity, and privacy were protected throughout the research process. At the beginning before embarking on this study, I explained to the participants and the two expert community members that their participation in the study was voluntary and that they could withdraw or stop participating in the study at any time if they wished to do so. Moreover, participants were encouraged to take part in the study, and good communication and trusting relations among participants and the researcher was established. I also specified to all participants that I would not share the information of this study without consulting or soliciting permission from them first.

3.3.9.2 Transparency and honesty

As I stated earlier, before I issued consent letters I provided a clear explanation of the purpose of the study. Participants were given consent forms and these were signed by both participants and participants' parents/guardians, indicating that they understood and agreed to the terms and conditions of the research study (see Appendices C & D). With the community members, I had to visit them four times following the community protocols. I visited the community members the first time not to discuss anything related to the research study but to exchange friendly greetings. The second visit was to establish a cordial relationship and discuss the significance of indigenous knowledge in general. The first and second visits were done to adhere to the African ethics of showing respect and interest in the participants' indigenous knowledge. The third visit was to cement our relationship, to discuss the planned research study, and seek consent from the participants which they agreed to without hesitation.

With regards to Rhodes University's ethical considerations, the community members refused to sign the consent letters. When asked to sign they said that there was no need to sign as they had already verbally agreed. Mama Fiina specifically explained that signing of documents is not part of the African culture and that our ancestors already left a trusted verbal system of working together (Ubuntu). She jokingly said "*iinima mbino yo kushanga oyepipi lyeni, oshoka kamushiwe nande aayinekela ngashi shakala pa muthingululwakalo wetu wo shiludhe, ne ina musimaneka euvathano lyo pakana*". Translation: This signing of documents only works with your generation because, you have issues of trusting and do not stick to your words. This is in affinity with Cohen et al. (2011) who argue that informed consent offers too little because it requires more than informed consent as it also seeks trust, active support from participants, and their cooperation. The fourth visit was to update the community members on the outcome of the research study and to thank them for their collaboration. Moreover, the letters of consent were written both in English, Oshiwambo, and Khoekhoegowab so that participants could understand the content of the study. However, I found it challenging to translate the English statement to Oshiwambo and Khoekhoegowab when it came to the statement "you can withdraw from this study at any given time if you want" as it is more of a Eurocentric view and indeed is a valid ethical research statement (as recommended by Chen & Brown, 2018). However, in terms of African ethics, which is guided by Ubuntu paradigm, that statement is

unacceptable and culturally inappropriate as it may be seen as disrespectful. This shows the contradiction between Afrocentric and Eurocentric viewpoints (Mutanho, 2020).

In addition, to conduct this study, permission was solicited and granted from the Director of Education in the Erongo region (see Appendix B) parents, learners, and expert community members who all responded promptly.

3.3.9.3 Accountability and responsibility

The study was conducted in accordance with the principles of the ethical policies and guidelines for educational research. Simply put, I did not misuse my positionality as a researcher. As a researcher, I was obliged to create an inviting environment which befitted the research process and adhered to the respect of human rights and dignity of all participants. Additionally, I was completely responsible for safe keeping of all data gathered. All research data (video and tapes) and equipment have been stored on an external hard drive and will be kept safely in a lockable cupboard for a period of five years. I was also in constant communicate with my supervisors to seek their guidance throughout the research process.

3.3.9.4 Integrity and academic professionalism

This study is my own product and was conducted in such a way that it explicitly discloses no political, racial, religious or other biasness (David & Resnik, 2010). I have also adhered to referencing guidelines and data were presented without any untruths or exaggerations.

3.4 Chapter Summary

In this chapter, I described the paradigms that informed this study which were the interpretive and Ubuntu paradigms. Within these paradigm, a qualitative case study approach was employed. In addition, the research goal and questions were outlined. Furthermore, the research site and participants of this study were described. Similarly, data gathering techniques such as a focus group interview, participatory observation, a stimulated recall interview, and journal reflections were also discussed. The analysis of data was described. In the next chapter, I present, analyse, and discuss data generated from the focus group interview and participatory observation.

CHAPTER FOUR: FOCUS GROUP INTERVIEW AND PARTICIPATORY OBSERVATION

4.1 Introduction

The aim of this study was to explore how the mobilisation of indigenous technology of oil extraction ¹⁰(*okuyenga/ ǀkhamtui oli-e*) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of the concept of enzymes. The study was motivated by the need to make science accessible and relevant to learners' life worlds or experiences. Moreover, central to the study was cultural revitalisation (Cocks et al., 2012; Smith, 1999) so that my learners could embrace diversity and respect each other's cultures and cultural heritage.

In this chapter, I thus present, analyse, and discuss data generated from the focus group interview ¹¹(sharing circle) and participatory observation. These were aimed at addressing the two research questions:

- What are Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?
- How do Grade 10 Biology learners interact, participate, and learn (or not) during the presentations on the indigenous technology of oil extraction by the expert community members?

First, I present, analyse, and discuss data from the focus group interview which took the form of a sharing circle (Afonso-Nhalevilo, 2013; Goduka, 2005). According to these scholars, sharing circles help to foster sharing of ideas and discussions amongst participants. Secondly, data were generated from a stimulated recall interview. I begin this chapter by presenting the

¹⁰ The indigenous practice of oil extraction is called *okuyenga* in Oshiwambo and *ǀkhamtui oli-e* in Khoekhoegowab

¹¹Sharing circle – format used to encourage discussions and sharing of ideas (Afonso-Nhalevilo, 2013; Goduka, 2005)

profile of the participants who were involved in this study. That is, their gender, ethnicity, and age group in the case of the learners. On the other hand, the expert community members' profiling is based on age, gender cultural background, home language, and level of education attained (see Table 3.5).

Six learners were interviewed during the sharing circle and tape recorded with their permission. They were given codes that are used throughout the thesis and the codes are L1 to L6 (see Table 4.1 below). The gender of each participant F and M at the end of the code was indicated, for example, L1F represents female and L2M male and so on. SCI is the code for the sharing circle interview and PO for participatory observation. This made it easy when presenting, interpreting, and discussing the data obtained from the SCI.

Table 4.1: The biographical information of learners

Biographical information	Category	No of learners	Learners' codes
Ethnicity	Aawambo	2	L1F, L2M
	Damara/ Nama	1	L3F
	Ovaherero	2	L4F, L5 M
	Lozi	1	L6 F
Gender	Females	4	L1, L3F, L4F, L5
	Males	2	L2, L6
Age group	16	L1,L3 L4	L1 - L6
	17	L2,L5	
	18	L6	

As explained earlier, this research was conducted at Iyaloo high school (pseudonym) in the Erongo region at the coastal town of Walvis Bay in Namibia (see Section 3.5). Six learners participated in the focus group interviews; that is, L1, L3, L4, L6 (girls) and L2 & L5 (boys). In terms of ethnicity, all six learners belonged to different tribal groups of which two were

Aawambo, two Ovaherero, one Damara/ Nama, and one Lozi speaking learner. Themes were developed from sub-themes and are presented in Table 4.1 below. These themes were developed from data from L1SCI to L6SCI.

4.2 Development of Sub-themes and Themes

Data generated from the sharing circle interview (SCI) and participatory observation were categorised according to the questions they were answering and sub-themes that were developed. Common sub-themes were subsequently combined into themes. The participants' prior knowledge, conceptions, and experiences were different and as a result, different themes were developed and data generated from the SCI are presented under those themes. The themes are: learners' understanding of, their conceptions and dispositions on integration of indigenous knowledge; learners' experiences, and links between science and IK.

After checking for similarities and differences between the SCI and stimulated interview, data categories were constructed. The categories were then reduced to seven preliminary sub-themes as shown in Table 4.2 below. Among the seven preliminary sub-themes, six were generated through (SCI) while the source of data of the last sub-theme was (SGI).

Table 4.2: Generating sub-themes from descriptions from the SCI

Description of SCI	Sub- themes
Cultural experiences/cultural knowledge/cultural norms and values	• Indigenous knowledge • Socio-cultural interaction
Building on existing knowledge/own knowledge/knowledge from home	• Learners' prior ideas and experience
Relationship between home science and school science	• Integrating prior experiences with school science
Teaching others and learning from MKO	• Collaborative learning. • Social interaction
Misconception about science/ perception about IK	• Misconception and perception about science

Translanguaging	• Language usage
Practical activity enhances understanding/learning new things/ sense making	• Knowledge construction • Hands on experience

Thereafter, I combined common sub-themes to form themes to answer my research question one:

What are Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?

Table 4.3: Themes and sub-themes that emerged from the focus group

What are Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?		
Themes	Sub- themes	Literature/theory
Learners' understanding of local knowledge	▪ Indigenous knowledge (IK). ▪ IK as prior knowledge. ▪ Learners' views on integration of IK.	Mosimege and Onwu (2004); Kibirige and Van Rooyen (2006); Roschelle (1995); Tylor (1999); Kuhlana (2011); Dziva et al. (2011); Higgs (2010); Mukwambo et al. (2014); Matamba and Lilemba (2015); Tylor and Cameron (2016); Mavuru and Ramnarian (2017)
Learners' conceptions on the integration of local knowledge	▪ Interesting culture and social interaction. ▪ Collaborative learning (<i>Ubuntu</i>). ▪ Misconceptions and perceptions about IK. ▪ Language usage. ▪ Hands-on experience.	Vygotsky (1978); Cobern and Loving (2001); Horsthemke and Schafer (2007); Shiza (2013); Erinosho (2013); Mashebe and Denunga (2015); Nyika (2017); Keane et al. (2016); Makhure and Otulaja (2017); Sedlacek & Sedova (2017); Lo et al. (2018); Seehawer (2018); Mavuru and Ramnarian (2019); Asheela et al. (2020)

Link between science and indigenous knowledge	▪ Learners' prior ideas and experiences. ▪ Socio-cultural interactions. ▪ Integrating prior experiences with school science. ▪ Construction of knowledge.	Jegede (1999); Ogunniyi and Hewson (2008); Mushanyika and Ogunniyi (2011); Govender (2014); Asheela (2017); Mpofu (2016); Nikodemus (2017); Shinana (2019); Chikamori et al. (2019); Hashondili (2020); Magwetshu (2020)
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As shown in Table 4.3, the themes that emerged were: learners' understanding of indigenous knowledge; learners' conceptions and dispositions towards integration of indigenous knowledge; and connections between science and indigenous knowledge. I now discuss each of these in detail below.

4.2.1 Learners' understanding of indigenous knowledge

Learners who participated in this study were requested to state their understanding of indigenous knowledge. Three learners explained that indigenous knowledge is:

My view on local knowledge is that it is the knowledge from the past ... that is passed on to us by our ancestors from long ago unto us (L2MSCI).

I believe traditional knowledge originates from my roots, for example being a girl taught certain skills on how prepare certain meals is indigenous knowledge to me (L3FSCI).

From these excerpts, it could be surmised that learners have some understanding of what indigenous knowledge is. Firstly, that it is knowledge from the past and it is based on different community contexts (Chikamori et al., 2019). Secondly, that it is passed orally from one generation to another. These findings resonate with definitions by scholars such as Kibirige and van Rooyen (2006), Mosimege and Onwu (2004) and Nyika (2017). On the other hand, L4F elaborated and highlighted that:

My view is that traditional knowledge is that language we use at home and the things my grandmother is teaching me like old stories and unique way of culturing milk (Omaere) in our Ojherero culture (L4FSCI).

From this excerpt, L4F included language and telling of stories in his understanding of IK. This finding corroborates with Nyika (2017) who posits that local or IK includes storytelling, rituals, beliefs, and local languages. Likewise, Iseke (2013), Smith (2012), and Tzou et al. (2019) accentuate that storytelling is a pedagogical strategy used by indigenous people to transmit

knowledge and wisdom about life. Therefore, the familiar culture of storytelling from learners' homes and communities enables them to understand and appreciate their past as espoused by Chikamori et al. (2019). As alluded to earlier, this unique legacy of knowledge is orally passed on from one generation to another (Kibirige & Van Rooyen, 2006; Mukwambo et al., 2014; Simpson, 2014).

In expanding their understanding of IK, L4F provided an example of preserving milk from the Ovaherero culture. Essentially, this is an example of an indigenous method of food preservation which entails controlling of water and temperature so that food such as *ombidi* (traditional vegetable), *Eembe* (berries) can last longer as evidenced in Hashondili's (2020) study conducted in Namibia.

4.2.2 Learners' conceptions and dispositions on the integration of IK in science lessons

The data gathered from the focus group interview (sharing circle) revealed that some learners have positive attitudes towards integration of IK in the learning of science. For example, L3F stated that:

Local knowledge from home experience can be used to make learners understand more of what they already know or have experience about that what they do not know at all (L3FSCI).

From this excerpt, the learner seemed to embrace the integration of IK, citing that it has the potential to enable them to link what they have learnt at home to what is taught at school. Aikenhead and Jegede (1999) referred to this as border crossing. Concurring, Erinoshu (2013) argued that the use of IK has the potential to pave the way for a broader understanding of science concepts during teaching and learning. That is, it allows cultural border crossing from home or community to the school of science (Aikenhead & Jegede, 1999; Nikodemus, 2017; Ogunniyi & Ogawa, 2008). Moreover, in order to bridge the gap between science and IK and vice versa, prior knowledge is important, as highlighted by L2M:

We want to learn by comparing our lessons to everyday life so that it does not make science sound alien or difficult to understand (L2MSCI).

L2M's opinion speaks to prior knowledge as espoused by Kuhlman (2011) and Roschelle (1995) that new knowledge starts with the selection of ideas from everyday experience. Therefore, when learners' prior knowledge is considered and their socio-cultural backgrounds are acknowledged, this results in new knowledge construction (Mavuru & Ramnarian, 2017;

Vygotsky, 1978). In light of this and extending on Vygotsky's (1978) seminal work, Mavuru and Ramnarain (2020) emphasised that it is very important for science teachers to take into consideration their learners' socio-cultural backgrounds.

Furthermore, L4F also indicated that science content could make more sense if it were taught in the learners' home language. In this regard, she highlighted that:

I would like to learn more traditional way as in our native mother tongues just to get a glimpse of what is really going on because now Biology is in English which is a little confusing (L4FSCI).

From this excerpt, it seems this learner is finding Biology confusing when taught in English (which is a second language and the medium of instruction) and would prefer it to be taught in her home language. This finding has affinity to Msimanga and Lelliot's (2014) as well as Mavuru and Ramnarain's (2019) assertions that through language, learners can construct knowledge and make sense of science. Therefore, the home language can be used to mediate learning. In other words, home language has the potential to become a cultural resource which makes science relatable to learners as espoused by Vygotsky (1978). For instance, as evidenced in Nhase's (2019) study conducted in South Africa, it was revealed that Foundation Phase teachers were able to promote scientific inquiry using isiXhosa.

4.3 Participatory Observations

As alluded to earlier in Section 3.7.2, participatory observation was used to get a holistic picture of learners' social interactions and sense making during the presentations on the indigenous practice of oil extraction by the expert community members. I now discuss the presentations by the expert community members.

4.3.1 Presentations by the expert community members

As part of the intervention, I requested two expert community members from the Aawambo and Damara>Nama ethnic groups to share their traditional practice of oil extraction (*okuyenga* in Oshiwambo and *l~~k~~ham~~t~~ui oli-e* in ¹²Khokhoegowab) from marula nuts and Kalahari wild melon seeds. Notably and as an innovation, is that the Kalahari melon seeds were used instead

¹² Language is a communication tool which facilitates engagement and encourages participation (Msimanga & Lelliot, 2014; Nhase, 2019)

of Nara seeds due to the late harvest of Nara fruits. A lesson to be learnt from the Damara expert community member is that as science teachers, we need to learn to improvise. The data garnered from this gathering technique sought to address the following question:

How do Grade 10 Biology learners interact, participate, and learn (or not) during the presentations by the expert community members on the indigenous practice of oil extraction?

All 30 learners from the Grade10 Biology class including the learners who participated in the focus group interview (L1-L6) participated in the presentations by the expert community members. Learners who did not take part in the focus group were also identified by codes from L7-L30. I also invited a critical friend who took part and video recorded the presentations and also took part in the discussions during the stimulated recall interview. The presentations were aimed at affording the expert community members an opportunity to share their cultural heritage, wisdom and expertise on oil extraction. The indigenous knowledge from the community members' presentations was subsequently used to mediate learning of the topic of enzymes. In this study, the community members decided to use their real names hence, the use of codes or pseudonyms were not applicable in this instance.

Table 4.4: Raw data from expert community members

Expert community members	Raw data
	▪ We must embrace our culture and pass it on to each other ▪ Sharing circle is a cultural norm ▪ Girls must show interest in <i>okuyenga</i> more than boys ▪ Not respecting culture is like a plant without roots ▪ Cultural beliefs must be respected. ▪ Singing in our culture serves as motivation ▪ Women's value is attributed to their skills and attitudes in cultural practices

	
Mama Fiina (Mkwankala) presenting okuyenga - marula nuts	
	▪ Culture is a generational wealth ▪ The cooking of oil melon seeds powder must be done by girls ▪ Men are not allowed to cook ▪ Women who do not practice their culture will not be married ▪ Working together is a way of promoting culture ▪ Cultural practices promote humbleness and hard work ▪ Mother tongue is our cultural identity ▪ Kalahari melon oil can be used as medicine

4.3.2 Summary of the presentations by the community members

The expert community members involved in this study presented skills on how oil can be extracted from marula nuts and wild melon seeds. The first community member demonstrated how oil can be extracted from marula nuts and the second community member demonstrated how oil can be extracted from Kalahari melon seeds. The fact that it was only women who were involved in this research as expert community members resonates with Samal, Shah,

Tiwari, and Agrawal (2004) who posited that women are the primary part as custodians of IK systems.

As indicated earlier, these presentations were in Oshiwambo (CM1) and Khoekhoegowab (CM2). From the presentations by the expert community members, I developed some episodes and then from these episodes, themes and related literature were developed. Themes are shown in Table 4.5 on the following page.

Table 4.5: Sub-themes and themes that emerged from data and supporting theory or relevant literature

Themes	Sub-themes	Literature	Framework
Theme 1: Nature of interactions and participation.	Learner talk	McRobbie and Tobin (2017)	Vygotsky (1978)
	Asking questions Listening attentively Explaining Elicitation of prior knowledge Promoted dialogue and arguments	Sedlacek and Sedova (2017) Sedlacek and Sedova (2017) Roschelle (1995); Khupe (2014) Ogunniyi (2007a); Govender (2014)	Vygotsky (1978)
Theme 2: Nature of learning opportunities	Promoting of border crossing Promoted arguments dialogues and arguments Using language as a resource Showing understanding	Aikenhead & Jegede (1999) Ogunniyi (2007a) Hoppers (2005); Kibirige and Van Rooyen (2006); Webb (2013)	Ogunniyi's (2007a) CAT

4.4 The Process of *Okuyenga*

Okuyenga is a traditional practice of extracting oil amongst the Aawambo tribe in the northern part of Namibia. This cultural practice of *okuyenga* is only carried out after the harvest. The

reason for this is that the marula fruits have to be allowed to dry (osmosis) before the nuts are removed from the kernel.

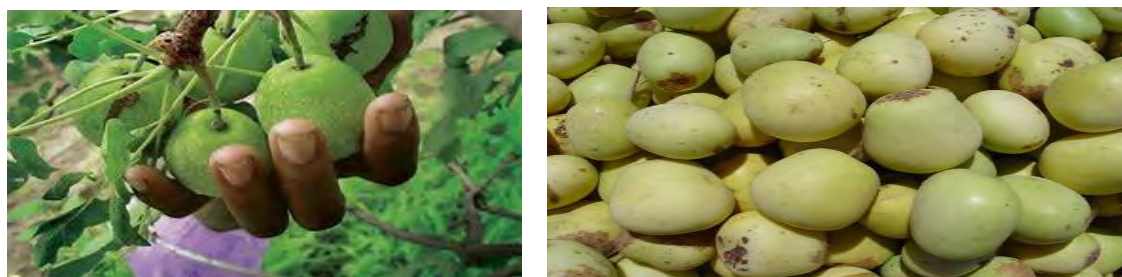


Figure 4.1: Unripened and ripe marula fruits



Figures 4.2 - 4.4: Peeling marula fruits; dried marula kernel; kernel cracked open for decortification

4.5 Nature of Interaction and Participation between the Expert Community Members and Learners

As I have explained in Section 3.10.2, I visited the expert community members as per the cultural norm of engaging with the elders (Smith, 2012). The first and second visits were done to adhere to the African ethics of showing respect and interest in the participants' IK. The third visit was to build trust, cement our relationship, and discuss the planned research study and seek consent from the participants. My fourth and last visit was to update them on the outcome of the research study. During my visit, I explained to the expert community members the goal of this study and Mama Fiina commented that: "*Onde ku pandula, nonda nyanyukwa oshoka otoka pandje ompito ombwanawa yo kulonga noku kalekapo omuthigululwakalo wAawambo*" (I appreciate you for coming here to consult about our traditional knowledge and for affording me an opportunity to share and preserve the cultural practices of Aawambo).

From this statement, it was evident that Meme Fiina saw the importance of preserving traditional knowledge so that it is not lost. This resonates with Cocks et al.'s (2012) advice that there is a need for cultural revitalisation. On the other hand, the second community member, Meme Jaco said that: "*Gangans sa lga!nâ-aos go !hao!nâsi †ansa khoratuis xoa†amsa a lhûi*

!khaisa, nē !haosi !aediba kai!gûs !aroma mûhesa anu xui-ao” (I’m grateful that you as a teacher you decided to find out about our local/traditional knowledge. This is what we want to see the culture being preserved and passed on to our generation).

Similarly, Meme Jaco emphasised the importance of IK being passed on from generation to generation as reiterated by Kibirige and Van Rooyen (2006). This corroborates with some scholars who are in support of integration of IK in science teaching (Abah et al., 2015; Erinosh, 2013; Le Grange, 2007; Mukwambo et al., 2014; Mushanyika & Ogunniyi, 2011).

For example, Abah et al. (2015) stated that the integration of IK has the potential to contribute to improving learners’ understanding of science concepts. This could afford learners and teachers alike with opportunities to comfortably learn and teach within their cultural contexts (Mavuru & Ramnarian, 2017).

From the above responses, it could also be deduced that both expert community members were willing to share their cultural heritage. Their interest in being part of my study signifies the importance of passing on of IK from one generation to the next as reiterated by Kibirige and Van Rooyen (2006) and other scholars. Essentially, the involvement of the community members is congruent with Mukwambo’s (2016) assertion that the community elders are the custodians of the cultural knowledge.

Indeed, in her introduction, Meme Fiina asked us to listen attentively so that we could get the correct firsthand information. She said: “*Ondahala mu pulakene nawa opo kehe gumwe i ilongeni mo sha moshinyangandhalwa shika shopamuthigululwakalo, ne tamupula omapulo ngele kamuuviteko nawa*” (I want everyone to pay full attention to this cultural practice so that we all learn something from it). Before the presentation, she greeted and welcomed all participants. Thereafter, she asked learners to sit in a circle (*ongonga*) so that each one had an equal view of her presentation on oil extraction. When I asked about the meaning of the circle, she explained that:

Moshiwambo ohatu kala omutumba mongonga unene ngele tatu kudathana iinima ya simana ngaashi oshinyangandhalwa shonena. Tse otu hole iinima yaandjuka nawa opo kehe gumwe amone kutya ehlokepo lye olya simana (In the Aawambo culture we sit in a sharing circle especially if we are discussing important issues such as this presentation).

This signifies that all the people involved in the activity were considered *equal* and all their opinions mattered during the discussions. This is also consistent with Goduka's (2005) approach who posits that in discussions in his study, for instance, around *eziko* and *Ganma* there was no perspective that was viewed as more superior than the other. Instead, all the different ideas or stories that the participants brought were considered *equal*.



Figure 4.5: Presenter 1 in a sharing circle Figure 4.6: Learners taking some notes

4.6 Indigenous Knowledge of Oil Extraction

Meme Fiina started the presentation by asking the learners to identify materials surrounding her. Additionally, she also asked learners to raise their hands and mention the names of the materials in their mother tongue or dialects. She smiled and said:

Ondahala mukatumbule omadhina ngiinima mbika tatu ka longitha melaka ndi ho popi kegumbo, otashi ka kala oshiwana opo kehe gumwe aze po iilonga posha kombinga yo malaka (Well, I want you to say the names of the materials that you are seeing here in your mother tongue/dialects. It will be good so that we can also learn each other's languages in this space).

From this excerpt, it is clear that Meme Fiina was aware of the significance of mother tongue in teaching. This coheres with Mavuru and Ramnarian (2020) as well as Masimanga and Lelliot (2014) who posited that home language can be instrumental in integration of scientific concepts as it has a potential to afford learners with an opportunity to think and express their opinions explicitly. In this regard, researchers such as Mavuru and Ramnarian (2020) advocated for use of home language to allow learners to access science.

After identification of materials used in the presentation, she asked if there was anyone who was in distress or who had a personality of being emotional to step forward. She said:

Ngele opuna ngoka ena omahodhi geli popepi nahedhe popepi mpano opo tu yenge naye oshoka aantu yuukwatya watya ngawo ohaya ziitha omagadhi nawa (If there is any person who got a personality of being a crybaby, must come forward so that she can be next to me when I extract the marula oil. This is because in our cultural belief people who have a crybaby personality are more likely to increase the quantity of oil extracted).

She proceeded and said:

Okuyenga ohaku endele pamwe no maitango nenge omuntu ta imbi, ndele nena po mpito ndjika itandi ka imba, oshoka otandi ki ipyakidhila noku fatulula (*Okuyenga* is normally done while singing praises to mother nature and as a way of motivating each other throughout *okuyenga*).

However, she explained that she will not be able to sing as she had to explain the steps of *okuyenga*. As she started the process of *okuyenga*, learners took some notes on the whole presentation. She started: “*Pamuthigululwakalo gwetu wAawambo, ohatu longitha Omushi , Oshini, Omahuku nomeya galomoka kashona uuna tatu yenge*” (Culturally, we use objects such as a pestle (*omushi*), a mortar (*oshini*) and marula nuts (*omahuku*) and lukewarm water (*omeya ngalomoka kashona*) when we extract oil.

She continued: “*Tango oto tula omahuku koshini, omakuhu omuga wete shigeli manga inaga tsuwa? Eewa, oto tameke oku ga tsa kashona na kashona sigo taga kala gafa giikwata kashona*” (First, you place marula nuts in the mortar, can you see how they look before being crushed? Then start crushing with a pestle, slowly by slowly, bit by bit until the nuts become thick and fine in texture) (surface area).



Figure 4.7: Marula nuts (*omahuku*)



Figure 4.8: Putting marula nuts in the mortar

Learners were called to observe and feel the texture of marula nuts and compare it to the original texture before it was crushed or pounded. One the male learners asked Meme Fiina “*What will happen if you continue crushing the nuts even after noticing that its texture is fine?*” and she answered: “*Omahuku ngele owega tsu shapitila kage nashi taga ningi, utya yaze omagadhi ogendji nawa*” (The more you continue crushing, the more the nuts become more fine and you will be able to extract more oil faster).

Meme Fiina further explained that: “*Uuna omahuku ga tsuwa gapya nawa, oto kutha okakopi komeya nga lomoka kashona ndele to tula koshini, manga to dhigi omushi kashona na kashona*” (Once marula nuts become fine in texture, we add a bit of lukewarm water, bit by bit while we move the pestle in a circular motion against the mortar).



Figure 4.9: Okuyenga in progress

She further explained that: “*Uuna nee omagadhi geya, ohatu longitha nduno okatapo/ omhindo ndele tatutula omagadhi metiti. Ezi/ edi, ohali pewa aanona ya lye oshoka ahali palutha nawa aanona*” (Once the oil starts to emerge, we take the calabash and remove it from the mortar and put it in the clay pot (*etiti*)). In Oshiwambo culture the clay pots are also used to store and preserve food such as mahangu and marula seeds (Mateus & Ngcoza, 2019). Furthermore, Hashondili (2020) accentuates that food preservation is intended to make food last longer for later use. The remaining marula residue (*Ezi/Edi*) would be used to feed children or adults. Since some participants were so eager to taste the residue (*Edi/Ezi*), the community member invited them to taste it.



Figure 4.10: Marula oil and marula residue (Edi) **Figure 4.11: Learners having a closer look inside mortar**

At the final stage of *okuyenga*, Meme Fiina went the extra mile to explain the cooking of marula oil and method of preserving it. She emphasised that:

Omagadhi goongongo ohaga tulwa peziko ndele taga fuluka opo ga pike mo omakako, go kaga ninge nayi mbala. Uuna nee gapi nawa, etutu ndi hali kala kombanda ohali puko. Opo ne taga kuthwapo peziko opo ga pole nawa omanga inaga ka siikililwa pehala lya talala nawa (The oil extracted is then cooked until the foam appearing on top disappears. Thereafter, it is removed from the stove, cooled down and then poured into a clay pot for storage in a dry cool place).

Furthermore, after the expert community member had finished explaining the cooking of marula oil, one of the Oshiwambo speaking learners asked: “*Omagadhi ohaga vulu oku longithwa kiikulya yapy nenge inayipya?*” (Can marula oil be used on uncooked food or only on cooked food?). Meme Fiina responded that “*Ohaga wapalele kiikulya yapy ngaashi ombidhi nenge omagungu ya telekwa nawa nenge to telekitha nago iikulya inayi pya*” (You can use it in cooked food like *ombidi* (traditional spinach) or uncooked food).

Learners were amazed by the richness of IK shared by the expert community member. As she was about to end her presentation, L8 interjected: “*Oh, wait meme, meme, before you go I just I want to say: Nani otuna e scientists dhopamuthiguluwakalo wetu, Hmm iihuna shili!, Hmm iihuna shili!*” (My goodness, I just realised that our elders are traditional scientists). Meme Fiina smiled and commented:

Onda uva etumba oshoka ondi wete kutya moshinyangandhalwa shonena shopamuthigululwakalo shinasha nokuyenga omwiilonga mo sha, notashi kemuwathela mokwiilonga kweni. Inandi hala oku mana po ethimbo lyeni lyo ku ke ilonga, nandi hulile mpaka nena. Otandi kakala noku kagandja omawathelo ngele tamu kega pumbwa ishewe komasiku go komeho, tangi unene. (I’m grateful that you managed to learn something from this presentation of cultural practice of *okuyenga*, I

believe that the knowledge gained today might help you to understand your schoolwork. I'm always available to assist should you need me to come share more cultural practices with you. I would want to end the presentation because you still have to go and study. Thank you!).

From this excerpt, it seemed that Meme Fiina saw the importance of IK in school science. This is consistent with Aikenhead and Jegede (1999) who proffered that we need to bridge the gap between home and school science. Moreover, evident in this excerpt is a sense of Ubuntu on the part of Meme Fiina as she expressed that she was available at any time when she is needed to share her cultural heritage and wisdom (Mangena, 2015; Ogunniyi, 2007a ; Seehawer, 2018).

4.7 Kalahari Melon: *Citrullus Lanatus* (scientific name)

Meme Jaco also explained at the begin of her presentation and said: “*Nē! khomdi ge!garob tsamasa xu ra hōhe*” (The melon seed which she used to extract oil came from Kalahari melon). Kalahari wild melon fruits which normally grow in the wild or are cultivated are oval in shape with light green and dark green mottled stripes. The *Citrullus* is the melon's genus name and *lanatus* is the melon's species name. The Kalahari wild melon fruits grow throughout Africa and Namibia, but are mostly found in the Kalahari Desert hence the word, Kalahari melon. The melon fruit is regarded as a great food source in many parts of Africa (Mabaleha, Mitei & Yeboah, 2007). This Kalahari melon seed can be crushed for oil extraction.



Collected melon

Melon smashed open

Grilled melon seeds

Figure 4.12: Illustrates different stages of Kalahari melon fruits and seeds

In Figure 4.13 below |*Gaiodaman* was busy explaining the extraction of oil from Kalahari melon seeds while learners looked on. She kept on emphasising that her skills in cultural practices came about because of her ancestors. She said: " *Nē ta ra mā!kharu †ansa ta ge ti †naosa xu ge †umi,!hao!nāsib ôananôagub †khūsib †naedib a xui-ao*" (I inherited this knowledge from my grandmother and now I'm passing it on to you). This resonates with Kibirige and Van Rooyen (2006) who accentuate that IK is a legacy of knowledge based on

wisdom and cultural skills passed orally over generations. Concurring, Shizha (2013) argued that IK is based on what was done in past generations and then passed on to the next.



Figure 4.13: CM 2 presenting extraction of oil from Kalahari melon seed while researcher as participant observer

Meme Jaco requested all participants to observe well and not to miss out on anything during the presentation. She started with the presentation and explained: “*Tsamasdi !khomdi gera !khûtsautsauhe tsî !napaxu ra sîb e, tsaura xuruba hōs !arom*” (You crush the melon seeds on the mortar and then sift it to get the fine powder). She continued saying that: “*Nē tsaura xurub ge !gami !kha ra sâ!uihe, !gammi nî doro tsî !nuib !guiba !gapise !goe!gaus kose*” (The powder will be mixed with water and cooked for some time until the oil starts to appear on top). She further indicated that the cooking and preparing of oil cannot take place in the school and explained:

Kaise a !hausenxa !khais ge !khûtsautsauhe hâ xuruba ta go nētsē sâi !loa i !khaisa, xawe !norasase tssen re ti !gâus tawa !îsa hol!ae si kō!hara sa’ (It is an unfortunate thing that we cannot cook the crushed powder today but you are free to visit me at home so that we can continue where we are ending this presentation).

As I was a participant observer during these presentations, I also had an opportunity to ask questions from the expert community members in order to get a better understanding of the indigenous practice so that I would be able to relate their presentations to the concept of enzymes. I asked in English and it was translated into Khoekhoegowab by the Khoekhoegowab teacher. For instance, I asked Meme Jaco: “*Why can the preparation and cooking of melon seed cannot take place in the school?*” (Mâti î ios !khâl!khās ai!khomis melons (tsamas) !khomdi

disa skoli !nâ a dīhe !oa?) (After the translation she explained that: “*Tsamas oli-e ai#homis ge !nâu !khain ai !gui ra dīhe !aediba !oa, skoli tawas ose , !na-amaga ta ge ti !gâus tawa !gau go !âba si nî !kharu!kharu*” (Melon oil must be cooked at a well prepared sacred place at home. Hence, I would like us to make time so that we can complete the cooking of melon seeds).

This excerpt speaks to the spirituality of the community member as she explained that the last part could only be done at a sacred place at home. This resonates with Breidlid and Botha (2015) who posited that spirituality is one aspect that is an essential skill used by indigenous people as a way of knowing. In support of this, Mkabela (2015) posited that existing local/traditional ways of doing things as well as acknowledging that some knowledge may be considered sacred or spiritual, with observance to specific protocols, must be respected.



Figure 4.14: Presenter 1 (Kwankala) showing Aawambo skills

4.8 Nature of Learning Opportunities

The first presentation by the expert community member was done in Oshiwambo and the teacher had to translate it into English. Notably, learners who spoke the same language as Meme Fiina indicated that they understood the presentation well in Oshiwambo rather than in the translated form. This resonates with Mavuru and Ramnarian (2020) who posited that home language empowers and has the potential to become a cultural resource to make science relevant. I also had an opportunity to ask Meme Fiina if the cultural practice such as making *oshikundu*, *omalodu* and making of clay pots have science in them. She responded and said:

Otashi vulika nga muna unogononi wa pa shitilingane kakele kasho ondi shishi kutya unogononi wo pasha shiluudhe omo uli lela. Pamwe otandi ka ngaluka esiku limwe opo ndi kangaluka opo ndiye ndi mulukile nghene oshikundu hashi ningwa opo kafanithe unogoni wa paali (It could be that it has the science you learn at school but I cannot confirm it, all I know is that it is our cultural practice. Unless I come back

again next time to come show you how to make *oshikundu* so that you may compare it with what you learn at school).

The excerpt above speaks to the notion of Ubuntu, central to which is humility, politeness, and respect towards others (Mangena, 2015; Seehawer, 2018). The isiXhosa proverb often used to express the core of Ubuntu is ‘*Umntu ngumntu ngabantu*’ which can be translated, according to Seehawer (2018) and others, to ‘*I am because of others*’. Essentially, Ubuntu strives at harmonising people to work together irrespective of their cultural differences.

Furthermore, another learner asked: “*If our culture has so much to offer in school, then why are teachers not asking us our culture from home?*” Meme Fiina replied that: “*Otashi vulika pamwe aalogi yeni inayeshi mangulukila oshoka nayo iyalogwa omudhingululwa ihe oya longwa omaunongononi yo pasha tilingane*” (It could be that your teachers lack in cultural knowledge since they were only exposed to the science from the Westerners).

This finding corroborates with Shizha (2013) who posited that integration of IK is neglected because of the Western dominant system under which the African academics were trained.

After Meme Fiina had finished explaining about other cultural practices which could be used in the science classroom, at the end of the presentation all learners decided to applaud her and say thank you in their different vernacular languages:

Tangi unene – Oshiwambo; *Okunene okuhepa* – Otjiherero; *Lizi tumela* – Lozi and *gan! gan!* – Khokhoekhowab. All this translates to: we thank you!

This excerpt has affinity to Diwu and Ogunniyi’s (2012) assertion that argues that utilisation of home language allows learners to comfortably express themselves. In support, Khupe (2014) accentuated that home language is a valuable tool of communication. This was revealed in her study conducted in Mqatsheni village, KwaZulu-Natal – in her case, IsiZulu was used by community members.

Meme Fiina replied and said: “*Iyaloo! nangame ondapanula unene, thingineni omalaka yeni ngashi mweshi holola paife*” (Thank you, I appreciate it very much, keep your culture alive especially your mother tongue just as we have done it).

During my last visit at Meme Fiina’s house, she invited other community elders from the neighbourhood to join her for our research update session. She explained:

Ondi ithana aankuluntu oya kwetu opo tu pulakene oshiyetwapo shoye sho pa muthingululwankalo wetu wo po Shiwambo. Osho ne ndi ithanene oyakwetu mbaka opo tu shi pwilikine pamwe. Shino onde shininggi omolwo magwedhelepo go madhilodhilo (I have invited my colleagues from the community to come and join me for the update of your research study about Aawambo cultural practices. I have done that so that we can share opinions amongst us).

This suggested that by their nature, indigenous peoples are a collective, rather than being individualistic. This resonates with Mangena (2015) who argued that as part of Ubuntu, every person's opinion is important for the betterment of the community and that individual action cannot be judged in isolation from the community. It seemed that all contributions from the community members were considered valid. This also coheres with Seehawer (2018) who posited that knowledge is not validated by individuals but through discussion with the community.

Moreover, during the presentation of oil extraction from Kalahari seeds by Meme Jaco, she was joined by Meme Fiina who volunteered to attend the presentation of oil extraction based on the Damara cultural practice. To our surprise, Meme Jaco subsequently requested Meme Fiina to show her how they extract oil from melon seeds in the Oshiwambo culture. Meme Jaco's question was translated into Oshiwambo for Meme Fiina to understand. She asked her: "*Kailgûs Fiinas ge mati ta Oshiwambo !naedib !oa tsama oli-e nî kuru !gauba ge !gaude*" (Meme Fiina, kindly show me how you extract oil from melon seeds in Oshiwambo). Meme Fiina replied and said that: "*Ohandi keshi ninga neitulemo*" (I will do it with pleasure).

This is congruent with Smith (1999) who postulates that the issue of negotiating and mutual agreements are part of the indigenous values and normal practice for harmonising of the community. Hence, the sharing of ideas between the two expert community members was of mutual benefit as a result of being engaged in this study.



Figure 4.15: Researcher closely observing the CM1 and CM2 cultural exchange

With much excitement the Damara community member said: “*Nēsisa du ra mû!khais ge tita tsîn tsamas oli –e a kuru !kha !khaisa ‡khari !kharagagusib kuru!gaugu !nâ hâ xawe*” (Ahaaaaa! You see, today I learnt the Oshiwambo culture of extracting oil from melon seed, it is basically the same culture as mine with just minor differences in procedures). She continued: “*!Hao!nâsi !aedib tsî ‡ûsigu ge tâtse !guri !gui a !khā!khāsenhe, mâ khoe-i hoa i di ‡ans tsî ‡âi!gauba !hao!haos nēsa nî ī !ka kai xui-ao*” (As you have seen today that culture is learnt together and every person’s opinion matters).

At end of the presentation the community members concluded. Meme Jaco and Meme Fiina said, respectively:

Ada! kharaga!nâgu !hao!nâsi !aedīgu ‡ande !goragu re, Kai!gûs Fiinas ge dīs !khas khami. Kai ios.’ (Let us keep on sharing our cultures just as we did today with Meme Fiina, *Kai ios* (Thank you!)) (Meme Jaco).

Omudhingululwakalo olyo eetumba lyetu ... natu ukalekeni po, tangi unene! (Our culture is our pride, generational wealth and our identity and we must guard it jealously, thank you!) (Meme Fiina).

These excerpts are a testimony of the humility demonstrated by the two expert community members involved in this study and they emphasise the importance of people respecting their culture. Honestly, I was humbled by their gesture of mutual benefit and collaboration during their presentations. In addition, it is important that the traditional experts such as community members should be brought into science classrooms, cementing the cultural identities of learners (Cocks et al., 2012). Collaboration with community members also served as a mechanism to address the scarcity of teaching materials that teachers could not access as a result of the lack of documentation on indigenous knowledge (Seehawer, 2021).

4.9 Chapter Summary

In this chapter, I presented, analysed, and discussed qualitative data from focus group interviews and presentations by the two expert community members. This aimed at answering my first and second research questions of my study. The findings revealed that learners have some understanding of indigenous knowledge. Firstly, it is unique to a certain community and secondly it is passed on from one generation to another. The data also revealed that learners appreciated the community members for sharing their expertise in indigenous knowledge.

In the next chapter, I present, analyse, and discuss data generated from the stimulated recall group interview and learners' journal reflections.

CHAPTER FIVE: STIMULATED RECALL INTERVIEW AND LEARNERS' JOURNAL REFLECTIONS

5.1 Introduction

In this chapter, I present, analyse, and discuss qualitative data generated from the stimulated recall group interview and learners' journal reflections on their experiences based on the expert community members' presentations. Such data were used to answer the following research question:

How do Grade 10 learners' conceptions, dispositions, and sense making shift/evolve (or not) as a result of the presentations on the indigenous technology of oil extraction by the expert community members?

5.2 Data Generated from Stimulated Recall Interview and Learners' Journal Reflections

In this section, I discuss the data generated from the SRIs and learners' journal reflections (J). The stimulated group recall interview and learners' reflections took place after the presentations by the two expert community members. I used codes such L1 –L10 to represent (learner one) to L10 to represent (the 10th learner). LF was used as a code for female learners and LM for male learners. I then presented the forementioned codes in relation to specific data gathering tools such as LFSRI/LMJ.

Table 5.1: Data gathering tool and codes in the data discussion in this section

Data gathering tools	Codes used in data discussion of data
Stimulated group recall interview	L1FSRI , L2MSRI, L3FSRI, L4FSRI, L5MSRI–L6FSRI
Learners' journal reflections	L1FJ, L2MJ, L3FJ, L4FJ, L5MJ, L6FJ, L7MJ, L8MJ, L9FJ, L1M0J,

Notably, all six learners who participated in the stimulated recall interview were part of the focus group interviews prior to the intervention and the presentations by the two expert community members. On the other hand, only 10 learners' journals were analysed as indicated in Table 5.2 since only 10 learners submitted their journal reflections. The rest of the learners were in isolation as it was suspected that they had been in contact with people who had contracted COVID-19. These learners' journal were coded, for example, L1J is learner 1 journal reflection and L10J for learner 10 journal reflections. The gender of each participant F and M at the end of the code was also indicated. For example, L1FSRI is female 1 stimulated recall interview and L5MJ is learner 5 male journal reflection. These codes are used throughout the thesis.

Firstly, the data from the stimulated recall interview and journal reflections were colour coded to identify themes. After identifying similarities from the stimulated group recall interview and journal reflections, themes were constructed and presented with relevant theory and literature as in Table 5.2 below:

Table 5.2: Emerging themes with theory and literature/theory

Themes	Theory/Literature
Learners' understanding of indigenous knowledge	Kibirige and Van Rooyen (2006); Iseke (2013);
The benefits of integrating indigenous knowledge in science classrooms	Roschelle (1995); Aikenhead and Jegede (1999); Kuhlana (2011); Cocks et al. (2012); Erinoshu (2013); Mukwambo et al. (2014); Mhakure and Otulaja (2017); Seehawer (2018b); Chikamori et al. (2019); Tzou et al. (2019)
Challenging cultural stereotypes and 'myths' about <i>Okuyenga</i>	Waldrup and Taylor (1999); Le Grange (2007); Ogunniyi (2007a); Horsthemke and Schafer (2007); Ogunniyi and Hewson (2008); Hodson (2009); Oloruntegbe and Ikpe (2010); Muvhunga and Rollnick (2013); Govender (2014); Keane et al. (2016)

Shifts in learning	Ogunniyi and Hewson (2008); Mavuru and Ramnarain (2019); Specht, Prinsen, Kalz, and Tenier (2018); Mavuru and Ramnarain (2020); Asheela et al. (2021); Msimanga & Lelliot (2014); Mavuru & Ramnarain (2020); Sedlacek & Sedova (2017); Vygotsky (1978); Ogunniyi (2007a)
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I now discuss in detail each of these themes below.

5.2.1 Learners' understanding of indigenous knowledge

After the presentations by the expert community members, it seemed learners had a paradigm shift in terms of understanding what indigenous knowledge is. For instance, L2M and L4F commented that:

The knowledge that is practiced by people from different races. It involved skills that are passed on from generations by our elders. In Africa we are full of different traditions (L2MSRI).

This is the traditional or cultural skills that are passed on from generation to the next, it can be skills or facts through talking stories (L4FSRI).

From these excerpts, it could be surmised that learners seemed to have some understanding of what indigenous knowledge is. This is evidenced by the fact that they highlighted that it is based on different community contexts and secondly, that it is passed on orally from one generation to another. These findings resonate with definitions by scholars such as Kibirige and Van Rooyen (2006), Mosimege and Onwu (2004) and Nyika (2017). To elaborate, Nyika (2017) posited that indigenous knowledge includes *storytelling* (Afonso-Nhalevilo, 2013; Iseke, 2013; Simpson, 2014; Smith, 2012; Tzou et al., 2019), ritual beliefs, and local languages. For instance, Iseke (2013) highlighted that cultural teaching from the elders are passed to new generations by means of storytelling.

Regarding the unique legacy of knowledge that is passed on from one generation to another (Kibirige & Van Rooyen, 2006; Mukwambo et al., 2014), L2M further reflected that “*I learned that peoples speaking different languages can share culture*”. This affirms that he learnt many things he was not aware of before the intervention by the expert community members. This

could be attributed to the spirit of Ubuntu of the two expert community members in their willingness to share their cultural heritage.

5.2.2 The benefits of integrating indigenous knowledge in science teaching

This study revealed that there are benefits in integrating indigenous knowledge during science teaching as indicated by the following learners' comments:

Local knowledge from home experience can be used to make learners understand more of what they already know or have experience about that what they do not know at all (L3FSRI).

Indigenous knowledge can be used in school hence it is relatable; learners can always compare the knowledge they attain in school with that taught at home (L4FSRI).

Traditional knowledge is important at home and at school because it teaches us our moral values and teaches us where we are going and where we are coming from (L2MJ).

From these excerpts, these three learners seemed to embrace the integration of indigenous knowledge citing that it enables them to link what they have learnt at home to what is taught at school. These findings cohere with Aikenhead and Jegede (1999) who averred that indigenous knowledge allows smooth cultural border crossing from home or community to the school of science. Notably, L2MJ highlighted the importance of taking into consideration the past (*retroduction*), the present and future (*retrodiction*) as espoused by Chikamori et al. (2019). These scholars aver that the past experiences pave way for present and future learning.

Furthermore, all these learners' views seem to resonate with the notion that prior knowledge could be in the form of learners' home and everyday experiences which they bring to school (Kuhlane, 2011; Roschelle, 1995). That is, when learners' prior knowledge is considered, their socio-cultural background is acknowledged resulting in new knowledge construction (Mavuru & Ramnarian, 2020; Vygotsky, 1978). However, these findings contradict Horsthemke and Schafer's (2007) assertion that integrating IK does not solve the main problem of making science relevant to an African child because it is a challenge to locate and identify scientific skills embedded in the cultural practices. Certainly, this was not the case in the context of my study as learners were able to see the scientific concepts in the indigenous practice of oil extraction.

For instance, some learners seemed to appreciate the importance of cultural/traditional knowledge both at home and at school as evidenced by their reflections:

Traditional knowledge is important at school as it helps us to reflect back home on certain issues that we can relate to and at home for us not to forget our heritage and local knowledge and have a better understanding (L4FJ).

Having traditional knowledge at school is a blessing because I'm being taught a part of who I am and since school is where I spend most of my time, it is perfect place, plus it is part of Biology, having to be taught referring to something at home will be great (L7MJ).

It is clear from L4F's and L7M's reflections that these learners appreciated the teaching that draws from their everyday home experience which is part of what they are familiar with. L4F talked about heritage and local knowledge. This is evidence that learners' indigenous knowledge has a potential to be part of the foundation of their prior knowledge (Roschelle, 1995). The mentioning of the word 'heritage', for instance, is an indication that L4F is knowledgeable about the importance of inherited knowledge. L7M also seemed to appreciate the integration of her socio-cultural background because it is part of her home experiences which is part of her identity as emphasised by Smith (2012). This too is a manifestation of the significance of considering learners' everyday home experiences in the teaching and learning of science.

All the above excerpts concur with scholars such as Akenhead and Jegede (1999). Mukwambo et al. (2014) and Seehawer (2018) who advocated that there is great need to integrate indigenous knowledge into the science classroom. It could be deduced from these excerpts, therefore, that the integration of indigenous knowledge in teaching may potentially influence learners' conceptions and dispositions towards science, in particular Biology in the context of this study. This was also evidenced by the learners' excerpts after probing during the stimulated recall interview. For instance, learners commented that:

My experience with expert community members was splendid; I witnessed something I never witnessed before. I was exposed to the process which I believed could only be carried out by modern machineries (L1FSRI).

I enjoyed the practical activity by the community member as it makes us curious because we were from different tribes; you can see how the process is taking place and you can see the traditional tools being used (L2MSRI).

It is clear from both L1F's and L2M's reflections that the practical demonstration by the expert community members contributed to the promotion of their interest and curiosity. Moreover, L1F seemed to appreciate the cultural knowledge imparted during the practical demonstration. Seemingly, L2M's views concur with Suarez et al. (2018) who indicated that practical presentations stimulate learners' curiosity to learn science and also promote learning with great understanding (Asheela, 2017). L2M also mentioned enjoying seeing the process taking place and tools being used. This speaks to visualisation or representation. In this regard, her views are congruent with Muvhunga and Rollnick's (2013) ideas that representations play a significant role as they serve as teaching aids which could assist learners to make sense of what is being taught.

Additionally, learners also reflected on the significance of the use of mother tongue by the expert community members. In light of this, L5M reflected that:

The use of the mother tongue used makes me to understand the information better in our own language, and we asked questions in our mother tongues which we would not have done if it was in English (L5MJ).

This excerpt has affinity to Mavuru and Ramnarian's (2019) findings that using home language has a potential to pave the way for knowledge construction and making sense of science concepts. In this way, language as a cultural resource (Vygotsky, 1978) seems to make science accessible to all learners. L5M's findings also resonate with Msimanga and Lelliot (2014) and Nhase's (2019) findings who postulated that language can be used as a cultural tool to facilitate engagement and encourage participation. For instance, in her study conducted in South Africa, Nhase's (2019) findings revealed that Foundation Phase teachers were able to promote scientific inquiry using mother tongue in their classrooms. As a result, learners were afforded an opportunity to discuss, learn, and understand science concepts in their mother tongue.

5.2.3 Challenging cultural stereotyping and 'myths' about *okuyenga*||*khamtui oli-e*

During their presentations, both the expert community members continuously stressed that the cultural practices are the norms of our ancestors and must be respected by the whole community. However, some learners disagreed and by doing so they were challenging some cultural stereotypes embedded in the practices. For example, L9F reflected that:

I was not happy with the fact that if a girl child is not interested in okuyenga/ḷkhamṭui oli-e it is like it is against the culture, but if the boy behaves in a similar way it is considered normal. I do not agree (L9F).

From this excerpt, it was clear that this learner who is a girl showed unhappiness about gender issues related to *okuyenga/ḷkhamṭui oli-e* as she felt that this cultural practice was discriminatory in the sense that boys and girls are treated differently in a similar cultural situation.

This finding is consistent with Govender (2014) who accentuated that dominant views can suppress less dominant views – in this case, the cultural belief of gender specifically regarding *okuyenga/ḷkhamṭui oli-e*. Moreover, it seems that certain cultural practices and skills are reserved for a certain gender because of known cultural symbolic meanings. That concurs with the learners who suggested practicing *okuyenga* for cultural knowledge gain. For instance, L5M and L2M reflected respectively that:

I believe boys and girls must all be taught and practice okuyenga so that they have the same cultural skills. Helping Meme Fiina during okuyenga did not make me feel less of a boy, it just make me appreciate my culture and science more (L5M).

Okuyenga must be a responsibility for both male and female, otherwise some cultural things will be known only by us girls and not boys (L2M).

From these excerpts, these learners seemed to accommodate different worldviews and agreed that the cultural practice of *okuyenga* must be gender balanced. For instance, these learners suggested that both males and females should be exposed to the same cultural skills. This statement resonates with Ogunniyi (2007a) who in his Contiguity Argumentative Theory (CAT) referred to this equipollent cognitive state. This means that two different ideas (cultural belief) and (gender equality), in my case, must coexist and not compete against each other. It could also be surmised that L5M's view concurs with those of Oloruntegbe and Ikpe (2010) who proffered that household chores can be used as sources of meaningful experiments to facilitate learners' understanding in science.

As a boy I want to know the skills of okuyenga so that I can have the same indigenous knowledge as girls, culture must not be selective (L8J).

This learner seemed to agree with some scholars who suggest that any misconceptions/myths which come with such knowledge should be identified and rectified (Afonso-Nhalevilo, 2013; Keane et al., 2016; Mhakure & Otulaja, 2017; Mukwambo et al., 2014). For instance, some

learners were not happy that boys are forbidden from practicing *okuyenga*. That is why they were challenging such cultural stereotypes about *okuyenga* as it may lead to some cultural segregation.

Some cultures seem to not support males practicing *okuyenga*. However, some of these cultural beliefs are regarded as ‘myths’ since there is no scientific evidence (Horsthemke & Schafer, 2007). Moreover, we ought to be careful not to consider indigenous knowledge as the only valid knowledge and shut out other forms of knowledge because all knowledge systems are equal (Cobern & Loving, 2001). For instance, during the presentations Meme Fiina made the following statement:

In our culture, okuyenga is only allowed to be done by women, the men are not allowed because it makes the men cowards, men must be out there hunting.

The excerpt above according to Ogunniyi (2007a) is as a result of a dominant cognitive state that explains the ideas behind some acceptable cultural norms. In this case, the dominant culture states that males are not allowed to carry out *okuyenga*. This view discourages males from carrying out certain cultural practices or helping out their women as far as *okuyenga* is concerned. Hence, this cultural stereotyping that is one gender sided, might compromise the benefits of gender equality in a social-cultural space. In contrast, L10M tended to differ with the views of Meme Fiina as he reflected:

It seems us boys we are labelled as less of a man if they like things women like to do like okuyenga; is it a culture for women? I thought culture is for both genders (L10MJ).

From this excerpt, it seemed that this learner is proposing that culture should accommodate both genders. Additionally, L10M further suggested that cultural practices like *okuyenga* should be included in other practical science subjects like Chemistry and reflected that:

I think this practical activity of okuyenga can also be used to chemical reactions topic in chemistry; it is easy to understand ... just my thinking ma'm (L10MJ).

L10M's belief about hands-on practical activities is that they make science less complicated. Such findings are congruent with Govender's (2014) assertions that there should be an equilibrium and coexistence between suppressed IK and WS in *okuyenga*. By doing so, Cocks et al. (2012) believe it may improve learners' understanding in science as well as appreciating and respecting their culture.

5.2.4 Shifts in learning

The presentations by the expert community members afforded learners an opportunity to relate the indigenous practice of oil extraction to what they were learning in the science lessons. As a result, learners were able to extract and reflect on some scientific concepts that emerged from the presentations and link them with specific explanations or topics in the science classroom. The identification of scientific concepts which emerged as a result of the expert community members' presentations was an indication that learners made sense of the science lessons and indigenous knowledge. This was evident from the development of mind maps (see Figure 5.2).

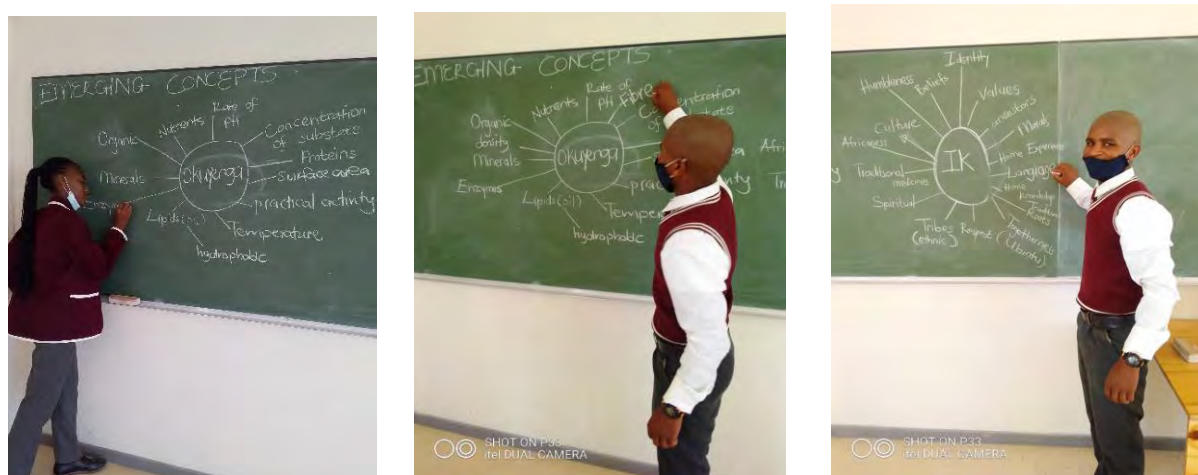


Figure 5.1: Emerging science concepts and indigenous knowledge from *okuyenga*/Ikhamtui oli-e

Some of the concepts that emerged from the presentations were temperature, surface area, enzymes, fibre, nutrients, and hydrophobic just to mention a few. All the above concepts were consolidated into the topic of enzymes. The above mentioned concepts emerged when the community members said that the water added into the mortar was not hot or cold (temperature) but lukewarm, otherwise the oil would not be extracted. As a result, temperature was related to enzymes because low temperature (cold water) deactivates enzymes, high temperature (hot water) denatures the enzymes, and the optimum temperature (lukewarm) is where enzymes function best, hence the use of lukewarm water.

Moreover, surface area was linked to rate of chemical reactions – the larger the surface area (smaller particles) the faster the rate of the reaction. The concept of surface area emerged when the community member said that the marula/melon seed must be crushed so that the process of extracting takes less time. The concept of hydrophobic was related to the cell surface membrane

(phospholipids bilayer) in that the head is water loving (hydrophilic) and the tail is water loving (hydrophobic) – this explains why water and oil do not mix. The concept of lipids was also related to marula oil as a liquid at room temperature. Fibre was related to nutrition as a nutrient that improves digestion and reduces the chances of colon cancer.

Interestingly, when learners were discussing and constructing concepts that emerged from the presentations, certain contradictions emerged. One contradiction was about the rate of reaction (extracting oil) depending on the surface area versus rate of reaction of an emotional person extracting oil as narrated by one of the community members during the presentation. I had to intervene and explain to learners that some of the concepts that emerged were based on cultural beliefs and are not based on any scientific evidence. This finding seems to affirm some scholars such as Cobern and Loving (2001), Hodson (2009), and Horsthemke and Schafer (2007) that IK should be considered as a different knowledge and separated from WS. For instance, Horsthemke and Schafer (2007) rejected the idea of ownership of indigenous knowledge because it is difficult to identify and locate scientific skills embedded in cultural practices.

Throughout the presentations by the expert community members, I could observe that most learners were actively engaged as espoused by Sedlacek and Sedova (2017). Moreover, learners would discuss their observations amongst themselves and ask questions of the community members. At some point, they indicated that they could relate to some science concepts emerging from the presentation. This to me was an indication that learning was taking place.

After the presentations by the two expert community members, learners were asked to reflect on their experiences about cultural beliefs and practices during the presentations by the community members on *okuyenga*. In this regard, L2F and L5M reflected that:

It was a nice presentation, I got to know that okuyenga is only done by us females and not males, this makes me feel unique as a girl (L2F).

I enjoyed the culture of okuyenga; it is very rich in culture but I was disappointed that men are not allowed to take part in okuyenga (L5M).

These above excerpts gave a clear indication that learners did not entirely agree on the aspect of cultural stereotyping in the practice of *okuyenga*/*\\khamtui oli-e*. For instance, L2F felt very privileged to be exposed to the practice which is considered as a female chore. On the contrary,

L5M expressed that it is unfair that males are discriminated against and cannot practice this powerful cultural activity which could empower both genders.

According to Ogunniyi and Hewson (2008), the less powerful idea in my case (gender balance) and the dominant one (IK) should complement each other rather than compete with each other. Some of these learners argued that although they embrace their culture they are against the fact that culture is selective, hence both genders must be exposed equally to *okuyenga*. For instance, L5M and L7M stated that “*Culturally, boys who want to take part in okuyenga are regarded as cowards*”.

This cultural belief might make males distance themselves from the rich cultural practice of *okuyenga* because of such stereotyping. However, during the reflection session, L5M indicated that he went home to ask why boys could not participate in *okuyenga* and he was told that it was just a cultural responsibility of women and per the cultural norms. In addition, L5M also narrated that he was also advised that culture is adaptable, especially nowadays with issues of gender balance, hence in this era, boys should be allowed to participate in most cultural activities including *okuyenga*. This finding has affinity with Mavuru and Ramnarian (2020) who argued that learners tend to engage more when they learn what they can relate to.

5.3 Chapter Summary

In this chapter, I analysed, presented, and discussed the data generated from the stimulated recall interviews and learners’ journal reflections. This was aimed at answering my third research question of my study. The findings revealed that learners understand that integration of indigenous knowledge can help them to understand science concepts. This was evident during the construction of concepts emerging from the community members’ presentations. In addition, the findings also revealed some cultural beliefs such as prohibiting boys from *okuyenga* because they become ‘cowards’ and that an emotional person speeds up the rate of oil extraction, both which are not relevant to science as they are not based on any scientific evidence. In the next chapter, I present the summary of the findings, recommendations, and conclusion.

CHAPTER SIX: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

The main goal of this study was to explore how the indigenous technology of oil extraction from marula nuts and melon seeds (*okuyenga*/*ikhamtuli oli-e*) influences (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of the concept of enzymes. I employed a qualitative research design to generate data using a focus group interview, participatory observation, a stimulated recall interview, and learners' journal reflections. Data in this study were analysed using an inductive approach and discussions were made using relevant theory and literature. A thematic approach to data analysis was employed to come up with sub-themes and themes.

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

- What are the Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?
- How do Grade 10 Biology learners interact, participate, and learn (or not) during the presentations on the indigenous technology of oil extraction by the expert community members?
- How do Grade 10 learners' conceptions, dispositions, and sense making shift/evolve (or not) as a result of the presentations on the indigenous technology of oil extraction by the expert community members?

I thus present a summary of findings in relation to these three research questions. Additionally, recommendations, areas for future research, limitations of the study, and my reflections are presented. The chapter ends with an overall conclusion of the study.

6.2 Summary Findings

Herein, I present my findings in relation to my three research questions.

6.2.1 Research question 1

What are Grade 10 Biology learners' understanding of, conceptions, and dispositions towards the use of indigenous knowledge?

This findings revealed that most learners involved in this study seemed to understand what indigenous knowledge (IK) is. For instance, they viewed IK as a knowledge passed on from one generation to another. Moreover, learners used similar terms such as 'knowledge from the past', 'ancestors', 'storytelling', and 'passed on'. These findings have affinity to Chikamori et al.'s (2019) assertion that IK is orally passed on from the past to the future generations. In this regard, Kibirige and Van Rooyen (2006) and Mukwambo et al. (2014) asserted that IK is verbally passed on from one generation to another. These findings further resonate with Iseke (2013), Smith (2012), and Tzou et al. (2019) who asserted that storytelling is a pedagogical strategy used to transmit IK and wisdom about life. Hence, home experiences and community's culture of storytelling can make learners understand and appreciate their past (Chikamori et al., 2019; Simpson, 2014).

The study further revealed that learners appreciate the benefits of integrating IK and seemed to be positive about the inclusion of IK in the science lessons. That is, they regarded IK as a 'mediation vehicle' to link their prior knowledge to what is taught at school and Aikenhead and Jegede (1999) referred to this as border crossing. For instance, these scholars point out that when IK is integrated it helps learners to learn by relating to their home experiences in order to make sense of school science. This affords learners opportunities to improve their conceptual understanding especially in this study on the topic of enzymes. Erinosho (2013) asserted that the use of IK can serve as a vehicle to pave the way for a broader understanding of science. It is therefore of great cognisance that learners' prior knowledge can serve as a foundation to build on newly acquired knowledge. That means that considering learners' socio-cultural backgrounds will result in new knowledge construction (Mavuru & Ramnarian, 2020; Vygotsky, 1978). For instance, one learner indicated that relating science lessons to everyday home experiences makes science less difficult to understand. This coheres with Nikodemus (2017) who acknowledges that IK is a guiding tool that facilitates the bridge between what is

known to what is unknown. This can result in effective learning as it enhances learners' discussions and promotes participation (Sedlacek & Sedova, 2017).

Although these learners seemed to understand and appreciate the benefits of inclusion of IK, they also revealed that the use of English during teaching deprives them of making sense of science. For instance, L4FSCI lamented that:

I would like to learn more in a traditional way as in our native home language just to get a glimpse of what is really going on, because Biology is in English which is a little confusing (L4FSCI).

This finding supports literature that suggest that through language, learners can construct knowledge and make sense of science (Mavuru & Ramnarian, 2020; Msimanga & Lelliot, 2014; Nhase, 2019). In this way, language becomes a cultural resource which makes science relevant. Notably, when learners decided to thank the Oshiwambo expert community member in their diverse languages, it was consistent with what Khupe and Keane (2017) referred to as cultural connectivity which is essential for cultural revitalisation (Cocks et al., 2012).

6.2.2 Research Question 2

How do Grade 10 Biology learners interact, participate, and learn (or not) during the presentations by the expert community members on the indigenous practice of oil extraction?

It was observed that the practical demonstration of *okuyenga/ikhamtui olie* by the expert community members enhanced social interactions that took place between participants and the expert community members. This finding resonates with Nikodemus's (2017) whose focus was on the use of *oshikundu* to enhance learning of rates of reactions and confirmed that learners develop interest and tend to enjoy learning science if they are taught what they can relate to. This result agrees with Shizha (2007) who asserted that learners engage more when they learn what they can relate to. Similarly, Erinosho's (2013) study also revealed that learners' engagement and participation could have been attributed to the fact that learners could relate to the demonstration by the community member. Hence, curiosity was aroused during the presentations (Vygotsky, 1978).

One could also attribute the high level of participation as a result of the relationship between learners as less knowledgeable others and the expert community members as MKOs as custodians of IK. This finding further resonates with Mukwambo (2016) who postulated that community members are custodians of cultural knowledge or customary knowledge (Smith, 2012).

It could be argued, therefore, that the sharing of cultural heritage by the expert community members in this study symbolises or is an example of how IK can be passed from one generation to another (Kibirige & Van Rooyen, 2006). That is, IK could be used as accessible learning resources to mediate learning of science. To Asheela et al. (2021), the use of accessible materials and resources enhances interactions and paves the way for meaningful and authentic learning in science. Notably also, is that the use of home language by the expert community members enhanced social interactions and participation especially for those learners who belonged to the same ethnic group as the expert community members.

This finding corroborates with the views of scholars who assert that the use of home language allows learners to express themselves comfortably (Diwu & Ogunniyi, 2012; Mavuru & Ramnarian, 2020; Msimanga & Lelliot, 2014). It is precisely the same reason why Vygotsky (1978) argues that language plays an important role in the process of mediation of learning. The community members were also delighted to showcase their indigeneous practice of oil extraction to the learners. For instance, Meme Fiina was happy to share her IK with learners, asserting that it might assist them with understanding their school science better. This coheres with Aikenhead and Jegede (1999) who posited that the gap between home and school science needs to be closed to enable smooth border crossing.

Moreover, there was evidence of Ubuntu from the expert community members as they were willing to continue sharing their cultural heritage and wisdom from their ancestors with each other and with the learners even after my study was completed. For example, Meme Fiina agreed that she would share with Mama Jaco her Aawambo cultural skills of oil extraction. This finding is consistent with Smith (1999) who argued that negotiating and mutual agreement are part of normal practices of harmonising in the community. Thus, the integration of IK by the expert community members could contribute to cultural revitalisation (Cocks et al., 2012).

6.2.3 Research question 3

How do Grade 10 learners' conceptions, dispositions, and sense making shift/evolve (or not) as a result of the presentations on the indigenous technology of oil extraction by the expert community members?

Learners reflected that:

Having traditional knowledge at school is a blessing because I'm being taught a part of who I am and since school is where I spend most of my time, it is a perfect place; plus it is part of Biology, having to be taught referring to something at home will be great (L7MJ).

I enjoyed the practical activity by the community member as it makes us curious because we were from different tribes; you can see how the process is taking place and you can see the traditional tools being used (L2MSRI).

The above mentioned excerpts exemplify that there was some shift in learning as a result of the indigenous practice of oil extraction presented by the two expert community members. Congruent with these findings are Suarez et al.'s (2018) findings that posited that practical presentations stimulate learners' curiosity to learn science. For instance, L2F expressed that she enjoyed seeing the process taking place and tools being used. This resonates with Muvhungu and Rollnick (2013) who asserted that representations serve as teaching aids which can help make sense of what is being taught. In this study, the presentations of the cultural practice of oil extraction by the expert community members served as a form of representation or visualisation which resonates well with Hashondili (2020), who suggested that expert community members' presentations can greatly enhance sense making of science concepts. This was evident in the mind map that learners came up with (see Figure 5.1). In addition, the knowledge from the expert community members' presentations mediated learning and paved the way for contextualising and making sense of the concept of enzymes. This indicates that IK has the potential to be part of easily accessible learning resources which could be used to promote learning with great understanding (Asheela, 2017; Asheel et al., 2021).

Notwithstanding these arguments, at the end of the day learners had different opinions on the issues of gender stereotyping when it comes the cultural practice of *okuyenga* in particular. For example, L9F pointed out that "*Okuyenga must not be for us women only but boys also, otherwise some cultural things will be known only by us girls and not boys*". On the other hand, Meme Fiina argued that "*In our culture, okuyenga is only allowed to be done by women, the men*

are not allowed because it makes the men cowards, men must be out there hunting". In this regard, Govender (2014) posited that a dominant view can suppress a less dominant view, in this case the issue of gender in the practice of *okuyenga*. In contrast, Ngcoza (2019) and Ogunniyi (2007a) maintained that the two different views of cultural beliefs should not compete against each other but rather coexist and complement one another. I, therefore, conclude that the indigenous knowledge of *okuyenga/ikhamtui olie* could be used as an easily accessible learning resource to mediate learning of science. Apart from the concept of enzymes, it can also be used when teaching the topic chemical reactions, nutrition, biological molecules as well as food preservation.

6.3 Recommendations

The study recommends that there is a great need to integrate IK during the teaching of science in schools. The cultural practice of oil extraction (*okuyenga/ikhamtui olie*) in this study sufficed as being effective in mediating learning of enzymes. Thus, the study recommends that teachers should work in collaboration with expert community members as custodians of IK in order to learn about IK which could be integrated in their teaching pedagogies. This concurs with Mukwambo et al.'s (2014) assertion that integration of IK paves the way for Africanisation of the science curriculum. This might assist in retaining and sustaining the notion of Ubuntu/Unhu which might result in the advancement of the culture and dignity of indigenous people (Taylor & Cameron, 2016).

I also recommend that learners should be taken out of the science classroom into the community in order to learn IK and wisdom from expert community members which could assist them in understanding learning of school science. As evidenced in this study, the integration of IK succeeded in changing the narrative of viewing an African child not as a "bundle of Pavlovian reflexes, but as a human being who is culturally and cosmologically located in authentic valued system" (Higgs, 2010, p. 477). Drawing from this quote there must be good collaboration between the school and the community for proper IK to be integrated in schools. This will in turn ensure that learners' cultural heritage is always considered as a starting point of learning (Kibiringe & Van Rooyen, 2006). In this light, teachers should accommodate all learners from all spheres of cultural diversity as pointed out by Mavuru and Ramnarian (2020).

I therefore recommend that platforms should be created at national, regional, and local levels to emancipate teachers by affording them opportunities to collaborate and source IK from

expert community members from different ethnic groups. This will benefit teachers in effectively implementing the integration of IK in schools, resulting in them teaching learners within their cultural contexts (Mavuru & Ramnarian, 2017).

6.4 Areas for Future Research

The study has opened opportunities for possible further research in other topics such as chemical reactions in Grade 10 Chemistry as well as biological molecules in Biology. Secondly, a similar research could be done which involves teachers on the same topic in Biology/Chemistry. Thirdly, it would be interesting to see engagement and interaction between learners and the expert community members if a similar presentation is done in a community member's natural setting as opposed to the school setting. Lastly, a further intervention could be conducted with science teachers to co-develop lessons on enzymes using IK of oil extraction to mediate learning in science classrooms.

6.5 Limitations of the Study

The participants in this study were 25 Grade 10 Biology learners in the Erongo region. For this reason, the sample was quite small and cannot be generalised as representing the whole Erongo region. Nevertheless, the findings provided insight on how indigenous oil extraction (*okuyenga/!khamtui olie*) influenced learners' understanding, conceptions, dispositions, and sense making of the concept of enzymes.

Another limitation was during the translation from mother tongue to English, in this case Oshiwambo to English and Khokhoegowab to English. Although mother tongue plays a crucial role in facilitating discussions, engagement, and encourages participation as reiterated by Msimanga and Lelliot (2014), I am mindful of the fact that in the process of translating from mother tongue to English some information might have been lost or misconstrued. To counteract this limitation, transcripts were double checked together with my critical friend.

The last limitation was that I was a teacher at the school where I conducted the research. My position as a teacher could have influenced learners' participation in the study. As an attempt to address this, the issue of positionality was addressed from the outset that although co-operation throughout this study was highly appreciated, participation was voluntary and participants could withdraw at any time if they felt to do so.

In this study, learners could not sit in proper groups because of the COVID-19 regulation of social distancing. I also observed that learners' voices during interactions and discussions were sometimes not clear because they wore COVID-19 protective masks.

On a final note, if I were to do this study again, I would divide the learners into smaller groups so that I could audio record each group and capture all discussions. This would improve the quality of data in both focus group and stimulated recall interviews.

6.6 My Personal Reflections

As I alluded earlier, this research journey started in 2017 when I was doing my BEd Honours degree at Rhodes University. Things were really tough at the beginning as I was grappling with understanding what research is all about. In my final year, Professor Ngcoza and Dr Nhase introduced the notion of Ubuntu to all scholars doing the science education elective. Ubuntu is the spirit of togetherness whereby people are sensitive toward each other and care for each other (Venter, 2004). Professor Ngcoza's teachings about Ubuntu were quite useful to me as it helped us work in harmony as a community of practice. As we worked together, we cherished the African proverb: *if you want to go fast walk alone but if you want to go far, walk together*. Indeed, we walked together and updated each other on the latest research articles related to our research studies.

Moreover, during my final year of the BEd Honours, we had the privilege of engaging with one of the master's scholars who demonstrated to us the use of the indigenous practice of making *oshikundu* as an easily accessible resource to teach science. That presentation captivated my interest in doing research on IK and science. Although I grew up in a Christian home where cultural practices are not considered and had little knowledge about IK, I was ready to learn. Hence, I registered for my master's degree in science education and embarked on a research study on the influence of integrating IK in teaching of science. At the end of the year 2018, I had to write a research proposal which was intended to guide me on my research focus for my master's studies. I must admit that I struggled throughout the writing up of my proposal but I managed to submit it. In March 2019, I had the privilege of attending a workshop on the introduction to research design at Rhodes University, South Africa. It was only after the research design course that I experienced a paradigm shift on what research is and what its implications are. While at Rhodes University for the research design course, I had an

opportunity to be a participant in ¹³Mama Nolingó's presentation of making ¹⁴*Umqombothi* in a multicultural lecture. Umama Nolingó is a church elder who is a MKO as a custodian of IK in her traditional practice of making *Umqombothi* (Vygotsky, 1978). She demonstrated the making of *Umqombothi* with versatility in terms of her cultural skills with a lot of humility, composure, and confidence. I was impressed by the humbleness and the spirit of Ubuntu/Unhu of Umama. This particular demonstration triggered my interest to carry out a research study on integration of IK in a multicultural science class.

Although it was the first time I had seen the process of making *Umqombothi*, I could immediately relate it to some science concepts that emerged from Umama's presentation. I actually found myself in the space of cultural border crossing from the home context to the school of science (Aikenhead & Jegede, 1999). That whole experience of Mama Nolingó's presentation made me realise that we are sitting on a gold mine of IK and we should collaborate more with expert community members to tap into their wisdom and skills about IK and possibly document it for future generations to come. Henceforth, expert community members like Umama Nolingó, Meme Fiina, and Meme Jaco (my expert community members in Namibia) deserve to be honoured and rewarded for sharing their traditional expertise in IK and for reviving and revitalising our African culture (Cocks et al., 2012).

After the research design course, I had to start with my research proposal and the ethics clearance issue which was a thorn in my flesh. This was not an easy exercise and was a whole new learning experience as I had to redo certain parts of my ethics form and proposal over and over again. At the end of the day, the hard work paid off and was well rewarded as my research proposal and ethics clearance were finally approved.

Furthermore, the mobilisation of IK and collaboration with the expert community members started well in February 2020. All the participants were well informed and ready to carry out this research with me. While we were busy with preparations for our first activity of the focus group interview, COVID-19 broke out and schools had to close because of lockdown. Since our town Walvis Bay was the COVID-19 hotspot in Namibia, the lockdown had to be extended

¹³ Mama is Meme in Oshiwambo and is intended to show respect to a married woman.

¹⁴ *Umqombothi* is a traditional alcoholic beverage made by many indigenous people in South Africa.

further from three months to five months. This caused me to fall behind with collecting data due to the unavailability of participants as a result of the lockdown.

The COVID-19 era made things complicated as we had to get used to the new normal of COVID-19 regulations of social distancing, sanitising, and wearing of masks. Due to COVID-19, it was also very challenging for learners to talk or show their facial/emotional expressions as they had to wear masks. The issue of social distancing also made it difficult for learners to sit in groups. Similarly, the second presentation was delayed because one of the expert community members was registered as an immediate contact of a COVID-19 case in her community. I must also mention that we tried to improvise by using technology to reach out to all participants but due to our different socio-economic backgrounds, technology was new vernacular to most participants and we could not use it. However, because of the commitment of all participants we completed this research study and pulled through the first wave of COVID-19 and are still surviving the challenges of COVID-19. I should also state that all participants of this research study are well and still alive.

From this study, the presentations by the expert community members made me realise how much we as teachers neglect our learners' cultural heritage and prior knowledge. I also came to learn that the use of the indigenous practice of oil extraction can be used to mediate learning of enzymes, chemical reactions, and nutrition. I observed that learners who could speak the same language as the expert community members were actively engaged and participated fully, compared to other learners who could not understand the expert community members' languages. This resonates with Sedlacek and Sedova (2017). In addition, it also made me appreciate the power of home language as it can be used to facilitate engagement and make sense of science (Mavuru & Ramnarian, 2019; Msimanga & Lelliot, 2014; Nhase, 2019).

6.7 Conclusion

This study sought to mobilise the indigenous practice of oil extraction to influence (or not) Grade 10 Biology learners' conceptions, dispositions, and sense making of the concept of enzymes. To achieve this goal, I used a focus group interview, participatory observation, a stimulated recall interview, and learners' journal reflections as my data gathering methods.

The study aimed at finding out if there were any shifts as a result of the presentations by the expert community members. The findings revealed that most learners' conceptions and

dispositions were positively influenced by the integration of IK which certainly assisted them to relate better to the science concept.

The findings from this study validated that the integration of IK in oil extraction mediated learning of science. Secondly, the presentation by the expert community members in mother tongues stimulated most learners to participate and enabled them to engage well with the community members and amongst themselves. However, some female and male participants were not convinced about the cultural belief of denying males in society of certain cultural skills. Notably, most learners acknowledged the benefit of the integration of IK and appreciated the fact that their socio-cultural backgrounds were considered as reiterated by Mavuru and Ramnarian (2020). It also emerged that although learners had a high modern educational standard, they still regarded the expert community members as MKOs as they were more knowledgeable in IK (Vygotsky, 1978).

For instance, L8M agreed that expert community members are traditional scientists and that they gained new knowledge from their presentations. It also emerged that in this study home language was a valuable cultural tool of communication (Khupe, 2014). That is, the use of mother tongues allowed transmission of IK, at the same time allowing learners to express themselves comfortably as reiterated by Diwu and Ogunniyi (2012). In totality, this study contributes to the decolonisation of a more Western-based curriculum which seems to neglect the cultural heritage of an African child. This was made possible through collaboration with expert community members who are the custodians of IK.

This study therefore revealed that the integration of IK has potential for increasing understanding of science during lessons (Erinosho, 2013). Thus, there is great need for teachers to advocate and more importantly consider learners' socio-cultural backgrounds during teaching (Mavuru & Ramnarian, 2020; Vygotsky, 1978).

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Appendices

Appendix A: Permission to conduct research



REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION, ARTS AND CULTURE

Tel: +264 61 2933202
Fax: +264 61 2933022
264 61 2933022

Luther Street, Govt. Office Park
Private Bag 13186

Private Bag 13186

Enquiries: G. Alunene

Windhoek

Gibson.munene@moe.gov.na
13/2/21

Email: Namibia 191/e no,

Ms Manha Ndeyatila Nyamakuti

Email: marthaaimwata@gmail.com

Cell, No 081 405 9540

Dear Ms Nyamakuti,

SUBJECT: PERMISSION TO CONDUCT RESEARCH IN ERONGO REGION

The Ministry wishes to acknowledge receipt of your letter seeking permission to conduct an academic research at schools for your master's degree in Science Education on the topic; "Exploring How the Mobilisation of Indigenous Practice of Oil Extraction from Marula Nuts Influences (or not) Grade 10 Biology Learners' Conceptions, Dispositions and Sense Making Q/ Enzymes in Erongo Region .

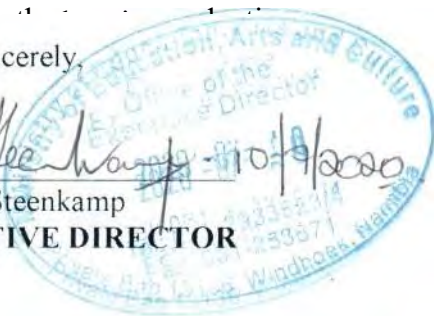
Permission is hereby granted to you provided you seek for further clearance from the Regional Director of Education, Arts and Culture at Erongo region to ensure that.

- permission IS sought from the school principals,
- teaching and learning is not interrupted and
- That all participation IS voluntary.

Furthermore, you are kindly requested to share your research findings with the Ministry after completion of your study. You may contact Mr. G. Munene at the Directorate: Programmes and Quality Assurance (PQA) for submission of a summary of your research findings at the above indicated details.

Yours Sincerely,


Sanet L. Steenkamp
EXECUTIVE DIRECTOR



All official correspondence correspondence must be addressed to
the Executive Director

Appendix B: Ethical clearance letter



29/06/2020

Prof Kenneth Ngcoza

Email: k.ngcoza@ru.ac.za

Review Reference: 2020-1201-3547

Dear Prof Kenneth Ngcoza

Re: Exploring how the mobilisation of the indigenous practice of oil extraction from Marula nuts influences (or not) Grade 10 Biology learners' conceptions, dispositions and sense making of Enzymes.

Principal Investigator: Prof Kenneth Ngcoza

Collaborators: Mrs. Martha N Nyamakuti

This letter confirms that the above research proposal has been reviewed by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) subcommittee and **PROVISIONALLY APPROVED PENDING GATEKEEPER PERMISSION.**

Gatekeeper permission is required from:

a) Ministry of Education, Namibia

Once the Gatekeeper permission letter/s have been received please forward it to the Ethics Coordinator, (s.manqele@ru.ac.za) in order to finalize your ethics approval. Sincerely,

A handwritten signature in black ink, which appears to read "Arthur Webb".

Prof Arthur Webb Chair: Human Ethics Sub-Committee, RUESC- HE

Appendix C: Learners' consent letter

Enquiries: Mrs MN Nyamakuti Cell number: 0814059540

Dear.....(Learner Name)

Re: Participation in research on the integration of local or indigenous knowledge when teaching the topic on enzymes in the Grade 10 Biology class.

I am Martha N Nyamakuti a part-time student doing Master's in Science Education with Rhodes University, South Africa. I am a Science teacher at Tataleni High School. I hereby humbly request your permission for me to conduct a research study with your child who is studying at Tataleni High school. I plan to conduct the study for about two weeks in July 2020. The learners will be required to (a) complete pre and post questionnaires, (b), present in class and (c) interact with community members who will be presenting about indigenous knowledge and related cultural practices about the extraction of oil, and these activities will be observed and I will videotape and interview the learners and the community members, with your permission.

The focus of the study is to explore the learners' conceptions, dispositions, and sense-making when integrating local or indigenous knowledge when teaching the topic on enzymes and to the Grade 10 Biology Class. Kindly be informed that participation in this study is voluntary. It is therefore the right of the parent to decide whether his/her child should participate or not. Also, participants are free to withdraw any time as they wish to do so. The identity and views of the participants will not be revealed, and I will maintain anonymity, and data that will be collected will not be used for other purposes apart from this study.

Please note: Extra support and activities such as worksheets, video lessons and other relevant teaching materials will be made available for all those learners who do not wish to be part of this research and they will not be disadvantaged in any way.

If you have any question about the research, please feel free to contact me at 0814059540, marthaaimwata@gmail.com or my supervisors Prof Ken Ngcoza at k.ngcoza@ru.ac.za and Ms Zukiswa Kuhlana (E-mail: z.kuhlana@ru.ac.za).

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

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

Lastly, if you agree or do not agree to participate in this research, please complete the consent form below.I.....(full name of the learner), hereby confirm that I understand the content of this document and the nature of the research. I henceforth request you to indicate your choice by making a tick (✓) in an appropriate box below.

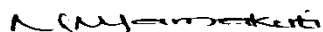
Agree to participate in the study ☐

Do not wish to participate in the study ☐

Signature:..... Date:.....

Yours sincerely.

M Nyamakuti



Appendix D: Letter to the participants' parents

LETTER TO THE PARENTS/GUARDIANS

Enquiries: Mrs N Nyamakuti

Cell number: 0814059540

Dear Sir/Madam

Re: Participation in research on the integration of local or indigenous knowledge when teaching the topic on enzymes in the Grade 10 Biology class

I am Martha N Nyamakuti a part-time student doing Master's in Science Education with Rhodes University, South Africa. I am a Science teacher at Tataleni High School. I hereby humbly request your permission for me to conduct a research study with your child who is studying at Tataleni High school. I plan to conduct the study for about two weeks in July 2020. The learners will be required to (a) complete pre and post questionnaires, (b) present in class and (c) interact with a community member who will be presenting about indigenous knowledge and related cultural practices about the extraction of oil, and these activities will be observed, and I will videotape and interview the learners and the community members, with your permission.

The focus of the study is to explore the learners' conceptions, dispositions, and sense-making when integrating local or indigenous knowledge when teaching the topic on enzymes and to the Grade 10 Biology Class. Kindly be informed that participation in this study is voluntary. It is therefore the right of the parent to decide whether his/her child should participate or not. Also, participants are free to withdraw any time as they wish to do so. The identity and views of the participants will not be revealed, and I will maintain anonymity, and data that will be collected will not be used for other purposes apart from this study.

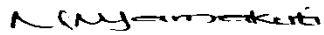
If you have any question about the research, please feel free to contact me at 0814059540, marthaaimwata@gmail.com or my supervisors Prof Ken Ngcoza at k.ngcoza@ru.ac.za and Ms Zukiswa Nhase (E-mail: z.kuhlane@ru.ac.za).

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

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

Yours Sincerely

MN Nyamakuti

A handwritten signature in black ink, appearing to read 'MN Nyamakuti', written in a cursive style.

Appendix E: Letter to community members in English

Letter to the Community Member 1[English version]

Dear Sir/Madam

Re: **Participation in research on the integration of Indigenous knowledge in science**

My name is Martha N Nyamakuti, a part-time student at Rhodes University. I write to kindly request you to participate in my study. The study will involve an intervention comprising of a demonstration of okuyenga /*!khamtui oli* from the community members of which you are going to present how to make Marula oil from Marula nuts. Being someone knowledgeable about the practice of Okuyenga/*!khamtui oli* I trust you that you can run well a presentation to learners and the teacher.

Your participation in this research study will be highly appreciated and is completely voluntary which means that you can withdraw at any time if you wish to do so. The data collected in this study will only be used for academic purposes and shall not be released to anyone else without your consent. I also ask for your permission to take videos of the demonstrations so that I can be able to analyze the lessons after the presentation. Your identity, views or contributions will be treated with a high degree of confidentiality and anonymity.

For any queries concerning the study contact me at 0813191876 or my supervisors Prof

Kenneth Ngcoza (E-mail: K.Ngcoza@ru.ac.za) and Ms Zukiswa Nhase (E-mail: z.kuhlane@ru.ac.za).

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

Yours sincerely

Martha N Nyamakuti

DECLARATION BY PARTICIPANT

I agree to participate in the research, and I understand that I am free to withdraw at any time.

Name.....

Signature.....

Contact number.....

Appendix F: Letter to the community member [Oshiwambo translation]

Omusimanekwa

Re: ekutho mbinga moshinyangadhalwa nkene omuthigululwakalo hagu kwa thele aalongi sikola opo yalonge aalongwa okuvako uunongononi wa kwatelwa mo kuyenga mookaalasa mono muna uunona waza komihoko dhayooloka.

Ongame Martha Ya Nyamakuti ndili omwiilongi kouniversiti ya South Africa, nesimaneko enene ota ndi ku indile opo wuye wu kwadhele nokuningila aalongisikola omadheulo nkene Aantu ha yange omahuku mo Shiwambo.

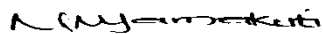
Oshinyangadalwa eshi oshili mee ndondo dili natu. onghatu yo tete, ova longwa ota va ka nyamukula o mapulo yo pa kanya. Eundekolavo no maluundo avo kombinga yok u longifa ounongo wo mu fyuululwakalo oku longa ounongononi.

Omufimanekwa, onde ku pumbwa neh opo uka kwafenge nounongo woye ekutu ulikile onghe okuyenga hakuningwa. embinga mohinya ngadalwa eshi okuliyamba, no to ndulu okulikufamo shama wuundite inopumbwa vali oku ku fa ombinga. Ekufombinga loye ota li ka la lili me holeko nakapena eshi handi kaulukila ina shindja kehalo loye.

Koma uyelele awedwapo denga 0814059540 ilo Prof Kenneth Ngcoza (E-mail: K.Ngcoza@ru.ac.az) and Ms Zukiswa Kuhlana (E-mail: z.kuhlana@ru.ac.za).

Woye

Martha Nyamakuti.



Appendix G: Letter to the community member (Khoekhoegowab translation)

2Æĭ ĀHûhâsib khoe-i æoa hâ sĭ,khanis[Khoekhoegowab FL]

ĀNamsa æGôahesa(t)se

æAromas: Ôaænâdi ænâ Æhaos æhaoænâsi ,ansa Ægoa,uis dis

Tita ge Martha N Nyamakuti, tsĭ Rhodes Universitis tawa ra ÆkhfÆkhfsen. æAromas nĭ sĭ,khanisa ta go xoabas ge sado ,gao,gaoænâsa nĭ ôaænâdi hĭna Kalahari Melons ækhomde xu oli-e Ækham,uis xa ra ægûde Æhaoænâsa. ÆKhfti ta Ænf ,gomægâba sadu ænâ ĩhâs a xui-ao, oli-i di Ækham,uisa ægfsas Āgôana ÆkhfÆkhfsa.

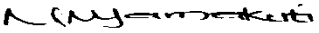
Nĭba ra harehe ,ans ge ÆkhfÆkhfsens di æâse Āgui nĭ sĭsenĭhe, tsĭ Ānĭ æaromas æaroma sĭsenĭhe tide. Mf-amsa ta ge Ækhfti ra ,gan gon-Œesiga ækhœÆnâ tsĭ sĭsenĭsa. Nĭ ta ra ĀhaoĀhao xĭn hoana ta ge sâusase nĭ sĭsenĭ, tsĭ Ākhara khoe-i Ākha Āgoragu tide.

æNfsa ægfsasib æaroma ægôas 081 319 1876 tawa Ākhao-ĭ te tamas ka io ti mû,am-aob Prof Kenneth Ngcoza (E-mails: K.Ngcoza@ru.ac.za) tsĭ æGss Zukiswa Nhase (E-mails: z.kuhlane@ru.ac.za) di tawa.

Sa(t)s ra Æhûi xĭ-e (√) Ākha ,hanu ækhais ai sao re.

Kai ægôasib Ākha

Martha N Nyamakuti

ĀkhauÆnâ


Mĭ-AMSENS ÆHAO-AO-I DIS

Tita ge mf-senxase ra Æhao nĭ ôaænâdi ænâ, tsĭ ra Ænâuæf mâ Æae-i hoa-e ta a ænorasasa Æĭsa xĭ ,oasa.

ĀOns:

Xoaægaos:

Cellphoni ægôas:

Appendix H: Focus group schedule

Adapted from Cetin-Dindar and Geban (2011, p. 89)

What are Grade 10 Biology learners' understanding of IK and conceptions and dispositions towards the use of indigenous knowledge?

Questions	Purpose
• Could you please tell why has your group chosen you to represent them in this focus group interview? • Could please tell me what made you to choose to do Biology in Grade 10? • Could you please tell me what makes you want to learn Biology or not? • Could you please tell me how do you learn science concepts in Biology? • Could you please tell how would you like to be taught Biology and why? • What are your views on local or traditional/ indigenous knowledge? • Do you think home experiences/indigenous knowledge can be used in school? • What relevancy do the Biology concepts that you learn at school have to your everyday life? • Could you tell me about any Biology concepts that are related to the topic of enzymes in your everyday life experiences?	• To put the participant to feel at ease • To establish learners' conceptions towards Biology as a subject. • To establish the factors that influence the learners to learn Biology. • Elicit learners' ideas about the strategies how they learn Biology. • To ascertain the learners' preferences on how Biology should be taught. • To establish learners' understanding about indigenous knowledge. • To establish learners; conception and disposition on the use of IK • To establish if learners are able to relate what they learn in Biology at school to their everyday life experiences. • Elicit learners' ideas about enzymes related concepts in their everyday life.

Appendix I: Analytical framework (Adapted from Atallah et al., 2010, p. 48)

KEY CONCEPT	CONCEPTUAL FRAMEWORKS	RELATED PRACTICES (THE INDICATORS)
Integration of IK	CONCEPTIONS	C1. Describing what is the purpose of learning science.
		C2. Describing what they believe is required to learn science.
		C3. Describing the perceived value of integrating IK when learning science.
		C4. Describing what they believe indicates that have learned science during the presentations by the community members on IK and traditional practices about oil extraction
	DISPOSITIONS	D1. Describing their ability in learning science during the integration of IK when teaching the concept on enzymes.
		D2. Describing their attitudes towards learning science during the presentations by community members on IK and traditional practice about oil extraction
		D3. Describing the learning approaches during the integration of IK when teaching the concept of enzymes.
		D4. Describing their perceived value and evidence of learning science during the integration of IK when teaching the concept of enzymes.

Appendix J : Focus group interview transcripts

What are Grade 10 Biology learners's conceptions and dispositions in relation to the concept of enzymes do Grade 10 Biology learners bring to the classroom?

1. Could you please tell why your group chose you to represent them in this focus group?

L1: I was chosen because it was a fair draw and luck on my side.

L2: It was a decision based on ethnic group to include a person from all ethnic group

L3: It was an ethnic group represented Ovambo, Herero and Damara and I was one of them.

L4: To showcase our diversity and different ethnic group.

L5: Chosen to represent my ethnic group

L6: Q1A: Because I have represented quite a number of groups in the past and they always gotten good marks after my presentation.

2. Could please tell what made you to choose to do biology in grade 10?

L1: Biology is a fascinating subject that really got my attention because biology is compulsory subject to have when doing science and I really wanted to do it because I would like to pursue it in future and it's also part of my future career.

L2: I was part of the subject I choose.

L3: I opted for science field and biology was part of that field and another aspect was that I performed really well in life science in the previous two years and felt Biology was the goal.

L4: I wanted to pursue a career in science field

L5: Chose Biology because I think it is my calling for future interest in human study that is why I chose Biology.

L6: Chose Biology because my future career has to do more with Biology mmmmm..... in life I has gathered more information regarding things we do in Biology.

3. Could you please tell me what makes you want to learn biology or not.

L1: I want to know more about the various components of nature. To study organisms and how they function. I want to understand how human and various life forms came into existence, curiosity made me want to study biology.

L2: I always found it interesting subject because it is so diverse and it explores more about nature and everything that is part of it.

L3: Biology is an amazing aspect of nature as it entails the biodiversity of living organisms, influence of human activities on the environment, population and conservation you name it. I just want to know where I fit on this planet as a human being.

L4: I want to be a psychologist, so I thought in order to do that, I have to know how the body works. It is amazing to have an understanding of how my body like how. the body carries out its functions.

L5: I find it interesting and help me to understand me, my biodiversity.

L6: As I have stated in my previous answer, I would like to gain more information on the living world around me and get general idea on how nature really works.

4. Could you please tell me how do you learn science concepts in Biology?

L1: By studying from books we are given and by doing research and doing experiments where needed.

L2: Firstly, I look at the objectives each component or topic, then I read ahead before teacher explain to see which part I don't understand that I need to focus more.

L3: I observe and try to understand each objective from the beginning of a chapter. It takes me a about a day or two to fully understand a concept in Biology before my teacher explains it to me.

L4: By relating and comparing it to every life that is why it does not make it sound alien or difficult to understand.

L5: We have a syllabus in Biology which is divided into ordinary and higher levels and each of this levels consists of different chapters and the chapters are what we do in class for e.g experiments and other practical work.

L6: I learn them with assistance of my teacher, she likes to really contextualise things for us to understand more easily. She uses example of things we are familiar with, things we encounter from home and our everyday lives.

5. Could you please tell how would you like to be taught biology and why?

L1 ... With more practical work to get a better sense or view of how certain process we are learning are actually taking place.

L2: We want to learn by comparing our lessons to everyday life so that it does not make science sound aliens or difficult to understand.

L3 : I prefer to be taught based on certain concept for example if we are dealing with human anatomy we study, deal with it without leaving any concept because when we skip, mix concept and we can do plant, we go to human and go back it jumbles up concepts of the information.

L4: I would like to learn more traditional way as in our native mother tongues just to get a glimpse of what is really going on because now Biology is in English which a little confusing

L5: I would like more traditional way as in our native mother tongues just to get a glimpse of what is really going on because doing Biology in our official language is a little confusing.

L6: It would be beneficial if our textbook has more practical examples that we can relate to from our country, something familiar and we can relate to something from home.

6. What are your views on local or traditional/ indigenous knowledge?

L1: Important knowledge from our elders at home.

L2: My view on local knowledge is that is knowledge from the past, passed down by our ancestor from long ago unto us.

L3: I believe traditional knowledge originates from my roots, for example being a girl taught certain skills on how to prepare certain means is indigenous knowledge to me.

L4: My view is that traditional knowledge is language we use at home and the things my grandmother is teaching me like old stories and unique way of culturing milk (Omaere) in our Ojiherero culture

L5: Indigenous knowledge is the knowledge from my culture, my identity as as African boy.

L6: Indigenous knowledge is my cultural morals on what to do and what you are not allowed to do in the community.

7. Do you think home experiences/indigenous knowledge can be used in school?

L1: It can be used in school if there is something similar to it being learned in the classroom

L2: Yes, it can be use I just don't know how.

L3: I believe so..... Local knowledge from home experience can be used to make learners understand more of what they already know or have experience about that what they do not know at all

L4: Yes, It can be used like talkin in the language from home to explain schoolwork to us

L5: It depends if the knowledge is important for school

L6: Yes, like the traditional knowledge of working together and respecting each other.

8 What relevancy do the biology concepts that you learn at school have to your everyday life?

L1: Everything that I learn at school in biology..... is related to everyday life.

L2: Certain biological concepts help me understand certain things better around me, forexample, the topic of monohybrid inheritance help me to understand albinism. It is something that happen in our community and help to reduce stigma.

L3: In the concept in Biology, micro-organisms. My mum always make bread but I did not understand how bread rises, I thought it was some sort of magic she did to the bread. When we encountered the concept in class, my teacher taught me that the yeast produced breaks down starch to glucose. Glucose is used for respiration and carbon dioxide is produced which makes the bread like cushion and giving the bread alcohol taste.

L4: The concept relates to me when making dough fat cake, I know I should not use hot water otherwise my enzyme will get denatured.

L5: The topic of enzymes really helps me to understand what happens when I am baking bread or making *omaere*.

L6: As I have perceived through my learning of biology until now is that everything we do in Biology really happens at home or vice versa and that Biology has been there from beginning we just didn't..... What it was.

9. Could you tell me about any biology concepts that are related to the topic of Enzymes?

L1. Digestive system, Nutrition and seed germination.

L2: Immune system, the process of phagocytosis, it contains enzymes called lysosomes to engulf and destroy bacteria. Digestion- has an enzyme in starch amylase.

L3: The human digestive enzymes. I have learned that what every type of food I consume is digested with enzymes.

L4: The digestive system, seed germination and phagocytosis in the immune system whereby lysosomes digest pathogens into proteins

L5: Well for starter we could talk about the preparation of oshikundu, whereby we mix traditional flour called omahangu with hot water and here the hot water is for enzymes to speed up the process..... We also add different powders to activate the

process, then keeping stirring so we stir. Stir until it becomes cold and we add cool water which is diluting it. And we add some oshikundu from previous day and leave it for hours until it is good enough for drinking.

L 6: Digestive system, certain enzymes they digestion example, enzymes breaks down starch into glucose, fermentation, baking.

10. Tell me more on why some of you indicated that you want learning biology to include your experiences from home

L1: Yes, it can be used at school to explain certain topics in subjects

L2: Yes indigenous knowledge is to be used in schools. I believe if indigenous knowledge was to be used in school than our teachers would not know that practice makes perfect. Indigenous knowledge is very important when you are learning practising your cultural knowledge with what you learn in school will help you understand your work better.

L3: Yes it can, instead of using labs and lab utilities, rather invite elders from the villages to carry out and experiment traditionally so we as learners understand it better in our mother tongue. We also learn each other culture and learn together

L4: Yes, most scholars depend on the ovaherero ethnic group of Namibia and have never experienced and activity as such based on enzymes and the power of indigenous knowledge.

L5: True, because it helps to understand to respect and to take note of the true factors of life.

L6: For me personally yes it is important because I believe that it is very important to know where you are coming from and also to understand your culture better. It is also important in school because learners are not taught traditional knowledge because there are no subjects for tradition. It is also important in school because learners are coming from different homes and traditions and it is very nice if they got the chance to learn about one another's cultures or traditions.

Appendix K: Journal reflection questions

1. What is your current view on indigenous knowledge?
2. What did you understand traditional knowledge to be before the community members?
3. What did you enjoy/ not enjoy during the community members' presentations?
4. What did you learn new about traditional knowledge after the presentation?
5. Do you think traditional knowledge is important at home or at school or both?
6. Do you think traditional knowledge can be useful in school?
7. Any other comments/ suggestions

Appendix L: Stimulated recall interview questions

1. How was the experience with the community members?
2. What do you think is indigenous knowledge is.
3. Can knowledge from home be used at schools?
4. Do you consider traditional knowledge important? Explain .
5. What else would you like to share with me regards the presentation by community members?

Appendix M: Journal reflections

Questions	Answers
1. What is your current views on indigenous knowledge?	L1: The culture at home which passed on from one generation to another. L2: My view on local knowledge is that is knowledge from the past, passed down by our ancestor from long ago unto us. L3: I believe traditional knowledge originates from my roots, for example being a girl taught certain skills on how to prepare certain means is indigenous knowledge to me. L4: My view is that traditional knowledge is language we use at home and the things my grandmother is teaching me like old stories and unique way of culturing milk (Omaere) in our Ojherero culture L5: My culture, my identity L6: Indigenous knowledge is my cultural morals L7: I believe indigenous knowledge is knowledge that originates from my roots. L8: I really did not take it to heart although my grandparents practice some their traditional staff slash thing. L9: From my point of view I thought traditional knowledge is the knowledge that is send on from generation to generation. L10: Use to stand at an angle were local knowledge is something that can only be used at the farm but now I know is my heritage.

2. What did you understand traditional knowledge to be before the community members?	L1: Our elders important knowledge L2: I thought traditional knowledge was only for old people. L3: I only knew little about traditional things. But when the community members came and teach us about traditional things more. L4: I thought only old people were to use traditional knowledge because we live in a different generation and have modern ideas. Indigenous knowledge is out-dated and not useful in our time. L5: though it is knowledge that is changing but different in each generation L6: I thought it was only things that were used by early ancestors or in the past and that we cannot use. But what I understand and learned is that our generation can also use it. L7: Local/indigenous knowledge to me is something more like morals and values that are past down from generation to generation. L8: Before I met the community member I thought it had nothing to do with me now because It's what my elders did until I discovered how simply, easy and help traditional knowledge is. L9: I thought traditional knowledge is only for specific traditions I never knew that different traditions share the same knowledge I thought it was just for a specific tradition / culture. L10: thought it was knowledge which is important at home I later came to understand that local knowledge is important for the school
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3. What did you enjoy/not enjoy during the community members' presentations?	L1: : It was a very great experience and I find myself very fortunate to gain such experience. L2: I t was great and it helped us a lot but I think okuyenga must be the responsibility of both male and female, otherwise some cultural things will be known only to us girls and not boys. L3: My experience was amazing, because I learned a lot of things that I didn't know. L4: Truly speaking it was enjoyable, I had so much fun. It only did not teach me how important the local knowledge is, but how our old generation lived. It also taught me that family is important and for you to move forward you need to look where you come from. L5: It was very special and understandable. But I was not happy that okuyenga is only meant for girls. As a boy I want to know skills of okuyenga so that I can have the same indigenous knowledge as girls, culture must not be selective. L6: It was quite, good feeling because they were explaining it in our mother tongue, and it was very nice. L7: It was a wonderful experience but was not happy with the fact that culturally boys who want to take part in okuyenga are regarded as cowards. L8: It was enjoyable and helpful because we got knowledge that some of us have been rejecting. L9: My experience with the community members was very inspiring because they taught me how to make oil from seeds, but. I was not happy with the fact that if a girl child is not interested in okuyenga/lkhamu#ui li-e is like against the culture
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	but if the boy behave in a similar way is considered normal. I do not agree. L10: It was amazing, educational and motivating. It was something to witness, how our community explained very understanding a (especially in our mother tongue). I did enjoy the part where It seems us boys are labelled as less of a man if they like things woen like to do like okuyenga, is it a culture of women, I though culture is for both genders
4. What did you learn new about traditional knowledge after the presentation?	L2: It was a nice presentation, I got to know that okuyenga is only done by us female and not makes, this makes me feel unique as a girl. L3: I thought of the language the youth uses. L4: Know my point of view change, traditional knowledge is a way for me to understand more of many aspects of life. It totally changes my mind-set of certain topics I didn't understand. L5: I enjoyed the culture of okuyenga, it is very rich in culture but was disappointed that men are not allowed to take part in okuyenga, and are regarded as cowards. L6: From my point of view, I think traditional knowledge is the knowledge that has been passed on by our ancestors. L7: As I said before, traditional knowledge are morals and values that are past down from generation to generation. Example: Preparing a traditional meal [Mahangu porridge with Ekaka].

	L8: It is the knowledge or way of life and living that is useful and cheap which has been passed down from generation to generation. L9: I think traditional knowledge is the knowledge that has been passed onto us by our ancestors. L10: I simply think that traditional knowledge is the future of our cultures, country and our continent. It is the knowledge that we got from our ancestors.
5. Do you think traditional knowledge is important at home or at school or both?	L1: Both at home and at school. It is very important to be taught IK in school to understand things better. L2: Traditional knowledge is important at home and at school because it teaches us our moral values and teaches us where we are coming from. L3: At school and at home will be equally important. L4: Traditional knowledge is important at school as it helps us to reflect back home on certain issues that we can relate to and at home for us not to forget our heritage and local knowledge and have a better understanding. L5: Is important at school because the use of mother tongue make me understand the information better in our own language, and we ask questions in mother tongues which we would not have done if it was in English L6: I prefer traditional knowledge at school because it will be a great opportunity to be taught at school because we will be discovering new ways and learning our fellow student's traditions to.

	L7: I consider at both home and school because. having knowledge at school is a blessing because being taught a part of who I am and since school is where I spend most of my time, it is perfect place, plus is part of Biology, having to be taught referring to something at home will be great L8: I prefer at school because modern kids don't get taught at home and school is where they spend most of their time. L9: I prefer traditional knowledge both at home and school because it teaches us where we came from and how our elders lived. L10: I prefer traditional knowledge both at home and at school Like okuyenga, :At school I think this practical activity of okuyenga can also be used to chemical reactions topic which is also a topic and make it easier to understand to understand, just my thinking mam
6. Can traditional knowledge be useful in school?	L1: Yes, we really need this type of knowledge at schools L2: Yes, because it is important for everyone to know their moral values and their traditional background. L3: Yes, because it is important to learn about your traditional ways. L4: Yes, because it helps students like me to understand more on certain topic's because you know how the substance or object look like because you have seen it at home before. L5: Yes, it can be used in schools because it will help students to learn more about the different traditional knowledges that we have in Africa so that we don't only focus on our own traditional knowledge but explore more.

	L6: Yes, because it would give us an idea of how our ancestors lived and what they use to survive. L7: Yes, having traditional knowledge at school will be a blessing because I am being taught a part of who I am and since school is where I spend most of my time it's the perfect place. Plus it's part of biology, having to be taught referring to something at home will be great. L8: Yes, because it would be a very fun and educational experience. L9: Yes, it can be used in schools because it will be a great opportunity for some of the students that don't discuss their traditions at home or even know about their traditions. L10: Yes, because everything we learn in school can always be related to what we do in some way. Makes us understand better, participate more and interact with others.
7. Any other comments/suggestions	L5: I believe boys and girls must all be taught and practice okuyenga so that they have the same cultural skills, Helping Meme Fiina during okuyenga did not make me feel less of a boy, it just make me appreciate my culture and science more