

**EXPLORING THE INTEGRATION OF INDIGENOUS KNOWLEDGE IN  
THE LIFE SCIENCE CLASSROOM: A CASE STUDY OF THREE  
SENIOR SECONDARY SCHOOLS IN THE GERT SIBANDE DISTRICT  
IN MPUMALANGA PROVINCE OF SOUTH AFRICA.**

**by**

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**submitted in accordance with the requirements for the degree of**

**MASTER OF EDUCATION**

**in the subject**

**Natural Science Education**

**at the**

**UNIVERSITY OF SOUTH AFRICA**

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**February 2022**

## DECLARATION

**Student No: 5149-576-7**

'I declare that **'EXPLORING THE INTEGRATION OF INDIGENOUS KNOWLEDGE IN THE LIFE SCIENCES CLASSROOM: A CASE STUDY OF THREE SENIOR SECONDARY SCHOOLS IN THE GERT SIBANDE DISTRICT IN MPUMALANGA PROVINCE OF SOUTH AFRICA'** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.'

Chinenye Constance Elekwa

.....

SIGNATURE

.....

DATE

Supervisor (Prof. N. Nkopodi)

.....

SIGNATURE

.....

DATE

## DEDICATION

This study is dedicated to:

- My late dad Peter Elekwa, my mum Juliet Elekwa and my late sister Ebere Ndubuisi.
- My husband Chimezie and daughter Oluomachukwu.

## ACKNOWLEDGEMENT

I owe the success of this study to the following individuals or groups of people to whom I will be eternally grateful:

- The Almighty God for wisdom, physical and mental strength.
- Prof. Nkopodi my supervisor for his invaluable inputs, continued support and advice.
- My dear husband Chimezie, for always being a source of inspiration and encouragement.
- My dear daughter Oluomachukwu Chiamaka Onyinyechi, for the emotional encouragement from her.
- A host of family and friends who have stood by me and provided encouragement throughout this process.
- The principal, staff and learners of the schools where I conducted my research for their valuable contributions during the data gathering process.

## **ABSTRACT**

The amended Curriculum and Assessment Policy Statement (CAPS) for Life Sciences promotes the idea of grounding knowledge in local contexts in South African schools. However, as inspired as the CAPS may be, it still remains a challenge for educators who do not necessarily know the details of the various indigenous knowledge (IK) within South Africa, and may not be disposed to teach such knowledge.

This is a qualitative case study which was conducted among Life Sciences educators and learners at three schools in Gert Sibande District to explore the educators' and learners' understanding of IK and how the educators integrated IK in their teaching.

The findings from semi-structured interviews, lesson observations and documents revealed a limited understanding of the scientific principles and concepts upon which IK can be integrated into the Life Sciences curriculum. The study offers recommendations regarding the implementation of the integration of IK in Life Sciences.

### **Key words**

Indigenous knowledge; Life Sciences; Educators; Teaching; Integration; Curriculum Assessment Policy Statement; Learners; South Africa; Implementation; Concepts

# **GO SEKASEKA KOPANYO YA TSEBO YA TLHAGO KA PHAPOŠING YA THUTAMAHLALEBOPHELO: NYAKIŠIŠO DIKOLONG TŠE THARO TŠE PHAGAMEGO SELETENG SA GERT SIBANDE KA PROFENSENG YA MPUMALANGA KA AFRIKA BORWA**

## **KAKARETŠO**

Setatamente sa Pholisi sa Kharikhulamo le Asasementa (CAPS) se se fetotšwego sa Thutamahlalebophelo se hlahloša kgopolo ya tsebo ya mathomong ka tlhalošo ya gae dikolong tša Afrika Borwa. Le ge go le bjalo, le ge CAPS e ka ba e hlohleletšwa, se ke tlhohlo magareng ga bobedi baithuti le barutiši bao ba sa tsebego dintlha tša go fapafapana goba bohlokwa bja tsebo ya tlhago (IK) ka Afrika Borwa thutong ya saense. Ka gona, ba kaba ba se na le maswanedi a go kopanya tsebo ge ba ruta.

Nyakišišo e šomišitše mokgwa wa khwalithethifi magareng ga barutiši le baithuti ba Thutamahlalebophelo dikolong tše tharo Seleteng sa Gert Sibande go lekola kwešišo ya barutiši le baithuti ya IK le ka fao barutiši ba kopanyago, goba ba ikemišeditšego go kopanya IK ka thutong ya bona. Go šomišitšwe mokgwa wa dipoledišano tša dipotšišo tšeo di sego tša rulaganywa, mokgwa wa go lekola thuto le tshekatsheko ya ditokomane go kgoboketša datha.

Dikutollo di laeditše gore go na le kwešišo ye e lekanyeditšwego magareng ga baithuti le barutiši ka melawana le dikgopolo tša saense tšeo go tšona IK e ka kopanywago ka go kharikhulamo ya Thutamahlalebophelo. Nyakišišo e fa ditšhišinyo tša ka fao IK e ka kopanywago ka go kharikhulamo ya Thutamahlalebophelo dikolong tša Afrika Borwa.

**Mantšu a bohlokwa:** Tsebo ya tlhago; Thutamahlalebophelo; Barutiši; Go ruta; Kopanyo; Setatamente sa Pholisi sa Asasemente le Kharikhulamo (Setatamente sa Pholisi sa Lenaneothuto le Kelo); Baithuti; Afrika Borwa; Phethagatšo; Dikgopolo

# **UKUHLOLA UKUHLANGANISWA KOLWAZI LOMDABU EKLASINI LESAYENSI YOKUPHILA: UCWANINGO LWEZIKOLE EZINTATHU ZEMFUNDO EPHEZULU ESIFUNDAZWENI SASE-GERT SIBANDE EMPUMALANGA ENINGIZIMU AFRICA**

## **OKUCASHUNIWE**

Isitatimende esichitshiyelwe seNqubomgomo Yombhalo ohlanganisa izifundo Nokuhlola (CAPS) seSayensi Yokuphila sikhuthaza umqondo wokuqinisa ulwazi ezimeni zendawo ezikoleni zaseNingizimu Afrika. Kodwa-ke, noma igqugquzelwe kangakanani i-CAPS, kuyinselelo kothisha abangayazi imininingwane noma ukufaneleka kwemiqondo eyahlukene yolwazi lwendabuko (IK) eNingizimu Afrika esimeni sokufundisa isayensi. Ngakho-ke bangase bangahlomi kahle ukuhlanganisa lolo lwazi ekufundiseni kwabo.

Ucwaningo ngokuchaza imininingwane lwenziwa phakathi kothisha beSayensi Yokuphila kanye nabafundi ezikoleni ezintathu esifundazweni sase-Gert Sibande ukuhlola ukuqonda kothisha nabafundi nge-IK nokuthi othisha bayihlanganisa kanjani, noma bazimisele ukuyihlanganisa, i-IK ekufundiseni kwabo. Izingxoxo ezihleliwe, ukubhekwa kwezifundo kanye nokuhlaziywa kwemibhalo kusetshenzisiwe ekuqoqweni kwemininingwane.

Okutholakele kuveze ukuthi kunokuqonda okulinganiselwe phakathi kwabafundi kanye nabafundisi bemigomo nemibono yesayensi lapho i-IK ingahlanganiswa khona nombhalo ohlanganisa izifundo weSayensi Yokuphila. Lolu cwanningo lunikeza iziphakamiso zokuthi i-IK ingahlanganiswa kanjani embhalweni ohlanganisa izifundo weSayensi Yokuphila ezikoleni zaseNingizimu Afrika.



**Amagama asemqoka:** Ulwazi lwendabuko; Isayensi Yokuphila; Abafundisi; Ukufundisa; Ukuhlanganisa; Isitatimende seNqubomgomo Yombhalo ohlanganisa izifundo Nokuhlola; Abafundi; INingizimu Afrika; ukuqaliswa; Imiqondo

## TABLE OF CONTENTS

Dedication .....	i
Acknowledgement .....	ii
Abstract.....	iii
Table of contents.....	viii
List of Tables.....	xv
List of Abbreviations and Acronyms .....	xvi

### CHAPTER 1: INTRODUCTION AND RESEARCH OVERVIEW

1.1 Introduction .....	1
1.2 Focus and purpose of the research .....	4
1.3 Rationale for the research .....	4
1.4 Research problem .....	6
1.5 Research questions .....	10
1.6 Aims and objectives .....	11
1.7 Significance of the study .....	11
1.8 Context of the study .....	12
1.9 Overview of the dissertation .....	13
1.10 Chapter summary .....	14

## CHAPTER 2: LITERATURE REVIEW

2.1 Introduction .....	15
2.2 Indigenous knowledge and indigenous knowledge system.....	16
2.3 Indigenous knowledge systems connected to a specific community .....	19
2.4 The recent emerging interest in indigenous knowledge in education and development .....	22
2.5 Indigenous knowledge and science teaching .....	25
2.5.1 The South Africa experience .....	25
2.5.2 Integration of indigenous knowledge in the science classroom: the educational benefits.....	26
2.5.3 The importance of incorporating indigenous knowledge into the curriculum .....	30
2.6 Indigenous knowledge and science education in Africa.....	32
2.7 South African school science education and indigenous knowledge .....	38
2.8 The organisation of the life sciences curriculum and specific aim three ....	41
2.9 How to integrate indigenous knowledge in learning of science .....	44
2.10 Challenges of bringing indigenous knowledge into the classroom.....	51
2.11 Chapter summary .....	54

## **CHAPTER 3: THEORETICAL FRAMEWORK**

3.1 Introduction .....	56
3.2 Subsumption theory of meaningful learning .....	57
3.3 The collateral learning theory .....	58
3.4 Cultural border crossing theory .....	61
3.5 Educators as cultural brokers .....	65
3.6 Teaching strategies for educators as cultural brokers .....	67
3.7 Chapter summary .....	70

## **CHAPTER 4: RESEARCH METHODOLOGY**

4.1 Introduction .....	71
4.2 A qualitative case study .....	71
4.3 Research design .....	73
4.4 Location of the study .....	74
4.5 Gaining access .....	75
4.6 Purposeful and convenience sampling .....	75
4.7 Data collection and instruments .....	76
4.7.1 Piloting of Research Instruments .....	76
4.7.2 Document Analysis .....	77

4.7.3 Classroom Observations .....	78
4.7.4 Interviews .....	80
4.8 Data analysis .....	81
4.9 Credibility .....	82
4.10 Limitations of the study .....	83
4.11 Research ethics .....	84
4.12 Chapter summary .....	85

## **CHAPTER 5: DATA ANALYSIS AND PRESENTATION**

5.1 Introduction .....	86
5.2 Data Analysis and Presentation .....	86
5.2.1 <i>Research Question 1: How is Indigenous Knowledge Featured in the Life Sciences CAPS Document?</i> .....	87
5.2.1.1 Representation of indigenous knowledge in the life sciences curriculum .....	90
5.2.1.2 Elements of indigenous knowledge .....	92
5.2.1.3 A variety of indigenous knowledge are linked to science topics .....	96

5.2.2	<i>Research Question 2: What Issues Did Educators encounter in the Implementation of Indigenous Knowledge Topics in the Life Sciences Curriculum?</i> .....	98
5.2.2.1	Challenges in teaching indigenous knowledge .....	100
5.2.2.2	Difficulty in instructional language .....	106
5.2.2.3	Struggle between science and indigenous knowledge .....	109
5.2.3	<i>Research Question 3: How Do Educators Conceptualise the Role of Indigenous Knowledge in the Amended CAPS Document?</i> .....	114
5.2.3.1	Educators' understanding of specific aim 3 of the caps policy document .....	118
5.2.3.2	Educators' understanding of integration of indigenous knowledge in the life sciences curriculum .....	121
5.2.3.3	Educators' ideas of integration of indigenous knowledge in life sciences .....	123
5.2.3.4	Educators' explanations on how to integrate indigenous knowledge into life sciences .....	126
5.2.3.5	Educators' evaluation of integrating indigenous knowledge system into curriculum .....	130
5.2.4	<i>Research question 4: What are views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom? ...</i>	133

5.2.4.1	Learners' Understandings of Indigenous Knowledge in the Life Sciences Curriculum .....	135
5.2.4.2	Learner's Evaluation of Integrating Indigenous Knowledge System into Curriculum .....	137
5.3	Lesson observation results .....	142
5.4	Summary of findings .....	148
5.5	Chapter summary .....	150

## **CHAPTER 6: DISCUSSION AND RECOMMENDATIONS**

6.1	Introduction .....	152
6.2	Discussion of key research findings .....	153
6.2.1	Clarity and Adequacy of Curriculum .....	153
6.2.2	Educators' Content Knowledge and Quality of Instruction .....	155
6.2.3	Language for Science Classroom Instruction .....	158
6.2.4	Relationship between Indigenous Knowledge and Science Ideas.	161
6.2.5	Lesson Planning Capability .....	165
6.2.6	Negative Attitude Towards Indigenous Knowledge .....	167
6.3	Chapter summary .....	169
6.4	Limitations of the study .....	169
6.5	General conclusion .....	170

6.6 Recommendations .....	171
6.6.1 Recommendation for Educators .....	172
6.6.2 Recommendation for Curriculum Designers .....	173
6.6.3 Recommendation for Further Research .....	175
<b>REFERENCES</b> .....	<b>176</b>
<b>APPENDICES</b> .....	<b>193</b>
1. Ethical clearance from the University of South Africa .....	193
2. Request for permission to conduct research from the Mpumalanga Department of Education.....	196
3. Letter to the principals of schools in Gert Sibande District .....	198
4. Letter to the Life Sciences educators of schools in Gert Sibande District ...	202
5. Letter to the parents for minors to participate in a research project .....	206
6. Letter requesting assent from learners in a secondary school to participate in a research project .....	209
7. Interview schedule .....	212
8. Lesson observation schedule .....	216
9. Educators' understanding of specific aim 3 of the curriculum and assessment policy statement (CAPS) for Life Sciences .....	218
10. Educators' understanding of indigenous knowledge in the Life Sciences curriculum.....	220
11. Educators' ideas of integration of indigenous knowledge in the Life Sciences .....	222



12. Educators' explanations on how they integrate indigenous knowledge in their teachings .....	224
13. Educators' evaluation of integrating indigenous knowledge system into curriculum .....	227
14. Challenges faced by educators during the implementation of indigenous knowledge topics in the Life Sciences curriculum .....	230
15. Lesson observation results .....	232
16. Learners' understandings of indigenous knowledge in the Life Sciences curriculum .....	235
17. Learners' evaluation of integrating indigenous knowledge system into curriculum .....	237

## **LIST OF TABLES**

Table 1: Themes and their sources for Question 1 .....	88
Table 2: Themes and their sources for Question 2 .....	99
Table 3: Themes and their sources for Question 3 .....	115
Table 4: Themes and their sources for Question 4 .....	134
Table 5: Educators' understanding of specific aim 3 .....	218
Table 6: Educators' understandings of indigenous knowledge .....	220
Table 7: Educators' understandings of integration of indigenous knowledge in Life Sciences .....	222

Table 8: How the educators integrate indigenous knowledge into Life Sciences lessons .....	224
Table 9: How the educators expressed both positive and negative perceptions of the role of integrating indigenous knowledge in the Life Sciences curriculum in regards to learners' benefits .....	227
Table 10: Educators' challenges in teaching topics related to indigenous knowledge.....	230
Table 11: Representation of indigenous knowledge in Educator 1 lesson observation .....	232
Table 12: Learners' understandings of indigenous knowledge .....	235
Table 13: Learners' attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits .....	237

## **LIST OF ABBREVIATIONS AND ACRONYMS**

CAPS:	Curriculum and Assessment Policy Statement
ESR:	Education for Self-Reliance
FET:	Further Education and Training
ICT:	Information and Communications Technology
IK:	Indigenous Knowledge

IKS: Indigenous Knowledge Systems  
NCS: National Curriculum Statements  
NSC: National Senior Certificate  
PCK: Pedagogic Content Knowledge

# CHAPTER 1

## INTRODUCTION AND RESEARCH OVERVIEW

### 1.1 INTRODUCTION

The worldwide accomplishment of the 'science for all' method and the African educational reform has given rise to various thoughts on the way learners relate their indigenous knowledge to the western science taught in school (Jegede & Aikenhead 1999:45). Learning school science may help learners to solve problems and understand their everyday life experiences in a better way (Hewson & Ogunniyi 2011:683). This could be achieved when learners learn scientific ideas effectively and meaningfully in the classrooms. Thus, there should be a connection between the science learnt at school and what learners already know, which includes indigenous knowledge. Consequently, this has led to some countries such as South Africa to include indigenous knowledge in the school curriculum. Since 2003, the school curricula in South Africa has been reformed on the basis of including indigenous knowledge throughout the entire school system (Department of Education 2003:4). South Africa is a country with diverse cultures and local knowledge which are relevant to the people. Therefore, it will be a positive development of including indigenous knowledge in school as this will give opportunities for indigenous knowledge to interact with western science (Le Grange 2007:581).

After 1994, South Africa has continued with the goal of reforming the country's school curriculum to integrate diverse indigenous knowledge in the educational system in assisting learners to have self-esteem rooted in the construction of their individual traditional knowledge (Department of Education 2003:9). It is no more a new idea to incorporate indigenous knowledge and practices in South African schooling system. The National Curriculum Statements (NCS) for Grades 10 to 12 and Revised National Curriculum for Grades R to 9 were developed in 2003. These curricula were on the

basis of 'science for all', and in keeping with the socio-political environmental transformation. They also intended to discuss the legitimacy of cultures regarding the knowledge and values of South Africans. Theoretically, this would provide learners with necessary grounds for learning effectively, and promoting awareness of different views in this diverse society, and with hope, it would also make better the level of achievement rates in the sciences (Hewson & Ogunniyi 2011:680). The implementation of the NCS for Grades 10 to 12 started with Grade 10 in 2006 and continued in other grades gradually in the following years. Despite these efforts and the fact that there are diverse indigenous knowledge system in South African, a deserved attention needed has not been given to the topic (Le Grange 2007:581).

As noted above, there is a wide recognition of the need to incorporate western science and indigenous knowledge in promoting diverse science learning environments in schools. The South African amended Curriculum and Assessment Policy Statement (CAPS), "aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives" (Department of Basic Education 2011:4). The CAPS document implies the incorporation of indigenous knowledge (IK) in the science curriculum for learners to learn within their traditional knowledge context. Indeed, the CAPS document underscores the principle of "valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution" (Department of Basic Education 2011:5). The formulated principles and aims of the CAPS document are attained through the specific aims that described the cognitive competencies to be achieved by learners. For instance, the CAPS document encourages learners to appreciate and understand the history, importance and the applications of Life Sciences in society (Department of Basic Education

2011:17). This refers to the Specific Aim 3 of the curriculum, which emphasises on the relationship between indigenous knowledge and science. The year 2014 marked the ninth year since indigenous knowledge has been included in the South African school curriculum and three years since the implementation of the amended CAPS in Grade 10. Jegede and Aikenhead (1999:1) call the development towards 'science for all', which had contributed as a part of including IKS in school. The question is whether the policies are being implemented as intended?

An imperative aim of science education is to incorporate clear and inherent meanings specified in the curriculum into the dominant culturally determined worldview templates of learners (Ogunniyi 2014:2). Globally, it is expected of educators to conform to changes in curriculum policies (Mudaly & Ismail 2013:179). However, many practicing educators in South Africa disagree on the curriculum change since the amended curriculum expects more from teachers (Hewson, Javu & Holtman 2009:6). Sadly, the educators who are required to enact the new curriculum have not been adequately prepared for the implementation of the curriculum in the classrooms (Ogunniyi 2014:1). Educators indicate that there is minimum assistance regarding the real content and pedagogic content knowledge (PCK) of incorporating indigenous knowledge in science. Ogunniyi (2007:963) and Govender (2009:119) confirm this, by emphasising that some science educators do not implement curriculum which include IKS, as they have little relevant skills and knowlegde. This suggests that curriculum reform "is fraught with tensions, conflicts and contradictions that are necessary for change to occur" (Maistry 2011:119).

The integration of indigenous knowledge and science has been a contentious issue in South Africa and elsewhere (Diwu & Ogunniyi 2013:333). In this study, integration might begin from the perspective of indigenous knowledge and seek relevant scientific knowledge and be taught in a manner that works properly for African children.

Consequently, the study intends in exploring teachers' understanding on how they integrate indigenous knowledge in Life Sciences and to investigate how teachers reconcile indigenous knowledge and Life Sciences effectively in the teaching of Life Sciences in the classroom. The achievement of a successful incorporation of indigenous knowledge into science learning could only occur when teachers understand the meaning of incorporation of indigenous knowledge and possess the capability of integrating indigenous knowledge in the teaching (Le Grange 2007:581). There is need for teachers to find a means of making science to be relevance to learners' lives. This study therefore aims to ask, "How and to what level do educators incorporate indigenous knowledge system (IKS) in the teaching of Life Sciences"? To this end, this study seeks to explore, through a qualitative case study, the way indigenous knowledge has been integrated and mediated by Life Sciences educators in their teaching in three senior secondary schools in the Gert Sibande district of Mpumalanga.

## **1.2 FOCUS AND PURPOSE OF THE RESEARCH**

This study focuses on the integration of indigenous knowledge in science and related teaching practices, specifically to Life Sciences in South Africa. The purpose of this study is to explore how teachers understand the integration of indigenous knowledge in science and to investigate how teachers effectively integrate indigenous knowledge into the teaching of Life Sciences in the classroom. Thus, the study focuses on a group of Grades 10 to 12 Life Sciences teachers in three secondary schools in the Gert Sibande district of Mpumalanga.

## **1.3 RATIONALE FOR THE RESEARCH**

A number of factors aroused the researcher's interest in this topic. The first was the researcher's experience in school as a young learner in Africa. Studies in science have revealed that in several cases it is contradictory for indigenous learners to make sense

of the science because of the way indigenous people make sense of their lives (Aikenhead 2006:20). The researcher as one of the many African children that construed school science to be abstract, unexciting, disengaging, poorly taught and difficult to relate to. This implies that the school science learnt by the researcher did not connect explicitly to the researcher's' daily experiences.

Secondly, the researcher's interest in this study arises from the knowledge and ideas developed in her Bachelor of Education Honours module, "Current issues in Science Education", which comprised of Indigenous Knowledge Systems (IKS) unit. The researcher's recent experience in the module exposed her to the current challenges in science education, mainly the challenges involving the incorporation of IKS in teaching of science in schools and its implications within a non-western context like Africa. For this reason, the researcher developed interest to explore the way current incorporation of indigenous knowledge can link the difference between the experiences of learners and learning of science at school in South Africa. Since, the indigenous knowledge which includes daily experiences of learners could be brought in the classroom; thus it becomes relevant that teachers and policy makers start to explore the way these experiences can be reconciled with learning of science in school. It is against this background that the researcher's interest to explore the integration of indigenous knowledge in the teaching of science in the classrooms by teachers in South African schools grew tremendously.

Lastly, the current global discourse by various African scholars, African governments and the United Nations Organization on the value of integrating indigenous knowledge in school systems in Africa (Diwu & Ogunniyi 2013:334; Government of South Africa; Nkopodi & Mosimege 2009:377; UNESCO 2006:7), further stimulated the researcher's interest. School science should be made relevant to the learners' daily experiences to yield more meaningful and effective learning. To support this view, Srikantiah



(2005:1) suggested that indigenous knowledge (IK) can serve as a strong tool in teaching learners in schools. To achieve this, there is a need to ensure that the contexts in which knowledge is applied are those important to learners and indigenous people, not just to science.

With the growing awareness on the value of indigenous knowledge to sustainable development and its relevance to common daily activities, it is of importance for teachers and curriculum developers to start exploring the way indigenous knowledge can be incorporated successfully in science learning, and also look at the challenges that affect teachers' efforts to incorporate indigenous knowledge in school curriculum. This study is a contribution to such efforts.

#### **1.4 RESEARCH PROBLEM**

Indigenous knowledge has become one of the important issues in global discourses on strategies to solve economic, social, political and environmental problems of African countries, of which South Africa is part. The incorporation of indigenous knowledge in science has received more attention in both academic and social circles in South Africa. However, according to Mehta et al. (2013:2) education on the way to integrate indigenous viewpoints in the study of science at all academic levels is lagging in some disciplines and virtually absent in others. Evidence has shown that western science has been taught at the expense of indigenous knowledge in most science classrooms around the world (Snively & Corsiglia 2001:6; Quigley 2009:80). Nevertheless, interest in integrating indigenous knowledge and science is steadily growing along several lines of argument (Houde 2007, in Bohensky & Maru 2010:1). Increasing attention has been given to the value of indigenous knowledge in science in the area of cultural survival, environmental responsibility and sustainable development (Emeagwali 2003:2). However, indigenous knowledge has long been and continues to be assigned a lower status in both development and scientific circles

than western-based science and technology (Quigley 2009:76). Despite all these criticisms and surging attention, much has not been done to guarantee the maximum use of indigenous knowledge for the common good in public education, particularly in sub-Saharan Africa (Mawere 2015:57)

The Life Sciences CAPS Specific aim 3 states that the learner will be able to show the relationship between Life Sciences and indigenous knowledge (Department of Basic Education 2011:17). Thus, it is assumed that teachers know of these relationship and their significance. Also, the fundamental idea of the policy statement is that teachers possess the basic knowledge and instructional skills to integrate indigenous knowledge into school science in the classrooms (Jacobs 2015:165).

Science education in Africa has undergone criticism because of lack of relevance to African cultures, being a collection of facts from western science with little or no adaptation and pedagogy that is less critical and less oriented to transmission of fact (Shizha 2010:28). This has led to the desire to change the curriculum in some African countries to include relevant contexts that encompass the cultural aspect of science as human activity, in science learning in schools (Mashoko 2014:528). The concept of multiculturalism as a teaching approach have been adopted in current curricula in some African countries to describe science in school (Mashoko 2014:529). Also, many science professionals and teachers have little understanding of the value of indigenous knowledge or its cultural context (Kimmerer 2002:432). Regardless of these huge efforts by several science curricula to broaden the context of science education globally and integrate the cultural aspects, school science in the African context and content remains in a western form (Mashoko 2014:529). Thus, it implies that the content of science reflects western forms with little or no indigenous sciences important to the lives of learners.

The educational developments in South Africa since 1994 has focused on the reconstruction of the curriculum in the education system at all levels to reflect the diverse indigenous knowledge and to promote social change and empower learners in South Africa (Department of Education 2003:9). As inspiring as the amended CAPS may be, science educators who do not know the necessary details of the several indigenous knowledge systems (IKS) within South Africa may face challenges to teach such knowledge in the classroom (Hewson et al. 2009:5). Despite these tremendous efforts to incorporate several cultural groups, it becomes challenging for teachers in South Africa to apply this in the classroom, particularly in science and mathematics classrooms (Nkopodi & Mosimege 2009:377).

Science educators' do not fully understand how to implement the principle of the incorporation of indigenous knowledge into science, and research on this is still ongoing (Abah, Mashebe & Denuga 2015:668; Dziva, Mpofu & Kusure 2011:88; Ogunniyi 2005:1; Ogunniyi 2007:964 & Ogunniyi & Hewson 2008:160). Educators play vital roles in attaining a successful and effective incorporation of both science and indigenous knowledge in the classroom. Although some studies have been carried out in South Africa on the implementation and the difficulties educators faced in the incorporation of indigenous knowledge and school science (Hewson & Ogunniyi 2011:679; Keane 2008:587; Mavuso, Olawale & Mkosi 2021:1; Ogunniyi & Hewson 2008:159 Wiebesiek-Pienaar, Letsekha, Meyiwa & Feni 2014:159), to the best knowledge of the researcher, there is no clear evidence of any large scale research in Mpumalanga investigating the implementation of the incorporation of indigenous knowledge in the Life Sciences classrooms. Hence, the need to investigate the role of educators and their understanding of the integration of indigenous knowledge in Life Sciences in the Mpumalanga Province, South Africa.

Learners have the impression that cross-cultural perspectives have little application to the sciences due to the lack of incorporation of cross-cultural competence with science (Kimmerer 2002:434). Urgently, it is necessary to enhance how indigenous knowledge is transmitted to complement school education. This involves making local peoples' indigenous knowledge and the supposed "positive" knowledge to be part of science created by the people, particularly teachers who have the opportunity to create and authenticate science curriculum in the school (Shizha 2010:35). However, the science that is practised unknowingly in the everyday lives of the people is isolated from school science. Provided that the teaching of science is not affected and not linked to the learners' daily lives, it will be surprising that science remains unpopular and learners are not successful to learn the science (Hewson et al. 2009:7). The learners' variety of life experiences are neither integrated into the classroom nor linked with Life Sciences concepts.

Ugwu (2013:3) asserts that "the local knowledge/experiences are abandoned for modern science". This results to science being isolated, abstract or clinical in the context of a classroom (Seraphin 2014:12). The abandonment of the indigenous knowledge and practices of communities for academic ways of teaching and learning science makes science abstract to learners (Ugwu 2013:3). These challenges of science being abstract and having no relevance to daily activities are being experienced by learners, educators and policy makers. The various challenges faced by teachers and curriculum designers include appropriate monitoring tools, work overload, lack of clear policies, selection of appropriate materials to be included in the curriculum as well as lack of professional development (Mavuso et al. 2021:13-14).

Consequently, teachers should understand how to incorporate indigenous knowledge in science teaching and be competent enough to expand and incorporate more flexible, more legitimate and a broader cultural viewpoint and knowledge construction

identity. It is then necessary to monitor properly on the way and the level this could be attained by teachers in science teaching. Needless to say, more research studies are even needed to explore the process of learning undergoing in a science classroom and to find out the extent indigenous knowledge is incorporated in science classrooms by teachers.

However, the question concerning the way educators incorporate indigenous knowledge in everyday classroom interactions and their attitude towards incorporating the latter in science classrooms still needs to be addressed. We need to rethink how we can acknowledge, accommodate and represent the indigenous knowledge of learners in our science classrooms. Therefore, based on this ground, this study seeks to investigate teachers' understanding on the integration of indigenous knowledge and the way they mediate indigenous knowledge effectively in the teaching of Life Sciences in the classroom in the context of Gert Sibande District. The study investigated four research questions as we turn to the next section

## **1.5 RESEARCH QUESTIONS**

The following four sub-questions guided this study.

- How is indigenous knowledge presented in the Life Sciences CAPS document?
- What issues do educators encounter in the implementation of indigenous knowledge topics into Life Sciences curriculum?
- How do educators conceptualise the role of indigenous knowledge in the amended CAPS document?
- What are the views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom?

## **1.6 AIMS AND OBJECTIVES**

The main aim of the research is to investigate teachers' understanding of the integration of indigenous knowledge and to investigate how they mediate indigenous knowledge effectively in the teaching of Life Sciences in the classroom.

The specific objectives of the study are:

- To find out how the content proposed under indigenous knowledge topics is represented in the CAPS document.
- To determine the classroom practices, communication between educators and learners, educators' lesson organisation, development of scientific ideas, achievement of specific aims and assessment.
- To explore teachers' knowledge about indigenous knowledge and science, teachers' attitude towards indigenous knowledge in relation to content and how they valued indigenous knowledge content in relation to learners' benefits.
- To identify the views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom.

## **1.7 SIGNIFICANCE OF THE STUDY**

The findings of the study will make a significant contribution and raise awareness in enhancing educators' understanding of indigenous knowledge and science, which is new and rarely touched in academia; it will enhance educators' capability to incorporate indigenous knowledge and science in the classrooms including how indigenous knowledge is translated and communicated. The study will be of value to inform curriculum planners as it will attempt to provide findings and recommendations that will make valuable contributions to the implementation of the curriculum by

ensuring effective training of teachers, specifically on integrating indigenous knowledge into science classrooms. Furthermore, a study of this nature is critical to educational institutions to make some fundamental changes in providing adequate guidance and support required to successfully integrate indigenous knowledge into mainstream science in the classrooms.

### **1.8 CONTEXT OF THE STUDY**

This research was carried out with 15 teachers from three high schools in Gert Sibande District. The Gert Sibande district constitutes the following categories of schools: black, white and Indian schools. The three schools in the district were categorised as 'under resourced' and 'well resourced'. This study was conducted in one well-resourced high school and two under-resourced high schools. The 'well-resourced' schools are the former model C schools which are mainly situated in the historical white suburbs of Gert Sibande central. The model C schools are typically multicultural with higher tuition fees, adequate facilities and conducive learning environments. Educators in model C schools are from varied cultures and, this could be an opportunity to help learners in incorporating their indigenous knowledge that would lead to understanding of science. The incorporation of indigenous knowledge in the classrooms can be facilitated if educators have similar cultural experiences with the learners. Also, learners in former model C schools are from different cultures with different traditions, experiences and beliefs in classroom. This diverse cultures could be advantageous to learners in the way they understand and learn in the classroom. The learners in under-resourced schools come mostly from the Zulu cultural background and are situated in the historically black suburbs of Gert Sibande townships. These schools provide no or low school fees, inadequate facilities and poor learning environments. Learners mostly speak Zulu, and also present their indigenous knowledge and tradition similar to the model C schools which, again, will serve as a

very important role on how they understand and learn in the classroom. Despite the inadequate learning facilities, teachers usually have similar cultural experiences with the learners. Thus, the shared cultural background should play a relevant role on how indigenous knowledge is incorporated in the classroom.

## **1.9 OVERVIEW OF THE DISSERTATION**

This research is organised in six chapters:

### **CHAPTER 1: Introduction and research overview**

The chapter one outlines the introduction, the background and rationale, the aims and objectives, problem statement and research questions, significance and context of the study and an overview of the study.

### **CHAPTER 2: Literature review**

The chapter two focuses on the overview of literature on indigenous knowledge, indigenous knowledge system, emergence of interest on the integration of indigenous knowledge, indigenous knowledge in science education, science education in South Africa and the challenges faced by educators to bring indigenous knowledge in the classrooms.

### **CHAPTER 3: Theoretical framework**

This chapter three unpacks and elucidates the theoretical framework that underpins this study. Chapter 3 focuses on collateral learning, cultural border crossing and subsumption theory of meaningful learning.

### **CHAPTER 4: Research methodology**

The chapter four provides a discussion of the research methods and design employed in this study. This chapter will also present the research site, sampling methods, data gathering techniques, data analysis, credibility of the study and research ethics.



## **CHAPTER 5: Data analysis and presentation**

The chapter five focuses on the analysis of data and findings of the study gathered from the participants taking part in the study in Gert Sibande District. References to the literature are analysed and interpreted.

## **CHAPTER 6: Discussion and recommendations**

This chapter six discusses the summary of the findings related to the emerging literature in the field and the theoretical framework for the study. Recommendations for educators, curriculum designers, and further research are be made.

### **1.10 CHAPTER SUMMARY**

In this chapter, which is the introduction and research overview, the researcher discussed the background and rationale, the aims and objectives, the statement of the problem and research questions, significance and context of the study.

In the next chapter, the researcher discusses the literature relevant to this research.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

The contentious concerns surrounding indigenous knowledge ranges from its recognition and meaning in educational development, to its importance and who owns it. In regards to these debates, this research lay emphasis on indigenous knowledge in regards to effective and meaningful teaching, particularly to science teaching in the amended CAPS document in South Africa. As the Life Sciences CAPS document urges the integration of indigenous knowledge in the classroom, there is need for educators to integrate indigenous knowledge in the teaching. Learners will be able to understand well about the physical, biological, technological, societal and environmental practices that affect the environment such as conservation and sustaining the environment, health promotion, production, storage, distribution and consumption of food. When indigenous knowledge is incorporated in school, learners connect well with the concept being taught and could be a main source for sustainable development in their community (World Bank 2005:2; Brayboy & Castagno 2008:733).

Semali and Kincheloe (1999:3) explore the ideas underlying the present arguments, questions and attention to indigenous knowledge in schools and educational development. Mosimege (2005:31) argues that although, various educational groups have recognised indigenous knowledge, however a proper place has not been assigned to indigenous knowledge in the current system. Semali and Kincheloe (1999:3) assert that it has reach to a point where indigenous knowledge has to change from just being discussed to a practical application in teaching. The school community (educators, departmental officials, learners and parents) should assist one another in order to have an easy transmission of knowledge that could make learners to experience more positively.

Indigenous knowledge is an indispensable part of study. It embraces varied experiences which are brought to bear in an attempt to improve learners' everyday lives. Also, by incorporating indigenous knowledge in school, the specific cultural and social identities of the learner will be recognised. Similarly, the integration will spread throughout the boundaries of teaching and outside the school. This will make the learning of science effectual since such a strategy will make the learners see science as part of daily life activities (Ameyaw & Amankwah 2014:313). Learners will get more skills for their daily lives, for example socialisation and problem-solving skills. Also, learners will have the opportunity to evaluate and analyse critically the information and be aware culturally and ethically. All these will be explored in the subsequent sections.

## **2.2 INDIGENOUS KNOWLEDGE AND INDIGENOUS KNOWLEDGE SYSTEM**

The present use of indigenous knowledge (IK) in educational and development circles is confusing (Semali & Kincheloe 1999:3). Although, some scholars have indicated interest about indigenous knowledge, yet no agreement has been reached as to the meaning of indigenous knowledge (Ngulube & Lwoga 2007:118). To ICSU (2002:5) what indigenous knowledge means is hard to define clearly. Different terms have been given to indigenous knowledge, and these have raised questions regarding the cause of its current attention in educational development. It is because of the difficulty to get an acceptable definition of indigenous knowledge by some researchers that led to various alternative terms like “folk knowledge”, “local knowledge”, “traditional environmental knowledge”, “indigenous”, “native knowledge” and “rural knowledge” (Berkes, Colding & Folke 2000:1252; Hay 2009:196; Hunter 2003:3). The literature reveals that, the definition of indigenous knowledge by researchers is similarly linked to any kind of knowledge upheld together by a group of people to reflect how they view and interpret the world.

Semali and Kincheloe (1999:3) explain that “indigenous” comprises of a local community of where certain people live and being differentiated by the aspects of their shared cultures. For Owuor (2007:23) the term “indigenous” “refers to a specific group of people defined by their cultural territories, collective cultural configurations and historical ties”. Shizha (2013:3) view indigenous knowledge as a heritage of skills and knowledge that are specific to any local culture. Odora Hopper (2005:2) regards IK as the all the total practices and knowledge, which may be clearly expressed or inherent employed in managing ecological, socio-economic and spiritual aspects of life. Indigenous knowledge is the local knowledge rooted in the people’ culture that contributes to their daily experiences and sustains their way of life (Mkabela 2006:5; Moahi 2007:2). This means that it might be difficult to separate indigenous knowledge from the people that possess and produce it.

Shava and O’Donoghue (2014:4) say IK could be transmitted orally by people in the form of dance, songs, arts, poetry, stories, folktale, craft ware, hunting, crop farming, keeping livestock and traditional healing from one generation to another. Indigenous knowledge is made of all knowledge inclusive of existed and current practices and technology utilised by specific people to survive and adapt in a diverse environments; and these are knowledge that comes from engineering, mathematics, architecture, governance, agriculture, medicinal and different local plants and social activities. (Onwu & Mosimege 2004:2). Moahi (2007:2) posits that local knowledge originated from the experiences shared by individuals in a specific locality.

According to UNESCO (2010:2), indigenous knowledge “encompasses knowledge and practices that are unique to particular communities, cultures or societies”. “Indigenous knowledge is the complex set of activities, values and practices that has evolved cumulatively over time and is active among communities and groups who are its practitioners” (Owuor 2007:23). This implies that, IK is gained through the

interaction between people and their environments. Similarly, Semali and Kincheloe (1999:3) point out “that indigenous knowledge reflects the dynamic way in which individuals who live in a given locality have come to understand themselves in relationship to their natural environment and how they organize that folk knowledge of flora and fauna, cultural beliefs and history to enhance their lives”. In agreement with this view, Barnhardt and Kawagley (2005:10) see indigenous knowledge to be a way of knowing. There are some aspects of indigenous knowledge that are common among diverse communities, although indigenous knowledge is specific to a particular community. (Sillitoe 2006:3). For example, the process of preparing traditional beer is widespread among diverse communities, with only slight differences.

Mashoko (2014:531) “defines IK as information base or skills for a society which facilitates communication and decision making”. Indigenous knowledge is regarded as a knowledge developed, owned and used by non-western people in a particular society and context to sustain their daily survival (Semali & Kincheloe 1999:3). Though the terms “indigenous knowledge” and “indigenous knowledge system” are frequently used in a synonymous manner, Vhurumuku and Mokeleche (2009:98) “define IK as referring to elements of knowledge or knowing that are part of IKS”.

Some scholars in the field have used the terms “indigenous knowledge” and “indigenous knowledge system” interchangeably. In various instances, the “system” ascribed to indigenous knowledge denotes the scientific, technological, economic and social identities of local individuals (Hoppers 2002:8). With regard to science education, indigenous knowledge system includes knowledge of climatology, forest resource management, fishing, agriculture, in addition to teaching, pharmacology, engineering, veterinary science, architecture, medicine and architecture (Hoppers 2002:8). Ogunniyi (2007:965) regards IKS as “a conglomeration of knowledge systems

encompassing science, technology, religion, language, philosophy, politics, and other socio-economic systems”.

Vhurumuku and Mokeleche (2009:98) see “IKS as worldviews with their own ontology and epistemology”. IKS is the totality of the skills and knowledge possessed by people in a specific environment that allows them to survive (Hoppers 2005:2). Indigenous knowledge systems are transmitted, maintained and retained in a particular locality for education and sustainability (Shizha 2013:4). In agreement with this view, Onwu & Mosimege (2004:2) argue that IKS is inclusive knowledge that have existed and currently used by individuals to survive and adapt in a diverse environments. This means that indigenous knowledge is part of indigenous knowledge systems.

In the South African context, Indigenous Knowledge Systems is a body of knowledge rooted in African social practices and philosophical thinking that have developed over thousands of years (Le Grange 2004:204). The indigenous knowledge has existed and practiced by people long before the arrival of the colonial masters in Africa, thus the knowledge is suitable to be referred to as indigenous. For the purpose of this research, the terms “indigenous knowledge” (IK) and “indigenous knowledge system” can be used in an interchangeable manner.

### **2.3 INDIGENOUS KNOWLEDGE SYSTEMS CONNECTED TO A SPECIFIC COMMUNITY**

Various Indigenous groups are situated in several parts of the world. Some examples of local practices specific to a community are discussed as follows:

The Djitoumou and Bambara agropastoralists of Mali have one of the most complete indigenous systems of classifying soil which helps in the management of their indigenous necessity (Ossai 2010:7; Diallo & Keita 1995:371). The agro-pastoralists differentiate seven major soil types which largely correspond to western soil

classification systems. The Djitoumou and Bambara soil classification criteria used were top soil texture, colour, vegetation, inundation potential, ease of cultivation and potential for particular crops. Thus, it was seen that farmers differentiated five types of soil: “Bafuga gilin” (lithosol), “bèlè dugukolo” (poorly differentiated soil on duricrust), “cincin dugukolo” (tropical leached ferrimorphic soil), bira dugukolo (hydromorphic pseudo-gley soil), “fala dugukolo” (hydromorphic gley soil). Soil Type 2 (“bèlè dugukolo”) and Type 5 (“fala dugukolo”) are further divided into two types (Diallo & Keita 1995:371).

The Nguni people of South Africa maintain a unique way of preserving where they get water such as streams. Firstly, they place rocks around the headwater to prevent their cattle from drinking near the headwater which is for their personal use. This practice also prevent the cattle from contaminating the water. Then, the Nguni’s approach the water quietly, to avoid scared water animals from stirring up dirt. Also, the Nguni’s prevent their kids from urinating inside the river by telling them frightening stories of turning into an opposite gender if they urinate in water. The Nguni indigenous knowledge of preserving water helps to check water pollution which can cause illness and death. (Ayerst, Langley, Majosi, Metherell & Smith 2005:62).

The Zulu people use a local way to preserve maize which is similar to the scientific method of maize preservation using storage towers called silos. The process begins by digging a pit inside the ground which is burned and covered to destroy pests and to remove moisture from the pit. The pit is covered with dry grass, as soon as the maize has been arranged inside the pit and the mouth of the pit is closed with a rock. Then, the rock is sealed by spreading cow dung around the rock. Some of the maize on the sides of the pit undergo fermentation and released carbon dioxide that kills any pests that enters the pit. The preservation conditions in the pit is similar to the one in

silos, as scientists also use pesticides that have carbon dioxide to kill any pests that might want to eat the maize inside the silos (Ayerst et al. 2005:66).

The Matengo people who lived in the steep slopes of Matengo Highlands in Southern Tanzania built the cultivation technique called ngoro system to protect their farmlands against erosion and to trap the rapid run-off to improve the soil moisture, as well as to conserve soil fertility by composting. The ngoro system demonstrates the multipurpose function of many of the indigenous knowledge approaches to environmental conservation (UNEP 2008:33).

Ossai (2010:6) explains how the Igbo of southeastern Nigeria used their indigenous practices in postnatal motherly and child health care ceremonies. Through the four weeks after a mother has given birth, the nursing mother is served with a stimulating hot soup prepared with meat, dried fish, yams, plenty of pepper and a special herbal seasoning called '*Udah*' which helps in the contraction of uterus and removes blood clots. The soup also helps to restore blood lost during childbirth, facilitates the healing of wounds, restores energy and normal body functions and stimulates lactation (Ossai 2010:6).

Research projects have been carried out on indigenous knowledge practices which support sustainable development in countries such as Venezuela, Ecuador, Indonesia and Ethiopia (Grenier 1998:63-70). For example, in Bali (Indonesia), where indigenous beliefs and practices are used in the prevention of excessive use of resources, maintaining crops production by using indigenous biological methods and assist in maintaining agricultural production levels (Grenier 1998:66-67). Based on this, Grenier (1998:67) concludes that sustainable development could be achieved through the resources of the local people and their indigenous knowledge.



## **2.4 THE RECENT EMERGING INTEREST IN INDIGENOUS KNOWLEDGE IN EDUCATION AND DEVELOPMENT**

The integration of indigenous knowledge and science has been a contentious issue in South Africa and elsewhere (Diwu & Ogunniyi 2013:333). The advancement of western science to the detriment of indigenous knowledge had received criticism throughout the world, giving rise to recent calls to give a place and attention to indigenous knowledge in science education (Semali & Kincheloe 1999 3-7; Snively & Corsiglia 2001:6; Maru 2010:1). In addition, there was an argument that education should include indigenous knowledge, since the content of education has values that underpin it and is connected to a specific culture (Thaman 2000:175). The attainment of an effective learning requires closing the gap between indigenous knowledge and western science in educational system. This implies that both knowledge have to be taught and incorporated in the science classrooms. Learners should know the meaning of science and its relationship with the environment and society and the way it affect their everyday experiences (Vhurumuku & Mokeleche 2009:99). This could be attained by incorporating appropriate indigenous knowledge in school to cater for the needs of the indigenous communities in addressing some insufficient knowledge needed for the current improvement expressed from the western perspective (Owuor 2007:21).

There is a growing awareness that western knowledge systems based on models of industrialisation and capitalism have contributed to a crisis of environmental degradation and unsustainability around the globe (Hunter 2003:7). Studies have expressed the increasing significance of indigenous knowledge in promoting sustainable development in Africa in particular and the developing world in general (Ngulube & Lwoga 2007:117; Owuor 2007:21; Snively & Corsiglia 2001:20-21), hence showing the potential role played by indigenous knowledge systems in technology and

science education for human development both locally and globally. The objective of achieving sustainability and maintaining stability between humankind and the environment are contributing factors that led to the emergent attention in indigenous knowledge (Owuor 2007:21; Emeagwali 2003:2; Ossai 2010:2). Presently, the global aim of achieving sustainability has resulted into accepting indigenous knowledge and its role towards eradicating poverty in developing countries. There is a growing recognition of the significance of incorporating the social and global relevant themes of indigenous knowledge in the curriculum if we are to educate learners effectively for the globalised world (Mehta, Alter, Semali & Maretzki 2013:2). Sustainability, for example, is one of the topics where teachers can use the wisdom of indigenous people and combined it with scientific knowledge for the development of effective solutions to this shared global challenge. Thus, this could greatly assist to revive the teaching of science, as well as improving the principles underlying sustainable educational development in Africa and around the globe.

Another issue that called for the recent development in education regarding indigenous knowledge is the “African renaissance” (Semali & Kincheloe, 1999:3-4). Hoppers (2002:2) sees the African renaissance as a change in Africa that aims at building a broad understanding of Africa, its languages and its developmental approaches in the 21<sup>st</sup> century. This African renaissance might require the local knowledge of learners which could be incorporated in their school learning. At the same time, having the knowledge of the value and use of indigenous knowledge has increased among curriculum and development planners, educators, scientists and other researchers (Hunter 2003:8). Thus, giving a value to indigenous knowledge is very significant and might be a means of reinstating the lost identity of Africans (see section 2.9). For example, during the apartheid era in South Africa, many South Africans were deprived of their democratic voices and cultural identities (De Beer &

Whitlock 2009:209). It was forbidden in the classroom for learners to discuss about traditional medicine, music and folktales.

Integrating indigenous knowledge in the school might assist learners to feel that they own the knowledge they bring to the classroom (Srikantaiah 2005:2). Learners having ownership of their knowledge implies respecting the cultures, traditions and identities that learners bring to the classroom. For example, educators can ask relevant questions to the learners, and value learners' different points of view on the issue being asked. People desire a school science that does not separate learners from their indigenous cultures (Ogunniyi 2005:2). There is a worldwide effort towards the incorporation of indigenous knowledge with western science. Therefore, the aims of sustainable development and the spirit of African renaissance could be attained when learners who are the future generations could connect what they learnt in school with their daily experiences.

In a nutshell, the three factors contributing to the current development in indigenous knowledge are interconnected. The African renaissance could be attained together with the goals of sustainability, and both goals could be attained when learners who are future generations can relate what they are taught in school with their daily experiences. Similarly, sustainable environment can be achieved when teachers embrace environmental sustainability in their teaching approach. This implies that all knowledge systems should be recognised and incorporated in the classrooms for the inherent value they have as part of the process of nation building and development. To grow awareness and make science education effective, the cultural context of the society must be taken into account. Thus, education should offer learners the opportunity to explore the community. It is against this background that this research seek to explore educators' understanding of the integration of indigenous knowledge

and to investigate how they mediate indigenous knowledge in the teaching of Life Sciences in the classroom.

## **2.5 INDIGENOUS KNOWLEDGE AND SCIENCE TEACHING**

### **2.5.1 The South African Experience**

The integration of indigenous knowledge and science in South Africa has been promoted and widely accepted in recent years (Botha 2010:35; Ogunniyi 2007:963). There is huge demand to create an identity and a national heritage that surpasses race and cultural roots. Hoppers (2002:1) believes “that indigenous knowledge systems represent both a national heritage and a national resource that should be protected, promoted, developed and, where appropriate, conserved”. Besides the complementary role of IKS in relation to how learners engage themselves into the curriculum, IKS seeks to transform, mainly on how educators across all subjects in South Africa, involve learners in a form of constructing knowledge where learners would identify themselves (Van Wyk 2002:307).

The learning environments should be adapted in a way to assist learners build on their indigenous communities’ knowledge systems, cultures and values (World Bank 2005:1). Therefore, the call is for an interdependent relationship between indigenous knowledge system and the global western science. Ogunniyi, Jegede, Ogawa, Yandila, and Oladele (1995:818) assert that the “knowledge of what students and teachers bring to class is critical in situating the teaching-learning process within a meaningful context”. For learners to understand science, scientific concepts need to be integrated with learners’ indigenous knowledge. Indigenous knowledge represents an important component of learners’ knowledge of the environment, although indigenous knowledge is often under-utilised in the classroom instructional process as science is taught as if it is a foreign subject forced on the learners to memorise

without any bearing on their everyday life activities (Ameyaw & Amankwah 2014:313; Shizha 2013:7).

### **2.5.2 Integration of Indigenous Knowledge in the Science Classroom: The Educational Benefits**

Semali (1999:316) defined education as “engagement of educators and learners in mutual construction of meaningful knowledge”. Research conducted in the teaching field shown that local people have deep knowledge of the environments where they live. The incorporation of indigenous knowledge into science means enabling science to be of relevance to learners that comprises of teaching culturally relevant contexts (Naidoo 2005, in Dziva et al. 2011:91). In addition, science taught in connection with indigenous knowledge will bring a sense of place and also assists in making science not to be seen as foreign by learners (Sommer, Talus, Bachman, Barnes, Ebinger, Lynch & Maestas 2004:1), and relates to the learners’ lived experiences. Learners have the experience of not less than two kinds of culture when they learn in the realm of school science: the school science culture and the everyday culture (Jegede & Aikenhead 1999:50). Thus, it becomes necessary for learners to mediate a transition of culture from their everyday cultures into the school science cultures, in order to make sense out of their experiences in classrooms.

Recently, some of the debates held by African countries through the African Union and regional commissions have suggested that it is of relevance to draw from local knowledge in order to strengthen developmental imperatives such as finding a means of poverty alleviation and of improving the quality of education within the continent, especially in rural communities (Meyiwa, Letsekha & Wiebesiek 2013:3). With this, it is hoped that the current local problems that affect African communities, such as

HIV/AIDS pandemic and poverty, can be addressed effectively (Owuor 2007:22). Van Wyk (2002:307) calls on science and technology educators to “expand and integrate the social and academic aspects of learning to contribute to an increasingly globalized world”. Thus, it becomes relevant for science educators to pay particular attention to the learners’ indigenous knowledge when learning in the realm of science and emphasize on the advantages of indigenous knowledge instead of portraying it as a barrier to science learning.

Firstly, by including indigenous knowledge in the classroom, the individual cultural and social identities of learners are recognised, which results in more positive learning experiences for learners struggling to learn and understand the school curriculum (De Beer & Whitlock 2009:210). (See section 2.1). In line with this, indigenous knowledge has a part to play in learners’ identity formation where learners are needed to have knowledge in indigenous knowledge and western science through important teachings making science to be meaningful and learner-friendly (Shizha 2010:27). Also, the main criticisms of the school examination style and school-centred, in conflict with indigenous systems on transmitting of culture would be addressed (Thaman 2000:179). Learners’ education will be directed towards western patterns of thought and also, to provide a balance between African knowledge system and western knowledge (Emeagwali 2003:4). Such balance can enhance learners’ self-esteem, help them in developing caring and sensitive attitudes and values to build a sustainable future and maintain judiciously a balance between their individual and environmental needs (McCarter & Gavin 2011:2; Mehta, Alter, Semali & Marezki 2013:7). In science, like other learning areas, teaching that integrates learners’ indigenous knowledge significantly improves the learners’ understanding of scientific concepts, attachment to science learning, heightens their level of confidence, improves self-esteem and motivation while furthering their rights to an appropriate

education (Ng'asike 2011:63), thus resulting to better grades, higher quality work and test scores and increase in science lessons retention by learners (Seraphin 2014:17). The integration of indigenous knowledge and science is vital to avoid a cultural clash when learners try to learn science meaningfully (Aikenhead & Huntley 1999, in Dziva et al. 2011:89). It facilitates the ease on how learners culturally cross-border to science (Ogunniyi 1988, in Dziva et al. 2011:89). It also simplifies concepts and creates good communication and respect with the community (Sommer et al. 2004:2).

Secondly, incorporating indigenous knowledge in school curriculum might lead to the harmonisation of the two knowledge systems. It is necessary for educators to recognise that the indigenous knowledge system and science can come together and serve as resources to one other in a science classroom (Regemi & Fleming 2012:482). On the one hand, this will provide teachers the chance to teach learners by using what they can obtain from their immediate surroundings (Jegede & Aikenhead 1999:52). On the other hand, learners are able to make meaning of their everyday experiences when they are exposed to indigenous knowledge and also develop a cultural identity that reflects their cultural and social groups (Shizha 2010:28). This means that learners are capable of connecting with ease on what they are taught at school to their everyday experiences to understand concepts clearly and to retain knowledge for a long time, thus enhancing effective and meaningful education. Learning needs to expose learners to their immediate environments and get them travel from known to unknown, ensuring more effective learning. As of the pedagogical viewpoint, IKS provides learners with a more comprehensive world-view and the ability to interact with a broad range of entities in their environments (Onwu & Mosimege 2004:3). In addition, learners have to make sense of both knowledge for an effective integration to occur (Ogunniyi 2008, in Dziva et al. 2011:92); and to appreciate and use their environmental natural resources towards their community development in a

sustainable way. This whole method will ensure a meaningful learning and acquisition of holistic knowledge because learners will likely appreciate and recognise their place in learning of science.

Thirdly, to consider the benefits that accrue from integrating indigenous knowledge into formal schooling basically implies that school knowledge will have richer content. Equal place will be given to the African knowledge and western science in the educational field. Thus, school science becomes more integrated body of knowledge, taking up diverse kinds of knowledge that will bring learners nearer to their everyday experiences. The border between western science and indigenous knowledge facilitates “access to new knowledge which is likely to elicit higher order thinking and thus make learning more meaningful and accessible” (Onwu & Mosimege 2004:4). In a similar vein, this will produce good inventors, well-rounded nationalist, better scientists and learners with stronger critical thinking skills we so much desire (David & Tanimu 2008:2; Brayboy & Castagno 2008:741). Further, the investigation of a science concept through various knowledge systems could enhance perceptions and build thoughtful dialogue.

Lastly, incorporating indigenous knowledge into school will likely improve how educational objectives are delivered (McCarter & Gavin 2011:1) and creates a complete change regarding the worldwide education through making learning have a different direction. Western science will no more be seen by learners as being foreign and insignificant to their everyday lives. (De Beer 2016:35). Indigenous or local knowledge can provide complementary viewpoints, “born from long periods of shared observation and experimentation that are often lacking in scientific knowledge” (Sutherland, Gardner, Haider & Dicks 2013:1). Education will no longer be limited only to the concept taught in school; rather some of the learners’ everyday lives experiences will be included. Learners in science classrooms would be able to connect



science experiments to phenomena within their immediate environments taken into account other factors in the form of resources, curriculum, pedagogy, etc. Science experiments could take the form of observing the learners environment and their daily life practices and will not be restricted to the laboratories alone (Semali & Kincheloe 1999:23) to link deeper to one another and to the rest of the whole worldwide. Chemistry, Physics, Computer science and other learning areas could be taught in schools by incorporating local knowledge. Education should relate the concepts learnt by learners in school to their daily lives experiences, rather than teaching learners with abstract descriptions different from what they see in the surroundings. This would enhance learners' interest and understanding and also help learners to value their environment and culture (Ameyaw & Amankwah 2014:312). Thus, the responsibility of the teachers is to make sure that education is important to learners' context, given that there is a relationship to the learners' everyday lives.

### **2.5.3 The Importance of Incorporating Indigenous Knowledge into the Curriculum**

Incorporating indigenous knowledge into the curriculum may contextualise educational systems, making them more relevant, enhancing understanding of curricular knowledge and provide a better sense of place and identities to learners (Botha 2010:37; Ameyaw & Amankwah 2014:312-313; Castagno 2008:733). This would allow learners to understand academic science content better as scientific language is accessed (Klos 2006, in De Beer & Whitlock 2009: 210); relate science to learners social and cultural environments, recognise the border between indigenous knowledge system and science and uphold their self-worth as people of diverse cultures (Mushayikwa & Ogunniyi 2011:2). Integrating indigenous knowledge in school might be a significant means of increasing learners' awareness and participation in the contemporary environmental problems (McCarter & Gavin 2011:2). This fact is

theoretically enshrined in the amended Curriculum and Assessment Policy Statement (CAPS), and Life Sciences educators are anticipated to incorporate indigenous knowledge in their teaching that reflect different South African cultural groups (Department of Basic Education 2011:17) that would connect what learners learn in school with life out of school.

Previous research has also revealed that curricula and teaching approaches that integrate local knowledge in school indicate a decrease in drop-out rates, an increase in university attendance and increase in learner achievement scores (Alaska Rural Systemic Initiative (AKRSI) 2002:25), and increased rates of intergenerational knowledge transmission (McCarter & Gavin 2011:2). To support this view, Thaman (2000:51) revealed that the cultural gaps that exist between what the curriculum anticipated to learners' socialised cultures contributed to learners' underachievement. It has been observed that learners performed actively during science learning because science was taught in learners' own language and they were allowed to apply their local knowledge in the classroom (Cleghorn & Rollnick 2002:349), and this could even encourage parents involvement in their kids' schooling (Meyiwa et al. 2013:7).

De Beer and Whitlock (2009:209) assert that indigenous knowledge is most often marginalised in the biology classroom, and that even in biology classes where indigenous knowledge is considered, it is often very clinical. However, a lot of learners from disadvantaged homes could not link between the concepts taught in school with their cultural background (Nkopodi & Mosimege 2009:377). Nkopodi and Mosimege (2009:378) assert that "this may well have contributed to the high failure rate amongst mathematics learners as well as the perceived difficulty of mathematics". However, the marginalisation of indigenous knowledge may lead to the achievement of ineffective educational goals in schools and this might remove diverse language and

cultures (Botha 2010:34); and also threatens learners' confidence and self-affirmation (Shizha 2010:39).

In contrast, the integration of indigenous knowledge in science lessons would present a chance of bringing the necessary cultural diversity straightaway into the school curriculum (Kimmerer 2002:435). For this reason, educators feel the need to expose learners as much as possible to these two distinct world-views in the little time they have available in the classroom. Indigenous knowledge creates experiences directly with the surroundings and the natural world, which becomes valued by educators and learners to enrich science lessons, enhance their everyday thinking and thereby facilitate teaching and learning.

## **2.6 INDIGENOUS KNOWLEDGE AND SCIENCE EDUCATION IN AFRICA**

Science education in several African countries is neither situated in their everyday cultural activities nor builds on the cultural inheritance of their societies (Botha 2010:35-41). There are examples from various African countries where schools have taken responsibility for teaching indigenous knowledge, for example, Tanzania and Kenya (Semali 1999:310-311); South Africa (Onwu & Mosimege 2004:2) and Namibia (Abah et al. 2015:668). The goal of education is to use quality teaching to equip learners to achieve full potential and contribute to the societies in a meaningful way (Department of Basic Education 2011:4); and to survive in the world they live in. This can only be attained if learning is effective and meaningful and depend on the indigenous knowledge of the people that makes it effective (World Bank 2005:3).

The clash that occurs between the western sciences taught in school and the indigenous knowledge of learners is a contributing factor to an unsuccessful learning of science of an African child (Aikenhead & Jegede 1999:278). Also, studies revealed that educators disregard the way learners' view about the world which might be

conflicting with western modern science (Aikenhead, Calabrese & Chinn 2006:405). It has been shown that in Africa, science should be taught using a simulated experimental teaching in academic circles (Ma & Chen 2009:89) which is dominantly affected by scientific meanings and emphasises on the relevance of empirical evidence and data on which concepts are built (Shizha 2010:34). In line with this, the recent developments in education lay emphasis on the science laboratory and inquiry-based teaching which are not contextualised and irrelevant to the people and their daily experiences in Africa (Ugwu 2013:3-4). In addition to Brady's observation (1997:414), school science that depends on theorization, positive evidence and science laboratories do not support "science for all" and "cultural differences". Science education in Africa result in dissatisfaction as learners experience difficulty with concepts that need memorising instead of practical applications that relate with daily activities. The researcher argues that learners' knowledge in science should not be abstract, rather science should have real-life applications in order to explain fully the ideal behind learning and development. Thus, for children to learn with meaningful practical applications in their environments, it is necessary to extend science teaching in Africa by facilitating learning through the incorporation of the learners' indigenous knowledge system (Abah et al. 2015:672).

A scrutiny of various science curricula developments employed in Africa shows a bias in the western content and practice that did not focus on integrating science and indigenous knowledge in their theories, hence depriving learners who have achieved local cultural resources (Shizha 2010:29). This means that the curriculum innovations did not take into consideration the learners' place and culture in learning of science; thus, the science content isolates learners. In the same vein, the change of personal knowledge from the daily experiences of learners into science classroom is discouraged and not appreciated at all times. In the process, African ways of learning

and their related science are not recognised, often deliberately by some teachers (Shizha 2010:37). Even when examples of indigenous knowledge examples are given in the curriculum, it occurs in a western science perspective (Keane 2008:589). A few examples cited by Abah et al. (2015:671) and Semali (1999:313) include cultivating weeds that prevent animal pests from eating up the crops. A diversity of local animals and plants (amphibians, birds, reptiles, mammals, fishes and insect) represent important parts of traditional medicine in Africa and conservation of flora and fauna.

The science knowledge of learners should change from abstract level to practical use (Abah et al. 2015:669). The reason for continual alienation of science to many learners in Africa is that the knowledge, skills, science and technology possessed and practised by indigenous people are not taken into consideration (Knamiller 1989:2). “By understanding key aspects of an African worldview, science educators can contribute to both meaningful science education and community well-being” (Keane 2008:610); for example water, food, history, time, nature, Ubuntu and medicine. A few examples of such science and technologies include the process of fermentation and distillation, food processing and storage, and charcoal production (Knamiller, O-Saki & Kuonga 1995:75). Also, many local people possess similar content areas and practices as the ones in the curriculum that are linked to food preparation and preservation, human nutrition, pregnancy, medicine, childbearing, animal husbandry and plant growth (Mawere 2015:62).

Science education in some African countries has been criticised because it is irrelevant to peoples’ culture (Engida 2002:942). Thus, western science has not linked with the cultural material that learners interact with in their everyday experiences. For example, formal education in many countries continues to reflect the cultures of western science than the educators’ and learners’ cultures (Abah et al. 2015:668). The educational structures inherited from colonialism is different from the cultural values

found in most African indigenous communities (Kaya & Seleti 2013:32). Learning was restricted to a classroom and learners experienced separation from their environment and culture (UNESCO 2010:2). Also, the method of teacher-centered kind of teaching has isolated learners from their parents, thus, parents find it difficult to transmit their own inherited knowledge to their children (Abah et al. 2015:669).

Onwu and Mosimege (2004:1) stated clearly that the South African curriculum statement concerning IKS has good objectives, but “failed to show how the recognition and valuing of IKS could provide the engaging tension perhaps amongst learners in our schools, between indigenous and scientific ways of knowing with the possibility of each stimulating and supporting the other in our classroom contexts”. Learners that see schools as dominated institutions are likely to interpret education and learning organisation as sets of connected activities (Regemi & Fleming 2012:480). These disconnected pieces of information are not meaningful or useful to learners as any knowledge that failed to promote the daily living process is not valued to be retained (Regemi & Fleming 2012:480). These disconnected pieces of information often happen at school when educators de-emphasise the home cultures of learners, particularly when there is a conflict between the home cultures and the values that the school is trying to uphold (Abah et al. 2015:669). Thus, the prior knowledge of learners is disconnected from the notion upheld by the curriculum and for learners’ progression to the next grade, many learners are likely to memorise the concepts but are without the practical use needed to find a difference between the educated and uneducated people in societies (Abah et al. 2015:669).

The researcher argues that any educational reform taking place elsewhere in Africa would be complete only when it incorporates indigenous knowledge systems and aim at being more immersed in the real situations of the community and their indigenous ways of knowing and traditional practices that will govern an important proportion of

their daily activity. Presently, it is of importance for scientific knowledge to connect to the everyday life experiences of learners and allow its application by learners into their everyday experiences (Shizha 2010:40). The integration of the learners' indigenous knowledge would change the content knowledge into a form that learners will understand and apply (Abah et al. 2015:669).

According to IK Notes (2000:1-2), an indigenous curriculum might come to utilise the space created for a new curriculum through the educational reforms that have been taking place in Africa. Such educational reforms have caused the incorporation of local knowledge in science education to be necessary. Science learning could be effective and meaningful if the prior knowledge of learners, which include indigenous knowledge would be integrated in science (Jegade & Aikenhead 1999:45-62; Wyatt 1978-79:16-17). Jegede and Aikenhead (1999:45-62) went further to explain that teachers should serve as cultural brokers to achieve the development required. A person who can interact in a community and school settings and can explain knowledge and skills from one to the other is referred to as a cultural broker (Wyatt 1978-79:17).

Researchers in the field of science and mathematics education advocated for a culturally responsive curriculum to be incorporated as a method to involve learners in the science classrooms (Brayboy & Castagno 2008:733; Atwater 2010:112; Regemi & Fleming 2012:482). Over the years, various school programmes and curriculum around the world (including South Africa) have incorporated indigenous knowledge. Some examples of educational programmes that have successfully incorporated indigenous knowledge are Ethiopia's Popular Participation in Curriculum and Instruction (PoPCI) (World Bank 2005:2), New Partnership for Africa's Development (NEPAD) Projects (Kaya & Seleti 2013:38), Global Fund for Children (GFC) (World Bank 2005:3), Tswana Indigenous Pathways to Health (Kaya & Seleti 2013:40), Bachelor of IKS (BIKS) programme (Kaya & Seleti 2013:41); Fundisa for Change

programme (2013:2); Alaska Rural Systemic Initiative project (AKRSI) (Barnhardt 2010:4); and the World Learning for International Development (WLID) (World Bank 2005:2). Indigenous knowledge of the different groups formed the bases for further development in these programmes.

The significant developments in Africa including South Africa have deep interest and intended proposals for the incorporation indigenous knowledge systems in the educational system (Shizha 2010:44), of which teachers of African learners should be conscious. Also, teachers might engage with a knowledge idea that addresses their social context, as curriculum changes could enquire on this type of knowledge because it has remain a powerful tool (Van Wyk 2002:306).

In the South African education, there is widespread agreement that local knowledge need to be incorporated in the curriculum. For example, the Department of Science and Technology in 2004 issued an IKS Policy acknowledging the importance of understanding, recognising, developing, protecting and promoting IKS in South Africa, and calls for schools and communities to recognise and value indigenous knowledge systems (Department of Science and Technology 2004: 6,17). The NCS – Life Sciences for Grades 10-12 clearly advocated for the incorporation of local knowledge into science teaching (Department of Education 2003:4). Also, it becomes refreshing to note that the current CAPS, which was introduced for Grade 10 in 2012, explains the integration of indigenous knowledge in teaching Life Sciences. Both indigenous knowledge and school science are regarded as two parallel modes of acquiring knowledge about the universe (Maweu 2011:38).

Furthermore, for the past two decades we have seen a rise in the awareness of indigenous knowledge systems in South Africa. It is evidenced by numerous seminars, workshops and conferences held on the topic such as the 2014 Mpumalanga IKS Train



the Trainer Project Focus; the 2004 Fifth Annual Educationally Speaking Conference; the 2005 African Conference; the 2005 Common-Sense Conference; the 2009 SADC Ministerial Conference; the 2002 World Summit; the 2011 Third International Conference in Science and Indigenous Knowledge Systems; the 2011 SAARMSTE Conference; the 2008-2012 Science Indigenous Knowledge Systems Projects (SIKSP); Seminars-Workshops series and the collaboration of the Department of Arts, Culture, Science and Technology with the National Research Foundation in the identification of IKS as a research focus area (South Africa 1996:21).

The Namibian government has reviewed the basic education curriculum where the senior primary phase (Grades 5-7) new curriculum includes mother tongue instruction (Abah et al. 2015:672). This is significant and a strong decision adopted by the Namibian government to recognise the view of incorporating indigenous knowledge in improving educational outcomes.

Another example of integrated indigenous knowledge in the curriculum was the “Education for Self-Reliance” (ESR) in Tanzania (Semali 1999:310). The aim of ESR programme is to localise the curriculum by laying emphasis on practical rural-oriented education. Semali (1999:310) elucidated that the ESR programme was more philosophical than educational, resulting to an unsuccessful programme.

In Kenya, the current primary school curricula have changed to include the local histories, concepts and principles of the practices, tools and technology of Kenyan people and other cultures in Africa (Semali 1999:311).

## **2.7 SOUTH AFRICAN SCHOOL SCIENCE EDUCATION AND INDIGENOUS KNOWLEDGE**

The educational system has experienced a lot of changes in policy development since the apartheid era ended in South Africa, because of social, economic and political

changes that began at its democratic era. The stakeholders and governments made efforts to introduce a curriculum that embraces their diversity, cultural backgrounds and to correct the inequalities made by the apartheid government which was intended to choose the type of knowledge accessed by African learners. However, it was analysed that the NCS was dominated by the westernised science and that the indigenous peoples' worldviews in education remains limited in South Africa (Botha 2010:35; Meyiwa et al. 2013:1-2). The current educational policy CAPS calls for indigenous knowledge systems to be incorporated with science (Department of Basic Education 2011:17), for science to be more accessible and meaningful to learners. The present South African school policy recognises learners' diversity with specific indigenous knowledge systems and varied cultural background. Yet, it continues to be a demanding situation for teachers to integrate indigenous knowledge in schools, mainly in mathematics and science classrooms (Nkopodi & Mosimege 2009:377).

The implementation of a successful school curriculum depends on the responsibility of quality educators (Ogunniyi 2005:3). At the same time, the quality of educators is dependent on an extent on how educators were trained in higher educational institutions. It is no exaggeration that educators can make the curriculum work or thwart the success of any school curriculum regardless of its content or design quality (Ogunniyi 2005:3). Of course, it is because no curriculum is left in its naked form but assumes a different form for that particular setting. The curriculum contents are highlighted, explained or attenuated as educators see fit for their specific setting.

The majority of South Africans have taken indigenous knowledge as a primary factor towards their survival and welfare (Department of Science and Technology 2004:4). However, education does not show an appropriate recognition of and commitment to nurturing indigenous people's knowledge in South Africa and the specifically local, temporal and spiritual nature of their understanding of the world (Botha 2010:44). The

indigenous knowledge systems in South Africa has been marginalised, suppressed and subjected to ridicule (Department of Science and Technology 2004:5). Òtúlàjà, Cameron and Msimanga (2011:698) assert that the inclusion of indigenous knowledge in the curriculum is a welcomed decision in South Africa, but it still remain a challenging effort, particularly in science classrooms. The failure to incorporate IK in learning of science in South Africa is continuous and problematic because of its social and political histories and for the reason that the curricula have gone through some reformations in rapid succession at its democratic era (Òtúlàjà, Cameron & Msimanga 2011:698). The absence of teaching materials, unwillingness, ignorance and teachers' reluctance can be linked to the failure of not integrating indigenous knowledge (Keane 2015:3).

The progress of incorporating indigenous knowledge in mathematics and science curricula is optimistic in South Africa. However, some educators are still not certain on the requirement and ask about their capability of responding to what seems to be diverse radical teaching (Ogunniyi 2007:965). Firstly, in many science classrooms, educators experienced difficulties to link the world views of learners with the concept taught in the classroom (Regemi & Fleming 2012:482). Secondly, African teachers face the challenges to incorporate local knowledge in the school curriculum which is strongly aligned with the westernised science (Ogunniyi 2005:3). Ogunniyi (2004:290) maintains that the effect of school science has taken away the practices rooted in the traditional beliefs of Africans in the school system. Further, the researcher argues with regard to the incorporation of local knowledge into school system, that local knowledge is epistemologically different from the western science that dominates the education system in South Africa. Thus, as long as the educational framework remains almost exclusively based on the western worldview and its focus is so strongly directed at global trends, South Africa's indigenous knowledges will continue to suffer

marginalisation and neglect, as will the people for whom this heritage remains a significant cultural resource (Botha 2010:44).

Despite the focus on IK and the progress described above, there are few differences, particularly in relation to the practical application of IKS policy in South Africa (Hays 2009:202). The implementation and monitoring of indigenous knowledge have been unclear in spite of the fact that many policy statements recognise the significance of this body of knowledge in education (Botha 2012:59). A literature review in this area shows that appropriate ways of monitoring and evaluation need to be in place in order for indigenous knowledge to have effective implementation (Botha 2012:68). This remains a huge task in science education that needs serious contribution and attention from the policy makers, stakeholders, parents and curriculum implementers.

The South African education should be a representation of the country's demography and be much responsive to and inclusive of cultures and traditions (Botha 2010:34-35). This can be attained by combining the western science and indigenous knowledge in a more collaborative method in learning science. It is necessary to create processes to attain this if such goals are to be turned into good practice. In a similar vein, it is necessary for the educators to know properly and be able to incorporate local knowledge successfully into science education in South Africa (Le Grange 2007:581).

## **2.8 THE ORGANISATION OF THE LIFE SCIENCES CURRICULUM AND SPECIFIC AIM THREE**

The amended Life Sciences CAPS document came into effect in 2012 and comprises of four knowledge strands that are developed progressively and conceptually for a period of three years in the Further Education and Training (FET). The four knowledge strands for Life Sciences are:

- Life at the Molecular, Cellular and Tissue Level (Department of Basic Education 2011:).
- Life Processes in Plants and Animals (Department of Basic Education 2011:9).
- Environmental Studies (Department of Basic Education 2011:10).
- Diversity, Change and Continuity (Department of Basic Education 2011:10).

The abovementioned four strands and the topics within each knowledge strand should be taught in a manner that helps learners to recognise the connections between related topics, to understand the nature better and to interconnect life (Department of Basic Education 2011:17). The specific topic selected for study should reflect different South African cultural groups when teaching indigenous knowledge systems (Department of Basic Education 2011:17) and address the indigenous knowledge with the necessities of South Africa on the basis of the availability of resources at a particular time.

The curriculum policy stipulates three broad subject-specific aims in Life Sciences, which link to the goals of science learning (Department of Basic Education 2011:13), namely:

- i. Specific aim 1 relates to knowing Life Sciences.
- ii. Specific aim 2 relates to investigating phenomena in Life Sciences.
- iii. Specific aim 3 relates to appreciating and understanding the history, importance and applications of life sciences in society.

The three specific aims in Life Sciences identified the specific skills or competences to be achieved by learners by the end of the year from Grades 10 to 12 (Department

of Basic Education 2011:18). “The third aim of Life Sciences is to enable learners to understand that school science can be relevant to their lives outside of the school and that it enriches their lives” (Department of Basic Education 2011:17). The relationship between indigenous knowledge and Life Sciences is one of the related sub-specific aim of specific aim 3. The sub-specific aim emphasised that the indigenous knowledge examples chosen for study should reflect different South African cultural groups and, these examples should link to specified areas in the subject content of Life Sciences (Department of Basic Education 2011:17). Learners should undergo cultural border crossing every day as they interact within and outside the science classrooms (see section 3.4). It is therefore, the view of the amended CAPS document to incorporate IKS with science.

The CAPS document emphasizes the need to expose learners “to the history of science and indigenous knowledge systems from other times and other culture” (Department of Basic Education 2011:17) and also mentions the need for science to be taught in an incorporated manner for improving the subject and to elucidate the connection between the subject and society (Department of Basic Education 2011:17). The Department of Basic Education laid emphasis on the importance of incorporating indigenous knowledge in Life Sciences with the aims of improving the cultural wellness and learners’ science knowledge and skills. This is in line with the fact “that knowledge and methods of knowing cannot be singularly universal” (Òtúlàjà et al. 2011:699). This means that there are various ways of knowing. Also, the CAPS document emphasizes on the necessity for learners to “understand the different cultural contexts in which indigenous knowledge systems were developed” (Department of Basic Education 2011:17).

Science education professional development programmes need to expose science educators to experiences based on indigenous knowledge in the same way they do

with western science in order to effectively achieve specific aim 3 in their teaching. Also, there should be teaching resources made available to science educators for the incorporation of indigenous knowledge and science. Therefore, teachers, in achieving specific aim 3, have to teach learners to know the applications of Life Sciences knowledge in daily life, to know the history of science discoveries and to relate indigenous knowledge systems to a specific science topic (Department of Basic Education 2011:17).

## **2.9 HOW TO INTEGRATE INDIGENOUS KNOWLEDGE IN LEARNING OF SCIENCE**

The findings of studies carried out in science field show that local people understand the environment where they live (Abah et al. 2015:670 & Semali 1999:309). Effective and meaningful learning occur when indigenous knowledge system is taken into consideration in school. (Semali 1999:312). Thus, having discussed the value of incorporating indigenous knowledge in the curriculum (see section 2.5.3), it is necessary to investigate how indigenous knowledge could be incorporated into learning of science.

Firstly, the educational policies have to recognise the value of indigenous knowledge in science programmes by the inclusion of indigenous knowledge in the curriculum. There should be inclusion of diverse learners' cultural practices and indigenous knowledge system in the curriculum (see section 2.8). The indigenous practices and knowledge of the people are recognised and valued by the South African CAPS document. Therefore, it is necessary for educators to teach and see science as subjective and dynamic which needs varied practices and ideas that can be utilised as teaching resources in the classrooms.

Secondly, the integration of local knowledge into the curriculum should not be taken as a discrete exercise. Instead, indigenous knowledge should be integrated in the prior knowledge, which encourages several explanations (Semali & Kincheloe 1999:15). Democracy and social justice should be promoted by allowing learners to explore different views on a phenomenon, involve in critical thinking and also evaluate indigenous histories. It is assumed that learners come into the classroom with the beliefs, skills and understandings from their everyday lives. The school plays a role to recognise and make connections to that understanding without ignoring or replacing such understandings (Teacher's Guide 2001:4). Educators should depend upon learners' body of knowledge in such a way that learners would be motivated to understand the concepts and principles of science (Atwater 2010:107). Learners would be able to analyse two types of knowledge if learners are exposed to a science programme that integrate indigenous knowledge and science (Jegede & Aikenhead 1999:47).

Teachers can use learners' prior knowledge of as a basis to develop and teach new ideas which could also motivate learners. This is similar to constructivism where learners build new knowledge by connecting their prior knowledge with their new knowledge (Woolfolk 2013:360). As learners connect with ideas, learners travel from their prior knowledge which indigenous knowledge is part to the unknown. This teaching method has the possibility of assisting learners to do some tasks that could result into building a sustainable understanding of the concepts and, therefore, make learners to be in control of developing their individual understanding and knowledge (Abah et al. 2015:670).

It is the teachers' task to explore and build on learners' preformed ideas (indigenous knowledge) on how the natural world works and find ways of linking the learners' indigenous knowledge to their knowledge of formal science in a lively and



academically sound way. Most of these preformed ideas come from the learners' knowledge which have developed over time and continue to develop in a particular community (Ameyaw & Amankwah 2014:312). Educators have to take into consideration the learners' prior knowledge and questions if learners are to learn science effectively without any difficulty (Hewson et al. 2009: 6).

A context-based and learner-centred teaching method could result to a successful incorporation of indigenous knowledge rather than the content-based and teacher-centred teaching method (Emeagwali 2003:4; Abah et al. 2015:668). The learner-centred approach might include the learners' wealth of knowledge and experiences, which will engage and involve learners in the process of learning, taking up the responsibility of their individual learning. The teachers' role is to assist the learners to link to their environment in a manner that will make learners to face the opportunities and responsibilities as adults (Teacher's Guide 2001:4). In line with this, educators as change agents need to rethink critically on the way to create strategic possibilities to identify and develop the experiences and knowledge of learners (Odora Hoppers 2005:3); and use well-designed and suitable teaching approaches to attain their goals in Life Sciences lessons. As learners link their own knowledge and science, it makes science to become more effectual, meaningful and accessible by enabling learners to relate the concepts learned to their everyday experiences. This places learners in a situation where ideas are explored for better understanding of phenomena which will result in improved knowledge development and production.

Quigley (2009:76) points out that teachers have begun to recognise that western knowledge continues to be just one knowledge system amongst others. There is need for educators to utilise the relevant resources of indigenous people to realise the huge science knowledge base they make use of in everyday lives (Quigley 2009:76). On the one hand, the attitudes and beliefs of educators on the importance and possible

role of indigenous knowledge and practices to sustainability explain the way educators incorporate indigenous knowledge in school curriculum (Gachanga 2007:1). This is in line with the view of Aikenhead and Ogawa (2007:540) that science teachers should connect other knowledge systems with western knowledge systems. On the other hand, teachers' social responsibilities entail creating awareness to learners on the value of cultures and practices of indigenous knowledge, and also motivate the interest of learners in science fields for example, chemotaxonomy and ethnobotany (De Beer & Van Wyk 2012:1). In support of this view, research indicates that teachers can assist learners to develop their indigenous knowledge by combining more appropriate pedagogical models and techniques which involves culturally based and responsive teachings (Srikantiah 2005:1; Owuor 2007:34; Dziva et al. 2011:92). For example, some scholars proposed the use of argumentation teachings as a way to introduce IK into science, guide learners to understand indigenous knowledge and to involve learners with science (Hewson & Ogunniyi 2011:680). Furthermore, educators would use field trips, laboratory exercises, free-hand experiments that involve everyday or locally available materials, discussion groups, demonstrations, storytelling and indigenous knowledge topics short videos to bridge the cultural gap between indigenous knowledge and school science to weave something meaningful and culturally appropriate for those under their care (learners), and also to facilitate the enrichment of learning.

Thirdly, the design of textbooks and other learning materials should integrate the indigenous people practices and activities. Indigenous environments have to be taken into account in designing the learning materials to provide memorable contexts that help learners retain information and integrate it with their everyday experiences. For example, the available artefacts found in the environment could serve as a tool that can be used to connect between what is found in the community to what is usually

taught in the school (Kaino 2013:83). Thus, learners would not view science as boring and incomprehensible. Other examples, such as indigenous games, songs and oral stories could be used as vehicles for communicating, sharing and representing the knowledge of indigenous people. These could be compiled for use in school science learning for expanding scientific understanding. In addition, these culturally responsive science curricular practices are significant to inspire learners in understanding science principles and concepts (Atwater 2010:107). In a similar vein, learners employ their indigenous knowledge to engage with the concepts of science and how the elements of their cultural resources can be used more productively in the science classrooms (Chigeza 2010:2). Semali (1999:311) explains that local teachers do not follow any other teaching practices except their individual concepts acquired from indigenous way of knowing. Thus, teachers have to familiarise themselves with the indigenous peoples' lifestyles and also use their own indigenous knowledge. Science educators will be able to develop the understanding of learners beyond easy memorisation of ideas, since ideas would be demonstrated in local meanings. (Abah et al. 2015:670). Abah et al. (2015:672) also noted that "in this way, learners could achieve analytical skills that can be applied to other problems and situations, rather than accepting teachers' explanations".

Fourthly, it is necessary to inform educators on the concepts and practices of local knowledge and the position it occupied in today's learning. Research on indigenous knowledge has to be conducted by teachers, particularly on the local knowledge found where they teach and also where their learners originated from. Teachers will be culturally competent and also become familiar with the learners' culture and knowledge and have better ways of incorporating this body of knowledge in the classrooms to create optimal learning. Also, there is need for teachers to know in detail the idea of the policy statement on indigenous knowledge and how to incorporate it

into teaching and aligned to the Africa needs on the basis of the availability of resources. In addition, teaching should give learners a chance to explore their community (Ameyaw & Amankwah 2014:313) and enable learners to know the role of science. In a similar vein, integrating indigenous knowledge into formal schooling can also assist learners have the ownership of the knowledge they bring into the classroom settings (Srikantaiah 2005:1).

The use of local materials and local people serve as teaching resources in the schools (Jegede & Aikenhead 1999: 52) to bridge the divide between school and community life. Moreover, in order to fully incorporate IKS into any formal education, it is critical to involve the elders who are the bulk repositories of the IK in the local community and have extensive experience and skill but who rarely have formal qualifications (Hays 2009:194,205; Òtúlàjà et al. 2011:698). Teaching and learning can be shared by these elders through science, creation stories, plant biology, environmental education, health care delivery, biodiversity and natural resource management and other education-centred activities, all of which are part of the curriculum and which can be acknowledge and examined. Another good description is where the science teachers explained the science topic from a western perspective and the elders explained the concept using indigenous knowledge (Foy 2009:25) for a deeper understanding of concepts.

Fifthly, “as educators, it is our responsibility to prepare ourselves and our students to participate productively in a complex, multicultural scientific community” (Kimmerer 2002:435). Learning environments have to be adapted to assist learners in building on the communities’ indigenous knowledge and by recognising learners’ beliefs and cultural systems (Srikantaiah 2005:1). It means that educators have to make use of the diverse cultures and activities in their classroom for the learners to understand the concepts from different perspectives. Thus, teachers have to recognise and adapt to

the diversity of knowledge systems represented within one class (Ameyaw & Amankwah 2014:315), because learners might simply identify the links between the school science concepts and their daily experiences (Regemi & Fleming 2012:482). In turn, educators may be able to use these connections between learners' own knowledge and science to be a foundation for planning lessons as educators try to get learners ready for life in a global environment by teaching learners the other realms of life. Learners need to develop, involve and excited to acquire more positive approaches to science, when educators make these connections to explain to learners that science could be significant to them (Brayboy & Castagno 2008:743). "To achieve such a goal requires attention to the local culture in a holistic and integrative manner across the curriculum, rather than as an add-on component for a few hours a week after attending to the "real" curriculum" (Teacher's Guide 2001:4). Also, the teacher's role is to make sure that education is related to learners' environment. For example, the use of indigenous games builds a connection between classroom activities and particular culture activities (Laridon, Mosimege & Mogari 2005:147) and have great value in the classroom.

However, there is need for educators to use various approaches for a successful incorporation of indigenous knowledge which requires relating science to learners' daily experiences. Actually, "proper integration of indigenous knowledge system into science teaching activities will greatly assist African science teachers and learners to make extensive use of hands-on activities, investigative laboratory activities, open-ended questions, inquiry-oriented discussion, co-operative learning, and in fact performance assessments as pedagogical tools" (Abah et al. 2015:670). Thus, despite the commitment of South Africa government to integrate indigenous knowledge properly in education, the process has encountered huge challenges as will be discussed in the section that follows.

## **2.10 CHALLENGES OF BRINGING INDIGENOUS KNOWLEDGE INTO THE CLASSROOM**

Having explained the value and potential of indigenous knowledge to provide explanations to some difficulties affecting African societies, it is necessary to examine some of the underlying tensions associated with integrating IKS in science as stated in the amended South African CAPS document and the effect of incorporating indigenous knowledge will have in teaching and how to sustain it in the present classroom settings. “In South Africa, there is the realisation that the current form of western education practised in schools needs to be more inclusive of the diverse backgrounds that South Africans draw from in their knowledge construction” (Botha 2012:57). Evidently, in a bid to achieve an inclusive learning of indigenous knowledge in South Africa, both learners and educators struggle with crossing cultural borders (Botha 2012:58).

Firstly, “the western-based schooling system recognizes teachers’ professionalism as central in facilitating the process of classroom knowledge construction” (Owuor 2007:28). This discourages an atmosphere for discussions in classroom where the practices of indigenous community people such as community elders could be used to facilitate learning process and integrated in constructing classroom knowledge. This might be a challenge to the present discussions on the integration of African indigenous knowledge in education and for sustainable development (Owuor 2007:28).

Secondly, educators and curriculum developers need to consider the diverse nature of indigenous knowledge across South Africa to avoid bundling together the diverse indigenous knowledge systems under one group of indigenous knowledge. As a result such generalisation may distort these types of knowledge from their particular settings (Semali 1999:308), which may in turn result in over simplification and superficial

implementation (Owuor 2007:27). Owuor (2007:29) maintains that such homogenisation is expected to jeopardise the significant role that particular types of indigenous knowledge could contribute to development in the environment and amongst indigenous members that accept such knowledge.

Thirdly, some research has found out that among the challenges faced by educators in integrating indigenous knowledge in science classrooms are educators' lack of understanding of the nature of science and pedagogical content knowledge (PCK) in addressing indigenous knowledge systems (De Beer & Van Wyk 2012:1; Ogunniyi 2005:2; Ogunniyi 2007:972). This may lead to a danger of inappropriate knowledge integration in which treatment of indigenous knowledge is superficial in the classroom. Similarly, most educators are hesitant to integrate indigenous knowledge in the classroom as a result of "fear of infecting classroom teaching with pseudoscience" (De Beer & Whitlock 2009:208). Nevertheless, the effort in transferring indigenous knowledge from daily lives to school works remains without any value or recognition by educators because of their attitudes and beliefs about IK (Owuor 2007:33). Furthermore, the combination of cultures, the number of learners, the time restrictions and the level of science content in the present day's lessons allows it to be challenging for educators to incorporate specific learners' indigenous knowledge with learning about science (Seraphin 2014:12).

Fourthly, the challenges of integrating indigenous knowledge into school include educators' attitude towards the role of curriculum in contributing meaningfully to the country's social and economic requirements (Gachanga 2007:4). Also, the ability of educators to incorporate indigenous knowledge in the classrooms may depend on limited knowledge on what aspects to integrate (Owuor 2007:33), the methods and processes of integration, and the inadequate resources within the school system.

Fifthly, the differences between the world views of indigenous knowledge and global scientific knowledge remain a barrier to significant relationship, as assumed that the other knowledge systems is inferior to western science (Dziva et al. 2011:90). In some science classrooms in Africa, a teaching and learning method that can bring together the western science and indigenous knowledge is missing. This might result in learners staying in the community without going to school or compelled to attend school on a regular basis but ignoring their traditions and cultures. In the latter case, it builds the desires of city lives encouraging learners to accept that they might not find any future in their rural societies. This discourages the transmission of indigenous knowledge and the learners' learning process (Hays 2009:199). Thus, educators have difficulties to explore the methods of utilising adequate teaching approaches that merge the indigenous knowledge and school science (see section 1.4). Seraphin (2014:14) went further to assert that "this separation of self from learning can hinder student engagement in and ownership of science concepts, especially for those students whose traditional knowledge worldview incorporates both natural and metaphysical phenomena".

The South African CAPS document stipulates that the educators are responsible for integrating indigenous knowledge in schools and discusses the necessity of integrating IKS into the education system. However, it does not propose how this can be done in terms of providing educators with a plan or a sequence of steps to get there (Department of Basic Education 2011:28). South African educators are thus expected to encounter limitations during curriculum implementation and trying to put government policy into practice. Each curriculum change in South Africa has supported the relevance of integrating indigenous knowledge, yet the curriculum stated little or no clear guidelines on the way it has to be implemented at school. Even those that developed interest in incorporating indigenous knowledge are likely to remain



secluded in their efforts to implement an effectual integration of indigenous knowledge in the school (Òtúlàjà et al. 2011:698; Owuor 2007:25). Unfortunately, the educators who are expected to implement the new curriculum in the classrooms have been inadequately equipped to enact the curriculum (De Beer 2016:37; Ogunniyi 2014:1). Science educators have been trained mainly in the scientific rather than the IKS modes of inquiry (Ogunniyi 2005:2). In addition, there is no guidance in the curriculum on what aspects of diverse South African indigenous way of knowing and practices are to be integrated into science learning. Thus, there is a danger of inappropriate knowledge integration in which treatment of indigenous knowledge is superficial.

There is evidence that suggests that teaching of sciences needs to be embedded in indigenous knowledge and practices. Therefore, a place has to be created in science to incorporate indigenous knowledge, as this would contribute to effective science learning and for learners to be empowered.

## **2.11 CHAPTER SUMMARY**

Chapter two emphasised the position and implications indigenous knowledge have specifically in teaching. The current development of attention in indigenous knowledge in the educational field and sustainability has involved the interest of many academics (Ngulube & Lwoga 2007:117; Owuor 2007:21; Snively & Corsiglia 2001:20-21). There is a move to incorporate indigenous knowledge and practices in teaching (Srikantaiah 2005:1). Some countries across the globe have realised the great significance of incorporating indigenous knowledge in schools (Semali 1999:310). The school system in South Africa has designed curricula that integrate local knowledge in subjects such as Life Sciences (Department of Education 2003:4). With the right training and the knowledge to incorporate indigenous knowledge in science learning effectively, teachers as agents of change can help to achieve these goals. Educators are faced with many challenges in integrating indigenous knowledge successfully in science

education. More research is required at primary and secondary school levels on what teachers are required to do while integrating indigenous knowledge in the classrooms. Most of the indigenous knowledge systems work has concentrated on Higher Education (Vhurumuku & Mokeleche 2009:109). The concept of “educators as cultural brokers” was used to explain the function of teachers in assisting the movement of learners from their daily lives to the world of science taught in the classrooms. Teachers as cultural brokers serves as the theoretical background that underpins this research and is discussed in the chapter that follows.

## **CHAPTER 3**

### **THEORETICAL FRAMEWORK**

#### **3.1 INTRODUCTION**

The research explores the way secondary school teachers in Gert Sibande district incorporate indigenous knowledge into Life Sciences. The nature of the study deemed it crucial to employ a theoretical framework that gives an insight on the way teachers could incorporate indigenous knowledge in the classrooms. Also, the theoretical framework employed have an important part to play in shaping scientific practices and should duly be reflected in science instruction.

This study drew inspiration from a number of theories. Thus, the concept of “teachers as cultural brokers” is explained along with “subsumption theory of meaningful learning” (Ivie 1998:35), “collateral learning theory” (Jegede & Aikenhead 1999:55) and “cultural border crossing theory” (Jegede & Aikenhead 1999:52). The latter concept directly explains the need for teachers to be cultural brokers. The concept “educators as cultural brokers” analysed the responsibility of teachers to resolve traditional clashes that might occur in multicultural teaching (Stairs 1995, in Jegede & Aikenhead 1999:58). The idea of a teacher being a culture broker is pertinent in the classroom, and also focuses on the way teachers could assist to reconcile between learners’ life-worlds and the culture of science (Jegede & Aikenhead 1999:60).

An evaluation of the concepts gives a background to discuss the incorporation of indigenous knowledge in the learning of science. To achieve a better idea of the theories that drives the programme that incorporate indigenous knowledge and the issues surrounding the process, there is need to discuss the key theoretical frameworks that educators need to know as they seek understanding. First, we are going to discuss subsumption theory of meaningful learning.

### **3.2 SUBSUMPTION THEORY OF MEANINGFUL LEARNING**

Ausubel's learning theory has made significant and unique contributions to the fields of educational psychology, cognitive science and science of education learning (Adhakari 2013:1; ICDST 2017:1; Ugwu 2013:5). Ausubel (1960) (as cited in Ivie 1998:37), explains that in Ausubel's theory, individuals incorporate new knowledge (facts, concepts, principles and generalisations) into their hierarchical arrangement of existing cognitive structures. Ausubel's continuous attention is the actual condition of the classroom where learners and educators are struggling with difficulties but very important verbal material (West & Fensham 1974:63). Ausubel's theory recognises the importance of what is already known in organising and creating new knowledge into the learner's reasoning structures. Thus, Ausubel's theory of meaningful learning provides teachers with an organised method to teach higher order thinking which offers a suitable method to assist learners to create intellectual structures meaningfully (Ivie 1998:36).

Ausubel believes that one of the processes of learning of new knowledge depends on what is already known. Ausubel's model of learning emphasises the role of the existing cognitive structure (subsumers) or advanced organisers in incorporating newly introduced concepts to be learnt (West & Fensham 1974:63; Adhakari 2013:3)). The organisers can be used to assist learners to assimilate, organise and interpret new incoming information, thus acting as a subsuming bridge or connect between what is already known and what is to be learned, which leads to meaningful learning (Ivie 1998:38). The organisers are therefore a way of organising learners' cognitive structures for the learning experiences about to occur.

The primary idea of Ausubel's theory is that learning of new knowledge depends on the prior knowledge of learners, which must be ascertained and used accordingly. Another major concept of Ausubel's model of learning focuses on meaningful learning.

According to the proponent of subsumption theory, meaningful learning happens when the learners' suitable prior knowledge interact with the new material to be learnt (Ivie 1998:40; West & Fensham 1974:63). Thus, the notion of meaningful learning begins with the existing knowledge of learners before new concepts are introduced. Learners need to connect new knowledge to the concepts that already exist for a meaningful learning to take place. The cognitive structures need to be strengthened for learners to hold ideas for more time and subsumption provides learners with fundamental structures to create new ideas (Ivie 1998:35).

Ausubel understood that it is necessary for educators to prepare a preview of information to be learnt. This can be done by preparing a short overview on how the information to be demonstrated is being organised. In a similar vein, indigenous knowledge and practices of learners that have Life Sciences undertone have to be infused into Life Sciences teaching to serve as advanced organisers for new related Life Sciences concepts, thus, the theoretical framework of this study.

### **3.3 THE COLLATERAL LEARNING THEORY**

“Collateral learning generally involves two or more conflicting schemata held simultaneously in long-term memory” (Jegede & Aikenhead 1999:55). Jegede and Aikenhead (1999:54) explains what occurs in the learners' mind between the borders of school science and their community. In a science classroom, learners learn western and traditional meanings of simple concepts of science simultaneously (Ng'asike 2011:62). Ng'asike (2011:63) went further to assert that the theory of collateral learning recognises multiplicity of cultures and allows learners to learn both the context of valid ideas and the science ideas. A learner could retain s/he community cultural ideas and conflicting ideas of the science culture in their memory at the same time for a long time (Jegede & Aikenhead 1999:53).

The contrasting ideas could either interact or not interact in the mind of the learners. In a situation when the contrasting ideas interact, learners build up foundations to hold on to the contrasting ideas and will have recognised resemblances in the ideas which will result in learners developing new ideas in the long term memory. Thus, there is resolution of the clash between the ideas (Aikenhead & Jegede 1999:278). Then, in the case when the contrasting ideas failed to relate, a learner accesses the ideas individually depending on whether they are where the science culture ideas or community culture ideas are used (Aikenhead & Jegede 1999:278). Aikenhead and Jegede (1999:278) identified four types of collateral learning experienced by a learner which are not necessarily distinct from each other. These are summarized here:

- *Parallel collateral learning* is a situation where the opposing schema show no interaction resulting to learners accessing one schema or another depending on the situation (Aikenhead & Jegede 1999:278). A learner holds the two ideas in their schema about a concept in their long-term memory while still attempting to understand them. Learners allow the new ideas to coexist in their schema without experiencing any conflicting concepts (Aikenhead & Jegede 1999:278).
- *Simultaneous collateral learning* is a situation that occurs when concepts from two different worldviews (e.g., indigenous knowledge and scientific knowledge) about a specific idea are learnt at the same time. It thus allows learners to be in a situation to look out for the differences and similarities of concepts from two worldviews that relate to the idea being assessed (Aikenhead & Jegede 1999:278).
- *Dependent collateral learning* occurs in a condition when a learner adapt one knowledge based on a challenge presented by another knowledge, resulting in the construction of new concepts triggered by what is already known without

radically restructuring the existing knowledge base. It could be the adaptation of indigenous knowledge on the basis of the conflicting idea of science or vice versa (Aikenhead & Jegede 1999:278).

- *Secured collateral learning* is a condition where the contrasting ideas that have been posed by the school science taught in the classroom and the indigenous knowledge base brought in the classroom interact with each other, enabling the resolution, in some manner, of the mental dissonance or cognitive conflicts (Aikenhead & Jegede 1999:278).

Collateral learning explains the experience learners encountered whenever the indigenous knowledge is brought into the classroom and involve in the knowledge of science. A learner who requires “effective collateral learning in science classrooms will rely on successful cultural border crossings into school science (Aikenhead & Jegede 1999:277). Collateral learning assists educators in understanding learners’ experiences in science knowledge and indigenous knowledge when learners border cross. Also, teachers could help learners to progress through these abovementioned types of collateral learning for meaningful learning to occur. In this way, this helps teachers to devise better strategies to function as cultural brokers.

The commonality of all knowledge systems are representations, performances and locality while they differ in the manner in which they are brought together (Turnbull 1997:552). There is possibility of creating a space where history of knowledge can be achieved collectively if knowledge is recognised to be performative and representational. (Turnbull 1997: 553). Turnbull (1999:553) argues that “in both cases, it is a process of knowledge assembly through making connections and negotiating equivalences between the heterogeneous components while simultaneously establishing a social order of trust and authority resulting in a knowledge space”. “The

future for local knowledge traditions is, I believe, dependent on the creation of “a third space, an interstitial space, a space in which local knowledge traditions can be reframed, decentered and the social organisation of trust can be negotiated” (Turnbull 1997:560).

In a classroom situation, it is not hard to understand how a learner learns collaterally and the learner’s acceptance of this situation as an everyday occurrence. Educational clashes occur in classroom when the worldviews and learners’ culture differ from what is represented in the science textbooks. (Jegede 1997:149). As learners attempt to wrestle with the situation of cognitive dissonance, learners accumulate funds of knowledge through their homes, school and community experiences, which then meet, interact and perhaps fuse together in the conceptual third space to form new understanding and knowledge (Yahya & Wood 2017:306). This ‘third space’ results from the merging of the indigenous knowledge and science in the cognitive processes of both educators and learners (Turnbull 1997:552).

### **3.4 CULTURAL BORDER CROSSING THEORY**

“Cultural border crossing is the movement of learners from the cultures of everyday life to the culture of science” (Jegede & Aikenhead 1999:55). Jegede and Aikenhead (1999:48) opine that “a pupil encounters the culture of home, the culture of peers, the culture of school, the culture of the science classroom, and the overarching culture determined by the community in which the pupil lives”. Thus, learners make sense of their world as learners move between all these sub-cultures. As learners move into the world of science, learners bring along with them other cultures already carrying and at the same time be able to recognise and relate with the science taught in their science classrooms. The clash of cultures at school could result to the loss of meaningful science learning which might have been applied to understand the natural surroundings outside the school (Jegede & Aikenhead 1999:49). “In non-Western



countries, the science curriculum itself may be experienced as cultural violence by pupils who strongly believe in their community's Indigenous belief system (Jegede & Aikenhead 1999:55). The cultural clashes which the learners experienced might affect teachers and also in learning of science. For learners to have real access to education, cultural conflicts need to be identified and respected in teaching and learning (Mulholland & Wallace 2003:882).

Cultural border crossing has great implications for non-western learners that learn science at school. The western culture will be disparate from the learners' everyday culture, of which their indigenous knowledge is involved. Learners' crossing from their everyday culture to the science culture does not necessarily mean that learners should abandon their everyday cultures to adopt the culture of science; rather, the cultural border crossing creates provision for the availability of other cultures (Mulholland & Wallace 2003:882). Mulholland and Wallace (2003:884) went further to assert that border crossing allows an individual to access skills, values and knowledge of a new culture without any need to set aside the prior knowledge in order to favour the new knowledge. The four types of border crossing recognised by Jegede & Aikenhead 1999 are discussed as follows:

- *Smooth border crossing* occurs when the learners' worldviews or domain of knowledge are congruent with school science. It could happen through a process of adopting the surrounding culture that corresponds with different traditional ideas (Jegede & Aikenhead 1999:51).
- *Managed border crossing* happens where the worldviews of learners are somewhat different from the worldview of science, thus involving the movement from one worldview to the other to be managed. Learners find the world of

science contradictory to their life-world knowledge (Jegede & Aikenhead 1999:51).

- *Hazardous border crossing* occurs where the learners' worldviews and science worldview are so diverse that the encounter leads to a hazardous transition from one to the other. Learners "generally resist being assimilated into the culture of science, but their lack of academic savvy tends to limit their success at school science" (Jegede & Aikenhead 1999:51).
- *Impossible border crossing* occurs where the domain of knowledge of learners and culture of school are very conflicting that movements into the culture of school science appears almost unachievable. It thus places learners in a position to "avoid (or dropout of) of school science to sustain their self-worth whenever they experience the foreign culture of school science" (Jegede & Aikenhead 1999:51).

The crossing of cultural borders is a difficult task for learners. A learner must possess the capability to reason in a different way regarding other several cultures and for resolving the cognitive conflict that arises from the combination of the diverse cultural concepts in order to border cross successfully (Jegede & Aikenhead 1999:50). Then, as learners move successfully from their culture of community border into the culture of science border, effective learning occurs. Successful border crossing by learners is dependent on the extent of the difference between the community culture and the science culture experienced by the learners.

The worldwide aims of science education seek to get rid of cultural violence and encourage fair opportunities for success for all learners (UNESCO 1994:4). Cultural violence is "when language or conventional actions of a group have little or no meaning to a person who happens to be immersed in that group and who needs to accomplish

some action” (Jegede & Aikenhead 1999:54). To attain the culture of science in the classroom, learners must move from their daily life-worlds into the world of school science or vice versa (Aikenhead & Jegede 1999:274).

For border-crossing to be successful, a relationship should exist between the science learned at school and what occurs in homes of learners. For example, in South Africa green vegetable leaves are cooked for food until the green colouration (chlorophyll) are lost or removed. In case whereby a South African learner is learning ‘photosynthesis’ in school and comes across concepts such as *chlorophyll*, *denaturing* and *chloroplast*. To minimise encountering problems understanding these school concepts, science could be exciting and clearer if the kitchen is brought into the classroom or learners are asked to watch their mother prepare vegetable leaves at home. This is an example of simultaneous collateral learning which involves two situations (school and home), where a concept is learnt in an unplanned way, but occurs naturally and at the same time (see section 3.3). This facilitates the learner’s cross-cultural border crossing between home and school science (Aikenhead & Jegede 1999:280).

Learners need to travel between the worlds of their families, school, classrooms and peer groups for a meaningful learning of science (Snively & Corsiglia 2001:8). It is the role of educators to try to understand and make it easier in learning of science by learners and also to adapt science to the learners rather than simply urging learners to become “more scientific” in order to adapt themselves to science (Mulholland & Wallace 2003:883). How a learner successfully crosses between both cultures easily is determined by the degree of assistance s/he gets from educators in border crossing between both cultures (Jegede & Aikenhead 1999:52). This requires adequate teaching approaches to assist learners to border cross between their daily experiences and in learning of science. The teaching method being proposed for cross-cultural

science teaching is that teachers are required to serve as cultural brokers in assisting a learner for a successful border crossing in science (Jegede & Aikenhead 1999:55).

### **3.5 EDUCATORS AS CULTURAL BROKERS**

A broker is defined as an intermediary who most normally features in states of commerce such as in stockbroker (Michie 2003:3). Connecting this definition of broker to culture, a cultural broker is “a person who facilitates the border crossing of another person or a group of people from one culture to another culture” (Michie 2003:3). In other words, cultural brokers are people who can assist in the negotiation between the culture of people and another culture. In this sense, a cultural broker is a person “who can communicate effectively in both a school and a community context and can translate knowledge and skills from one to the other” (Wyatt 1978-79:17). Thus, in the context of science teaching, a person that enables and guides learners to move from the culture of community to the culture of science is called a cultural broker.

In a classroom where learners have diverse indigenous knowledge and come from different indigenous communities, the role of teachers should be to serve as cultural brokers to facilitate learners to border cross from their indigenous knowledge to western knowledge. Teachers make explicit border crossings by acknowledging and identifying the learners’ cultural backgrounds that connect to learners’ daily culture and then introduces the western science culture in the context of indigenous knowledge (Aikenhead 2001:342), without denying the value of any culture.

Collateral learning and cultural border crossing require teachers to be cultural brokers. This implies that teachers should assist learners negotiate cultural borders. Since science learning demands learners’ moving from their communities’ cultures to the school science cultures, the role of a teacher is to assist learners in border crossing, making sure that the concept of collateral learning is utilised effectively to assist

learners in resolving the contradictory concepts stored in the long-term memory (Jegede & Aikenhead 1999:60). The teachers' utilisation of concept of collateral learning will assist learners in reconciling contrasting ideas and also guide learners' successful movement from their community culture to the science culture. The metaphor "teacher as culture broker" was used by Stairs (1995) as cited in (Jegede and Aikenhead 1999:60), "to analyse a teacher's role in resolving cultural conflicts that arise in cross-cultural education". Thus, as cultural brokers, educators clearly identify the borders of cultures to be crossed, guide learners backward and forward to cross the borders and get learners make meaning of cultural conflicts that might come up in the science classroom. (Aikenhead 2001:348).

The effect of collateral learning and cultural border crossing can be seen in the policy documents. For example, the South African Revised National Curriculum Statement for Natural Sciences explained that:

"However, the existence of different world-views is important for the Natural Science Curriculum. One can assume that learners in the Natural Sciences Learning Area think in terms of more than one world-view. Several times a week they cross from the culture of home, over the border into the culture of science, and then back again" (Department of Education 2002:12).

Teachers as cultural brokers entails teachers to employ diverse approaches to teaching that make the new cultures open to learners, and not teaching approaches that estrange learners from the new cultures (Jegede & Aikenhead 1999:63). The teachers are required to incorporate the learners' ideas from their community cultures to explain natural events for learners to feel free with the new culture in the classroom. A good example is demonstrating the concept of "rainbow" by merely raising soap

bubbles towards natural sunlight although, in some African cultures, a rainbow appearance means a python crossing a river or the demise of an important traditional leader (Jegede 1997:148). Teachers in South Africa should guide learners to cross smoothly the barriers that separate indigenous knowledge from western science. For example, in a Life Sciences classroom, learners could be encouraged to look at the different ways of explaining health conditions in regards to the similarities and differences, the strengths and weaknesses of these explanations. With this, a teacher could then determine the ways to incorporate diverse knowledge system in the science classrooms.

Teachers have to value learners' cultural identity in the community through science education (Jegede & Aikenhead 1999:63). For example, teachers should accommodate different cultural resources and values such as traditional stories, songs, folk drama, ceremony, legends, proverbs, myths, indigenous games, etc. in science classrooms. Furthermore, teachers need to assist learners to develop ways to accept and make meaning of their local knowledge and science knowledge (Hewson et al. 2009:6). For example, the concept of traditional fermentation of amasi (sour milk), umqombothi (traditional beer) and udombolo (pot bread) could be discussed with learners in a way where the indigenous knowledge connects and complements the scientific knowledge. Also, local farmers could be invited to the class to talk about their work using local stories that will connect learners with the local culture.

### **3.6 TEACHING STRATEGIES FOR EDUCATORS AS CULTURAL BROKERS**

Scholars continue to explore and analyse various approaches to teaching that would assist learners' border crossings between their daily lives into learning of science to achieve effective and meaningful learning (Jegede & Aikenhead 1999:60). For example, in Canada, a strategy was initiated in the science classroom requiring

learners to divide their notebook pages into half to create two columns: one titled “culture of science ideas” and the other titled “my ideas” (Jegede & Aikenhead 1999:61). The two columns were completed by the learners at the completion of the lesson. Then, the teacher reads the notes written by the learners to have ideas on learners’ thoughts with regard to their diverse community ideas and scientific ideas. This activity allows learners to carefully move backward and forward between their life-world and the culture of science (Jegede & Aikenhead 1999:61). Thus, the teacher assesses what the learners have written in their notebooks and apply the role of a culture broker to facilitate learners’ border crossings for effective and meaningful learning.

There are 15 specific instructional strategies that could be taken for considerations by teachers to use as cultural brokers when teaching western science to learners. These strategies as summarised by Solomon (1992) (in Jegede and Aikenhead, 1999:63-64) are explained as follows:

1. “Use a variety of materials and resources, and ensure that racially stereotyped material is either eliminated or addressed in an anti-racist fashion” (Jegede & Aikenhead 1999:64).
2. “The oral narratives and heritage of the Native community should become part of the school science experience. These should not be demeaned as being merely myth and legend” (Jegede & Aikenhead 1999:64).
3. “The similarities and differences and the strengths and limitations of the two traditions should be articulated and explored during instruction” (Jegede & Aikenhead 1999:64).

4. "Teachers should give attention to the language of science and help pupils who are accustomed to an oral tradition or who have language difficulties" (Jegede & Aikenhead 1999:64).
5. "Cultural imperialism should be acknowledged" (Jegede & Aikenhead 1999:64).
6. "Integrate discussions about science with history, morality, justice, equality, freedom and spirituality" (Jegede & Aikenhead 1999:64).
7. "Where possible, direct comparisons between classification schemes in both traditions should be made" (Jegede & Aikenhead 1999:64).
8. "Show pupils how concepts such as heat, snow and life cycles are culture-laden in both traditions" (Jegede & Aikenhead 1999:64).
9. "Instruction should provide sensory experiences and experiential pupil-centred learning" (Jegede & Aikenhead 1999:64).
10. "Instruction should identify local approaches for achieving sustainability" (Jegede & Aikenhead 1999:64).
11. "The pupil's world should be related to science instruction" (Jegede & Aikenhead 1999:64).
12. "Teachers should provide a multicultural view of science and technology by drawing upon a variety of cultures when teaching science" (Jegede & Aikenhead 1999:64).
13. "Activities should be designed to help students recognize the likelihood of continual change, conflict, ambiguity, and increasing interdependence" (Jegede & Aikenhead 1999:64).



14. “Interactivity among pupils should encourage them to identify their own ideas and beliefs” (Jegede & Aikenhead 1999:64).
15. “Teaching strategies should emphasize solving science and technology problems, environmental problems, resource management, and sustainable societies’ problems” (Jegede & Aikenhead 1999:64).

The purpose of the abovementioned strategies is for teachers to consider the local knowledge of the learners in their teaching of science to assist learners to culturally border cross between the culture of their community and western science effectively. Learners should be allowed to observe the differences between their indigenous knowledge and scientific knowledge. Also, the usage of local resources from the learners’ culture in teaching science might simplify some scientific concepts and assist learners in resolving conflicting ideas that persist in the learners’ schemata.

### **3.7 CHAPTER SUMMARY**

In this study, subsumption theory of meaningful learning”, “collateral learning theory” and “cultural border crossing theory” were employed along with “teachers as culture brokers” in exploring the way teachers incorporate indigenous knowledge in the teaching of science effectively. Educators as cultural brokers underpins how the research questions in this research were addressed. Thus, the frameworks act as a lens for data analysis that comes up from the data collection and during the summary of findings in this research.

## **CHAPTER 4**

### **RESEARCH METHODOLOGY**

#### **4.1 INTRODUCTION**

Chapter four gives details on the research approach used for this study. The chapter explains the research design and instruments, research type, sampling methods, data gathering and method of analysis. The limitation of the study, research ethics and credibility of the study were also described in this chapter. Thus, this chapter gives a complete account of how this study was structured and carried out.

#### **4.2 A QUALITATIVE CASE STUDY**

A qualitative investigation was undertaken to investigate on how teachers understand the integration of indigenous knowledge and how they mediate indigenous knowledge effectively in the teaching of Life Sciences in the classroom. Qualitative researchers are mainly concerned about meaning. Creswell (2009:4) asserts that “qualitative research is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem”. Qualitative research is a research method which investigates problems that have unknown variables. The qualitative research variables are found by gathering of information from the research respondents (Creswell 2008:53).

Qualitative research allows participants to freely express their opinions, ideas, behaviours and experiences in the natural settings. This enables participants to provide reliable and detailed information, hence allowing the researcher to collect rich data from the respondents. Thus, the researcher chose the qualitative approach with the aim of capturing data in the natural social settings of educators and receiving perceptions from the educators themselves. Under these circumstances, teachers narrated their own experiences and interpretations pertaining to the area of study. The

“up close information gathered by actually talking directly to people and seeing them behave and act within their context is a major characteristic of qualitative research” (Creswell 2009:175).

The qualitative approach involves a process that comprises of emergent techniques and questions, typical data collection in the participant’s natural setting, inductive analysis of data emerging from particulars to general themes and interpreting the meaning of data by the researcher (Creswell 2009:4). The data collection methods in qualitative studies are documents, audio-visual materials, interviews, observations and interviews (Creswell 2009:181).

A case study involves “a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals” (Creswell 2009:13). In a similar vein, “a case study examines a *bounded system*, or a case, over time in depth, employing multiple sources of data found in the setting” (McMillan & Schumacher 2010:24). A bounded system maybe a process, event, activity or a set of individuals (Creswell 2008:476). In addition, “being *bounded* means being unique according to place, time, and participant characteristics” (McMillan & Schumacher 2010:344). This implies that a case study lay emphasis on a single unit to be explored.

A case study makes use of several different methods to obtain the necessary data, varying from personal observation to interviews (McMillan & Schumacher 2010:344), as it is focused on a participant or participants having or sharing common characteristics, for example a school or district. This allows the researcher to closely examine and scrutinise phenomena and collect rich data.

This study used a case study design where the cases being explored are the educators and learners in three senior secondary schools. The interest of the research is to gather in depth information on the how teachers understand the integration of

indigenous knowledge in their natural setting and how teachers integrate indigenous knowledge in their classroom. The case being explored in this study is the Life Sciences teachers who incorporate indigenous knowledge in the teaching of science concepts. It becomes necessary to select a qualitative method because it exposes individuals to their natural setting and the researcher can obtain authentic data in the setting in which the phenomenon naturally exists (see section 1.6). The researcher interviewed learners and teachers and observed how teachers incorporated indigenous knowledge into science concepts in the classroom.

In qualitative research, data is gathered from multiple sources such as documents, observations and interviews, rather than depending on a single source of data. Researchers review all of the data, make sense of it, and organize it into categories or themes that cut across all of the data sources” (Creswell 2009:175). The data gathering techniques used in this study were interviews, classroom observations and CAPS documents. The data collected in qualitative is usually primarily in the form of texts or words. In analyzing the data, descriptions and themes arose from the data text in which the research findings were developed (Creswell 2008:54).

### **4.3 RESEARCH DESIGN**

McMillan and Schumacher (2010:102) explain research design to be “a plan for selecting subjects, research sites, and data collection procedures to answer the research question(s)”. The researcher used a case study design in order to explore the incorporation of indigenous knowledge in the Life Sciences classroom. In this study, the researcher explained the functions of the respondents, aims and objectives of the research, and also the way the research problems were concluded (McMillan & Schumacher 2010:323).

The following four research questions directed the research:

- How is indigenous knowledge presented in the Life Sciences CAPS document?
- What issues do educators encounter in the implementation of indigenous knowledge topics into Life Sciences curriculum?
- How do educators conceptualise the role of indigenous knowledge in the amended CAPS document?
- What are views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom?

Teachers and learners were interviewed. The data gathering techniques employed in data gathering to answer the four research questions were document analysis, classroom observations and interviews. The findings were discussed in relation to the themes that emerged.

#### **4.4 LOCATION OF THE STUDY**

The research was carried out at three senior secondary schools in the Gert Sibande District of Mpumalanga Province. Gert Sibande is among the three districts in Mpumalanga Province covering a geographic region of approximately 31 841 km<sup>2</sup>. The location is on the south east part of the province and lies at about 26° 33"S latitude and 29° 10"E longitude. Gert Sibande district has a boundary with Free State Province in the west Swaziland in the east, Gauteng Province in the north and KwaZulu-Natal Province in the south. The total population of Gert Sibande is 1,043,194 (Wikipedia 2015:1-2). Gert Sibande is known to be a farming area and full of economic activities such as power stations and mining. This research was carried out in the rural area, township and suburbs of Gert Sibande. The three schools selected are in the district and are between 10 and 20 miles apart. Gert Sibande district is made up of individuals with diverse languages and cultural backgrounds due to the migration of people into the district. Though, everyone in the district can communicate mostly in isiZulu, they

do not have a homogeneous cultural backgrounds. Therefore, educators in Gert Sibande district came from diverse cultural roots.

#### **4.5 GAINING ACCESS**

The researcher applied to the College of Education of the University of South Africa for ethical clearance. A permission letter (see Appendix 3) was sent to the three secondary schools principals in the Gert Sibande district immediately the researcher received the ethical clearance certificate (see Appendix 1) from the research committee. The permission letter seeks for permission to conduct a research with the Life Sciences teachers in their schools. Immediately the researcher received the principals' permission, a letter (see Appendix 4) was sent to the Life Sciences teachers in the schools to seek for their consent in the study. Each of the educators was informed that their participation will be dependent on their willingness to take part in the study. Interviews were conducted with the 15 teachers whose consent was received.

#### **4.6 PURPOSEFUL AND CONVENIENCE SAMPLING**

In this study, purposeful sampling was used because it involves “selecting cases that are information rich” on the phenomena being investigated” (McMillan & Schumacher 2010:138). In purposeful sampling, respondents are chosen as they are likely to produce appropriate data for the study and also to address the purpose of the study. Fifteen Life Sciences teachers that signed the consent letters made up the sample in this research. At the time this research started, the Life Sciences teachers were having three to five years of experience, because the amended CAPS document that encourages the incorporation of indigenous knowledge was implemented first in Grade 10 in 2012. This gave the researcher the chance in selecting specific participants (Life Sciences teachers) that will give rich information regarding the topic under investigation in the Gert Sibande District.

Convenience sampling was also applied to this study because it involves selecting the nearest individuals to serve as participants until the sample size is obtained or selecting individuals on the basis of being accessible or available (Cohen, Manion & Morrison 2007:113-114; McMillan & Schumacher 2010:137). Convenient sampling was used to select the 15 educators since some of the teachers that received the consent letters did not participate in the research. The 15 teachers that responded were available, accessible and interested to participate in the study. A total of three schools in Gert Sibande district were selected using convenience sampling, because of the accessibility of the researcher to the schools. Also, six learners each were selected purposely from each of the three schools making a sample size of 18 learners. In all, the sample size was 33. The purposeful sampling was used to ensure that rich information were provided for the research.

The sample size ( $n = 33$ ) might be small, but it represents a typical qualitative sample. In a qualitative research, the sample size is usually small and determined by “the purpose, the research problem, the major data collection strategy, and the availability of information-rich cases” (McMillan & Schumacher 2010:328). In this study, the researcher was not aiming for representations and generalisations from the findings, rather to get thick explanations of educators’ understanding in integrating indigenous knowledge into teaching Life Sciences.

## **4.7 DATA COLLECTION AND INSTRUMENTS**

### **4.7.1 Piloting of Research Instruments**

For the purpose of the research, the instruments for the research used are semi-structured interviews, classroom observations, examination of curriculum documents, in addition to the literature review. The instruments used in this study were conducted with Life Sciences teachers and learners in the school where the researcher teaches.

Piloting of the research instruments helped in reframing some questions before using the instruments for the main research.

#### **4.7.2 Document Analysis**

A research project may need some documents such as module syllabi, meeting minutes, strategic plans, educators' portfolios, faculty journals, etc. to be reviewed. The documents analysis carried out in this research are the CAPS Life Sciences document, teachers' lesson plans, teachers' guide, and learners' book. Documents exposed what individuals give value to and their actions. Since the behaviours of people took place in the natural settings, the information from documents are authentic. Thus, in this study, the data from the documents was employed to validate the data from the interviews.

The documents were analysed to obtain some understandings regarding the way teachers responded to learners that indicated culture border crossings into indigenous knowledge (Ogunniyi 2005, in Dziva et al. 2011:94). The researcher jotted down some comments and wrote down a number of notes in the research log. The insight gained from the document analysis influenced the researcher's classroom observations. The researcher was eager to understand the way educators handled a curriculum with unclear science concepts and the way indigenous knowledge was effectively integrated in teaching of science.

The researcher's actions and analysis of the CAPS document increased as the researcher saw educators struggle with planning for and actual teaching on topics: plant and animal tissues, human impact on the environment and current crises for human survival, biodiversity and classification of microorganisms. The researcher picked out these topics, because the curriculum has labelled the topics as possible areas where IKS can be integrated and also, the topics deal with issues emanating



from indigenous knowledge. As educators planned and taught work from the topics, the researcher's impressions about the CAPS document kept changing.

#### **4.7.3 Classroom Observation**

“Observation is a way for the researcher to see and hear what is occurring naturally in the research site” (McMillan & Schumacher 2010:350). Observation as a technique for gathering information provides firsthand understanding of the phenomenon under study because of the presence of the researcher in the context of the phenomenon. After the analysis of the curriculum documents, teachers were observed during their lessons. The classroom observation provided some ideas on the way teachers incorporate indigenous knowledge in science teaching.

Observation was employed as a means to validate the data collected from the document analysis and to understand the way teachers incorporated indigenous knowledge in the classroom (see observation schedule in Appendix 8). The observed numbers of lessons varied from the 15 educators. The number of observed lessons for each educator ranged from two to three on contents related to indigenous knowledge in order to gather information for the study within a short period of time. The topics taught were plant and animal tissues, human impact on the environment and current crises for human survival, biodiversity and classification of microorganisms. The duration for each lesson observation lasted between 45-50 minutes. Also, educators' experiences while planning lessons and what they actually do in the classroom during teaching provided data for this study. Thus, educators' actions, feelings, thought, and beliefs were all recorded as field notes (McMillan & Schumacher 2010:350-351). These were captured through informal questions before the observation of lessons and a formal semi-structured interview after the educators' lessons. The researcher writes a free description of educators' facial expressions,

gestures, interviews responses and records events that took place in the classroom. Thus, the field notes were then used as data to be analysed.

The researcher engaged in more of a naturalistic observation than in ideal practices that opened the possibilities of educators' expressing their experiences, struggles and needs in planning and teaching. Video observation is a technique used in this study to record what educators actually do in the classroom. The researcher used visual techniques for validation, as they document nonverbal behaviours and communication (McMillan & Schumacher 2010:363).

The observational research method as a data gathering technique depends "on a researcher's seeing and hearing things and recording these observations, rather than relying on the subjects' self-report responses to questions or statements" (McMillan & Schumacher 2010:208). Observation was considered suitable for data collection, as data was recorded as field notes that reflect gestures, movement and facial expressions of the participants which could be triangulated with verbal data (McMillan & Schumacher 2010:363).

The researcher's ability to gather much information was made easier through audio records. Besides audio records, the researcher wrote down summaries reflecting on each of the lessons observed. The handwritten notes focused on lesson organisation and how the educator interacts with learners on indigenous knowledge in the classroom. Also, the researcher was interested in learners' assessment and how educators were concerned to assist learners in acquiring skills and knowledge as required by CAPS documents. The assessment strategies used are oral presentations, tests and examinations that represent formal assessments, while observations, discussions and classroom interactions represent the informal assessment for Life Sciences (Department of Education 2011:66-67). The informal

assessment carried out before or during a lesson provides data used to change the teaching experiences. Formal assessment lays more emphasis on the specific aims and content for progression purposes rather than in the process of learning and teaching. The assessment of learners was observed to find out if educators are carrying out assessment as proposed by the CAPS policy document that requires the incorporation of both informal and formal assessments.

#### **4.7.4 Interviews**

In qualitative research, interviews are used as powerful tools in obtaining data. McMillan and Schumacher (2010:355) explain that interviews give participants better chances to clarify their opinions, suggest the flexibility to gather a wide range of information, and enable the researcher to have deeper interpretations of the response. The interview type used was semi-structured which was designed by referring to the literature review, theoretical framework and objectives of the study. In the semi-structured interview, the researcher asks the participants a group of predetermined questions while still allowing for further probing and clarification of ideas (McMillan & Schumacher 2010:355). Probing gives respondents the opportunity to respond using their own words without being compelled to choose from fixed responses.

Interviews for the educators took two forms in this study. Firstly, informal questions were asked before the observation of the educators' lessons. Secondly, a formal semi-structured interview was conducted after observing the educators' lessons. In this study, 15 questions were asked in the interview schedule for teachers to answer the research questions, but more questions were asked following teachers' responses for more explanation and probing of their ideas (see interview schedule for teachers in Appendix 7). Eighteen learners were interviewed to help answer specifically the research question 4 in this study (see the interview questions used for learners in

Appendix 7). Interviews which serve as a rich data source were used to confirm or contradict the assumptions of the researcher during classroom observations.

#### **4.8 DATA ANALYSIS**

In the data analysis, qualitative data emanated from the responses from the interviews, lesson observations, and curriculum documents. Responses were summarized and recorded for every session when data was collected to improve the understandings and focus. The qualitative data gathered in this study was analysed inductively by grouping it into categories. Then, similar categories were gathered together to generate themes. In this study, themes were mostly linked to educators as cultural brokers and cultural border crossing theory, and minimally to other theoretical frameworks (see chapter 3). The data was aligned to four research questions that were employed in this study in exploring the integration of indigenous knowledge in the Life Sciences classroom.

In qualitative research, the data analysis is on-going, emergent, “iterative and recursive, going back and forth between different stages of analysis” (McMillan & Schumacher 2010:367). In this study, the analysis of data was done during the gathering of data as well as after all the data had been gathered. Since the researcher and the participants spoke different indigenous languages, the only language in which we could understand each other was English. Interviews were thus conducted in English. The data gathered was qualitative data and the process of inductive analysis was used. “Inductive analysis is the process through which qualitative researchers synthesize and make meaning from the data, starting with specific data and ending with categories and patterns” (McMillan & Schumacher 2010:367). By doing this, there would be emergence of conclusions and more generalised themes and conclusions and might not be carried out before the collection of data.

The data was repeatedly read to keep abreast of the insights and for the main ideas to be identified. The data was well-arranged into categories to highlight the key themes. The analysis was carried out on the themes that arose from the data in regards to the research questions and discussed in Chapter 5. However, the findings of the study were interpreted and presented in a narrative form which was substantiated by thick descriptions and direct quotes from participants. The data analysis process employed directed the researcher to come up with empirical conclusions and recommendations.

#### **4.9 CREDIBILITY**

Credibility is one of the strengths of qualitative research that is used to assess and determine the accuracy of findings. Credibility of a study “refers to the extent to which the results approximate reality and are judged to be accurate, trustworthy, and reasonable” (McMillan & Schumacher 2010:102). The following strategies were employed to improve the credibility of this research.

In this study, triangulation was used to ensure credibility. Triangulation is the method of obtaining convergent data using “the cross-validation among data sources, data collection strategies, time periods, and theoretical schemes” (McMillan & Schumacher 2010:379). The best methods were chosen to answer the research questions as a result of the flexibility of the researcher in the usage of multiple sources of data. To enhance the credibility of the data analysis, triangulation was accomplished by using a wide range of data sources (document analysis, lesson observations, and interviews). The research findings were checked and compared from the data gathered from different sources before conclusions were made to obtain credible and valid responses.

Another important strategy of enhancing the credibility of the study was keeping of an extensive field logs. A field log documents provide a log of dates and time spent in the field, places and persons involved, including getting access to sites and participants (McMillan & Schumacher 2010:334). The field log keeps the step by step records procedures of the study. All information with regards to the collection of data and interpretations were recorded to allow people to validate the research once deemed crucial. Any process and interpretations that have not been taken into account is easily checked in the field notes.

Credibility depends on the participants' understandings and reviews of the data. Member checking is used to determine how accurate the report is. The research results are true when the responses of participants are compatible with those that are ascribed to them (Babbie 1995:127). Taking the themes back to the participants is one the strategies used to ensure credibility in this research. Member checks allowed the respondents to make corrections and comment on the findings. This was used as a confirmation that the data generated reflected truly of what had happened in the view of the respondents.

Furthermore, the accuracy of this study was enhanced by using peer-debriefing method. The information and results in this study were constantly discussed with the supervisor of the researcher who was very helpful to address the areas that required improvement and suggested how to address it. Thus, credibility is enhanced by ensuring that the researcher's interpretations of the findings remained the same with the ideas of others in the study.

#### **4.10 LIMITATIONS OF THE STUDY**

The major limitation of this research was the size of the study population. This research was restricted to three schools in the Gert Sibande District and not every of the Life

Sciences teachers and learners took part in the research. The small sample size of the research cannot be a fair representation of groups of Life Sciences educators in Mpumalanga Province of South Africa. Therefore, the findings cannot be generalised as appropriate to all learners and Life Sciences educators.

Another limitation was that of time frame. The study was limited to a short period of time due to the nature of the course study. In addition, the researcher does not know what the participants' level of exposure to Life Science was prior to engaging in the learning environments, or how it may have influenced their responses. Nevertheless, this research had the ability to interpret matters that could be utilised in curriculum developments or contribute towards further research after few cases have been thoroughly studied.

#### **4.11 RESEARCH ETHICS**

Understanding the research ethics principles and working with them carefully is a very important aspect of educational research (McMillan & Schumacher 2010:117). The College of Education of the University of South Africa granted an ethical clearance that described a detailed scrutiny of the research procedures so that no problem will be created for any individual that will partake in the study. The Mpumalanga Department of Education – Gert Sibande District and the school principals gave their permissions, while the Life Science teachers, learners and learners' parents gave their consent before field work and data collection began.

The purpose and nature of the research were clearly described verbally and written to each of the research respondents from the outset in a way they could understand. The participants were informed that this study was not harmful and the discussions in this research will not affect them and their careers. It is important to ensure that data

collected is kept confidential, as well as the identity of the participants (McMillan & Schumacher 2010:338-339; Morris 2015:13). The teachers were properly informed regarding their participation in this study to be voluntary and that they had the right to pull out at any stage of the research without any penalty. Participants remained anonymous (pseudonyms were used), and the information gathered remained confidential throughout the study. On completing the research, a summary of the research findings would be made accessible to the educators if asked for.

#### **4.12 CHAPTER SUMMARY**

In summary, chapter four explained the way this research was carried out. The methodology used took into account the objectives and the aim of the research, namely, how teachers incorporate indigenous knowledge into Life Sciences. The research type, methods of data gathering and purpose of using convenience and purposeful sampling were duly explained in details. Therefore, this study used triangulation to address any biased characteristic in a specific source of data to be neutralised once combined with another sources of data. The analysis and presentation of data regarding responses from the four research questions that guided this study will be explained in Chapter 5.



## **CHAPTER 5**

### **DATA ANALYSIS AND PRESENTATION**

#### **5.1 INTRODUCTION**

This chapter analysed and presented the results from the data collected through semi-structured interviews, classroom observations and CAPS documents are analysed and the findings presented. The data analysis addressed the responses to the four research questions that were asked to investigate how teachers understand the incorporation of indigenous knowledge and the way indigenous knowledge is effectively reconciled with their teaching of Life Sciences in the classroom.

#### **5.2 DATA ANALYSIS AND PRESENTATION**

To study issues that surrounded incorporation of indigenous knowledge in the classrooms, three data sources were used, as stated earlier. The sources of data include: (a) official curriculum documents (CAPS document, teacher's guide, lesson plans and learner's book), (b) lesson observations, and (c) semi-structured interviews. The data are presented in such a way that the themes were drawn from the curriculum documents are separately discussed from themes that arose from the experiences of teachers and end with themes that arose from the beliefs of teachers and learners. Therefore, the results analysed was in line with how the research questions were organised.

The researcher sought through the interview transcriptions and responses searching for sections important to the research questions and gave a phrase or a word that clarifies the meanings. Related entities of meanings were combined to form categories and related categories are brought together to form themes that are read through the lens of the theoretical framework and review of literature. Thirteen themes arose from this research and were drawn from analysing categorically the categories that were

processed from the raw data gathered from field notes, interviews, documents, and lesson observations (McMillan & Schumacher 2010:352; Morris 2015:128). The coding processes followed the inductive analysis process (McMillan & Schumacher 2010:367). The main sources of interview data were the 15 educators though curriculum implementers were informally asked for clarification on important issues relating to the curriculum implementation processes.

### **5.2.1 Research Question 1: How Is Indigenous Knowledge Presented in the Life Sciences CAPS Document?**

In responding to research question 1, documentary analysis was used as evidence to ascertain the extent indigenous knowledge is presented in the CAPS document. The researcher scrutinised the rationale, the specific aims and features of the CAPS and learner books for grades 10, 11 and 12 (Isaac, Chetty, Manganye, Mpondwana & White 2011:114-115, 2012:51-53, 2013:377-385), seeking to describe the curriculum representation of indigenous knowledge systems. It was interesting and relevant to explore the way indigenous knowledge was featured in the Life Sciences CAPS document.

The analysis of curriculum documents examined both structural and content information that showed the scope and sequence of content, clarity of ideas, suggested activities and purpose of the prescribed content to realise the aims of the curriculum, curriculum materials and evaluation methods. It was important for the representation and incorporation of indigenous knowledge in the documents and within Life Sciences topics to be checked. These parameters were compared resulting in the development of the 3 themes (see Table 1) generated from document analysis. These are discussed in the section 5.2.1.1 – 5.2.1.3 below.

Regarding the question involving how indigenous knowledge is presented in the Life Sciences CAPS document, 3 themes were explored:

*Theme 1.* How science concepts are extracted from indigenous knowledge.

*Theme 2.* The elements of indigenous knowledge systems presented in the curriculum.

*Theme 3.* How indigenous knowledge systems are linked to topics

The three themes stated above emerged from the data analysis gathered from the curriculum documents, lesson observations and interviews and the way indigenous knowledge is featured in the Life Sciences CAPS document. Evidence from these sources was compared, which led to developing of the themes and are presented in the table 1.

**Table 1: How indigenous knowledge is featured in the Life Sciences CAPS document.**

Theme	Category	Source of Evidence
Question 1: How is indigenous knowledge presented in the Life Sciences CAPS document?		
<i>Theme 1:</i> How science concepts are extracted from indigenous knowledge.	<ul style="list-style-type: none"> <li>• Representation of Indigenous Knowledge across topics</li> <li>• Connections between indigenous knowledge and other topics in the curriculum document</li> </ul>	<ul style="list-style-type: none"> <li>• Document analysis (Teacher's guides, lesson plans and Learner's books)</li> </ul>

<p><i>Theme 2:</i> Elements of indigenous knowledge systems presented in the curriculum.</p>	<ul style="list-style-type: none"> <li>• Teaching indigenous knowledge to encourage learners</li> <li>• Variety of indigenous knowledge systems are linked to science topics</li> </ul>	<ul style="list-style-type: none"> <li>• Classroom observations</li> <li>• Interviews</li> </ul>
<p><i>Theme 3:</i> How indigenous knowledge systems are linked to topics.</p>	<ul style="list-style-type: none"> <li>• Inconsistencies between indigenous knowledge linked topics and science topics</li> <li>• Disparity of content developed in teacher's guides</li> <li>• Little guidelines on the way to incorporate indigenous knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Curriculum documents</li> </ul>

Table 1 presents an overview of representation of indigenous knowledge in the curriculum. The analysis of the curriculum presented in the table described the representations of indigenous knowledge across the documents and some inconsistencies on how content under indigenous knowledge was presented which might probably interfere with the smooth implementation of the amended CAPS document. The details of how the themes in the table were attained is explained in

paragraphs 5.2.1.1 to 5.2.1.3. At this point, the themes outlined above would be described, starting with the issues regarding the Life Sciences curriculum documents.

### **5.2.1.1 Representation of indigenous knowledge in the Life Sciences curriculum**

#### *Theme 1: How science concepts are extracted from indigenous knowledge*

In theme one, there is a reflection of a common design seen from curriculum documents which depicts a selective use of the term *indigenous* in the four official documents (CAPS document, teacher's guide, lesson plans and learner's book). Considering the expressed representation of indigenous knowledge, the amended CAPS document emphasises the need to consider indigenous knowledge systems and clearly highlights the words *indigenous knowledge* under the rationale for specific aim 3 and several topics.

The analysis of the CAPS for Life Sciences indicated that the document focuses attention on culturally responsive science education, (specific aim 3), although the document is silent on methods of integration and on examples of indigenous knowledge systems to reflect different South African cultural groups. Also the examination of textbooks could not reflect the diverse learners in South Africa. The representations of indigenous knowledge as stated in the rationale for the Teacher's Guide and CAPS document are explained as follows:

“The third aim of Life Sciences is to enable learners to understand that school science can be relevant to their lives outside of the school and that it enriches their lives” (Department of Basic Education 2011:17).

“Learners must be exposed to the history of science and indigenous knowledge systems from other times and other cultures. Scientific knowledge and understanding have been developed over time by people who were curious and who persevered with their quest for knowledge. Our

present understanding of science will change and improve as modern scientists make new discoveries” (Department of Basic Education 2011:17).

“Since the knowledge that will be acquired in respect of Specific Aim 3 always relates to specific subject content, the content provides the context for learning about various aspects of science in society. Science should therefore be taught in an integrated way in order to both enhance the subject and to clarify the relationship between the subject and society i.e. indigenous knowledge systems that relate to a specific topic, related history of scientific discoveries and the applications of science in everyday life” (Department of Basic Education 2011:17).

“Learners should understand the different cultural contexts in which indigenous knowledge systems were developed. The examples of indigenous knowledge that are selected for study should, as far as possible, reflect different South African cultural groups. They should also link directly to specific areas in the Life Sciences subject content” (Department of Basic Education 2011:17).

From the outset the researcher was excited regarding the strong representations of indigenous knowledge in the rationale of CAPS document to be a leading statement of the whole document. The CAPS document intends indigenous knowledge to be related to specific areas in the Life Sciences subject content. The document wants learners to be exposed to diverse cultural backgrounds which include indigenous knowledge systems. Thus, specific aim 3 of the CAPS document emphasised the significance of incorporating indigenous knowledge into Life Sciences.

Integration of indigenous knowledge into Life Sciences curriculum is a requirement of the Department of Basic Education (2011:17), which recognises the link between Life Sciences subject content and indigenous knowledge. The policy document did not elaborate clearly on the connection between the indigenous knowledge systems topics and other science topics on scientific investigations. Little suggestions was stated in the teachers' guides on how investigations and learning activities were to be carried out across the science topics, inclusive of indigenous knowledge systems. Some educators might consider doing the activities under indigenous knowledge systems separately from the science topics rather than teaching the concepts in an integrated way. Thus, it is evident that fewer details on such connections might make it difficult to interpret what to teach and that the curriculum is likely to be misinterpreted.

The indigenous knowledge linkage with other Life Sciences topics in the policy document are not clear and absent in some topics. For example, indigenous knowledge is not found on the topic 'human reproduction' where it would be possible to learn various cultural practices on human reproduction and what people used or still use as fertility methods. The amended CAPS document does not pursue any indigenous methods of pregnancy prevention using the menstrual cycle nor the enhancing of sexuality using herbs. This absence might lead to the misinterpretation of the curriculum on what to teach by teachers. Therefore, this awareness of elements of local knowledge in the curriculum might assist in creating room for understanding of some cultural practices and promote learners' appreciation of cultural understandings.

#### **5.2.1.2 Elements of indigenous knowledge**

*Theme 2: Elements of indigenous knowledge systems presented in the curriculum*

The curriculum documents present indigenous knowledge systems under the topics entitled 'Plant and Animal Tissues', 'Biodiversity and Classification of Microorganisms'

and 'Human Impact on the Environment: Current Crises for Human Survival'. However, the curriculum highlights applications of these few indigenous knowledge systems to science without considering clear guidelines for educators to follow when teaching indigenous knowledge to encourage learners (see Table 1). This could make it very difficult for educators to interpret what to be taught and the way to incorporate indigenous knowledge in teaching. The absence of such details could open the curriculum to misinterpretation.

Considering the expressed representation of indigenous knowledge systems in the amended CAPS document, some efforts have been made by the textbooks writers to integrate indigenous knowledge systems into Life Sciences but this consists of only fragments of indigenous knowledge that are mostly concerned with the traditional treatment of health problems (Isaac, Chetty, Manganye, Mpondwana & White 2011:114-115, 2012:51-53). Also, the incorporation of indigenous knowledge in learners' books have been limited to Specific Aim 3 of the CAPS documents (see section 2.8).

Learners' books and teachers' Guides indicate a consistency of the range of content covered between topics that include indigenous knowledge system in Life Sciences. The curriculum and teachers' Guides indicate a simple interpretation of content resulting from indigenous knowledge. Thus, besides few elements of indigenous knowledge across the curriculum, the curriculum documents was unable to clearly elaborate on contents related with indigenous knowledge in terms of the nature of content details, suggested investigations and scope of coverage.

A perusal through the CAPS document shows that some parts of indigenous knowledge are lightly listed under science topics linked to indigenous knowledge. Meanwhile, some topics in the curriculum documents were not associated and do not



bear explicit relationship to indigenous knowledge. It appears that these observations seemed to indicate some exclusions of likely features of indigenous knowledge that could be important in the policy document. As it may be noted, if indigenous knowledge was broadly represented, there would be indigenous practices linked to human reproduction, plant and animal classification, gaseous exchange-respiratory infections, food and health, animal nutrition and the like. The scarce representation of indigenous knowledge reflects partial validation of indigenous knowledge in the policy document.

The respondents feel that there are additional elements of indigenous knowledge system which can be integrated in the document as they consider IKS to be the knowledge of old transmitted from one generation to another. Some of the expressions from the participants were (See Table 6, Appendix 10):

*“It is traditional practices used by traditional healers in the communities. For example, traditional circumcisions”* (Educator 12).

*“...the people of the past used it to meet their everyday needs such as food, protection and health”* (Educator 13).

*“Knowledge passed from generation to generations relating to cultures. Example, the extraction of chemicals from plants. It is a local knowledge”* (Educator 8).

As it may be noted, the amended CAPS document makes little room to understand some traditional practices across the country. For example, there is no mention of cultural practices related to human reproduction and fertility. The amended CAPS document does not pursue any indigenous methods of pregnancy prevention using the menstrual cycle and enhancing sexuality using herbs. This might have encouraged

learners to appreciate their traditional experiences which may lead to discussions on the connection or disconnection of indigenous knowledge from science.

Educators also claimed that it is difficult to see content details under indigenous knowledge, while the content details are easy to see for typical Life Sciences topics (see Table 1). For example, in a typical Life Sciences topic like “Plant and Animal Tissues”, the introduction states clearly: types of tissues, basic structure, characteristics, functions of plant and animal tissues, etc. In comparison, the details under indigenous knowledge explains basically the generalities, for example, “traditional technology, e.g. traditional medicines and healers” (Department of Basic Education 2011:28). In line with this, the curriculum was unable to lay emphasis on specific traditional medicines, so to say. This illustrates a limited content for the use of indigenous knowledge systems into curriculum. At the same time, it was noted that the indigenous knowledge content is not well linked to other Life Sciences topics.

Another good example of content which doesn't link with IKS is the topic, “Biodiversity and Classification of Microorganisms”, that directs learners to the basic structures of microorganisms which are the aspects to be used for classification or grouping. Thus, the learning activities were not difficult for learners to grab the concepts and also provide direction to acquire the appropriate basic structure and characteristics that assist learners in the grouping of microorganisms. The researcher saw from such observations that there are structural discrepancies pertaining the manner in which Life Sciences content under indigenous knowledge is represented, which departs from the systematic method in which Life Sciences content is presented. Furthermore, the curriculum document did not provide examples and suggest how investigations should be applied across the topics associated with indigenous knowledge.

### **5.2.1.3 A variety of indigenous knowledge systems are linked to science topics**

*Theme 3: How indigenous knowledge systems are linked to topics.*

In this theme, the pattern of content presentation in Life Sciences CAPS document shows some structural anomalies. Table 1 shows the whole range of structural inconsistencies that are expected to affect the smooth interpretation of the amended CAPS curriculum. There is a loose design of activities and suggested resources. It is stated in the CAPS document that the examples of indigenous knowledge selected for study should take into account the diverse cultural groups in South Africa, but there is few or no examples provided for educators (Department of Basic Education 2011:17). The absence of such guidelines will possibly leave educators to teach without any clear direction. The results of such knowledge might be indirectly connected to particular topics in the Life Sciences subject content and learners would find it difficult to “understand the different cultural contexts in which indigenous knowledge systems were developed” (Department of Basic Education 2011:17).

There is an absence of a unifying feature in the policy document on the different cultures to be learnt and the suggested resources and nature of activities that educators and learners should consider across the country in South Africa. In addition to that, the structural inconsistencies on how indigenous knowledge is presented in science might not end with the same outcomes in various locations across the country and also might lead to different variety of concepts that might be hard to assess in the National Senior Certificate (NSC) examinations.

While it is appreciated that educators could make choices of various indigenous knowledge to relate with the environments from where learners originated from, educators would find it easier to predetermine the learning objectives if different types of indigenous knowledge were suggested in the curriculum. This would encourage and allow educators to work on similar indigenous knowledge systems. Furthermore, it

would have been even easier if the curriculum detailed the kinds of traditional technology, e.g., traditional medicine, beer-producing technology and the like. This omission could lead to a disparity in developed science content in teacher's guides. Unfortunately, most curriculum content on indigenous knowledge systems is expressed in broader terms and not specifics as seen in other typical Life Sciences topics.

Besides, the CAPS documents did not clearly indicate the way educators could assist learners to value and identify indigenous knowledge to be able to incorporate it in the classroom. However, there are no suggested activities related to indigenous knowledge that would give educators focus and put much emphasis on learners' learning experiences for developing certain concepts. Thus, this might allow educators to design different activities and also assess differently from the activities. The curriculum contents involving indigenous knowledge have no suggested activities that reflect different South African cultural groups. In addition, lack of details and clear guidelines on the way to incorporate indigenous knowledge can lead to incorrect generalisation of concepts. Thus, these loose designs and learning experiences might not result in the same outcomes in various locations across the country.

The curriculum further indicates the need for enabling "learners to understand that school science can be relevant to their lives outside of the school and that it enriches their lives" (Department of Basic Education 2011:17) but presented activities without clearly defined principles, particularly those found in traditional technology. Recognising the importance of indigenous knowledge systems across different cultural groups would, on the one hand, maximise place-based education having a role to play in learners' identity formations while on the other hand, it would widen the view of learners to be experienced in both western science and indigenous knowledge (Shizha 2010:27), thereby extending learning opportunities.

In summary, the 3 themes outlined in Table 1 clearly show the whole categorical analysis of research question 1 related with the Life Sciences CAPS document. The curriculum documentary analysis reviewed the way indigenous knowledge was presented in the policy documents; the type of concepts and scope of content coverage with topics that include indigenous knowledge; and differences between the curriculum structures within Life Sciences topics that are related to indigenous knowledge and those related to science topics. The CAPS document mentions the need for the selected examples of indigenous knowledge for study to reflect different South African cultural groups, but no clear examples are provided for educators. This lack of details and clear guidelines in the curriculum document on the way to incorporate indigenous knowledge can lead to incorrect generalisation of concepts. The next section discusses the issues faced by educators when implementing the Life Sciences curriculum.

### ***5.2.2 Research Question 2: What Issues Do Educators Face During the Implementation of Indigenous Knowledge Topics in the Life Sciences Curriculum?***

The analysis of research question 2 aimed in discussing issues that educators came across in the implementation of indigenous knowledge topics in the classroom. It emphasised the things the educators were seen doing when they integrated indigenous knowledge and how they did it in the class during the lesson observations.

In exploring research question 2, three themes emerged on the issues of curriculum design, language and culture (see Table 2). However, the three issues will be discussed in the section 5.2.2.1 – 5.2.2.3 below in regards to instruction and the way the incorporation of indigenous knowledge topics contributed to the implementation of the Life Sciences curriculum.

*Theme 4. Challenges in teaching indigenous knowledge*

*Theme 5. Difficulty in instructional language*

*Theme 6. Struggle between science and indigenous knowledge*

The description of themes as outlined in Table 2 below clearly highlights the educators' instructional practices and experiences while teaching indigenous knowledge language issues, and cultural practices related to indigenous knowledge in the implementation of the CAPS document.

**Table 2: The issues that educators faced in the implementation of indigenous knowledge topics in the Life Sciences curriculum.**

Theme	Category	Source of Evidence
Question 2: What issues do educators encounter in the implementation of indigenous knowledge topics in the Life Sciences curriculum?		
<i>Theme 4: Challenges in teaching indigenous knowledge</i>	<ul style="list-style-type: none"><li>• Defined specific aims and lesson organisation</li><li>• Dealing with indigenous knowledge complexity and selection of scope of content</li><li>• Accessibility of resources for science</li></ul>	<ul style="list-style-type: none"><li>• Documentary analysis</li><li>• Lesson observations</li><li>• Interviews</li></ul>
<i>Theme 5: Difficulty in instructional language</i>	<ul style="list-style-type: none"><li>• Difficulty in using indigenous language to clarify concepts</li></ul>	<ul style="list-style-type: none"><li>• Observed lessons</li></ul>

	<ul style="list-style-type: none"> <li>• Changing scientific concepts into indigenous language</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> </ul>
<p><i>Theme 6: Struggle between science and indigenous knowledge</i></p>	<ul style="list-style-type: none"> <li>• Unclear initiatives due to negative attitudes</li> <li>• Educators' reluctance</li> <li>• Effects on teaching and learning opportunities due to negligence of culture</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Observed lessons</li> </ul>

Table 2 provides an overview of the issues faced by Life Sciences educators when implementing indigenous knowledge topics in the CAPS Life Sciences curriculum. The themes in the table were identified from educators' experiences while teaching indigenous knowledge, language issues, and issues in regards to cultural knowledge in a topic. Educators' responses to interview questions 10-15 (see the interview schedule in Appendix 7) helped create understandings that resulted in themes 4 to 6. The themes that emerged from research question 2 in Table 2 are addressed and analysed in more details in paragraphs 5.2.2.1 to 5.2.2.3. At this point, the themes mentioned above will be discussed, beginning with the issues in relation with curriculum design.

### **5.2.2.1 Challenges in teaching indigenous knowledge**

#### *Theme 4: Educators' challenges in teaching indigenous knowledge*

In this theme, responses showed that the participating educators are concerned with the content part of the sciences in policy documents. Eight respondents confirmed to

have read the importance of integrating indigenous knowledge from the policy documents. The rest indicated that they had seen the need to integrate indigenous knowledge in Life Sciences in various textbooks that they use but had not read it from the policy documents. This may be an indication that there is little effort made by the policy planners and curriculum advisors to support teachers to interpret and implement the amended CAPS document. This had led to educators teaching from the textbooks rather than teaching from the policy documents. This manifested during lesson observations in the classroom; most of the educators were not able to define the specific aims of their lessons. The views of educators in this regard are (See Appendix 14):

*“The policy planners have failed to give us the support needed to implement the amended curriculum”* (Educator 2).

*“Adequate trainings have not been given to us by the department on how to incorporate indigenous knowledge appropriately during lessons”* (Educator 8).

*“.....We were given a very little support and a once-off workshops on how to implement the curriculum”* (Educator 14).

Even in the Teacher’s Guide, the information for educators to plan and effectively have their lessons delivered to the learners was not adequately provided. In this study, most lessons relating to indigenous knowledge systems showed lack of scientific principles because of very little or no guidance in the teacher’s guide on what to do. As a result, it affected their lesson organisation and the design of various activities relating to different cultural groups. The researcher has an impression that the design of prescribed learners’ activities and the basic principles of science could provide learners with clarity, learning experiences, to solve and understand the matters



regarding diverse indigenous knowledge systems across South Africa and beyond. This can be seen in the following educators' responses (see Appendix 14):

*“There is no appropriate design of activities that covers diverse cultural groups in our country”* (Educator 5).

*“Little guidance on what and how to integrate indigenous knowledge in a science classroom”* (Educator 3).

During the interview, another issue raised by five educators was that the science in indigenous knowledge systems cannot be separated from other components of knowledge systems such as religion. The educators showed concerns in relation to the religious component of indigenous knowledge systems. Also, this observation is shared by Semali and Kincheloe (1999:15) who asserts that ‘science’ in indigenous knowledge systems exists alongside the other kinds of knowledge.

However, the unawareness of teachers about the requirements of the policy document in regards to incorporation of indigenous knowledge might be due to the fact that teachers are more concerned with the examinable aspects of the curriculum in the CAPS documents. Despite the fact that the amended CAPS document calls for the incorporation of indigenous knowledge in Life Sciences, educators claimed that the external examinations have not accommodated the indigenous knowledge systems. The respondents pointed out that integrating indigenous knowledge in science will negatively affect their teaching as components of indigenous knowledge are not examinable. This raises some fear as teachers felt that the incorporation of indigenous knowledge might not help the learners in passing examinations.

The educators also admitted that they are most concerned with finishing the regular Life Sciences curriculum and the pass rate of the subject and school in the NSC examinations than the incorporation of indigenous knowledge in the teaching and

learning of Life Sciences. The educators revealed that they give in to the pressure coming from parents, school managers and the Department of Basic Education in order to achieve a good result. What this pressure entails is that it might work against the effective incorporation of indigenous knowledge in the classrooms.

The educators responded that they must follow the curriculum and teach the content that should be tested in the NSC examinations. The researcher noticed that the learning condition in schools were dominated to accomplish the requirements of the curriculum to achieve a good examination results. As a result of this, educators made little or no references to the indigenous knowledge systems in science teachings. However, what this might mean is that teachers often made choices of scope of content as they mostly teach for the examination purposes. On this matter, educators had the following to say:

*“Since the examiners will not set questions on the indigenous knowledge systems during the examination. They test the regular content (factual information) in the curriculum and in textbooks. So, what is the need of teaching indigenous knowledge knowing quite well that the examiners will definitely ignore it?”* (Grade 12 educator).

*“We prepare learners for examinations by teaching them only the contents that will appear in the examination questions”* (Grade 10 educator).

*“Educators only stick to what is going to be tested for the school to be able achieve excellent examination performance”* (Grade 12 educator).

Educators who provided the above expressions were more concerned on the passing examinations or achieving an excellent pass rate for the school than with incorporating indigenous knowledge. Although the indigenous knowledge may not have appeared in examination questions, nevertheless they are necessary in facilitating and improving

the learners' cultural well-being and understanding of scientific skills. The educators forgot that education is not only about passing examinations, but also about assisting learners in making sense of the social, physical and spiritual understanding of the world, thus enhancing the general value of their lives.

As the lesson progressed, the researcher noticed that even the lesson activities chosen by educators were based on the available local teaching resources. The easiness of providing resources for teaching was different across the board. Of the 13 educators that showed confidence and readiness in integrating indigenous knowledge into Life Sciences, 8 educators found it easy to provide and make good use of teaching and learning resources, while 5 educators found it hard and taught without resources. There were diverse experiences on getting access to teaching materials in this study and a clear indication that educators require additional assistance in making good use of resources in producing meaningful cultural or scientific knowledge. This suggests that educators can use different kinds of available materials to improve the teaching of Life Sciences. The findings from the educators indicate little or absence of local knowledge teaching resources which makes it impossible or hard for educators to use resources in the teaching of indigenous knowledge systems in the schools. Educators did only as much as they could, based on their individual initiatives about which teaching resources to use in strengthening how learners understand indigenous knowledge. On this, educators had the following to say:

*“Since I am Zulu, during the Life Sciences teaching, I teach those things that learners are conversant with especially to those learners who were raised in rural areas”* (Educator 2).

*“If my learners failed to understand, I usually use Zulu language to explain better and also to improve learners' participation during lessons”* (Educator 7).

*“I do take into account most of the things shared in the communities such as folktales whenever I plan my lesson. We talk about local plants used by the traditional healers and the natural environment”* (Educator 5).

The respondents assert that the Department of Basic Education has given them little or no support systems on how to interpret and implement the policy requirement as stated in the curriculum. There seems to be a revelation of lack of support from the policy planners regarding the incorporation of indigenous knowledge in science. Also, the teachers claimed that, while they were given some training in CAPS, the policy planners provided them with little or no instructional skills needed for implementing the curriculum and how to integrate indigenous knowledge in the Life Sciences. This point was also made by Ogunniyi (2007:975) who saw that the delay in integrating indigenous knowledge in science was due to non-educator support drives by the policy makers. Additionally, on the subject of lack of support given to educators, Òtúlàjà, Cameron and Msimanga (2011:698) and Owuor (2007:25) observe that the CAPS policy document did not support educators to approach the issue of incorporating indigenous knowledge into science. On this point, one of the respondents had this to say:

*“The educational system has greatly experienced curriculum changes. But, the department had not make any enormous effort to assist educators to understand on how to deal with changes”* (Grade 12 educator).

The eight educators who claimed that they have read the importance of incorporating indigenous knowledge in Life Sciences from the CAPS policy documents observed that there is no elaboration on what aspects of indigenous knowledge to be incorporated in the classrooms, also the document does not indicate the ways indigenous knowledge can be incorporated during lessons. Thus, educators attributed the inadequacy of their knowledge to the absence of information in the policy documents.

The teachers claimed a general lack or little support and training by the curriculum advisors in terms of preparing them to implement the amended CAPS documents. What the researcher is not aware is whether the curriculum advisors themselves have received adequate training to “teach and train” educators about the need to integrate indigenous knowledge systems. In this same vein, De Beer and Ramnarain (2012) (as cited in) (De Beer 2016:46) emphasise that “many subject advisors do not have the knowledge to guide teachers in implementing indigenous knowledge in their classrooms”. Thus, what we are facing is implementation without adequate training of educators to teach indigenous knowledge systems.

Furthermore, respondents also claimed that the incorporation of indigenous knowledge is stated only in a few sentences in the CAPS documents which might mean that the incorporation of indigenous knowledge should not be taken very seriously. From the responses of the educators, it is revealing that, in spite of the fact that the CAPS calls for indigenous knowledge to be incorporated into science, the call has little or no support from the Curriculum Advisors employed by the education district offices to support educators. The educators indicated that their major concern was that the way to integrate indigenous knowledge in Life Sciences was not clearly explained in detail to them. What this might mean, however, is that the incorporation of indigenous knowledge has not been elaborated well enough in the policy documents and also has not received the maximum support to see its effective implementation at schools.

#### **5.2.2.2 Difficulty in instructional language**

##### *Theme 5: Educators struggle in instructional language*

This theme emphasised on what the teachers were seen doing when they incorporated indigenous knowledge in the class during the lesson observations (see Table 2). Of the 15 educators, 13 showed confidence and readiness in integrating

indigenous knowledge into Life Sciences while 2 educators did not give any response to the question. (see Appendix 14 for the interview responses of educators and Appendix 15 for the lesson activities that comprises of learners' activities, teachers' activities and lesson analysis). Educators were observed to:

- Struggle with using indigenous language in explaining scientific concepts;
- Struggle with changing scientific concepts to indigenous language;

Words and language play an important role in the teaching of science. This is not different for Life Sciences as a learning area. Learners in a science classroom not only have to learn the subject matter, but they also have to deal with language understanding too. The incorporation of indigenous knowledge Life Sciences depends largely on how words and language are used, both in local and in scientific terms. Educators established new tasks and dimensions that needed new knowledge and skills to achieve specific aim 3 as specified in the CAPS document.

The knowledge and understanding about words that would communicate suitable meanings to learners in regards to effects on teaching was one of the necessities for educators to function effectively as they assist learners to understand science learning. Educators claimed that the problem faced in using indigenous knowledge is lack of scientific terms in local language. This became necessary since the policy document intends indigenous knowledge to reflect different South African cultural groups. In addition, the increase in number of learners, the magnitude of content, the diverse cultures of learners and lesson duration in today's Life Science lessons can make educators face tremendous difficulties when trying to integrate individual learners' cultures with learning about sciences in their classrooms. The following quotes reflect the view of educators (see Appendix 14):

*“I struggle with using appropriate local language to explain science concepts for better understanding” (Educator 6).*

*“Many at times I find it so difficult to come up with appropriate expressions in our local language to explain scientific concepts” (Educator 12).*

In this study, the issue that arose was the selection and use of appropriate expressions by the educators to help learners understand Life Sciences and also the usage of words in local language that maintain scientific meanings. In the lesson observations and pre-observation interviews in regards to the ways teachers incorporate indigenous knowledge into teachings, the researcher observed that the incorporation of indigenous knowledge required teachers to look for local words and instructional vocabulary that have appropriate science meanings that will be suitable for explanations during teaching of indigenous knowledge. However, it was a necessity to choose appropriate words as educators dealt with (a) a diversity of indigenous plants (b) parameters used in investigating traditional technology, and (c) clarification of scientific concepts and processes.

Consequently, it was difficult for educators to choose words considered to be useful as they prepare for lessons on indigenous knowledge but in some instances they could not exactly give clear meanings or clarify concepts about indigenous knowledge. The educator used isiZulu language to quickly engage learners to explain some concepts in isiZulu. This approach improved the way learners participate, reason and express concepts in the classroom.

It is interesting to know that educators’ experiences with indigenous knowledge revealed the reason for absence of insight in lesson designs and addition of classroom concepts that happened during teaching. Also, there was a wide difference on the way educators carried out their lessons on indigenous knowledge, in regards to learners’

cultural prior knowledge and how the teachers involved the indigenous community members such as the elders who know some interesting ideas and have extensive experience and skills on indigenous knowledge.

It is necessary for educators to probe what learners know on a particular topic to determine their prior knowledge, but this is a great demand due to the diversity of people and cultures in South Africa. In a nutshell, the researcher would say that educators appeared to experience some difficulties in acceptance of teaching on indigenous knowledge due to disparities between the relevant scientific language and the cultural knowledge.

### **5.2.2.3 Struggle between science and indigenous knowledge**

#### *Theme 6: Educators' struggle between science and indigenous knowledge*

Generally, most respondents have negative attitudes and considered indigenous knowledge to be the knowledge of the past. Six of the respondents responded that indigenous knowledge is a primitive and non- scientific method of explaining natural phenomena. The following quotes reflect the view of educators (See Table 6, Appendix 10):

*“Knowledge of our forefathers about some practices which cannot be seen in the learners’ books but common to particular cultures” (Educator 1).*

*“This remains the wisdom of people who existed long time ago. A primitive way of interpreting the natural events” (Educator 11).*

*“A form of knowledge made by groups in a particular locality to explain natural events around them” (Educator 5).*

Educators’ perceptions on indigenous knowledge systems discouraged them from teaching learners the cultural issues that connect with science topics and also curtailed their initiative to capitalise on learners’ conflicting opinions during Life Sciences



lessons. As the lesson progressed, the researcher noticed that, some educators found it hard to draw relevant scientific ideas from the science found in the indigenous knowledge. Also, the teaching methods employed by educators showed some absence of scientific knowledge which would have assisted them to realise the scientific principles involved in indigenous knowledge.

As educators taught lessons on indigenous knowledge, they found it difficult to teach learners about indigenous knowledge rather, learners were indoctrinated against indigenous knowledge as wrong concepts. These approaches displayed by educators during lessons might inculcate negative attitudes towards indigenous knowledge in learners. Even though there are possible opinions that most indigenous knowledge was actually instituted on sound evidence, some teachers harbour negative opinions on indigenous knowledge. This following quotes below reflect the view of educators (see Appendix 14):

*“I tried to integrate indigenous knowledge during lessons because the policy document informed us to do so, but it is a challenge for me as indigenous knowledge is against my ethnic belief”* (Educator 10).

*“It is very difficult for me to include indigenous knowledge into teaching science because it is an old knowledge taught to learners by the elders.... So, I teach only modern science to learners”* (Educator 15).

*“Indigenous knowledge has no place in the teaching of Life Sciences. It is only important at home”* (Educator 13).

The integration of indigenous knowledge in science can be challenging. Some educators find it difficult in integrating the scientific knowledge and indigenous knowledge that often include traditions and family practices (see Table 2). The lesson on traditional medicine and genetics incited cultural conflicts among the learners.

However, the researcher saw it as a healthy improvement that should explain why science would not only take into account following the set concepts about knowledge but also include debating ideas. As the lessons progressed, it became emotional and cultural as the class comprised of learners from different parts of the country. Hence, this led to a heated debate and a clash of ethnic beliefs and preferences in connection with indigenous knowledge.

As learners emotionally debated and differed in opinions about indigenous knowledge, some educators discouraged their opinions and said, “This is not a good example and unacceptable (*Hakulunganga lokhu*)”. One educator stressed in isiZulu. In this study, the educators’ perceptions about indigenous knowledge made the researcher to think that motivating balanced discussions on cultural matters could be helpful to avoid knowledge and practices being misrepresented. The researcher believes that a means maintaining the wealth of knowledge that science builds upon might happen through a balanced representation of concepts.

The extreme notion about indigenous knowledge made educators to miss entirely the teachable moments in the classroom while some educators went through their lessons about indigenous knowledge halfheartedly. The educators were discouraged from teaching learners meaningful cultural issues in relation to science as indigenous knowledge was considered as having negative effects. On the one hand, the subsequent argument opened a space for learners to be engaged meaningfully on issues around indigenous knowledge and cultural beliefs. On the other hand, the contentious argument could expose the minds of learners to different opinions, as they engage in the process of reasoning, as contend by the constructivists. In summary, such arguments would yield better understanding of cultural values that could encourage learners to learn science in a meaningful way.

The same way learners varied in class, is the same way educators will vary on the choice of indigenous knowledge to teach. Some educators deliberately chose not to teach indigenous knowledge as they labeled it as taboo to them and against their worldviews. Based on that way of thinking, the researcher believes that educators' strong negative attitudes and reasoning could unknowingly impair and jeopardise the teaching visions of teachers to promote effective learning in Life Sciences. In addition, such a teaching approach by educators would result in passive learning among learners, which in turn might lead to culture negligence, which diminishes the chances of teaching and results in a failure among learners to identify good elements from their own cultural backgrounds.

Unclear initiatives and cultural biases were identified when educators were asked which challenges they face when they integrate indigenous knowledge into their Life Sciences lessons. Due to personal attitudes and hidden biases of some educators against indigenous knowledge in schools, they completely dismissed integrating indigenous knowledge in class. Some of the educators believed that indigenous knowledge systems do not have a place and are not recognised in science teaching. Rather, they portrayed western science as a hierarchical structure, universal and superior to indigenous knowledge.

Another challenge is that some Life Sciences educators, from different cultural backgrounds, show reluctance and hesitations on the incorporation of indigenous knowledge in science. A number of respondents were negative and cynical about indigenous knowledge systems and argued that science remains the useful, organised and valued knowledge, compared to how they regard other forms of knowledge systems. This observation supports that of Aikenhead (2001:34) who talks about many science educators who acknowledge and privilege western science as the only vital method of knowing. The reason why indigenous knowledge is poorly or not

incorporated in science classrooms might be the problem of low recognition of indigenous knowledge by some educators. The following quotes below reflect the view of some educators (see Appendix 13):

*“I consider it as not true representation of science knowledge. It might mislead learners. The use of herbal medicines for healing which most of the times do not work is an example. So, science remains the valued knowledge”* (Educator 15).

*“I would say that all cultural or traditional ideas in science are not good. So, because of beliefs they are not good for this generation. Western science is the useful knowledge for this generation”* (Educator 5).

*“Indigenous knowledge is perceived as taboos and spiritual in some community and so it must be discouraged. School science is a well-organised knowledge. For example, misconceptions around various traditional practices by the Sangomas and Inyangas (traditional healers) in our country”* (Educator 2).

Moreover, educators admitted that their classrooms consist of learners coming from diverse cultural backgrounds – so which indigenous knowledge of those learners should be thought? This really occurs where there is a heterogeneous population of learners who come from diverse cultural groups. This becomes challenging for educators to take care of all learners’ needs in class, it then becomes very hard to consider a specific set of indigenous knowledge since every learner has its own knowledge. This observation is also shared by Semali (1999:311) who asserts that “tensions and contradictions abound between what is intended by curriculum reforms and what is actually implemented in classrooms”. Surprisingly, some educators proposed that since the National Senior Certificate in South Africa do not test this kind of knowledge, indigenous knowledge system might as well be left out from the policy document because they are not helpful and not examinable; this suggests that

teaching is geared towards examinations. (See section 5.2.2.1). This is also in line with Seehawer's (2018: 92) point that each of the examinations that end the four terms of the academic calendar in South Africa do not include indigenous knowledge.

In summary, the issues discussed in this study are the design of curriculum activities, teachers' understanding of specific aim 3 for Life Sciences; inadequate scientific knowledge; challenges with instructional language; insufficient teaching resources; and educators' attitudes toward teaching indigenous knowledge. As some of the educators indicated that their major concern was that the incorporation of indigenous knowledge in Life Sciences was not clearly explained in detail to them. This reveals that not all educators may be adequately equipped to incorporate indigenous knowledge in Life Sciences. Then, if the CAPS document fails to explain such details, it places educators that lack such knowledge in a difficult position, which might lead to a failure to do a good job of teaching work on indigenous knowledge, unless something is done to show them what to do. In the next section, the issue of how educators conceptualise the role indigenous knowledge played in the amended CAPS document will be discussed in more detail.

### ***5.2.3 Research Question 3: How Do Educators Conceptualise the Role of Indigenous Knowledge in the Amended CAPS Document?***

Research question 3 meant to explore educators' understanding on specific aim 3 and what they considered its value to be in the amended CAPS policy document in relation to learners' benefits; and how educators incorporate indigenous knowledge in teaching. Also, this research question highlighted how educators understand the important terms connected to indigenous knowledge that affected the way the topics are taught and evaluates the role of indigenous knowledge to learners. The data analysis was done from lesson observations and interviews.

Five themes emerged in relation to how educators conceptualise the role of indigenous knowledge in the amended CAPS document. The educators' ideas regarding the role of indigenous knowledge in the amended CAPS document are informed by:

*Theme 7.* Educators' understanding of specific aim 3 (see 5.2.1.1)

*Theme 8.* Educators' understandings of indigenous knowledge.

*Theme 9.* Educators' ideas of integrating indigenous knowledge into Life Sciences curriculum.

*Theme 10* How educators integrate indigenous knowledge into Life Sciences.

*Theme 11.* Educators' attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits.

The themes as outlined in Table 3 show the summary of the categorical analysis of educators' ideas and knowledge on incorporating indigenous knowledge into Life Sciences. The source of evidence in support of each theme come from lesson observations and semi-structured interviews.

**Table 3: The educators' ideas regarding the role of indigenous knowledge in the amended CAPS document**

Theme	Category	Source of Evidence
Question 3: How do educators conceptualise the role of indigenous knowledge in the amended CAPS document?		

<p><i>Theme 7: Educators' understanding of specific aim 3</i></p>	<ul style="list-style-type: none"> <li>• Explains the importance of connecting learners' learning to everyday life</li> <li>• Links Life Science, environment, technology and society</li> <li>• Promoting a place for indigenous knowledge in Life Sciences</li> <li>• Investigation of past and present scientific discoveries of cultures</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> </ul>
<p><i>Theme 8: Educators' understandings of indigenous knowledge</i></p>	<ul style="list-style-type: none"> <li>• Knowledge embedded in cultures</li> <li>• A body of knowledge</li> <li>• Little connection to the school curriculum</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Lesson observations</li> </ul>
<p><i>Theme 9: Educators' ideas of integrating indigenous knowledge into Life Sciences curriculum</i></p>	<ul style="list-style-type: none"> <li>• Addition to western science knowledge</li> <li>• Mainstreaming indigenous knowledge</li> <li>• Promotes empowerment and social justice</li> </ul>	<ul style="list-style-type: none"> <li>• Lesson observations</li> <li>• Interviews</li> </ul>

<p><i>Theme 10:</i> How educators integrate indigenous knowledge into Life Sciences</p>	<ul style="list-style-type: none"> <li>• Usage of own ideas of indigenous knowledge in contextualised teachings</li> <li>• Teaching tool for motivating learners' interest</li> <li>• Usage of indigenous knowledge to build on science concept</li> <li>• Use of indigenous knowledge to stimulate learners' interest and enhance learners' participation</li> </ul>	<ul style="list-style-type: none"> <li>• Lesson observation</li> <li>• Interview</li> </ul>
<p><i>Theme 11:</i> Educators attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits.</p>	<ul style="list-style-type: none"> <li>• Positive value connecting indigenous knowledge with science</li> <li>• Indigenous knowledge concerning taboos and spirituality must be discouraged</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Lesson observations</li> </ul>

Table 3 provides an overview of educators' ideas and issues surrounding incorporating indigenous knowledge into the CAPS Life Sciences. During the interviews and lesson observations, research question 3 revealed an opportunity to learn about the understandings of teachers on the incorporation of indigenous knowledge and educators' perceptions of the role of indigenous knowledge to learners' lives. Educators' responses to interview questions 1-10 (see the interview schedule in



Appendix 7) helped create understandings that led to the generation of themes 7-11. The themes that emerged from research question 3 in the table 3 are discussed and analysed in more details in sections 5.2.3.1 to 5.2.3.5 as it explores the teachers' ideas on the role of indigenous knowledge in the amended CAPS document. The abovementioned themes will be discussed, beginning with specific aim 3 of the amended CAPS document.

### **5.2.3.1 Educators' understanding of specific aim 3 of the CAPS policy document**

#### *Theme 7: Educators' understandings of specific aim 3*

In this study, it deemed it necessary to explore the way teachers understand specific aim 3 of the CAPS policy document since it focused on how to integrate indigenous knowledge and its perceived value in the amended curriculum to learners' benefits. The investigation of the teachers' understanding of specific aim 3 indicates that the teachers build their opinions of indigenous knowledge from the CAPS document. In this theme, the four categories emerged from the teachers' understandings of specific aim 3. (see Table 5, Appendix 9). The specific aim 3 was understood by educators in the following four ways:

- *Specific aim 3 explains the importance of connecting learners' learning to everyday life;*
- *Specific aim 3 links to Life Science, technology, environment and society;*
- *Specific aim 3 supports a place for indigenous knowledge in Life Sciences;*
- *Specific aim 3 explores scientific knowledge of the past and present cultures.*

Firstly, teachers explain that specific aim 3 explains the importance of connecting learners' learning to everyday life. They assume that school learners bring along with them their experiences acquired from the everyday lives, and school should play a

role of not ignoring or replacing prior understanding, rather it should recognise and make connections to that understanding. The educators elucidated that specific aim 3 requires educators to connect science to the indigenous knowledge of learners. This following quotes below reflect the view of educators (See Appendix 9):

*“Life Sciences as a subject requires learners to incorporate daily experiences in the classroom”* (Educator 15).

*“Learners learn and relate to real life experiences”* (Educator 1).

The educators see specific aim 3 as relating the meaning of science to the daily lives of learners. This notion is similar to Jegede and Aikenhead’s (1999:49) idea that connecting everyday lives of learners to school science could lead to a meaningful learning.

Secondly, educators see that specific aim 3 links to Life Science, environment, society and technology. The researcher noted that some teachers’ responses are almost similar to the ones found in the CAPS document, while other respondents emphasise on the views of the policy document. Some views of the respondents are quoted below (See Appendix 9):

*“There is connection among Life Science, environment, society and technology”* (Educator 3).

*“Science, indigenous knowledge, society, environment and technology are interrelated”* (Educator 14).

Educators’ expressions indicate that they interconnected environment, Life Science, society and technology as stated in the CAPS document for Life Sciences.

Thirdly, educators understand that specific aim 3 supports a place for indigenous knowledge in Life Sciences. Semali and Kincheloe (1999 3-7), Snively and Corsiglia (2001:6) and Maru (2010:1), assert that there is a need for indigenous knowledge to

be given a place and attention in science for the occurrence of meaningful and effective learning. The educators see that the specific aim 3 identifies and incorporates indigenous knowledge into Life Sciences. Some educators' responses are quoted below (see Appendix 9):

*"...Incorporate indigenous knowledge in teaching"* (Educator 2).

*"It deals with indigenous knowledge and their effect on environment and society"* (Educator 11).

*"It acknowledges indigenous knowledge systems in Life Sciences"* (Educator 7).

The responses above suggest that teachers are aware of integrating indigenous knowledge in Life Sciences. The educators know that the CAPS document requires learners to be exposed to diverse forms of knowledge inclusive of indigenous knowledge. In teaching of Life Sciences topics (for example, biodiversity and genetics), the local ways of knowing belonging to a particular group of people is incorporated into lessons.

Fourthly, the educators understand that specific aim 3 investigates the past and present scientific discoveries of cultures. They claimed that it is required of learners to learn the past and present scientific knowledge to improve their individual science knowledge. This following quotes support this interpretation (see Appendix 9):

*"Explores the scientific knowledge of the past and present cultures"* (Educator 12).

*"Reveals the history of both science and indigenous knowledge of various cultures"* (Educator 5).

*"It explains what is happening in the environment and society"* (Educator 10).

In a nutshell, it is evident that the educators know the facts that the past generations used scientific knowledge and learners are required to explore this longstanding scientific knowledge as they learn the present ones. It is interesting to note that although teachers seem to have varied opinions and interpretations of the usefulness to incorporate indigenous knowledge in science, they are eager to study more on indigenous knowledge and the need to incorporate it in science.

### **5.2.3.2 Educators' understanding of integration of indigenous knowledge in the Life Sciences curriculum**

#### *Theme 8: Educators' understandings of indigenous knowledge*

This theme explores educators' understanding of indigenous knowledge that showed the level of content knowledge related to Life Sciences. The researcher believes that the evaluation of the importance of indigenous knowledge could have been influenced by such knowledge. Of the 15 educators, 13 showed that indigenous knowledge is of a great value while 2 educators gave no response. (see Appendix 10). As the researcher analysed all their responses, the researcher noticed that the educators understand indigenous knowledge in three categories:

- Indigenous knowledge as local knowledge embedded in cultures;
- Indigenous knowledge to be a body of knowledge;
- Indigenous knowledge lacks connection to the school curriculum.

Teachers have the impressions that indigenous knowledge is a knowledge embedded in cultures. Educators understand that indigenous knowledge is held and possessed by a particular group of individuals by interacting with each other and their surroundings to enhance their lives through cultural practices. The following quotes

support this interpretation that indigenous knowledge is embedded in cultural practices (see Appendix 10):

*“...the knowledge acquired from one’s culture as you grow up. For example, traditional herbal knowledge”* (Educator 2).

*“Local knowledge and traditional belief system of older people about certain practices that are peculiar to particular cultures”* (Educator 14).

The educators associated indigenous knowledge with beliefs, communities’ values, culture and tradition. Similarly, Onwu and Mosimege (2004:2), describe indigenous knowledge to be the totality of knowledge practised by local people to survive in different environments. (See Chapter 2). The educators in their responses linked indigenous knowledge to describe the diverse cultures of people in the community. This view is in support of Mkabela (2006:5) and Moahi (2007:2) opinions that local knowledge is rooted in local peoples’ beliefs and cultures which forms their daily lives, and sustains their existence as individuals.

Secondly, the educators’ responses identified indigenous knowledge as a body of knowledge. This can be seen from the following educators’ responses (see Appendix 10):

*“A body of knowledge that bring sense and meaning in the world we live in”* (Educator 3).

*“... knowledge of people that reflects on how they explain natural events around them”* (Educator 10).

Furthermore, the way teachers understand indigenous knowledge to be a type of knowledge is the same with the ideas of some researchers regarding indigenous knowledge. This is in agreement with some scholars like Semali and Kincheloe (1999:4); Mkabela (2006:5) and Le Grange (2004:204) who define indigenous

knowledge to be a body of knowledge created in a given community by the people through interacting constantly with their local environment; while Hoppers (2005:4) recognises indigenous knowledge to be one of the different means of knowing (see Chapter 2).

Thirdly, although indigenous knowledge is incorporated in the current school system, teachers still reflect indigenous knowledge as a knowledge that is not linked to the school curriculum. Surprisingly, three of the respondents made it clear that the concerns of the Department of Basic Education about poor science results at Matriculation level will not be solved by incorporating indigenous knowledge in science, indicating that teaching is focused mainly on pass rates and less on understanding (see section 5.2.2.3).

### **5.2.3.3 Educators' ideas of integration of indigenous knowledge in Life Sciences**

#### *Theme 9: Educators' ideas of integrating indigenous knowledge into Life Sciences curriculum*

In this theme, the ideas of educators of incorporating indigenous knowledge into Life Sciences is on the basis of their knowledge and understanding of specific aim 3 and indigenous knowledge (see Appendix 11). Three categories emerged from the teachers' responses on understanding the way indigenous knowledge should be integrated into Life Sciences curriculum.

#### ***Integrating indigenous knowledge to be addition to western science***

Educators' expressed the understanding of integration of indigenous knowledge into Life Sciences to be adding to the western science taught at school. The following quotes support this interpretation (see Appendix 11):

*"Indigenous knowledge is used to understand, strengthen and clarify western science"* (Educator 10).

*“Indigenous knowledge adds to the western science we teach to learners”*  
(Educator 2).

*“...adding traditional practices to our school curriculum which are not found in the textbooks”* (Educator 14).

The educators are informed by the policy document, which emphasised the need to incorporate indigenous knowledge in Life Sciences. The policy statement does not express the incorporation of indigenous knowledge to be adding to western science, instead it presents “indigenous knowledge systems that relate to a specific topic, related history of scientific discoveries and the applications of science in everyday life” (Department of Basic Education 2011:17). (see section 5.2.3.1)

### ***Integrating indigenous knowledge to be an attempt to mainstream indigenous knowledge***

The teachers’ understood the incorporation of indigenous knowledge in Life Sciences as an effort to mainstreamed indigenous knowledge. However, the educators understood that specific aim 3 laid emphasis regarding incorporating indigenous knowledge to be an effort for the inclusion of indigenous knowledge that could not be found in the school curriculum. The educators indicated that their understandings of science concepts informed their capability to incorporate indigenous knowledge in teachings. Besides, they had what they considered as good knowledge of the subject content, thus educators possibly will recognise the indigenous knowledge practices that relate to the subject content. The following quotes reflect the view of educators (see Appendix 11):

*“I see our cultural knowledge from scientific viewpoint. It makes me to know more of science”* (Educator 11).

*“To integrate the culture and practices of people in the classroom”* (Educator 8).

*“There should be a place for indigenous knowledge in the education system”* (Educator 13).

Scholars like Jegede and Aikenhead (1999:45-62) and Shizha (2010:40) understand the incorporation of indigenous knowledge as including indigenous knowledge in school learning. Similarly, Semali and Kincheloe (1999:3) explain the transmission of local knowledge found in learners’ daily understandings to their homework. The teachers’ responses on mainstreaming indigenous knowledge into science learning are in concurrence with the arguments of these scholars.

### ***Integrating indigenous knowledge to be a means to promote social justice and empowerment***

Teachers observe the integration of indigenous knowledge in Life Sciences to be a means of promoting equality, diversity and social justice in the knowledge taught in formal education and also enabling learners who local knowledge are investigated in school. This notion is in accordance with De Beer and Whitlock (2009:210) and Ng’asike (2011:63) who explain incorporation of indigenous knowledge as a way of promoting transformation, social justice and equality. (See chapter 2). This following quotes support this interpretation (see Appendix 11):

*“It is seen as comparing the effect of diverse beliefs of indigenous knowledge”* (Educator 1).

*“Integration of indigenous knowledge contributes to transforming learners and instilling pride in them”* (Educator 5).

*“...it encourages us not to neglect our beliefs as Africans as we have the chance as teachers to compare the subject content with our own beliefs”* (Educator 6).



The educators had different views altogether regarding learners learning their own indigenous knowledge in school that, it heightens their level of confidence, improves self-esteem and motivates the way they value their indigenous knowledge while furthering their rights to an appropriate education.

#### **5.2.3.4 Educators' explanations on how to integrate indigenous knowledge into Life Sciences.**

*Theme 10: How educators integrate indigenous knowledge into Life Sciences*

The 12 educators who showed that indigenous knowledge meant something important to them, also claimed that they integrate it in their teaching in Life Sciences. Thus, educators responded on the way they integrate indigenous knowledge into their teachings. Three categories emerged from the responses of teachers. Educators use:

- Their own local knowledge in Life Science teachings;
- Their indigenous knowledge to be a tool in motivating the interest of learners and enhance their involvement in learning of science;
- Indigenous knowledge to build on the scientific concept;

Educators' indigenous background, particularly the Zulu origins, allows them to be aware of some indigenous practices that could be integrated into Life Sciences lessons. The educators' responses indicate the use of their individual opinions of indigenous knowledge as a model in teaching when integrating indigenous knowledge in their teachings. Some of the educators have been adapting to their classrooms and contexts and using indigenous knowledge in their teaching. Hence, they depend on their individual understanding and experiences of local knowledge (see section 5.2.2.1).

Similarly, the same idea was previously discussed in Chapter 2 and Semali (1999:311), justified this idea by saying that "local teachers really do not have any

other model to follow except their own intuition from local knowledge". This idea is demonstrated by teachers' opinions of using their individual local ways of knowing in the teaching of Life Sciences.

The educators' explanations imply that local knowledge is used as teaching tools to motivate the interest of learners in science learning. The following quotations reflect this practice (see Appendix 12):

*"During lessons, I use indigenous knowledge to raise awareness in learners on the existence of diverse views of society that are based on science" (Educator 3).*

*"Since I have learners from diverse background. I usually use group discussion where every learner participates in the learning process" (Educator 7).*

Similarly, this same idea was previously discussed (see Chapter 2) and supported by Ameyaw and Amankwah (2014:312) that educators' use local knowledge as a means in the classroom to enhance the interest of learners and understanding and also help them appreciate their culture and environment.

Educators claimed that teachings are connected to learners' own indigenous knowledge. They believed that learners are able to construct knowledge, particularly those ones rooted in their indigenous lives, in the science class. Better still, they contextualised their teaching by teaching according to the learners' experiences of indigenous knowledge in their local communities rather than teaching according to the textbooks. Unfortunately, some of the science "textbooks used in class give little or even no proper information about indigenous knowledge. While some textbooks still provide information on IK in the form of examples, hardly any attention is given to teaching strategies and practical work that can be done in the classroom" (De Beer & Mothwa 2013:464). The following quotes support this interpretation (see Appendix 12):

*“It gives learners from diverse background the opportunity to share their knowledge during lessons. For example, various herbs used by traditional healers will be mentioned whenever traditional medicines is discussed”* (Educator 13).

*“We are supposed to add those local knowledge of communities to our curriculum which are not found in the textbooks, but are specific to definite cultures. Learners do not only accept information through the textbooks, but also express their prior knowledge if given an opportunity to do so”* (Educator 15).

This view supports that of Seehawer (2018:99) that educators need not rely on textbooks and teaching resources; rather, learners could be taken to places such as museum where indigenous knowledge can be learnt, or use resources such as the learners’ families and communities (e.g. a task given to learners to find out about a particular indigenous knowledge and discussing the knowledge in class), or possibly inviting the IK holders (e.g. community elders, traditional healers, herbalist) to the classroom.

As the researcher observed educators teaching indigenous knowledge related topics, the educators asked learners to investigate the indigenous knowledge of the past generations. From this practice, learners take the elders in their society as resources. Also, the teachers elucidated that learners were given the chance to discuss about the traditional practices used by the old generations in their communities. The educators used the teaching approach of probing and brainstorming during lessons in the classroom that led learners to explain the indigenous practices further until they blended the information that the learners reflected with the science concepts. The following quote supports this interpretation (see Appendix 12):

*“Teaching about cure for illnesses, learners were asked to find out and research about traditional medicines and various plants used by the communities before western medicines existed. Thus, they sought for assistance from the elders who are knowledgeable and experienced in that area” (Educator 10).*

The last part of the abovementioned quote explains that learners wanted to acquire information from the elders on how illnesses are cured in their communities. The teachers anticipated the learners to search for the information from elders in the community. Therefore, the educators see the elders or knowledge keepers in the community as the custodians of local knowledge. Thus as resources to incorporate local knowledge into teachings, community members may be invited and given the chance to share their expertise and knowledge in the schools.

The educators’ view of contextualising their teaching of indigenous knowledge relates to three of the 15 teaching strategies (see Chapter 3) to be used by teachers to as cultural brokers when teaching, as summarised in Jegede and Aikenhead (1999:61-62). Educators as cultural brokers should follow these strategies:

*Strategy 2: “The oral narratives and heritage of the Native community should become part of the school science experience. These should not be demeaned as being merely myth and legend” (Jegede & Aikenhead 1999:64).*

The teachers inspire learners to gather information from their community elders on local knowledge. Consequently, the heritage of learners is inclusive in the experiences of learners in the school.

*Strategy 10: “Instruction should identify local approaches for achieving sustainability” (Jegede & Aikenhead 1999:64).*

The indigenous knowledge gathered by learners on cures for illnesses is a local strategies to achieve sustainability.

Strategy 11: *“The pupil’s world should be related to science instruction” (Jegede & Aikenhead 1999:64).*

The search for the local knowledge in the learners’ community on cures for illnesses reflects the relationship of the learners’ world to science instruction.

During the lesson observations of educators regarding the way indigenous knowledge is integrated, the researcher noticed that some of them used indigenous knowledge to build on the scientific concept. What they actually did was to teach the scientific knowledge of biodiversity and classification of microorganisms and later used indigenous knowledge to promote the scientific ideas.

### **5.2.3.5 Educators’ evaluation of integrating indigenous knowledge system into curriculum**

*Theme 11: Educators attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners’ benefits.*

An opportunity to learn about educators’ impressions on the benefits to learners of integrating indigenous knowledge into science came up during the interviews done at the end of the observed lessons. Teachers had mixed feelings towards the importance of incorporating indigenous knowledge into science. Nine of the respondents observed that integrating indigenous knowledge in science will make learners identify themselves with the science concepts, thus improving learners’ performances in Life Sciences. Four respondents claimed that the incorporation of indigenous knowledge in Life Sciences might result into misunderstanding of science concepts in science classroom. This might have been influenced by their view that they hardly consider indigenous knowledge as a true type of western knowledge. (see section 5.2.2.3).

On the one hand, the nine respondents who observed that teaching indigenous knowledge will benefit the learners in Life Sciences lessons also went on to observe

that indigenous knowledge may be used to build on science topics and thus provide a foundation for science during lessons. For example, the knowledge of herbal medicines may be useful in Life Sciences lessons on the topics for example, reproduction and human fertility, biodiversity and classification of organisms and human diseases. On the other hand, all the respondents who gave responses that indigenous knowledge will create confusion among science learners also went on to interpret indigenous knowledge as a primitive method of explaining phenomena and that indigenous knowledge lacks place in science classrooms.

The following quotes reflect the positive attitudes of educators towards indigenous knowledge: (see Appendix 13).

*“I think it will good and nice to teach indigenous knowledge to learners because learners would be able to appreciate what the local people do”* (Educator 11).

*“Indigenous knowledge will benefit learners and make them develop more interest to learn more so as to improve their daily lives. Learners will have holistic knowledge not detached from their daily lives”* (Educator 8).

*“It will be very helpful for learners to know something about indigenous knowledge to be able to understand science concepts better”* (Educator 1).

*“Teaching indigenous knowledge will encourage learners to be proud of their own belief. An example is the usage of medicinal herbs for curing illnesses”* (Educator 3).

As it may be noticed from the responses (see section 5.2.2.3), some respondents regard local knowledge to be a set of spiritual beliefs, myths and taboos to be discouraged in classroom teaching. This is an indication that educators do not regard local knowledge to be a true kind of science knowledge and there might be some resistance from the respondents to integrate indigenous knowledge into Life Sciences.

Alternatively, a good number of respondents claimed that indigenous knowledge system comprises various categories of knowledge forms and that it facilitates the explanation of the natural phenomena. This concurs with the definition of indigenous knowledge system by Ogunniyi (2007:965) and Hoppers (2002:8) who claim that local knowledge is a universal body of knowledge that comprises some forms of culture, religion, technology and science.

Educators felt it was important relation to matters on cultures that go along with the universal call of indigenising science curricula. This supports the views of Semali and Kincheloe (1999 3-7); Snively and Corsiglia (2001:6); Maru (2010:1) (see section 2.4). However, a good number of educators considered integrating indigenous knowledge into Life Science to be a way of preparing learners for life after schooling in their communities. Educators claimed that using indigenous knowledge in science may keep learners in touch with the cultural roots of science and liberate them from cultural alienation. Some educators suggested that indigenous people have valuable indigenous knowledge, while some could not say more beyond what was presented in the Life Sciences curriculum (see section 5.2.3.3).

For the learners, integrating indigenous knowledge will enhance learners' interest and understanding in science very well and also help them appreciate their cultural diversity and local environment. This is not different from what Ameyaw and Amakwah (2014:313) who realised that when learners are made to interact with indigenous materials from the cultural environment in learning, the better is the understanding in the class and learners retain what they are taught for a very long time. Educators also claimed that learners will be motivated to learn Life Sciences when scientific concepts are linked to their indigenous knowledge.

In summary, the 5 themes focused on the educators' understandings of specific aim 3 for Life Sciences in the policy statement, the teachers' understandings to incorporate indigenous knowledge in the teaching of Life Science and its role in the CAPS document in connection with benefits to learners. The educators' understandings of specific aim 3 of the CAPS document displayed their extent of knowledge and valuation of indigenous knowledge to learners. Although, some educators regarded local knowledge as a set of spiritual beliefs, myths and taboos, some educators suggested that local people have valuable indigenous knowledge, while some could not say more beyond what was presented in the curriculum. In the section that follows, the views of learners regarding the role of incorporating indigenous knowledge into the science classroom will be discussed.

#### **5.2.4 Research Question 4: *What Are Views of Learners on the Role of Integrating Indigenous Knowledge into the Life Sciences Classroom?***

Research question 4 sought to unravel the opinions and attitude of learners in regards to the role of incorporating indigenous knowledge into Life Science. The data analysed was gathered through interviews.

As regards to the question involving the views of learners in relation to the role of integrating indigenous knowledge in Life Sciences, two themes were explored:

*Theme 12.* Learners' understandings of indigenous knowledge.

*Theme 13.* Learners' attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits.

The two themes in Table 4 show learners' perceptions on indigenous knowledge which indicated both positive and negative valuation of incorporating indigenous knowledge



into Life Sciences curriculum. The details of the evidence in support of the two themes come from observed lessons and interviews.

**Table 4: The views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom.**

Question 4: What are views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom?		
<b>Theme</b>	<b>Category</b>	<b>Source of Evidence</b>
<i>Theme 12:</i> Learners' understandings of indigenous knowledge	<ul style="list-style-type: none"> <li>• A form of knowledge</li> <li>• People's cultural practices and belief systems.</li> <li>• Primitive way of life</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Observed lessons</li> <li>•</li> </ul>
<i>Theme 13:</i> Learners' attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits	<ul style="list-style-type: none"> <li>• Improve performance of learners in school science</li> <li>• Learner misconceptions of concepts in science lessons</li> <li>• Components of indigenous knowledge are not examinable</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Lesson observations</li> </ul>

Table 4 presents an overview of learners' ideas regarding the role of integrating indigenous knowledge into science teachings. Research question 4 aimed at uncovering learners' understandings of indigenous knowledge and their impressions in relation to the role of integrating indigenous knowledge into Life Sciences curriculum. Learners' responses to interview questions 1-8 (see the interview schedule in Appendix 7) helped create understandings that led to the generation of themes 12 and 13. The details of how the themes in the table were attained is explained in paragraphs 5.2.4.1 to 5.2.4.2. At this point, the explanation of the themes as outlined above, starting with the issues related to learners' understandings of indigenous knowledge will be discussed.

#### **5.2.4.1 Learners' understandings of indigenous knowledge in the Life Sciences curriculum**

Theme 12: Learners' understandings of indigenous knowledge

A majority of learners admit that they are aware of indigenous knowledge and consider it as another way of knowing and interpreting natural events while a few of them considered indigenous knowledge as primitive. Of the 18 learners, nine pointed out that indigenous knowledge is of a great value to them, four learners had negative opinion about indigenous knowledge, 2 learners claimed that they are aware of indigenous knowledge but were uninterested to find out more about it while 3 learners gave no response. The following quotes reflect learners' perceptions on indigenous knowledge (see Appendix 16):

*"Indigenous knowledge is those local things used or practised in the villages or homes....it cannot be connected to science"* (Learner 2).

*"Knowledge of people living as communities that help them in their daily lives for survival"* (Learner 6).

*“Indigenous knowledge is the local knowledge of past generation in our country”*  
(Learner 1).

*“I can see it as a non-science and a primitive way of doing things in the past”*  
(Learner 12).

*“Indigenous knowledge is the cultural activities and daily practices of people”*  
(Learner 9).

The learners’ responses showed that they recognise indigenous knowledge to be a form of knowledge. They understand indigenous knowledge as a different way of knowing formed by a particular group of people in a community as they interact with the local environment. Also, the learners’ responses indicated that indigenous knowledge is connected to diverse cultures of the people. The following quotes support this interpretation (see table 12, Appendix 16):

*“Knowledge used by traditional healers. For example, the Sangomas prepared their medicines from local plants”* (Learner 15).

*“It is the traditions of the people that are familiar to them in their own community and environment”* (Learner 16).

*“I can say it talks about the diverse cultures and traditions of the people. Those things learners learn at home”* (Learner 8).

It is very important that the learners expressed their understanding of indigenous knowledge to be the traditional practices found in a particular locality. Learners understand that indigenous knowledge is peculiar to specific cultures and it is passed from one generation to another.

Meanwhile a good number of learners failed to associate themselves with indigenous knowledge. Some learners defined indigenous knowledge as the primitive knowledge

of the past that has no place in the increasingly global world. They also claimed that they are living in the modern era and also that urbanisation has made them to associate with what they see as modern. On this note one of the learners had this to say:

*Indigenous knowledge will not work, as you can see everything is developing. With ICT (Information and Communications Technology) and developments in the world now, we cannot rely on the old knowledge of our forefathers. Let the old information stay with the old ones, we need improvements..... and that is science. (Grade 11 learner)*

So, according to this view, indigenous knowledge is irrelevant in the present world. Learners claimed that lessons on indigenous knowledge sometimes becomes confusing, uninteresting and boring because they have little knowledge about indigenous knowledge. In line with this, during the observed lessons, the researcher observed that some learners struggled to understand Life Sciences concepts related to indigenous knowledge because they were ignorant of indigenous knowledge as well. These Life Sciences concepts are traditional technology, loss of biodiversity, biodiversity and classification of micro-organism (Department of Basic Education 2011:28, 39 and 52).

#### **5.2.4.2 Learners' evaluation of integrating indigenous knowledge system into the curriculum**

*Theme 13: Learners' attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits.*

Learners had mixed feelings towards incorporating indigenous knowledge into Life Sciences. Eight learners indicated that the incorporation of indigenous knowledge into science would make them identify themselves with science concepts, thus improving learners' performances in Life Sciences. Seven learners claimed that the incorporation

of indigenous knowledge in Life Sciences might result into misunderstanding science concepts in the science classroom while 3 learners did not respond to the question. This might have been influenced by their view that they hardly consider indigenous knowledge to be a true kind of science knowledge. The following quotations support this interpretation (see Appendix 17):

*“Indigenous knowledge is outdated and barbaric kind of knowledge that is not useful to this modern generation. It will rather confuse us to understand science”* (Learner 11).

*“Our teachers do not teach us the science from the indigenous knowledge. It makes the lesson to be boring and irrelevant”* (Learner 4).

Learners’ statements made me speculate that they have negative opinions and attitudes about indigenous knowledge. Learners also claimed that they can recount the little time (if any) when they were given an opportunity to learn the principles of science from indigenous knowledge. Learners claimed that most of the educators teach only for them to pass. During the observed lessons, the researcher also noticed that educators had some difficulties with academic knowledge to draw from to enhance science learning and practices. The following quotes support this interpretation (see Appendix 17):

*“I can see it as a non-science and irrelevant to teach. Our teachers are teaching the contents that will help us to pass during examinations”* (Learner 12).

*“I cannot see any positive role as it is difficult to connect local knowledge to science. It cannot help me in science learning”* (Learner 2).

Thus, learners might not have much opportunity to explore how the traditional worldview is connected to Life Sciences, particularly in areas like Genetics and Evolution where concrete information is highly valued.

Understanding of scientific concepts by learners, particularly for those learners whose cultural worldview incorporates natural phenomenon is often hindered because science is seen to be isolated in the classroom. This reflects the reality and variations of the science classrooms where some educators mostly just ended at exposing learners to indigenous knowledge with no or poor connections of indigenous knowledge with scientific concepts.

Another negative view is that the incorporation of indigenous knowledge might lead to confusion in science classrooms because the science the educators are teaching learners is an examinable subject. Also, the relationship of indigenous knowledge and religion might create a lot of misconceptions of concepts among the learners in science lessons. Besides, learners expressed concern that the components of indigenous knowledge are not examinable thus, the indigenous knowledge content are irrelevant to them. The following quotations reflects the negative impressions of learners on the role of integrating indigenous knowledge: (see Appendix 17).

*“I have no interest because they are irrelevant and I have not seen teachers asking indigenous knowledge questions during examinations”* (Learner 3).

*“Indigenous knowledge is for our forefathers and not for us. So, I do not see the reason why it should be asked as questions during examinations because the contents are irrelevant to us”* (Learner 10).

*“Indigenous knowledge is all those taboos and abominable practices in the community. Learning them in school will rather confuse us more”* (Learner 17).

However, some learners confirmed that the incorporation of science and indigenous knowledge makes teachings much more interesting and relevant, thus resulting into improved performances in learning, higher test scores and better grades in school science. This supports De Beer's (2016:35) view that, there might improvement in the

performance of learners when science becomes more relevant and interesting. “The rich IK and cultural practices in many areas in the country provide learners with a good entry point into the scientific world” (De Beer & Mothwa 2013:453). Also, as explained by Kaya and Seleti (2013:39), the students’ achievement improved when lecturers incorporated indigenous knowledge systems into their teaching programmes. This is as a result of student relating what they were taught to their individual local experiences. In addition, this might improve learners’ self-efficacy in science learning and understanding of scientific concepts. The following quotes support this interpretation (see Appendix 17):

*“Indigenous knowledge helped me to understand scientific concepts better. I now enjoy asking questions especially from my community elders on indigenous knowledge which has enhanced my science learning. For example, the use of herbs to cure diseases”* (Learner 13).

*“Though, we learn few of the indigenous knowledge in the class and it helps us to understand science and improve in our performances in learning science”* (Learner 9).

For the learners, integrating indigenous knowledge into science connects them to their everyday life experiences. This supports Kruger and De Beer’s (2019:212) assertion that, “by infusing relevant indigenous knowledge into curriculum themes, students will be able to better understand and appreciate the value of science in everyday life”. Despite the learners’ skepticism of learning indigenous knowledge in science class, they were enthusiastic to find ways of contributing to their local community. It creates a means whereby learners were allowed to recognise and appreciate their own forms of knowledge, thereby increasing awareness of their culture and identity. For example, the knowledge of using various local plants to treat illnesses. This following quotes reflects this interpretations (see Appendix 17):

*“I am happy and thankful to my teachers because they use our local language and local materials from the environment to teach us in the class. It makes the lessons more interesting and gives me a sense of belonging” (Learner 15).*

*“Learning indigenous knowledge will make me to appreciate my culture and also it will help me to preserve my heritage and talk about it. Also, it will encourage us to value our culture” (Learner 8).*

Learners claimed that the use of local knowledge in Life Sciences will assist them to explore the things in their immediate environment and also help to change the way they relate to the world, thus making the world a good place to inhabit. “A true constructivist teacher will realise the importance of building new knowledge on learners’ existing prior knowledge. This will show learners how relevant science is in our daily lives. It may even open future career opportunities and develop learners’ entrepreneurial skills” (De Beer & Mothwa 2013:453). Thus, learners stressed that integrating indigenous knowledge in science would help them to appreciate their culture thereby providing a means of preserving their cultural heritage and promoting cultural diversity. The following quotes support the interpretation (see table 13, Appendix 17):

*“This knowledge can prepare and equip learners for life after school in using that knowledge. So, we are happy and appreciate our teachers whenever they teach us indigenous knowledge” (Learner 5).*

*“It is like an eye-opener for me, as it made me to rethink positively on the ways I relate to the world in preserving my cultural heritage and promoting cultural diversity” (Learner 16).*

Another positive impression regarding the role of incorporating indigenous knowledge is to create an interactive forum and increases learners’ participation in the subject. For example, teachers could give assignments to learners to research and write a



report on particular cultural practices and get information from their families and communities or even allow the learners to do class presentations on the assignment given. This might assist learners to be comfortable while learning and share information and knowledge on their indigenous worldviews in class. The following quotes support this interpretation (see Appendix 17):

*“Indigenous knowledge is the local knowledge, the cultural activities and the daily practices of people, so it gives us the opportunity to express ourselves on what we know about indigenous knowledge during lessons”* (Learner 1).

*“I enjoy lessons on indigenous knowledge because I feel free to participate and share information on my cultural practices during lessons. For example, learning how the local plants could be used to brew medicines”* (Learner 6).

This strategy of using the learners’ families and communities as resources “ensures the integration of IK of all cultural groupings present in the classroom, which links to the aims of building a bridge between school science and home knowledge and making science teaching relevant to learners’ daily lives” (Seehawer 2018:99).

In summary, the two themes focused on the learners’ understanding of indigenous knowledge and their attitudes towards the incorporation of local knowledge in the CAPS document. Some learners valued cultural ideas and their benefits, while some showed negative perceptions regarding the incorporation of indigenous knowledge. In the next section, results from lesson observation will be fully discussed.

### **5.3 LESSON OBSERVATION RESULTS**

The observed lessons were conducted with educators that appreciate the existence of indigenous knowledge and are ready to incorporate indigenous knowledge into Life Sciences. The teachers were observed once during their lessons on topics related to indigenous knowledge systems. Eight educators found it easy to provide and make

good use of teaching resources, while 5 educators found it hard to teach without resources. It must be noted that the educator observed few participating Life Sciences educators' efforts to integrate indigenous knowledge, as the invitation was made when it was already towards the end of the year 2017. In this section, the observed lessons will be presented to provide evidence in the way some teachers incorporated indigenous knowledge in their lessons.

A set of first observed lessons for educators was Life Sciences Grade 10 and the topic was Plant and Animal Tissues. This topic deals with boosting the immune system using traditional technology (Department of Basic Education 2011:28). The educators started the lessons by asking the learners about different indigenous plants found in their locality and their uses. Learners gave varying responses such as:

- *I can identify two plants in my area but I cannot remember their names.*
- *I can identify bush potato that cures diseases.*
- *People use the parts of plants such as roots and leaves to prepare medicines.*
- *In my family, we use traditional medicines made from local plants to cure cold and fever.*

Upon receiving responses from the learners, the educators continued with the teaching and asked learners to explain how indigenous plants could be used to boost the human's immune system. Most of the learners indicated that the indigenous plants are used to treat and fight conditions such as fever, body pains and stomach problems.

The teaching approach used by three of the observed educators was that of probing and interactively leading their learners to participate in the discussion of medicinal plants found in their communities while two educators used brainstorming as a

teaching method. The use of indigenous knowledge in stimulating learners' interest, creating interactive forum and increasing learners' participation were adopted in the Life Sciences class and learners' participation was observed to improve significantly. Also, learners were allowed to use the knowledge from their community to clarify further on the use of indigenous plants until the educators blended the diverse knowledge that the learners reflected with the concepts. The educators further explained that since many of the medicinal claims of indigenous plants have scientific value, it becomes easy for groups of people or communities to accept their health values. The lessons were ended by the educators by asking learners to conduct a research on ways local plants are traditionally used in their local communities.

Previously during the interview, two educators indicated that learners were skeptical of indigenous knowledge and did not want to identify themselves with the indigenous knowledge. Nevertheless, the observed lesson contradicted the above statement as learners responded positively and revealed some knowledge of indigenous knowledge. Employing teaching and learning approaches that recognise indigenous knowledge generated enthusiasm, engagement and excitement in learners during the lessons. Also, some educators managed to identify the local knowledge to blend with Life Sciences topic while others failed to identify the indigenous knowledge because they thought that it was likely to lead to misconception and total confusion to learners as the lesson progressed.

Another set of observed lessons for educators was Life Sciences Grade 11 and the topic was Biodiversity and Classification of Microorganisms. The educators introduced the lesson by explaining to the learners that the lesson will be specifically on the traditional technology to produce cheese, wine and beer. Educators started by asking learners to discuss the role of micro-organisms in the production of beer, wine and cheese. They had the following to say:

- *They break down food materials such as sugar and starch.*
- *It will make beer to have a good taste during production.*
- *For large production of wine.*
- *To produce alcohol used in making beer.*

Upon receiving responses from the learners, educators asked learners to discuss the similarities of the traditional beer, wine and cheese-makings and industrial beer, wine and cheese-makings. Afterwards the educators asked learners to deliberate on the differences between the industrial preparation of beer, wine and cheese and the traditional preparation. Learners responded in the following ways:

- *The two processes use micro-organisms in production.*
- *Water is used in preparation of beer, but milk is used in cheese-making.*
- *They are kept in a place that is warm or you cover the container properly.*
- *I think that both the traditional and industrial beers contain alcohol.*
- *Beer produced industrially contains more alcohol than traditional beer.*
- *The industrial preparation of beer, wine and cheese is done in a more hygienic way than the traditional process.*

These responses can imply that the learners had realised that their traditional cultural knowledge offered an abundance of opportunities to explore authentic scientific knowledge. Thus, the sciences curriculum and teaching frameworks that embraces community's cultural practices might enrich science learning.

The teaching method used by educators was group work (small group discussions) and interactive forums to create and promote learners' participation. The researcher noticed that three educators initiated a strategy in the classroom requiring every learner to divide the page of his/her notebook into half to form two columns: one titled "Traditional preparation" and the other titled "Industrial preparation". The two columns were completed by the learners while the lesson ended. Then, the teachers read through every learner's notebook and develop views on the ideas going on in their minds in regards to their different community beliefs and science concepts.

Similarly, this idea was discussed earlier (see section 3.6) and supported by Jegede and Aikenhead (1999:61). The educators assessed learners' reports and guide their own roles of culture brokers in order to facilitate the border crossings of learners for a meaningful learning. However, learners considered the aspects of local knowledge integrated as a true form of knowledge. Also, teachers attempted to find out the indigenous knowledge linked to the topic which stimulated learners' interest in the learning of Life Sciences and made them understand the concepts effectively.

Another lesson observation was done with Life Sciences educators in Grade 11 and the topic was Human Impact on the Environment: Current Crises for Human Survival. This topic deals with indigenous knowledge systems and the sustainable use of the environment. In this lesson, the educators first questioned learners' understanding of indigenous knowledge. On getting varying learners' responses, the educators explained that indigenous knowledge is traditional knowledge employed by communities in the past that is passed from one generation to another.

The educators proceeded with the lessons by giving the learners an article to read and analyse a story on the San's indigenous practices and knowledge of using *Hoodia* to quench their thirst and suppress their appetite in the bush. The educators then

organised and grouped learners to explore and discuss the importance of other local plants and their sustainable use of the environment. After this, the educators explained to learners on how indigenous plants such as devils' claw, rooibos, fynbos, the African potato and *Hoodia* maybe used sustainably into the future. Two educators made use of indigenous knowledge to strengthen further the science concepts of sustainability. In other words, they utilised indigenous knowledge to build on the scientific concept. Some of the educators' responses on the sustainability of indigenous plants are quoted below:

- *People should cultivate the plants in their various homes for their own use.*
- *The seeds of the plants have to be distributed widely for increase.*
- *Due to high demand, the plants should be grown commercially to meet the needs of consumers.*
- *Collecting only the amount of plants that is permitted.*
- *Replanting processes could help in sustaining the plants into the future.*

The educators asked the learners of their understanding of the lesson on the use of indigenous plants and their sustainability. The educators highlighted on the increase in demand of indigenous plant-based products which might lead to the exploitation of the plants. After this, learners were asked to find out and research more on how to prevent the over-exploitation of the indigenous plants from the wild such that they might not be eliminated.

Lastly, two of the Life Sciences educators in Grade 12 invited the researcher to observe their efforts in integrating indigenous knowledge even though there is no topic labelled or related to indigenous knowledge systems in Grade 12 Life Sciences policy document. The educators picked out "Human Reproduction" as a topic of interest because they thought the topic is relevant to school science and also explains issues related to indigenous knowledge.

One of the educators taught the scientific knowledge of human reproduction and later used indigenous knowledge to strengthen the scientific concept. As the lesson progressed, the researcher observed the interaction between the western science and indigenous knowledge. The science experiences were explained from the learners' cultural knowledge using a concrete example on how the Zulu's of South Africa used their indigenous practices in postnatal and child caring practices. Within the four-week period after childbirth, the new mother drinks a stimulating hot soup prepared with indigenous plants such as the aloe plant, moringa or *snamankuni* which causes the contraction of uterus and helps to remove blood clots. Also, the soup restores energy, restores blood lost during childbirth, restores normal body functioning, promotes lactation and facilitates the healing of wounds.

During the observed lesson of one of the educators, the researcher noticed that some of the learners found it difficult to understand and represent the scientific concept of human reproduction, but when everyday cultural ways of knowing or learners' indigenous knowledge were employed by the educator in the classroom, the learners demonstrated better in their understanding of the Life Sciences concepts.

The educators asked learners to conduct research at the end of the lesson on the traditional methods of pregnancy prevention using the menstrual cycle and enhancing sexuality using herbs in their communities. The summary of the results will be discussed in the next section.

#### **5.4 SUMMARY OF FINDINGS**

The investigation of how teachers understand the incorporation of indigenous knowledge and the way indigenous knowledge is incorporated effectively into Life Sciences curriculum established seven main research findings that answered the four research questions in this research. The key research findings are outlined under each of the research questions.

**Research Question 1:** *How is indigenous knowledge presented in the Life Sciences CAPS document?*

One source was noted from the CAPS Life Sciences policy statement:

- Clarity and adequacy of curriculum

The curriculum issues depicted in themes 1-3 affected the processes involved in the planning of lessons as well as the actual teaching of Life Sciences. Thus, the clarity of curriculum guides affected the organisation of effective learning experiences, the choice of instructional language and understanding of Specific Aim 3 of the policy statement.

**Research Question 2:** *What issues do educators encounter in the implementation of indigenous knowledge topics into Life Sciences curriculum?*

Two issues were identified:

- Educators' knowledge content and quality of instruction
- Language for science classroom instruction

The language use serves as a crucial role in teaching. Classroom instruction tends to create meanings by careful choice of words. As educators start to teach indigenous knowledge, some words came from the educators' own understanding and experience of indigenous knowledge, while others came from the curriculum document and educators' professional development.

**Research Question 3:** *How do educators conceptualise the role of indigenous knowledge in the amended CAPS document?*

The role and incorporation of indigenous knowledge into Life Sciences were addressed by educators in two points:

- Connecting scientific ideas to indigenous knowledge
- Lesson planning capability



The role and integration of indigenous knowledge systems were based on what and how the educators understood how the CAPS document expressed the issues surrounding the integration of indigenous knowledge into Life Sciences. Teacher's understandings of indigenous knowledge and curriculum requirements contributed to the process of instruction.

**Research Question 4:** *What are views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom?*

Two sources were identified:

- Cultural background knowledge
- Negative attitude against indigenous knowledge

## **5.5 CHAPTER SUMMARY**

Connecting learners to their own learning remains a significant factor in the call to incorporate indigenous knowledge systems into westernised science in the classrooms, as recommended by the South African amended CAPS document. Allowing learners to create a worldview that integrates both the indigenous knowledge and western science would improve how learners relate with their environment and science concepts.

The call to integrate indigenous knowledge in Life Sciences was not supported through the provision of proper training by the policy planners with regard to its integration in teaching. This has resulted in educators making speculations and considering whether it will be relevant to incorporate indigenous knowledge into science. This unfavourable experiences indicate the difficulties faced by learners and teachers in the process of integrating indigenous knowledge with science.

In Chapter 6, the key research findings from the analysis of the themes will be discussed in regards with the developed ideas in the review of literature (see Chapter 2) and theoretic framework (see Chapter 3) of this research. Recommendations regarding the instructional practices, educators' knowledge and curriculum development will also be discussed.

## **CHAPTER 6**

### **DISCUSSION AND RECOMMENDATIONS**

#### **6.1 INTRODUCTION**

This research explores how teachers understand the incorporation of indigenous knowledge in Life Sciences and investigates the way teachers mediate indigenous knowledge effectively in Life Sciences classroom. This study also sought to understand how teachers understand indigenous knowledge and their attitude in the use of indigenous knowledge in science teaching. The previous chapter analysed the data generated from the research instruments.

Chapter 6 aims to discuss key findings from the analysed results by considering the main issues that emerged from the 13 themes and the way these key findings relate in the implementation of the CAPS Life Sciences document. In this study, the findings showed that educators encountered various instructional problems in integrating indigenous knowledge into Life Sciences because of curriculum design, lack of connection, limited understandings of indigenous knowledge and their negative attitudes towards indigenous knowledge. This condition showed some challenges that could affect the desired aims of incorporating indigenous knowledge into Life Sciences.

Generally, the discussion will be in regards with the developing ideas in the literature. This discussion will elaborate on the findings about the educators' pedagogical experiences and practices, knowledge content and educator's opinions regarding the role of the indigenous knowledge in the CAPS document.

Furthermore, recommendations are made to educational stakeholders and for future research following the developed ideas in the discussion of the results. This becomes

important because this study showed that educators are in need of help on the ways of integrating indigenous knowledge effectively in science classrooms.

## **6.2 DISCUSSION OF KEY RESEARCH FINDINGS**

### **6.2.1 Clarity and Adequacy of Curriculum**

The amended CAPS document supports knowledge in local settings though being sensitive to the world and its needs. The document seemed attractive and encourages cultural knowledge, thus driving indigenous knowledge forward as a means of inspiring and recognising diversity in cultures.

Notwithstanding, this study revealed that the amended CAPS document shows great optimism among curriculum designers about using indigenous knowledge systems in promoting knowledge development in Life Sciences and nurturing learners on how to solve problems. The rationale for the CAPS document have the intention by explaining the way in accessing indigenous knowledge and school knowledge could assist in solving daily problems of learners, though the choice of curriculum developers on the kind of indigenous knowledge were perhaps limited. However, there was unclearness on the way science principles are linked to indigenous knowledge. As a result, the amended CAPS document did not specify in details the type of diverse indigenous knowledge across South Africa and beyond that will be incorporated during science learning. It also did not to provide teachers with guidelines on the way to incorporate indigenous knowledge in teachings.

The participants noted that, while the CAPS calls for the integration of IKS in Life Sciences, however, such an exercise will be time wasting as the external examinations have not accommodated the IKS. This raises some fear as the educators felt that the incorporation of IKS might not help the learners to pass examinations in Life Sciences. The educators were most concerned with finishing the regular Life Sciences

curriculum and therefore concentrate on teaching learners to pass their examinations. Since indigenous knowledge is not examined, learners do not require IKS for examination purposes. As a result, “science teachers place more emphasis on Western science because of the pressure to achieve high test scores and good examination results” (Koopman 2018:7).

An analytical evaluation of specific aim 3 of the CAPS shows that, although the specific aim emphasises on the integration of indigenous knowledge into Life Sciences, it simply states the precepts on the incorporation of indigenous knowledge. The CAPS document gives a few practical idea on the way teachers should incorporate indigenous knowledge into science teachings.

Posner (2004:86) states that “from the perspectives of multiculturalists, the purpose of education is to accommodate the diversity of the student population”. This results to a great deal of understanding where there are diverse combinations of cultures as a result of migration and ethnic differences. The CAPS document does not prescribe diverse indigenous knowledge systems across South Africa that are relevant to science. On the contrary, “educators have the freedom to expand concepts and to design and organise learning experiences according to their local circumstances, including the availability of resources” (Department of Basic Education 2011:10). Within this framework educators have been innovating and adapting to their classrooms and contexts and using IKS in their classrooms (Wiebesiek-Pienaar et al. 2014:159). This encourages creativity among educators when they plan and teach the curriculum in an effort to make content more understandable and context-relevant. However, it might mislead some educators into thinking that the other forms of indigenous knowledge not reflected in the teachers’ guides are insignificant, due to how such knowledge was represented in the curriculum by the curriculum developers.

### **6.2.2 Educators' Content Knowledge and Quality of Instruction**

The responses from educators showed that educators had inadequate knowledge in regards to indigenous knowledge. From the inadequate understanding of indigenous knowledge, it is clear that not enough explanation or assistance was provided in the teacher's guides. Thus, it is significant to find out some means of assisting educators in improving the organisation of knowledge content effectively so as to provide the opportunity to engage learners in effective scientific ideas in classrooms. This condition makes it clear for educators to be aware of what is required to be involved in a meaningful learning.

Indigenous knowledge is regarded to be a traditional way of knowing, which may comprise the spiritual nature of peoples' understanding and connection to the world. The findings revealed that some educators viewed indigenous knowledge only in relation to artefacts. This indicates that educators' understanding of the topic was limited and hence willing to misinterpret the content being discussion. Then, a question arises, "Why were educators unaware of such knowledge?" A good response to that question may emerge from studies which revealed that educators tend to lack understanding about indigenous knowledge and deterred incorporating indigenous knowledge in school because they were not educated in following the indigenous knowledge curriculum, thus were unfamiliar with indigenous knowledge systems (Ogunniyi 2007:966). Most educators in South Africa were trained at schools and universities in the Western science tradition and unfamiliar with the principles of indigenous knowledge (Koopman 2018:5); thus they have little or no knowledge of indigenous ways of knowing.

One would anticipate such knowledge to be accessible to educators without much difficulty, but this seems to be a different case. Hence, it was not very odd to see these educators misinterpret indigenous knowledge because they were taught through a

curriculum that encourages school knowledge, thus they have superficial knowledge about indigenous knowledge. This reflects on an observation that effective learning depends on educators' understandings of integration between indigenous knowledge and western science and educators' capability to manage classrooms discussions connected to this issue (Le Grange 2007:581). The study went further to establish that teachers have shallow understandings of the ideas and concepts in support of the announced decision to move indigenous knowledge into formal education. Thus, there seems to be a gap and inadequate understanding on how educators incorporate indigenous knowledge into science teachings. As a result, it becomes hard for educators to incorporate indigenous knowledge in the teaching of concepts.

This study revealed that the educators' little understanding in teaching about indigenous knowledge in their lessons may be a result of inadequate in-service and pre-service trainings and effective monitoring to support educators' ability in handling the amended CAPS document (see section 5.2.2.1).

In addition to the above, from the findings, educators' inadequate content knowledge of indigenous knowledge affected the attainment of specific aims required in CAPS document. The inadequate content knowledge affected educators' capability to develop strategies for attaining the specific aims and promote critical thinking in one's field. Educators' limited knowledge about indigenous knowledge systems limited their understanding of the preparation of local knowledge lessons, thus lowering the learners' quality of learning in the classroom.

As it was noted in this study, some of the observed lessons revealed various problems of instruction with regard to lesson organisation, learning assessment, effective instruction and use of resources. One problem was that educators merely take learners through lessons, perhaps as they were uncertain about the content to be

covered in the teachers' guides or because they lacked sufficient content knowledge or a lack of guidelines from the CAPS documents. These findings from the study suggest that educators might need better additional knowledge content regarding indigenous knowledge to add to the content described in the teachers' guides.

The analysis of the way teachers incorporated indigenous knowledge in their teaching shows little information of a good understanding and effective incorporation of indigenous knowledge, even though the teachers asserted orally during the course of the interviews that they integrated indigenous knowledge in their lessons. Rather, the teachers' incorporation of indigenous knowledge focused on the use of indigenous knowledge to nurture and support learners' learning of western science and, also to encourage their learners' interest in the learning of Life Sciences.

From the discussion so far, one can infer that the investigation of the teachers' incorporation of indigenous knowledge does not actually show the link between Life Sciences and indigenous knowledge as stipulated in the CAPS (Department of Basic Education 2011:17). CAPS document did not stipulate in details any standard methods or best practices for such teaching. The policy statements were not clear on the way incorporation should be done and it led to varied ways of interpreting and implementing the curriculum (Jacobs 2015:51). Consequently, one cannot but agree that various educational groups have recognised indigenous knowledge, but a proper place has not been assigned to indigenous knowledge in the current system (Mosimege 2005:31).

In summary, most of the difficulties educators encountered could be related to lack of information and guidelines in the CAPS document. These findings imply that educators need to be equipped with additional knowledge content regarding local knowledge to complement described content in Teachers' guides.



### **6.2.3 Language for Science Classroom Instruction**

The literature suggests that using indigenous knowledge plays a role in learners' identity and assist in facilitating learning in learners (De Beer & Whitlock 2009:210; Shizha 2010:28; Ameyaw & Amankwah 2014:312-313). It was noted from the findings that, besides a deficiency in academic content knowledge, some educators also have to deal with issues of language. Some educators give little explanations and clarity of facts on science content despite the fact that they teach learners from the isiZulu speaking community. Since learners use English language as their first additional language and isiZulu as home language yet, this is not utilised during the teaching process, language heavily influences learners' ability to understand.

Moreover, the participating educators noted that the traditional knowledge of learners learnt in their communities might bring about misconceptions in Life Sciences. The observed lesson in one of the Life Sciences Grade 12 classes on Genetics and Human Reproduction illustrated the issues of misunderstandings. The educators explained to the learners that hereditary characteristics are passed on from the parents to the offspring through genes. But the Life Sciences learners argued and claimed that according to their traditional knowledge, hereditary characteristics are passed on from the parents to the offspring only through blood. The educators observed that this has confused blood with genes. Meanwhile, the participating educators noted that the learners' communal knowledge becomes difficult for the IKS to be effectively incorporated in the classroom. Hence, the teachers tend to monitor learners' expressions and responses and give them prompt feedback.

Interestingly, there were also situations where the educators gave explanations in both languages (English and isiZulu) to simplify some of the concepts, without or with minimum loss of scientific meanings. For example, when explaining the industrial and traditional processes of brewing beer the concept “fermentation process” (ukuvubela

in isiZulu) was explained. Educators clarified the making of the traditional beer in vernacular without changing the meaning and clarification of the concept being taught. Educators explained about the fermentation process in local language as, “*Ukuvubela umqombothi, kuqhuma isitshalo sikhophe izelekeleli ezizokwazi ukuguqula isimo somthombo wombila sibe wushukela ozobiliswa*” (Educators’ statement translated to English reads as follows: In traditional beer-making, the germination seeds release enzymes which convert starches stored in the maize grain into sugars which can be fermented).

The educators’ use of appropriate words, in the vernacular, that retain science content meanings facilitated the understanding of the Life Sciences concept covered. For example, the making of the traditional beer is translated as *umqombothi*; enzymes translated as *izelekeleli*; starches stored in the maize grain translated as *isimo somthombo wombila*. This is an example of teachers using local knowledge in strengthening the learning of western science concepts in their teaching.

The example above illustrates that one of the necessary assets that educators require, which can help learners understand Life Sciences and also make the most out of their learning, was the selection of the appropriate words, in the vernacular, that would maintain scientific meanings for learners. In some cases, as educators prepared and conducted lessons on indigenous knowledge, they made an effort in choosing words for teaching that they regarded as useful. However, in some instances educators could not exactly provide meanings or clarify concepts around indigenous knowledge to explain scientific concepts and processes.

Of course, there were also situations where the educators struggled to find verbatim translations of science concepts in vernacular; rather, educators used vernacular explanations of concepts that bear scientifically relevant meanings. For example, in

referring to the word “genes”, one educator used the vernacular explanation “*imbewu ephethe ufuzo*” in isiZulu (“gametes carry characteristics or traits” in English) which communicated appropriate explanations to learners to understand the science concept under study. The educator could not use the isiZulu word “*ufuzo*” that bears exact explanation with the science concept of genes because “*ufuzo*” is too loosely used and carries many meanings. Interestingly, the explanations of the concept in both English and isiZulu were almost the same. The educator figured out a better translation to fit explanations during teaching. The situation presented the researcher with the idea that educators’ success to identify proper vernacular explanations might rely on the instructional lucidity of ideas that educators have on Life Science concepts. Thus, science learning depends mainly on expressions in both English and vernacular.

The educators used culturally relevant materials and integrated local community practices into their Life Sciences lessons. As a result of this, they helped learners to make connections between the science content being taught and its relevance to daily life. “When science teachers make these connections and show students that science can be relevant to their lives, students are likely to be more engaged, eager to learn, and have more positive attitudes towards science” (Brayboy & Castagno 2008:743).

In regards to learners’ involvement in classroom, learners expressed themselves in a more freely manner using their indigenous languages than they did in English. It was noted that most of the educators teach learners from the isiZulu speaking community. Therefore, isiZulu (the learners’ home language) was used in the classroom teaching. Also, the educators who used code switching (English to isiZulu and translanguaging (for multilingual classrooms) in their teaching to explain some of the key subject content and for interaction with learners, were highly appreciated by learners (See Chapter 5: section 5.2.4.2). This is the same idea expressed by Kaya and Seleti (2013:39) “that the lecturers who used Setswana in their teaching and interaction with

students, incorporated local community practices into lessons, utilised culturally relevant material, were very much appreciated by students”. Educators managed to identify the IKS to blend with school science as they used isiZulu to make learners to clarify some scientific concepts in isiZulu. This approach improved learners’ participation, understanding, thinking and communication of ideas in the classroom. (See Chapter 5: section 5.3). Hence, it becomes significant to pay particular attention to the learner’s language when teaching school science (Chigeza 2010:2).

#### **6.2.4 Relationship between Indigenous Knowledge and Science Ideas**

Some challenges faced by educators resulted within the curriculum that show insufficient coherent regarding the guidelines on science ideas and the way to teach them. To worsen the situation, the indigenous knowledge systems suggested in the curriculum did not cover the diverse indigenous knowledge systems across South Africa and beyond, which made it hard for educators to design effective and useful lessons. Moreover, we can find learners with diverse language and cultures in the same classrooms. This raises the question, “Whose indigenous knowledge should they teach?” Hence, the curriculum design affected educators’ views on the content to teach and the way to organise and make available the resources to be used in teaching indigenous knowledge.

Educators claimed that the CAPS document lacked information on how IK content should be taught to learners. Perhaps this comment depicts educators’ belief in teaching by transmission of knowledge. However, educators’ claim about insufficient details and guidelines in the CAPS documents coincided with the document analysis, in which the researcher saw that the documents and learning activities had unclear expression of the indigenous knowledge that was targeted. Thus, the inadequate guidelines in the curriculum placed educators in a vacuum of ideas about the specific

indigenous knowledge systems to consider when planning lessons. This affected their teaching performance.

As stated earlier, the suggested activities for the curriculum contents involving indigenous knowledge do not reflect the diversity of South African cultural groups. Where the educators rely only on the teachers' guides, it may lead to frustration if educators failed to find or understand the particular examples of relevant indigenous knowledge or science content. "Given the diverse learning population in many science classrooms, teachers also do not always have sufficient knowledge of indigenous knowledge practices of the various cultural groups" (De Beer 2016:45). For example, an educator might be very knowledgeable about Zulu indigenous knowledge, but unlikely to know much of Khoi or San indigenous knowledge. In addition, insufficient details and guidelines on the way to incorporate indigenous knowledge can lead to incorrect generalisation of concepts to be covered at a particular level. Thus, this loose design and teaching experiences might not be completed with the same outcomes in various places across the country and also might lead to a different scope of concepts that might be problematic to examine during the National Senior Certificate (NSC) examinations.

Many education scholars in the discussion on indigenising have emphasised the importance of and need for the interaction of school knowledge and teaching that aims at meaningful science teaching (De Beer & Van Wyk 2012:1; Ogunniyi 2005:2; Ogunniyi 2007:972). The educators' demanded information on indigenous knowledge caused the researcher to deliberate on the connection between educators' lack of scientific ideas and their lack of ability to connect to indigenous knowledge as the main finding.

The demand for that information arose from their frustration at insufficient knowledge about the science and indigenous knowledge, especially when there were no clear guidelines regarding the scope of lesson activities and examples of indigenous knowledge needed in Life Sciences topics. This could be the foundation of the disconnection that created problems for most educators in the process of the way to incorporate local knowledge during lessons.

The participating educators during the course of the lesson observations, made some attempts to use the 15 interactive instructional strategies for teachers to serve as culture brokers, advocated by Solomon (1992, in Jegede & Aikenhead 1999:61-62). Although there were manifestations of these strategies during lessons, they were not completely developed. This is in relation to strategy 2, which encourages teachers to ascertain “the oral narratives and heritage of the Native community should become part of the school experience” (Jegede & Aikenhead 1999:61-62). The teachers made an effort to apply this strategy at the time they asked learners to research how indigenous plants are traditionally used in their local communities. Some of the educators who gave the learners the research work either did not explore the story or did not link the story of the use of indigenous plants to the scientific value of the indigenous plants. Further, it could be seen that, although the teachers integrated the indigenous knowledge of South Africans into the lessons, the use of strategy 2 for teachers as cultural brokers, was not properly expressed in the lessons.

The incapability of the teachers to appropriately link the local knowledge component of Life Sciences topics to their scientific knowledge components, reveals the ineffectiveness of the teachers as cultural brokers. This is the same idea revealed by Semali (1999:311) that “tensions and contradictions abound between what is intended by curriculum reforms and what is actually implemented in classrooms” (Semali 1999:311). There is no specific model designed for teachers to adopt other than using

their individual thoughts that arose from indigenous knowledge when teaching (Semali 1999:314).

Another lesson observation revealed that educators initiated strategy 2 in the classroom to develop their ideas. After the educators had discussed the similarities between the traditional and the industrial beer-, wine- and cheese-making, they asked learners to divide their notebooks pages into half to make two columns, one titled “Traditional preparation” and the other titled “Industrial preparation”, and compare the industrial preparation of beer, wine and cheese with the traditional preparation. The educators developed this activity and went further to develop some thoughts on what was going on in the minds of learners in relation to their different community beliefs and science concepts. One could see that the teachers incorporated indigenous knowledge in their teachings and were able to connect the indigenous knowledge involved in the lesson to the science of preparation of beer, wine and cheese. Thus, the literature suggests that all learning can start from the learners’ prior knowledge and experiences from their daily lives in learners’ respective communities.

The means by which the teachers incorporated indigenous knowledge in teaching encouraged learners to seek for local knowledge from the community’s’ elders and from their immediate environment. Both approaches of the lessons observed incorporated the South African’s indigenous knowledge into the science lesson. Thus, the learners’ culture is incorporated in the school experiences of learners. In the approach 1, the teachers employed indigenous knowledge to build on and teach the science concepts while in the approach 2, the educators used indigenous knowledge to create a link between indigenous knowledge and science ideas. Apparently, there is little or no guidance in the curriculum on the way teachers should incorporate local knowledge in classrooms. Thus, teachers incorporate indigenous knowledge on the basis of their individual understanding and ideas when teaching.

The incorporation of indigenous knowledge by teachers reveals the usage of indigenous knowledge to nurture and strengthen their learners' learning of western science. However, the CAPS document intends indigenous knowledge to be linked "directly to specific areas in the Life Sciences subject content" (Department of Basic Education 2011:17). Thus, there exist contradictions in the way teachers and CAPS describes the incorporation of indigenous knowledge. This shows that inadequate understanding of the incorporation of indigenous knowledge by the educators reflects their actual knowledge of incorporation of indigenous knowledge in Life Sciences curriculum. The researcher suggests that the design of science textbooks and other resources should comprise of the activities and practices of the indigenous people paying due attention to the teaching methods for effective integration of indigenous knowledge. Also, the design of the learning materials used in science classrooms should take the local settings into consideration.

#### **6.2.5 Lesson Planning Capability**

The results of this research revealed that educators have little understanding on the organisation of effective indigenous knowledge lessons, thus affecting the quality of teaching in indigenous knowledge lessons. This reflects an observation that educators do not think critically about the aims, concepts, approaches and resources that the incorporation of IKS in science curriculum calls for (Manzini 2000:20-23).

The analysis of the way teachers incorporated indigenous knowledge into Life Sciences shows that the educators' instructional approaches of incorporating indigenous knowledge differ from the aim of CAPS document on the incorporation of indigenous knowledge. The observed lessons in this study revealed that the teaching methods used by some educators did not lead to the interaction of science knowledge and indigenous knowledge, although indigenous knowledge was mentioned in the lessons.



In the observed lessons in this study, some educators superficially integrated indigenous knowledge during lessons. Apparently, there is little or no guidance on the concepts to be taught by the teachers and the way they should teach it when they incorporate indigenous knowledge in science classrooms. This is the reason why the researcher argues that the CAPS document was not coherent enough to provide concrete suggestions regarding the way educators are to incorporate indigenous knowledge in teaching.

As mentioned earlier, the educators that initiated the strategy 2 in the classroom focused on using indigenous knowledge to create a link between indigenous knowledge and science ideas in Life Sciences learning. Although, teachers incorporation of indigenous knowledge at certain points during lessons reflected inadequate principles on the incorporation of indigenous knowledge. (see section 1.1) Therefore, the researcher argues that educators could only embrace effective integration of indigenous knowledge if they are informed and assisted in getting resources and also exposed to methods that could assist in learners' knowledge development in Life Sciences content.

The study showed that most educators knew of using available local resources to teach. However, the provision of teaching resources easily for lesson was different across the board. Most of the participating educators were willing to integrate IKS during lessons as they anticipate that the incorporation of IKS into science might serve as reconciliation between their culture and school science. Of the 13 educators that showed confidence and readiness in integrating indigenous knowledge into Life Sciences, 8 educators found it easy to provide and make good use of teaching materials, while 5 educators felt it was hard to look for resources and taught without resources. Let me point out that if such materials will be unavailable, educators might

be unable to assist learners' understanding of science topics involving indigenous knowledge effectively.

During the classroom observations, it became clear to the researcher that the topics involving indigenous knowledge systems could be complemented with a rich supply of teaching resources. In this study, the researcher also noticed that the supply and usage of good local materials for teaching indigenous knowledge partly rely on educators' creativity. They did their best and managed to provide relevant teaching resources in the form of models, charts and indigenous plants, which were either borrowed or improvised for teaching indigenous knowledge.

Furthermore, the researcher would like to recommend that educators be encouraged to draw on the local activities and materials from their communities and also try to get information from the elders and other members of their communities who are the knowledge holders to contribute in the provision of information that educators may be lacking. It is critical to involve the elders who are the indigenous keepers of the greater part of the local knowledge in the community and have extensive experience and skills but who rarely have formal qualifications (Hays 2009: 194, 205; Òtúlàjà et al. 2011:698). This approach has proven to improve the connection between the school and the local community, where the keepers of indigenous knowledge originated from (Jegade & Aikenhead 1999:52). Thus, through such interactions, educators can gain extensive knowledge and skills relating to indigenous knowledge and wisdom from the elders.

### **6.2.6 Negative Attitude Towards Indigenous Knowledge**

The findings made it clear that teachers' aversion of indigenous knowledge could be as a result of the enculturation process in school science, which holds a single science interpretation of meanings and worldviews (Jegade & Aikenhead 1999:47). Cultural

biases were detected when some educators were asked how they integrate indigenous knowledge into their Life Sciences lessons. Educators' abstract ideas in western knowledge have the tendency to make educators to reject ideas that learners might bring while learning Life Sciences. Some educators believed that there is no place for indigenous knowledge in the school. Contrary to this approach, educators need to take learners' questions and experiences into account in their sciences classrooms and be free of cultural biases (See Chapter 5: section 5.2.2.3).

Also, the findings give the impression that teachers have inadequate knowledge on the realities of indigenous knowledge, which likely hindered them from seeing the advantages and value of covering it in a balanced way in their lessons (See Chapter 5: section 5.2.3.5). It would be interesting to see how educators can engage and convey a balanced teaching for learners with different cultural backgrounds when indigenous knowledge topics are taught since the role of education is partially to sustain and preserve cultures.

Most science learners have labelled indigenous knowledge solely from a negative perspective, because of the effect of scientific knowledge in the structure of education we call schooling. Science learners have rejected indigenous knowledge and committed themselves to the peculiar western science interpretations, which learners believed to be superior. Thus, learners' alienation from indigenous knowledge might be associated with border crossings and integration into western culture, which has disturbed their worldview due to the disconnection of their own cultural background ideas (Jegede & Aikenhead 1999:47-62). As a result, such a disconnection of cultural meanings regarding indigenous knowledge might have discouraged learners from making much scientific sense from indigenous peoples' ways of knowing. Educators need to convey balanced understandings of such knowledge to learners and not only the contrary expressions of some kinds of knowledge.

Furthermore, educators and learners have to be informed on cultural knowledge and liberated from the stereotypes connected to science that limit the possibilities of realising other ways of knowing. Otherwise, educators might develop negative attitudes towards indigenous knowledge and might not concentrate on the topics involving indigenous knowledge. Thus, this might affect the proper implementation of the CAPS document.

### **6.3 CHAPTER SUMMARY**

In summary, this study explored the understanding of teachers on the incorporation of indigenous knowledge in Life Sciences and found out the way teachers integrated indigenous knowledge effectively in their classrooms. The study showed several challenges that need attention. The findings from this study are convincing enough and certainly gain our attention to significant indicators on what the curriculum designers and educators should do as they carry on the role of implementing the amended CAPS document.

Furthermore, the researcher would acknowledge that each of the 13 themes that emerged in this study, plays a role in teaching processes, particularly to make sure that the specific aims related to indigenous knowledge in the amended CAPS document is achieved.

### **6.4 LIMITATIONS OF THE STUDY**

The main limitation of this research like all other qualitative research was the size of the research population. This research was restricted to three schools in Gert Sibande District of Mpumalanga province and not every of the Life Sciences teachers and learners participated in this study. The findings and results from 15 educators and 18 learners from the same province in the same education district are subjective and

contextual, therefore the findings cannot be generalised as appropriate to all learners and Life Sciences teachers.

## **6.5 GENERAL CONCLUSION**

The issues that came up in this study comprised inadequate clarity of the CAPS document, poor organisation of learning experiences by educators and communications. Educators complained that the CAPS documents had inadequate details of knowledge and guidelines, particularly on the scientific principles that are embedded in indigenous knowledge. Thus, it was difficult for the educators to motivate learners towards developing the science principles expected by policy designers.

The greater part of the study revealed that the call to integrate IKS in Life Sciences was not supported through the provision of sufficient professional development and training for the curriculum implementation. This led to the educators misinterpreting the curriculum in regards to what to teach in the classroom. Consequently, it led to low content knowledge coverage as educators lack the guidelines on the design of lessons due to inadequate details in the curriculum. Therefore, educators faced some problems in connecting Life Sciences and indigenous knowledge as stipulated in the CAPS document.

Nevertheless, the analysis of responses from this study indicated that many Life Sciences educators had better knowledge of indigenous knowledge with positive approach on the use of indigenous knowledge in the science classrooms. Also, educators acknowledged the incorporation of indigenous knowledge in Life Sciences as important and advantageous. Thus, it becomes important to pay particular attention to the learners' indigenous knowledge systems that are meaningful to their own lives when learning school science.

Lack of knowledge on indigenous knowledge by educators is a common development as indicated in the literature (De Beer & Van Wyk 2012:1; Ogunniyi 2005:2; Ogunniyi 2007:972). This suggests that the integration of indigenous knowledge would require recognising community knowledge holders or experts in local knowledge. In line with this, the elders or knowledge keepers in the community are considered as bearers of funds of knowledge (Aikenhead & Lima 2009:11; Hays 2009:194,205; Òtúlàjà et al. 2011:698). Thus, “we should strive to restore the wisdom of elders to our education and realise that we may have a deeper and broader understanding of the world and ourselves if we expanded the boundaries of what knowledge we valued and included. There are valuable authentic wisdom traditions in all cultures” (Keane 2015:4); which may improve science learning and motivate learners in their learning experiences.

Finally, since the objective of the school system in South Africa is to include indigenous knowledge systems as a fundamental base of educational development, it is important to consider the use of academic concepts in current literature and also to rethink how we can acknowledge and take into considerations the learners’ different indigenous knowledge in our classrooms. This might create chances of understanding learning better in every of its expressions for everyone’s benefit. Above all, we should strive to restore to our science education the knowledge and practices that we recognised and valued as worth learning. This possess the possibility of making school system to be culturally-inclusive and teaching of Life Sciences simpler for educators and learners in South African Schools.

## **6.6 RECOMMENDATIONS**

Educators “as culture brokers” have difficulties in assisting learners’ movement between western knowledge and indigenous knowledge. Although, the amended CAPS document expressed the principles for the incorporation of indigenous

knowledge in schools, the document did not stipulate clearly the way educators should do the integration.

The undermentioned recommendations are derived from the data analysis and discussions of the research findings. The recommendations are suggested for educators, curriculum designers, and helpful for future research on the incorporation of indigenous knowledge in the science field.

### **6.6.1 Recommendation for Educators**

It is necessary for educators to know fully that effective incorporation of indigenous knowledge in learning of science depends on their capability to incorporate indigenous knowledge in science and to understand the precepts on the incorporation of indigenous knowledge in schools, without only following what the CAPS document has indicated. Educators should know fully that the CAPS document states what needs to be done and not how it is to be done.

In view of the above stated background, it appears incorporation of indigenous knowledge in education can be improved if teachers are involved in research and come up with innovative and constructive input to improve the process as well as their teachings in the classroom. It is necessary as the study showed that educators need help. Educators require to know that whenever they incorporate indigenous knowledge in science, indigenous knowledge and scientific knowledge should be kept on similar platforms on which the concepts of both knowledge could be questioned respectively in improving the subject and understanding the concept better.

Indeed, this study recommends educators to be “cultural brokers” where the learners’ cultures are identified and learners are assisted to move more easily between the school science and their indigenous knowledge. Thus, teachers need to be exposed to the outlined 15 teaching strategies as a guide to developing better suitable teaching

approaches for the incorporation of indigenous knowledge into science that would enhance learners' understanding.

### **6.6.2 Recommendation for Curriculum Designers**

It was evident in the amended CAPS document that there was absence of clarity on the way the science concepts are linked to indigenous knowledge. As a result, the amended CAPS document did not specify in details the diverse indigenous knowledge across South Africa and beyond that will be incorporated during science learning and guidelines on the way indigenous knowledge should be integrated in teaching. It was noted from this study that there are inconsistencies in the structure of Life Sciences curriculum contents under indigenous knowledge, which deviate from the systematic content presentation. This may make the content hard to be linked to IKS. This suggests that educators “can only teach what they know, and without a standardized IKS curriculum there is a danger of the education system being fractured” (Mavuso et al. 2021:10).

It is then recommended that the CAPS document should outline clearly the varieties of relevant activities on indigenous knowledge, to standardise the intended curriculum and thus to ensure that it is simply implemented without any confusion among educators. The approaches utilised in countries such as Alaska to assist with the incorporation of indigenous knowledge might also be used to suit the school system in South Africa (Barnhardt 2010:4). As such, models and guidelines “for assisting teachers and districts with IKS integration could be developed; orientation integration programmes could be developed for teachers; and an online database of teaching curricular materials could be developed for easy access” (Mavuso et al. 2021:10). This would adequately prepare educators to work through the same curriculum and similar types of indigenous knowledge suggested in the curriculum and avoid a disparity of



science content. It would create room for indigenous knowledge to be tested in the South African National Senior Certificate (NSC) examinations.

Indeed, there is need for the educational policy makers to explicitly design the curriculum documents by incorporating various teaching approaches on the way to implement the curriculum concepts. This might serve as encouragement for educators to implement an effectual incorporation of indigenous knowledge in science. In addition, it is necessary for textbooks writers to address and provide enough indigenous knowledge content with appropriate examples and practical work that comprises of science method.

However, even if the above recommendations were implemented, educators' training on curriculum implementations would still remain a concerned issue that requires attention. For this reason, the Department of Education should increase their efforts to foster and implement training in schools to adequately prepare educators and provide relevant support for educators to be knowledgeable, culturally-sensitive and highly effective within the contexts in which their classrooms are found. There should be sufficient mechanisms for supporting and assisting educators to integrate indigenous knowledge into Life Sciences to up-skill their pedagogical content knowledge (PCK). Cluster meetings, which are organised by the curriculum implementers for assessment moderation, should be an opportunity to emphasise and develop educators' PCK.

Thus, the researcher recommends pre-service training of educators in the traditions of indigenous knowledge as the best way forward. In addition, since the majority of educators are currently in the teaching field, the Department of Basic Education requires to plan for in-service education and training for the educators who are already in service, in form of seminars, workshops, conferences and courses to upgrade their knowledge and skills they impart on learners in the classroom.

### **6.6.3 Recommendation for Further Research**

The study suggests further research on a broader scale and in different contexts to see how these results can be contextualised to suit different circumstances. Other issues that arose in this study such as the teachers' reflections on the teaching and implementations of the Life Science curriculum and teachers' perceptions on the integration of IKS in Life Sciences need further investigation to see how different attitudes can be accommodated. It is further suggested that custodians of IKS such as elders be involved to share their expertise and knowledge, and that investigations be done on how their knowledge could be incorporated in science classrooms as reflected in the curriculum document.

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**APPENDIX 1**  
**ETHICAL CLEARANCE FROM THE UNIVERSITY OF SOUTH AFRICA**

**COLLEGE OF EDUCATION RESEARCH ETHICS REVIEW COMMITTEE**

13 July 2016

Ref : 2016/07/13/51495767/17/MC

Student : Ms CC Elekwa

Student Number : 51495767

Dear Ms CC Elekwa

**Decision: Ethics Approval**

**Researcher:** Ms CC Elekwa  
Tel: +2779 611 6561  
Email: [conie4chi@gmail.com](mailto:conie4chi@gmail.com)

**Supervisor:** Prof. N Nkopodi  
College of Education  
Department of Science and Technology of Education  
Tel: +2712 429 4731  
Email: [nkopon@unisa.ac.za](mailto:nkopon@unisa.ac.za)

**Proposal:** Exploring the integration of indigenous knowledge in the life sciences classroom: A case study of three senior secondary schools in the Gert Sibande District in Mpumalanga Province of South Africa

**Qualification:** M Ed in Natural Science Education

Thank you for the application for research ethics clearance by the College of Education Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the research.

*The application was reviewed in compliance with the Unisa Policy on Research Ethics by the College of Education Research Ethics Review Committee on 13 July 2016.*

*The proposed research may now commence with the proviso that:*

- 1) The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
- 2) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the College of Education Ethics Review Committee. An amended application could be requested if there are substantial changes from the*



existing proposal, especially if those changes affect any of the study-related risks for the research participants.

3) The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.

**Note:**  
The reference number **2016/07/13/51495767/17/MC** should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the College of Education RERC.

Kind regards,



**Dr M Claassens**  
**CHAIRPERSON: CEDU RERC**  
[mcdtc@netactive.co.za](mailto:mcdtc@netactive.co.za)



**Prof VI McKay**  
**EXECUTIVE DEAN**



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**APPENDIX 2**  
**REQUEST FOR PERMISSION TO CONDUCT RESEARCH**



education  
MPUMALANGA PROVINCE  
REPUBLIC OF SOUTH AFRICA

Building No. 5, Government Boulevard, Riverside Park, Mpumalanga Province  
Private Bag X11341, Mbombela, 1200  
Tel: 013 766 5452/5115, Toll Free Line: 0800 203 115

Liliko le Temfundvo, Umnyango we Fundo

Departement van Onderwys

Hdzwale ya Dyondzo

Ms. C.C. Elekwa  
48 Naude Street  
Flat Number 2  
**ERMELO**  
2351

**RE: APPLICATION TO CONDUCT RESEARCH: MS C.C. ELEKWA (M.ED DEGREE)**

Your application to conduct research study was received and is therefore acknowledged. The title of your study reads: "Exploring the integration of indigenous knowledge in the life science classroom: A case study of three senior secondary schools in the Gert Sibande District of Mpumalanga Province of South Africa." I trust that the aims and the objectives of the study will benefit the whole department. Your request is approved subject to you observing the provisions of the departmental research policy which is available in the departmental website. You are also requested to adhere to your University's research ethics as spelled out in your research ethics document.

In terms of the research policy, data or any research activity can only be conducted after hours as per appointment with affected participants. You are also requested to share your findings with the relevant sections of the department so that we may consider implementing your findings if that will be in the best interest of the department. To this effect, your final approved research report (both soft and hard copy) should be submitted to the department so that your recommendations could be implemented. You may be required to prepare a presentation and present at the department's annual research dialogue.

For more information kindly liaise with the department's research unit @ 013 766 5476 or [a.balovi@education.mpu.gov.za](mailto:a.balovi@education.mpu.gov.za)

The department wishes you well in this important project and pledges to give you the necessary support you may

need.

MRS M.L.C MHLABANE  
HEAD: EDUCATION

08y 11, 16  
DATE





### **APPENDIX 3**

#### **LETTER TO THE PRINCIPALS OF SCHOOLS IN GERT SIBANDE DISTRICT**

School of Teacher Education

Department of Science and Technology Education

College of Education

University of South Africa

14 March 2016

The Principal,

#### **RE: REQUEST FOR PERMISSION TO CARRY OUT RESEARCH IN YOUR SCHOOL**

My name is Chinenye Constance Elekwa, a Master's student at the abovementioned institution. I am currently doing a research on the Integration of Indigenous Knowledge (IK) in the Life Sciences classroom in the Gert Sibande District. The research is towards the completion of my Master's degree in Science Education. The purpose of the study is to explore the teachers' understanding of the integration of indigenous knowledge in science education and to investigate how they reconcile indigenous knowledge effectively in their teaching of Life Sciences in the classroom. The benefits of this study are to raise awareness on how indigenous knowledge is integrated into science classrooms and to identify the problems experienced by teachers in integrating indigenous knowledge. The study will be of value as it will attempt to provide findings and recommendations that will make valuable contributions to the improvement of science teachings in classroom.

The study will be guided by the following questions:

1. How is indigenous knowledge presented in the Life Sciences CAPS document?

2. What issues do educators encounter in the implementation of indigenous knowledge topics into Life Sciences curriculum?
3. How do educators conceptualise the role of indigenous knowledge in the amended CAPS document?
4. What are views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom?

Your school is selected on the basis of it being a high school in Gert Sibande district. I hereby request to conduct my research at your school during the period when the Life Sciences educator/s in your school will be teaching the concept of biodiversity and classification of micro organisms.

You are guaranteed that all information gathered during the research will be used for the purpose of this study only. The anonymity of both the school and the participating educator/s are assured. Furthermore, you have the option to withdraw your school from the research project if you wish to.

The research will not cause any risk. Inconvenience due to time may cause discomfort but no harm or risk is anticipated. Appropriate measures will be taken to mitigate any negative consequences in a responsible manner. Also, every effort will be made not to disrupt the daily functioning of the school. Confidentiality and anonymity of schools and participants will be maintained at all levels of this research project. After the completion of the study, a summary of the research findings will be made available to you on request, please contact Ms Elekwa on 0796116561.

If you need further information regarding the research, please do not hesitate to contact either myself or my supervisor Prof N Nkopodi. Herewith are our contact details: Ms Elekwa: 0796116561, [conie4chi@gmail.com](mailto:conie4chi@gmail.com); Prof N Nkopodi: +27124294731, [nkopon@unisa.ac.za](mailto:nkopon@unisa.ac.za).

Please fill in and sign the attached declaration letter indicating your grant of permission for me to do the study in your school.

Thanking you in advance for your cooperation.

Yours Sincerely,

.....

Chinenye Constance Elekwa

**DECLARATION BY THE PRINCIPAL**

I ....., the principal of .....  
grant permission to MS Elekwa Chinenye Constance to conduct her study in the  
abovementioned school.

**SIGNATURE OF THE PRINCIPAL**

---

**DATE**

---

**APPENDIX 4**  
**LETTER TO THE LIFE SCIENCES EDUCATORS OF SCHOOLS IN GERT**  
**SIBANDE DISTRICT**

School of Teacher Education  
Department of Science and Technology Education  
College of Education  
University of South Africa  
14 March 2016

Dear Life Sciences Educator,

**RE: REQUEST FOR YOUR CONSENT TO PARTICIPATE IN MY STUDY**

My name is Chinenye Constance Elekwa, a Master's student at the abovementioned institution. I am currently conducting a research on the Integration of Indigenous Knowledge (IK) in the Life Sciences classroom in the Gert Sibande District. The research is towards the completion of my Master's degree in Science Education. The purpose of the study is to explore the teachers' understanding of the integration of indigenous knowledge in science education and to investigate how they reconcile indigenous knowledge effectively in their teaching of Life Sciences in the classroom. I have purposefully identified you as a possible participant because of your valuable experience and expertise related to my research topic. The benefits of this study are to raise awareness on how indigenous knowledge is integrated into science classrooms and to identify the problems experienced by teachers in integrating indigenous knowledge. The study will be of value as it will attempt to provide findings

and recommendations that will make valuable contributions to the improvement of science teachings in classroom.

I hereby ask for your consent to participate in my study. The study will be guided by the following questions:

1. How is indigenous knowledge presented in the Life Sciences CAPS document?
2. What issues do educators encounter in the implementation of indigenous knowledge topics into Life Sciences curriculum?
3. How do educators conceptualise the role of indigenous knowledge in the amended CAPS document?
4. What are views of learners on the role of integrating indigenous knowledge in the Life Sciences classroom?

In this study, I would like to observe you teach and also interview you after you have taught all the work that you will plan from the CAPS document, to learn how you teach about indigenous knowledge topics that are included in the curriculum. Also, I would like to read your planned work and your personal evaluations after teaching your lessons on the topics. The interview, to be conducted at the very end of your teaching will take about 35 minutes.

You are guaranteed that all information gathered during the research will be solely used for the purpose of this study and will be treated with great confidentiality. Furthermore, if you wish to withdraw from the research project at any given time, you have the option to do so without any penalty. The research will not cause any risk. Inconvenience due to time may cause discomfort but no harm or risk is anticipated. Appropriate measures will be taken to mitigate any negative consequences in a responsible manner. Also, every effort will be made not to disrupt the daily functioning

of the school. Confidentiality and anonymity of schools and participants will be maintained at all levels of this research project. Feedback procedure will entail sending you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points. After the completion of the study, a summary of the research findings will be made available to you on request, please contact Ms Elekwa on 0796116561.

If you need further information regarding the research, please do not hesitate to contact either myself or my supervisor Prof N Nkopodi. Herewith are our contact details: Ms Elekwa: 0796116561, [conie4chi@gmail.com](mailto:conie4chi@gmail.com); Prof N Nkopodi: +27124294731, [nkopon@unisa.ac.za](mailto:nkopon@unisa.ac.za).

Please fill in and sign the attached declaration letter indicating your willingness to participate in the research.

Thanking you in advance for your cooperation.

Yours Sincerely,

.....

Chinenye Constance Elekwa

**DECLARATION BY THE LIFE SCIENCES EDUCATOR**

I ..... a Life Sciences educator at ..... confirm my willingness to participate in this research. I understand that this research will not be harmful in any way, that I can withdraw from the study at any time should I desire, that I will remain anonymous and that the information that will be gathered will only be for the purpose of this study. I agree to the digital recordings of the interview.

**PARTICIPANT'S NAME & SURNAME** \_\_\_\_\_

\_\_\_\_\_  
**PARTICIPANT'S SIGNATURE** **DATE**

**RESEARCHER'S NAME & SURNAME** \_\_\_\_\_

\_\_\_\_\_  
**RESEARCHER'S SIGNATURE** **DATE**



**APPENDIX 5**  
**LETTER TO THE PARENTS FOR MINORS TO PARTICIPATE IN A RESEARCH  
PROJECT**

School of Teacher Education

Department of Science and Technology Education

College of Education

University of South Africa

14 March 2016

Dear Parent,

**RE: REQUEST FOR PARENTAL CONSENT FOR MINORS TO PARTICIPATE IN  
MY STUDY**

Your child is invited to participate in a study entitled “Exploring the integration of Indigenous Knowledge in the Life Sciences classroom: A case study of three Senior Secondary Schools in the Gert Sibande District in Mpumalanga Province of South Africa. I am undertaking this study as part of my Master’s research at the University of South Africa. The purpose of the study is to explore the teachers’ understanding of the integration of indigenous knowledge in science education and to investigate how they reconcile indigenous knowledge effectively in their teaching of Life Sciences in the classroom. I am requesting permission to include your child in this study because he/she is one of the science learners in the school. I expect to have 17 other children participating in the study.

If you allow your child to participate, I shall request him/her to take part in an interview. You are assured that there will be no negative consequences to your child by participating in the research project. Also, all information gathered during the research will be solely used for the purpose of this study and will be treated with great confidentiality. You will also have an opportunity to review any papers from this research project before they are submitted for publication. Furthermore, your child's participation in this study is voluntary. Your child may withdraw from the research project at any given time, without any penalty. The study will take place during regular classroom activities with the prior approval of the school and your child's teacher.

In addition to your permission, your child must agree to participate in the study and you and your child will also be requested to sign the assent form which accompanies this letter. If your child does not wish to participate in the study, he/she will be excluded with no penalty.

If you need further information regarding the research, please do not hesitate to contact either myself or my supervisor Prof N Nkopodi. Herewith are our contact details: Ms Elekwa: 0796116561, [conie4chi@gmail.com](mailto:conie4chi@gmail.com); Prof N Nkopodi: +27124294731, [nkopon@unisa.ac.za](mailto:nkopon@unisa.ac.za). Permission for the study has already been given by the Research Ethics Committee of the College of Education, UNISA.

You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him/her to participate in the research project. You may keep a copy of this letter.

Name of child:

Sincerely

---

Parent/guardian's name                      Parent/guardian's signature:                      Date:

---

Researcher's name                      Researcher's signature:                      Date:

**APPENDIX 6**  
**A LETTER REQUESTING ASSENT FROM LEARNERS IN A SECONDARY  
SCHOOL TO PARTICIPATE IN A RESEARCH PROJECT**

School of Teacher Education

Department of Science and Technology Education

College of Education

University of South Africa

14 March 2016

Title of study: Exploring the integration of Indigenous Knowledge in the Life Sciences classroom: A case study of three Senior Secondary Schools in the Gert Sibande District in Mpumalanga Province of South Africa.

Dear Learner,

I am doing a study on Indigenous Knowledge as part of my studies at the University of South Africa. Your principal has given me permission to do this study in your school. I would like to invite you to be a very special part of my study. I am doing this study so that I can find ways that your teachers can use to make science teachings better and interesting. This will help you and many other learners of your age in your different schools.

This letter is to explain to you what I would like you to do. You may ask me or any other adult to explain some words you do not understand in this letter. You may take

a copy of this letter home to think about my invitation and to discuss participation with your parents/guardian before signing the form.

I would like to interview you about your understanding of Indigenous Knowledge, the views you hold about indigenous knowledge and what indigenous knowledge you feel is important for you to learn in a Life Sciences class. Answering the questions will take about 15 minutes.

I will not use your name to write a report on the study or say anything that will let other people know who you are. You are not compelled to participate in the study. If you wish to withdraw from the research project at any given time, you have the option to do so. No one will criticise you if you do not wish to answer any of my questions. When I am finished with my study, I shall return to your school to give a short talk about some of the helpful and interesting findings in my study.

If you decide to be part of my study, please sign the written assent form below indicating your willingness to participate in the research. If you have any further questions about this study, you can talk to me or you can have your parent /guardian call me at: 0796116561. Do not sign the written assent form until you have all your questions answered and understand what I would like you to do.

## WRITTEN ASSENT

I have read this letter which asks me to be part of a study at my school. I have understood the information about my study and I know what I will be asked to do. I am willing to participate in the study.

---

Learner's name

Learner's signature

Date

---

Witness's name

Witness's signature

Date

---

Parent/guardian's name

Parent/guardian's signature

Date

---

Researcher's name

Researcher's signature

Date

**APPENDIX 7**  
**INTERVIEW SCHEDULE**

This interview aims to examine the understanding of integration of indigenous knowledge in Life Sciences and the extent to which indigenous knowledge is integrated by educators in the Life Sciences classrooms. Please you are requested to answer all questions and give your genuine opinion in each question. The information provided will be treated confidentially and you are assured of anonymity. Please note that there is no right or wrong answer. However, it is expected that your responses are honest.

Although qualitative research questions may not be predetermined, the semi-structured interview will be guided by the following key questions:

**SECTION A: BIOGRAPHICAL DETAILS**

- i. Gender.....
- ii. Race.....
- iii. Type of school teaching at.....  
E.g. former Model C, Township School, Independent School
- iv. Teaching qualification/s.....
- v. Years of experience as a Life Science educator.....
- vi. Did you have any training in the amended Life Sciences CAPS document for Grade 10-12?

Yes	No
-----	----

If yes, how long was the training?

Weeks	Months	Years

## **SECTION B: INTERVIEW QUESTIONS FOR TEACHERS**

1. What is your understanding of the Specific Aim 3 in the amended CAPS document for Life Sciences?
2. What is your definition of Indigenous Knowledge?
3. What views do you hold about indigenous knowledge?
4. Does indigenous knowledge system mean anything to you? If yes, please elaborate.
5. What aspects of this indigenous knowledge do you feel can be taught in a Life Sciences FET (Grades 10-12)?
6. What is your understanding of the integration of indigenous knowledge in Life Sciences?
7. What is/are the importance of integrating indigenous knowledge in the teaching of Life Sciences?
8. What do you intend to achieve when you incorporate indigenous knowledge into Life Sciences teaching?



9. Do you integrate indigenous knowledge in the teaching of Life Sciences? If so, how?
10. How do you think learners coped with content related to indigenous knowledge?
11. How do you respect the various cultural backgrounds of your learners, and the indigenous knowledge they bring to the classroom?
12. What informs the way you integrate indigenous knowledge in your Life Sciences classroom? Explain
13. In what ways are Life Sciences Textbooks and Teacher's Guides assisting you in integrating indigenous knowledge in your teaching?
14. How helpful to learners is the content related to indigenous knowledge?
15. What are the challenges you face when planning for teaching the topics related to indigenous knowledge?

**THANK YOU FOR YOUR SUPPORT**

## **SECTION C: INTERVIEW QUESTIONS FOR LEARNERS**

1. What do you understand by Indigenous Knowledge?
2. What do you think about indigenous knowledge?
3. Does indigenous knowledge system mean anything to you? If yes, please elaborate.
4. Do you think there is need to include indigenous knowledge in school science lessons? If yes, explain the reasons.
5. What indigenous knowledge do you feel is important for you to learn in a Life Sciences class?
6. Why do you think it is important?
7. Does your teacher integrate indigenous knowledge during Life Sciences lessons? If yes, explain how.
8. How helpful were the integration of indigenous knowledge in understanding science concepts?

**THANK YOU FOR YOUR SUPPORT**

**APPENDIX 8**  
**LESSON OBSERVATION SCHEDULE**

Name of the school:	District:	Date of visit:	
Subject:	Educator:	Specific Aim:	
Grade:	Lesson topic:	Duration of lesson:	
Lesson Objectives:			
Lesson Development:			
Aspects of Indigenous Knowledge (IK) to be integrated:			
Description of how IK will be integrated:			
Educator's Activities:		Learners' Activities:	
Lesson Analysis (Mark with <b>X</b> )			
Did the educator manage to identify the IK that relates to the topic?	Yes	Not at all	Not clear
Did the learners identify themselves with the IK?	Yes	Not at all	Not clear/ Could not tell
The integration of IK resulted in	Total confusion as the lesson progresses	Made learners understand the concepts better	There was no effect

Learners considered the aspects of IK as	Another type of knowledge	Primitive knowledge of the past	They were sceptical of the IK
General comments about attempt of integrating IK in the lesson:			

**APPENDIX 9**  
**EDUCATORS' UNDERSTANDING OF SPECIFIC AIM 3 OF THE CURRICULUM**  
**AND ASSESSMENT POLICY STATEMENT (CAPS) FOR LIFE SCIENCES**

**Table 5: Educators' understanding of specific aim 3**

<b>What is your understanding of the specific aim 3 in the amended CAPS document for Life Sciences?</b>	<b>Responses</b>
Educator 1	Learners learn and relate to real life experiences
Educator 2	It shows the interrelationship of science, indigenous knowledge, environment and society. Incorporate indigenous knowledge in teaching
Educator 3	There is connection among Life Science, environment, society and technology
Educator 4	.....
Educator 5	Reveals the history of science and indigenous knowledge of various cultures
Educator 6	Interacts with Life Sciences, environment and society
Educator 7	It acknowledges indigenous knowledge systems in Life Sciences
Educator 8	Relates to science and natural environment
Educator 9	.....
Educator 10	It explains what is happening in the environment and society

Educator 11	It deals with indigenous knowledge and their impact on environment and society
Educator 12	The exploration of scientific knowledge of the past and present cultures
Educator 13	It talks about indigenous knowledge and environment
Educator 14	Science, indigenous knowledge, society, environment and technology are interrelated
Educator 15	Learners need to integrate their daily life into their learning of Life Sciences

**APPENDIX 10**  
**EDUCATORS' UNDERSTANDING OF INDIGENOUS KNOWLEDGE IN THE LIFE**  
**SCIENCES CURRICULUM**

**Table 6: Educators' understandings of indigenous knowledge**

<b>Does indigenous knowledge system mean anything to you? If yes, please elaborate:</b>	<b>Yes√</b>	<b>Elaborate</b>
Educator 1	√	Knowledge of our forefathers about certain practices which are not found in the textbooks but are peculiar to particular cultures
Educator 2	√	I think it is the knowledge gained from one's culture as you grow up. For example, traditional herbal knowledge
Educator 3	√	I recognise indigenous knowledge as a body of knowledge which we make sense of and attach meaning to the world we live
Educator 4	N/A	N/A
Educator 5	√	A body of knowledge generated by members in a particular community to explain natural events around them
Educator 6	√	The knowledge gained from one's culture without going to school.
Educator 7	√	It is the knowledge I gained from my cultural practices and traditions

Educator 8	√	Knowledge passed from generation to generations relating to cultures. Example, the extraction of chemicals from plants. It is a local knowledge
Educator 9	N/A	N/A
Educator 10	√	It is the traditions practised in different communities in our country. The knowledge of a group of people that reflects on how they explain natural events around them
Educator 11	√	This remains the wisdom of people who have lived a long time ago. A primitive way of interpreting the natural events
Educator 12	√	It is traditional practices used by traditional healers in the communities. For example traditional circumcisions
Educator 13	√	Knowledge gained from one's culture and traditions. The people of the past used it to meet their everyday needs such as food, protection and health.
Educator 14	√	Local knowledge and traditional belief system of older people about certain practices that are peculiar to particular cultures
Educator 15	√	I think it is the culture of people passed from one generation to another. It is the ancient knowledge of the people over a long time



**APPENDIX 11**

**EDUCATORS' IDEAS OF INTEGRATION OF INDIGENOUS KNOWLEDGE IN THE  
LIFE SCIENCES**

**Table 7: Educators' understandings of integration of indigenous knowledge in Life Sciences**

<b>What is your understanding of the integration of indigenous knowledge in Life Sciences?</b>	<b>Responses</b>
Educator 1	It is seen as comparing the effect of different beliefs and values of indigenous knowledge
Educator 2	Indigenous knowledge adds to the western science we teach to learners
Educator 3	Identifies the richness of indigenous knowledge. To value people's knowledge
Educator 4	-----
Educator 5	Integration of indigenous knowledge contributes to transforming learners and instilling pride in them
Educator 6	I think it encourages us not to neglect our beliefs or look down upon our beliefs as Africans as we are given the chance to teach Life Sciences as a subject and to look at our own beliefs and try to compare the two.

Educator 7	To compare Life Science and our own different cultures and beliefs.
Educator 8	To integrate cultural knowledge and practices of people in the teaching of Life Sciences
Educator 9	-----
Educator 10	Indigenous knowledge is used to understand, strengthen and clarify western science
Educator 11	I see our cultural knowledge from scientific viewpoint. It makes me to understand the nature of science
Educator 12	Connecting science with our traditional practices during teaching. For example, herbs and their medicinal use
Educator 13	Indigenous knowledge supposed to have a place in the education system
Educator 14	It is all about adding traditional practices to our school curriculum which are not found in the textbooks
Educator 15	Connecting cultural practices to scientific knowledge

## APPENDIX 12

### EDUCATORS' EXPLANATIONS ON HOW THEY INTEGRATE INDIGENOUS KNOWLEDGE IN THEIR TEACHINGS

**Table 8: How the educators integrate indigenous knowledge into Life Sciences lessons**

Do you integrate indigenous knowledge in the teaching of Life Sciences? If yes, how?	Yes√	how?
Educator 1	√	I start my lesson by explaining indigenous knowledge and afterwards taught about scientific knowledge.
Educator 2	√	Since I am Zulu, during the Life Sciences teaching, I teach those things that learners are conversant with particularly the ones who grew up in rural areas
Educator 3	√	During lessons, I use indigenous knowledge to raise learners' awareness of the existence of diverse views of multicultural society that are based on scientific knowledge.
Educator 4	N/A	-----
Educator 5	√	When I plan my lesson, I do include most of the things we share as communities such as folktales, storytelling. We talk about local plants used by the traditional healers and the natural environment.

Educator 6	√	Firstly, I will engage learners in class discussion to discuss indigenous knowledge and then I will introduce scientific ideas for learners to see the interaction of the two.
Educator 7	√	Since I have learners from diverse background, I usually use group discussion where every learner participates in the learning process.
Educator 8	√	During lessons on indigenous knowledge, I do ask learners to explore the topic since indigenous knowledge is about social practices that has been existing for the past thousands years ago. Learners are given the opportunity to discuss and research about indigenous knowledge.
Educator 9	N/A	-----
Educator 10	√	Teaching about cure for illnesses, learners were asked to find out and research about traditional medicines and various plants used by the communities before western medicines came into existence. Thus, they needed help from older people who knew and had experience in that area.
Educator 11	√	During lessons, I start from what learners know to the unknown. This will make my lesson flow easily and learners will understand the concept better.
Educator 12	√	Since the curriculum allows for indigenous knowledge to be integrated into certain topics, I make

		sure that there is interaction between the indigenous knowledge and science knowledge during my teaching. For example, we compare the two forms of knowledge and look at the advantages and disadvantages.
Educator 13	√	It gives learners from diverse background the opportunity to share their knowledge during lessons. For example, when we talk about traditional medicines, we talk about the trees and plants used by the traditional healers.
Educator 14	√	I tried to use indigenous knowledge to build on the scientific concept. Sometimes, I use indigenous knowledge as a foundation for the Life Sciences lesson.
Educator 15	√	We are suppose to add those local knowledge of communities to our curriculum that are not in the textbooks, but are peculiar to certain cultures. Learners do not only accept information through the textbooks, teaching from others, they also express what they know by given a chance to contribute.

**APPENDIX 13**

**EDUCATORS' EVALUATION OF INTEGRATING INDIGENOUS KNOWLEDGE  
SYSTEM INTO CURRICULUM**

**Table 9: How the educators expressed both positive and negative perceptions on the role of integrating indigenous knowledge in the Life Sciences curriculum in regards to learners' benefits.**

<b>How helpful to learners is the content related to indigenous knowledge?</b>	<b>Responses</b>
Educator 1	It will be very helpful for learners to know something about indigenous knowledge to be able to understand science concepts better
Educator 2	Indigenous knowledge is perceived as taboos and spiritual in some community and so it must be discouraged. School science is a well-organised knowledge. For example, misconceptions around various traditional practices by the Sangomas and Inyangas (traditional healers) in our country.
Educator 3	Teaching indigenous knowledge will encourage learners to be proud of their own belief. For example, the use of medicinal plants in cure for illnesses.
Educator 4	-----
Educator 5	I would say that all cultural or traditional ideas in science are not good. So, because of beliefs they are not good for this

	generation. Western science is the useful knowledge for this generation
Educator 6	Learners will develop love and positive attitude towards Life Sciences as a subject as they learn different social practices occurring in their communities.
Educator 7	The richness of indigenous knowledge could contribute in transforming learners and instilling pride in them. Also, the particular social and cultural identity of learners will be acknowledged.
Educator 8	Indigenous knowledge will benefit learners and make them develop more interest to learn more so as to improve their daily lives. Learners will have holistic knowledge not detached from their daily lives
Educator 9	-----
Educator 10	It facilitates the explanations of the natural phenomenon. In some cases, indigenous knowledge serves as a foundation for science concepts.
Educator 11	I think it will good and nice to teach indigenous knowledge to learners because learners would be able to appreciate what the local people do. Learners will not forget their cultural roots.
Educator 12	It will not benefit learners rather it will confuse them on understanding science concepts as they have to struggle between two forms of knowledge systems.
Educator 13	It could lead to improvement in learners' performances and promote learners' participation in class during lessons.

Educator 14	I consider it as not true representation of science knowledge. It might mislead learners. For example, the use of herbal medicines for traditional healing which most of the times do not work. So, science remains the valued knowledge.
Educator 15	Indigenous knowledge can be used for the well-being of learners as the case may be and the society at large.



**APPENDIX 14**

**CHALLENGES FACED BY EDUCATORS DURING THE IMPLEMENTATION OF  
INDIGENOUS KNOWLEDGE TOPICS IN THE LIFE SCIENCES CURRICULUM**

**Table 10: Educators’ challenges in teaching topics related to indigenous knowledge**

<b>What are the challenges you face when planning and teaching the topics related to indigenous knowledge?</b>	<b>Responses</b>
Educator 1	There are no adequate local resources to be used while teaching indigenous knowledge.
Educator 2	The policy planners have failed to give us the support needed to implement the amended curriculum.
Educator 3	Little guidance on what and how the indigenous knowledge could be integrated in science lessons.
Educator 4	-----
Educator 5	There is no appropriate design of activities that covers diverse cultural groups in our country. Also, Lack of teaching materials related to indigenous knowledge is a big challenge for educators.
Educator 6	I struggle with using appropriate local language to explain science concepts for better understanding.

Educator 7	If my learners failed to understand, I usually use Zulu language to explain better and also to improve learners' participation during lessons.
Educator 8	Adequate trainings have not been given to us by the Department of Basic Education on how to integrate indigenous knowledge appropriately during lessons.
Educator 9	-----
Educator 10	I tried to integrate indigenous knowledge during lessons because the policy document informed us to do so, but it is a challenge for me as indigenous knowledge is against my ethnic belief.
Educator 11	There is little support from the department to organise workshops and train educators on how best to implement the amended curriculum especially on the issue concerning indigenous knowledge systems.
Educator 12	Many at times I find it so difficult to come up with appropriate expressions in our local language to explain scientific concepts.
Educator 13	Indigenous knowledge has no place in the teaching of Life Sciences. It is only important at home.
Educator 14	Lack of information on how to plan lessons related to indigenous knowledge topics. We were given a very little support and a once-off workshops on how to implement the curriculum.
Educator 15	It is very difficult for me to include indigenous knowledge in the teaching of science because it is an old knowledge taught to learners by the elders full of myths and legends. So, I teach only modern science to learners.

**APPENDIX 15**  
**LESSON OBSERVATION RESULTS**

**What the educators do when they integrate indigenous knowledge in the Life Sciences teaching**

The observed lessons were conducted with educators that showed confidence and readiness in integrating indigenous knowledge in Life Sciences. The educators were observed once in their teaching on topics related to indigenous knowledge systems. The lesson observation schedule comprises of the educator’s activities, learners’ activities and lesson analysis which intends to identify how the indigenous knowledge is represented in the lesson. In this section, the observed lessons will be presented to provide evidence on how educators integrated indigenous knowledge in their teaching. Reflective observations by the researcher are also included in a more detailed analysis in Chapter 5.

**Table 11: Representation of indigenous knowledge in Educator 1 lesson observation**

Subject: Life Sciences	Date: 27/10/2016	Educator: 1
Grade: 10	Topic: Plant and Animal Tissues	Specific aim: 3
Lesson Objectives: Learners to be able to identify and understand the use of different medicinal indigenous plants in South Africa.		
Lesson Development: Know if learners are aware of indigenous plants in their communities.		

Aspects of Indigenous Knowledge (IK) to be integrated: Traditional technology, e.g. traditional medicines and healers.			
Description of how IK will be integrated: To use indigenous knowledge to build on the scientific concept.			
Educator's Activities: Ask the learners about different indigenous plants found in their locality and their uses. Explains the use of indigenous plants in boosting the immune system. Gives the learners a homework to do research on how indigenous plants could be used in their local communities.			
Learners' Activities: learners use their traditional knowledge to clarify further on the use of indigenous plants.			
Lesson Analysis (Mark with <b>X</b> )			
Did the educator manage to identify the IK that relates to the topic?	Yes <b>X</b>	Not at all	Not clear
Did the learners identify themselves with the IK?	Yes <b>X</b>	Not at all	Not clear/ Could not tell
The integration of IK resulted in	Total confusion as the lesson progresses	Made learners understand the concepts better <b>X</b>	There was no effect
Learners considered the aspects of IK as	Another type of knowledge <b>X</b>	Primitive knowledge of the past	They were sceptical of the IK

General comments about attempt of integrating IK in the lesson: The educator managed to identify the indigenous knowledge to blend with Life Sciences topic.

**APPENDIX 16**

**LEARNERS' UNDERSTANDING OF INTEGRATION OF INDIGENOUS  
KNOWLEDGE IN THE LIFE SCIENCES CURRICULUM**

**Table 12: Learners' understandings of indigenous knowledge.**

<b>Does indigenous knowledge system mean anything to you? If yes, please elaborate:</b>	<b>Yes√</b>	<b>Elaborate</b>
Learner 1	√	Indigenous knowledge is the local knowledge of past generation in our country.
Learner 2	√	Indigenous knowledge is local things people locally use in their villages or homes....it cannot be connected to science.
Learner 3	√	Heard about indigenous knowledge but have no interest because they are irrelevant.
Learner 4	√	I have very little idea about indigenous knowledge because it is an ancient knowledge of our ancestors
Learner 5	√	It is knowledge on how to survive and live in a particular environment. This knowledge can prepare and equip learners for life after school in using that knowledge.
Learner 6	√	Knowledge of people living as communities that help them in their daily lives for survival. For example, local plants are used to brew medicines

Learner 7	N/A	-----
Learner 8	√	I can say it talks about the diverse cultures and traditions of the people. Those things learners learn at home.
Learner 9	√	Indigenous knowledge is the cultural activities and daily practices of people.
Learner 10	√	I am not interested in traditional ways of knowing. It is for our forefathers and not for us.
Learner 11	√	Indigenous knowledge is a barbaric kind of knowledge that is not useful to this modern generation
Learner 12	√	I can see it as a non-science and a primitive way of doing things in the past.
Learner 13	√	It is the knowledge of our forefathers. For example, the use of herbs to cure diseases.
Learner 14	N/A	-----
Learner 15	√	Knowledge used by traditional healers. For example, the Sangomas prepared their medicines from local plants.
Learner 16	√	It is the traditions of the people that are familiar to them in their own community and environment
Learner 17	√	Indigenous knowledge is all those taboos and abominable practices in the community.
Learner 18	N/A	-----

## APPENDIX 17

### LEARNERS' EVALUATION OF INTEGRATING INDIGENOUS KNOWLEDGE SYSTEM INTO CURRICULUM

**Table 13: Learners' attitudes towards the integration of indigenous knowledge into Life Sciences curriculum with respect to learners' benefits.**

<b>How helpful is the integration of indigenous knowledge in the Life Science classroom?</b>	<b>Responses</b>
Learner 1	Indigenous knowledge is the local knowledge, the cultural activities and the daily practices of people, so it gives us the opportunity to express ourselves on what we know about indigenous knowledge during lessons
Learner 2	I cannot see any positive role as I find it hard to connect local knowledge to science. They are local things people use in their villages or homes. It cannot help me in science learning.
Learner 3	I have no interest because they are irrelevant and I have not seen teachers asking indigenous knowledge questions during examinations.
Learner 4	Our teachers do not teach us the science from the indigenous knowledge. It makes the lesson to be boring and irrelevant.



Learner 5	This knowledge can prepare and equip learners for life after school in using that knowledge. So, we are happy and appreciate our teachers whenever they teach us indigenous knowledge.
Learner 6	I enjoy lessons on indigenous knowledge because I feel free to participate and share information on my cultural practices during lessons. For example, learning how the local plants could be used to brew medicines
Learner 7	-----
Learner 8	Learning indigenous knowledge will make me to appreciate my culture and also it will help me to preserve my heritage and talk about it. Also, it will encourage us Africans not to look down upon our culture.
Learner 9	Though, we learn few of the indigenous knowledge in the class and it helps us to understand science and improve in our performances in learning science.
Learner 10	Indigenous knowledge is for our forefathers and not for us. So, I do not see the reason why it should be asked as questions during examinations because the contents are irrelevant to us.
Learner 11	Indigenous knowledge is outdated kind of knowledge that is not useful to this modern generation. It will rather confuse us to understand science.
Learner 12	I can see it as a non-science and irrelevant to teach. Our teachers are teaching the contents that will help us to pass during examinations.
Learner 13	Indigenous knowledge helped me to understand scientific concepts better. I now enjoy asking questions especially from my

	community elders on indigenous knowledge which has enhanced my science learning. For example, the use of herbs to cure diseases.
Learner 14	-----
Learner 15	I am happy and thankful to my teachers because they use our local language and local materials from the environment to teach us in the class. It makes the lessons more interesting and gives me a sense of belonging.
Learner 16	It is like an eye-opener for me, as it made me to rethink positively on the ways I relate to the world in preserving my cultural heritage and promoting cultural diversity.
Learner 17	Indigenous knowledge is all those taboos and abominable practices in the community. Learning them in school will rather confuse us more.
Learner 18	-----