AN INTEGRATION OF INDIGENOUS KNOWLEDGE SYSTEMS INTO THE MAIN STREAM SENIOR PHASE NATURAL SCIENCE CURRICULUM AT UTHUNGULU DISTRICT SCHOOLS

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THE INTEGRATION OF INDIGENOUS KNOWLEDGE SYSTEMS INTO THE MAIN STREAM NATURAL SCIENCES CURRICULUM AT UTHUNGULU DISTRICT SCHOOLS

BY

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DEDICATION

This dissertation is dedicated to my lovely wife Nkosingiphile (uMaMchunu) and to my one and only son Nhlanzeko Mkhwanazi for their unwavering support and endured my timely absence from home. A special dedication is also extended to my mother, brothers and sisters who instil the love of the school to me.

DECLARATION

I, Mhlonipheni Evens Mkhwanazi hereby declare that the research involved in my thesis submitted in partial fulfilment of the Doctoral Degree in Education entitled: "the integration of indigenous knowledge systems into the main stream curriculum of Empengeni Schools" presents my own original work. The sources used and quoted have been indicated and acknowledged by means of complete references.

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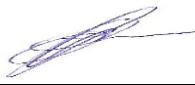
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ABSTRACT

There has recently been a renewed interest emanating from the Department of Basic Education in the inclusion of indigenous knowledge in the mainstream science curriculum. The aims and principles of the new curriculum statement seek to realign themselves with those of the Constitution of the Republic, which highlight inclusivity, valuing indigenous knowledge and the environment, and social justice for all. In an attempt to address some of the glaring fundamental oversights in the curriculum statement. To this end, the Department of Basic Education has identified indigenous knowledge that can be integrated into the science curriculum and be taught at school. The challenge that baffles many interested and affected parties in education is the absence of clear guidelines as to what aspect of IK can be integrated into the science classroom, as there was never any curriculum training for teachers in this regard.

This study was conducted within the community of Emacekane in the province of KwaZulu-Natal, South Africa, to explore the feasibility of integrating indigenous knowledge within the science curriculum. The following objectives were established to answer the research questions. The first was to determine whether or not IK can be integrated within the science subjects as taught in Empangeni schools. The second was to explore whether or not effective partnerships exist between schools and the surrounding indigenous communities in the development and authentication of IK for the purposes of integration within the school curriculum. The third was to examine the contribution of socio-cultural practices towards the preservation of indigenous knowledge. The results of this study reveal that the Department of Basic Education should invest more resources and underscore the importance of extending thinking about IK-science integration beyond aspects that suit science content, to considering more fruitful and comprehensive methods of teaching and learning science, as well as their relevance to community needs.

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ACRONYMS

CAPS   Curriculum and Assessment Policy Statement

DBE   Department of Basic Education

DVD   Digital Video Disc

FET   Further Education and training

HIV/AIDS: Human Immunodefiency Virus/Acquired Immune Deficiency Syndrome

IFAD   International Fund for Agricultural Development

IK   Indigenous Knowledge

IKS   Indigenous Knowledge System

IT   Indigenous technology

IWTC   International Water technology Conference

KZN   KwaZulu-Natal

NCS   National Curriculum Statement

NS   Natural Sciences

OBE   Outcomes Based Education

PCK   Pedagogical content Knowledge

SAQA   South Africa Qualification Authority

SPSS   Statistical Package for Social Science

STD   Sexually transmitted Diseases

UN   United Nations

UNESCO   United Nations Educational, Scientific and cultural Organisation

CHAPTER 1

INTRODUCING THIS STUDY

1.1 Background of the study

The limited integration of Indigenous Knowledge systems (IKS) in the National Curriculum Statement (NCS) and the current paradigm shift towards promoting education for sustainable development in the school curriculum is of paramount importance. It is argued that solutions to problems that plague South Africa can be understood by investing resources in local capacities such as indigenous knowledge systems. This is only possible if indigenous knowledge is integrated into the formal education system to better con+front major deficiencies that have crippled indigenous knowledge systems in South Africa. According to Owuor (2008), this strategy requires the adoption of an indigenous approach to education that involves the contextualisation of the school curriculum by integrating indigenous knowledge with other relevant knowledge systems into the formal school curriculum.

In recent years, the glimmer of hope arising from the limited integration of indigenous knowledge is an instrumental approach in harmonising different forms of knowledge systems (Maluleke, Wilkinson & Gumbo, 2006). Knowledge such as the one provided by IK is likely to create a social fabric for societies that can engender sustainable livelihood. These knowledge systems should, therefore, be created within relevant subject outcomes in South Africa for indigenous knowledge and Western knowledge to complement each other. The synergy that can exist from these two extreme knowledge systems can be better developed if the NCS is more sensitive to the needs of the local indigenous communities with a view to addressing their immediate problems. Since the 1970s scholars around the world and the United Nations Organisation have turned their attention to exploring how integrating indigenous knowledge and institutions could

contribute more to culturally appropriate development (Dei, 2002; Mwenda, 2003; UNESCO, 2006).

The NCS has linked indigenous knowledge systems nicely with broader goals of social transformation in post-apartheid era in South Africa. In essence, indigenous knowledge has always been synonymous with most traditional communities in South Africa, making it easier for our schools to identify content and context that can solve problems. This inclusion of IK into the main stream curriculum is likely to strengthen our societal values, and build more confidence in traditional communities to start believing that their knowledge is not primitive, as most Western knowledge suggests.

As part of an evolving world, human beings have been interacting with their environment using traditional knowledge both positively and negatively. It is a reality that economic development is important to relieve widespread poverty in the developing world (IWTC, 1994). There is no doubt that sustainable development is fundamental to conserving biodiversity and improving human well-being. In essence, sustainable development will not be feasible if the indigenous roles of people that manage it are not recognised in the policies of their communities in pursuing it. Their needs, roles and indigenous knowledge should be integrated into agro-ecological decision-making.

The challenge facing education in South Africa is the ability to define strength of existence, which is embedded in culture, language and identity. Furthermore, what is missing from analysis of the integration of indigenous knowledge systems in South Africa is an understanding of how science teachers, learners and communities address these subject aims to effectively make science education easier. The purpose of the study is to investigate whether the National Curriculum Statement (NCS) and Curriculum Assessment Policy Statement (CAPS) embrace the integration of IK. Are science teachers in particular willing to promote learners' IK in their teaching and learning process? Does the science curriculum in its present form allow teachers to explore whether alternative IK solutions can be integrated into the study of science? The role of local communities in education needs to be closely investigated to establish whether it is still relevant to the

education process taking place in our schools. Is there any relationship that can be forged with schools to establish real partnerships that will reinforce common values amongst learners and sharing of information to streamline IK?

1.2 Motivation of the study

This research is motivated by the fact that IK has been long overshadowed and underrated in South Africa. This emanated from the absence of coherent curriculum content within the mainstream curriculum which indirectly indicates a lack of political will. Therefore, a study of this nature is necessary to provide knowledge of the possible factors responsible for the absence of indigenous knowledge systems in the NCS. The conclusions drawn from the analysis will, it is hoped, enable the researcher to make a valuable contribution to the improvement and advancement of teaching methods for teachers that can be employed to better facilitate the inclusion of IK in the NCS. The insights gained from this research might inform the teachers, curriculum developers and implementers in the Department of Basic Education about the importance of IK in the school curriculum.

The debate on whether IK should be integrated within the NCS is located within post-colonialist and anti-discrimination discourse. However, too little is understood about its inclusion within the NCS. IK is argued to be a misnomer that raises more problems than it conceivably solves. The inclusion of IKS in the NCS needs to be accorded its rightful place in the vast array of scientific scholarly tradition.

1.3 Problem statement

In the context of this study, the researcher believes that IKS have always been under threat of disappearing from the activity of many South Africans. It is within this background that after 1994, the government of South Africa struggled to reconstruct the country's formal school curriculum to benefit the majority of its people. The reconstructed curriculum should have taken seriously the role of IK and technology in improving the quality of education in South Africa, and countered the public perception that government is dragging its feet when it comes to making sure that IK is captured and

stored in a systematic way. The focus on educational reforms has been to reflect the diverse indigenous ways of knowing which will ultimately promote social change and empowerment of all South Africans. Reclaiming cultural identities rooted within the authentication of indigenous traditions has been perceived as a way of decolonising a Western-dominated school curriculum. This study seeks to answer the following critical research questions.

1.3.1 Research questions

Thus, more specifically, this study seeks to answer the following research questions:
1. What are the ways in which teachers can integrate IKS within Natural Science and Life Science subjects as taught in Empangeni schools?
2. How is the partnership between schools and the surrounding indigenous communities in the development of integration within the school curriculum?
3. What is the role of socio–cultural practices in the preservation of IK?

1.3.2 Aims of the study

The fundamental aim of this study is to investigate the possible integration of IKS within the mainstream curriculum framework of Senior Phase. Furthermore, the researcher also seeks to find out whether or not parents see the value of IKS within the sustainable development paradigm.

1.3.3 Objectives of the study

The objectives of the study are:
1. To determine whether or not IKS can be integrated within the science subjects as taught in Empangeni schools.
2. To explore whether or not effective partnerships exist between schools and the surrounding indigenous communities in the development and authentication of IKS for the purposes of integration within the school curriculum.
3. To examine the role of socio-cultural practices in the preservation of IK.

1.4 Significance and the value of the study

The study hopes to revive the spirit of IK that is slowly fading away from the minds of the current generation. This study attempts to highlight the importance of IK to educationists responsible for curriculum design, with a view to their seriously considering the inclusion of IK in South African schools. There is a consistent belief amongst policymakers that integrating IK into formal education can create new respect for the culture of indigenous people (Maluleke, Wilkinson & Gumbo, 2006). The main challenge, though, is to bridge the gap that exists between IK and scientific knowledge systems in order to harmonise curriculum implementation. The NCS acknowledges the importance of IK, but the cascading model used in the implementation of NCS overlooked this significance.

The study intends to identify approaches that could be adopted in the teaching of science subjects using IK in schools. (Maluleke, et al., 2006) argue that the recognition of indigenous technology could help to address the content and context of specific needs of the learners and the community. This conclusion serves to promote awareness about the significance of sustainable development of all cultural traditions and the need for indigenous knowledge to occupy its rightful place in the curriculum arena. In this regard, the curriculum is the perfect platform where all the needs of any society can be highlighted, and social problems expressed in song, dance, poetry and storytelling. The kind of information derived from this study will lead to life-long learning and a better future for young South Africans.

1.5 The contribution of the study to the body of knowledge

This study will not merely produce words on paper but will add value on whether or not integration of IKS within the science subjects benefits students in Empangeni schools. This study will also add value to the body of knowledge provided effective partnerships exist between schools and surrounding indigenous communities in the development and authentication of IKS for the purpose of integration within the school curriculum. The

researcher also hopes that the study will add value to the body of knowledge provided that there is a role for socio-cultural practices in the preservation of IK.

1.6 Delimitation of the study

There exist limitations in this study that need to be taken into consideration when assessing its results. The sample of the study is confined to teachers, parents, members of the community. However, the study excluded teachers and community members outside the study area who could have contributed immensely due to financial constraints. This limitations of the study are in fact due to both the time and financial constrains the researcher has encountered.

1.7 Definition of operational terms

1.7.1 Indigenous knowledge

According to Melchias (2001), IK refers to what indigenous people know and do what they have known and done for generation – practices that evolve have evolved through trial and error, and have proved flexible enough to cope with change. This definition draws the researcher's attention to the colonial racist notion that IK is solely a matter of trial and error, whilst modern knowledge is represents a science of experimentation. The former is presumed to be clogged, concrete, and inaccurate, the latter is painted as intangible, weighty, right and imbued with universal reasoning.

According to the World Bank, IK is local knowledge that is unique to every society or culture (www.worlbank.org). It is grounded in local level decision-making, and reflects elements of agriculture, health care, food preparation, education, natural resource management and many community activities. It furthermore attempts to present strategies to communities to solve issues. It is tacit knowledge and therefore difficult to codify, embedded in community practices, institutions, relationships and rituals. Moreover, IK may enable the development of a community to learn more about indigenous or traditional practices in order to adapt global knowledge to local conditions and integrate

indigenous or traditional knowledge in the development process. IK is based on thousands of years of experience (Mishra, 1992). In the same token, Pawluk and Sandor (1992) consider IK as that knowledge that which develops within a certain culture or ethnic group, and strives to meet substance goals in a particular ecological setting.

1.7.2 Curriculum

According to Stenhouse (1975), the curriculum is an intention, plan or prescription, an idea of what one would like to happen in school, and also the existing state of affairs in schools, what does, in fact, happen. Grundy (1987:6) sees curriculum as a cultural construction, concerned with the experiences people have as a consequence of the curriculum, rather than with its constituent aspects.

1.7.3 Knowledge systems

According to Atte (1992:3), the term *indigenous* implies knowledge that originates in and is exclusive to an area without borrowing from or being influenced by knowledge from outside. The National Research Foundation (2002:1) defines IKS as the "complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area". Therefore, in the context of this study, knowledge systems should be legitimized and fortified under suitable institutional frameworks, culture and practices in the school curriculum. The researcher believes that this happens through the set of interactions between economic, ecological, political and social environments within the community with a strong identity, drawing existence from local resources through patterned behaviour that is transmitted from generation to generations to cope with change. The researcher also believes that these patterns can be sustained as micro level institutional arrangements. That is, a school curriculum must be vested with differentiated responsibilities to ensure that learners learn these indigenous practices for continuous survival.

1.7.4 Integration

According to the *National Encyclopedia* (2002), the word *integration* is defined as "fusion into a whole, or arrangement as a natural part of a whole." In the context of this study, the curriculum should be designed in such a way that the integration should be interdisciplinary, i.e., given a bigger role within science subjects, and cross-disciplinary with other subjects in the curriculum. In Webster's online dictionary the word "to integrate" can mean four things: 1) make into a whole; 2) open (a place) to members of all races and ethnic groups; 3) become one, become integrated; 4) calculate the integral of (in mathematics). In this study the word integration means becoming integrated into a whole in the main school curriculum. In the context of this study the curriculum is an integral core to embrace IKS into different subjects to equip present and future generations of South Africans with IK values.

1.7.5 Culture

According to Boult, Cunnigham and Popenoe (1997), culture is defined as the shared products of a human group or society. These shared values include not only values, language and knowledge but also material objects. The people of any group of society share non-material culture – abstract and intangible human creations such as definitions of right and wrong, some medium of communication, and knowledge about the environment and about ways of doing things. They also share material culture – a body of physical objects that reflect non-material cultural tools such as money, clothing and works of art. Stark (1978:38) coined a definition of culture which has neither been relegated to the background nor improved upon. He referred to culture as that complex whole which includes knowledge, beliefs, art, morals, law, customs and any other capabilities and habits acquired by man as a member of society.

1.8 The structure of the dissertation

Chapter One

Introduction

Chapter One is the general introduction to the study which seeks to unpack the motivation of the study, the statement of the problem, the aims and objectives of the study, and its methodology. It also outlines the purpose of the study, its contribution to knowledge, and the operational definitions of terms.

Chapter Two

Review of Literature and Conceptual Framework

Chapter Two provides a theoretical background to the study. It aims to provide an in-depth review of the literature on the inclusion of IK.

Chapter Three

Research Methodology

Chapter Three gives the details of the research design and the *modus operandi* (methodology) of the study. It also covers the selection of subjects or respondents, the way in which data were collected, how the confounding variables were controlled, the instruments and procedures for the administration of questionnaires, and the analysis and presentation of data.

Chapter Four

Results and Discussions

Chapter Four is concerned with the empirical investigation of the study and how the fieldwork was conducted. It covers the presentation and discussion of results. An inferential statistical approach (SPSS) was be used in order to do prediction, estimation and epitome (summary) of the findings from the sample, and making make generalizations about the population.

Chapter Five

Summary and Recommendations

Chapter Five summarises and concludes the study by drawing attention to some recommendations regarding the inclusion of IK in the school curriculum (NCS). This chapter concludes the entire study, providing a summary of and discussion on the major

findings that critically answered the main research question of this study. This section unravels the major lesson learned, and possible future research that can be undertaken in the area of IK design and implementation in future. The delimitation, acknowledgement and recommendations of this study are discussed briefly in this chapter.

1.9 Conclusion

This introductory chapter outlines some of the key concepts and procedures to be followed during operationalisation of the research inquiry. The background, problem statement, significance and objectives of the study were carefully described. Furthermore, as the South African education system continues the process of revision and renewal, it is the duty of professional curriculum developers and the policy makers to ensure that the content and context of the curriculum (NCS) reflects the need of IK.

CHAPTER 2

PERSPECTIVES OF INDIGENOUS KNOWLEDGE SYSTEMS AND THE THEORETICAL FRAMEWORK OF THE STUDY

2.1 Introduction

The aim of this chapter is to discuss the theoretical perspectives that underpin this study. To this end, an attempt was made to consult relevant literature on IKS at both international and national level in an attempt to identify current opportunities and challenges in previous research. Moreover, this chapter seeks to make comparisons between previous findings and the results of this investigation, thereby addressing issues with a common framework. The first section of this chapter provides a brief overview of IKS and curriculum development. The second section outlines the IKS in historical perspective. The third section reviews IKS and the implication of environmental education on water restoration and other indigenous practices.

2.2 Theoretical Framework

The theoretical framework chosen for this study is constructivism because the learners need to integrate and construct their own IKS and experiences in order to live in the world. The authors of the literature perceive this broad concept of constructivism as learning theory based on the assumption that knowledge is constructed by the learner (Prawat & Floden, 1994:37; Larochelle & Bednaz, 1998:3; Riesbect, 1996:49; Jonassen, Myers & McKillop, 1996:94; Morisson & Collins, 1996:107; Jonassen, 1991b:28). These experts view constructivism as a panacea in the integration of IKS into the main school curriculum since learners construct their own understanding of indigenous practices. Scholars like Jonassen, et al. (1996:95) contend that the knowledge we build depends upon what we already know, which depends on the kinds of experiences that we have, how we have organised those experiences into knowledge structures, and what we believe about those experiences. We construct our understanding of the world through the

interpretation of our experiences in the world. Woolfolk (1995:481) asserts that there is general agreement amongst educationist that a dramatic change in the focus of teaching consists in putting the learners' own efforts at the centre of the educational enterprise can yield positive results in pursuing quality education.

The work of Aldridge (1991:1) posits that for constructivism, knowledge is constructed from the inside, in interaction with the environment, rather than internalising it directly from the outside. In essence, Fleury (1998:157) sees constructivism as a range of ideas about the production of knowledge and its construction by groups and individuals. In the context of this study, learners and teachers will have to construct their own understanding of what IKS is within the framework of the science curriculum.

Brewer and Daane (2003:417) made the similar finding that constructivism as a theory perceives that each child builds knowledge from the inside, through his/her mental activity, in the environment. In this regard, constructivism is perceived as a philosophy of learning that is founded on the premise that we construct our own understanding of the world we live in, through reflection on our experiences. In the context of this study, the curriculum designers should ensure that integration of IKS is given the necessary attention in the curriculum so that the learners can construct the meaning of the world in which they live by using their experiences and indigenous practices.

2.3 Indigenous knowledge and curriculum development in South Africa

A substantial number of aspects related to the nature, patterns and trends of IKS based on its integration in the Curriculum and Assessment Policy Statement (CAPS) will be reviewed in this section. Curriculum design is based upon the central tenets of locality and experiential knowledge which should be used as a means to create a sense of place (Michael & Hunter, 2003). Closely linked to this perspective is the adoption of multicultural scientific textbooks and the integration of indigenous experts as a means of inculcating an understanding of IKS. This is a form of capacity building that science teachers need in order to empower their students to develop a greater awareness of

alternative perspectives, which are necessary within a pluralistic nation. Several opinions became conspicuous for marking shifts in the science curriculum, notably during the 1960s and 1970s, with their emphasis on scientific theories and processes of inquiry, and in the 1980s and early 1990s, when the focus was on science as a human activity and cultural phenomenon (Cobern & Loving, 2001). These curriculum changes explain why current curricula in some African countries have adopted the concept of multiculturalism as a teaching strategy to characterise school science.

Matsika (2012) states that, in developing countries there have been attempts to broaden the scope of science education because of the need to accommodate national and international competing interests. In South Africa, such curriculum changes are driven by the need to include relevant contexts in science teaching and learning in schools. This characterises the shift in curriculum emphasis from direct acquisition of the scientific facts to that which encompasses the cultural aspect of science as human activity (Hodson, 1993). The study conducted by Hassard and Dias (2009) in Zimbabwe shows that science education reforms are a worldwide trend that has been influenced by various international forces which include, among others, constructivist views on learning, national studies of student learning, globalization, and advances in science, technology and information technology. Yes, these knowledges are not mutually exclusive but rather complement one another.

In the pedagogical perspective, there are a number of models which have been proposed to harness the integration of Western and traditional knowledge. In this aspect, Jegede (1995, 1996) came up with 'collateral learning' of both Western and traditional concepts. The argument proposed was that a successful border crossing between home and school science can occur through a process which allows non-Western students to construct Western and traditional meanings of a simple concept that can exist side by side, and do so with minimal, if any, interference. Such knowledge can be stored as a long-term memory for strategic use in either a Western or traditional environment. In the final analysis, Jegede (1995) concluded that science curricula in South Africa should be guided by African imperatives. These imperatives seek to define teachers as 'culture brokers'

who assist students to master repeated 'border crossings' between their own life-world and that of the science classroom. The gap which exists between home and school science is wide for the majority of students, and as such it can pose a challenge for students who wish to learn science in a meaningful manner. According to the DBE (2011:8), our forebears would not have survived if they had not been able to learn about the natural world they depended on. The CAPS document suggests that these forebears had theories about causes and effects, and understood many of the relationships in the environment where they lived. However, these sets of knowledge were each woven into the history and place of people, and known as IKS. In the CAPS document, natural sciences includes IK covering aspects like knowledge of agriculture and food production, medicinal plants, management of biodiversity, food preservation, and management of soil and water.

Cuban (1993) argues that school curriculum reforms have seen little fundamental change in pedagogy in the past hundreds years in spite of a wide range of policy invention. Tschammen–Moran (2001) supports Cuban when he asserts that progress has been painfully slow in changing the structure and culture of schools to support integration. Indigenous people in some parts of the world still earn their living using IKS, which in turn calls for curriculum transformation to develop an inclusive curriculum which will be equipped not only with Western knowledge but also with IKS.

Day (1998) believes that change in education is not necessarily a once-off event: it requires strenuous efforts from time to time to improve the level of skills. He argues that change is a continuous process which involves adaptation to achieve small but significant improvements, rather than a matter of occasional all–out efforts. A curriculum framed according to South Africa's underlying philosophy must be based on people's participation that will give equal opportunities to all, irrespective of race, colour, creed or sex. A curriculum process that will bring about some changes and improvements in the education system is a radical curriculum opposed to rote learning. It is one that is based on critical thinking, independent work and integrated studies, aimed at equipping students to question and reveal the underlying causes of social inequalities (Kallaway, 1997).

It is apparent that in order for IKS to be incorporated into a National Curriculum Statement (NCS), the national policy for knowledge management will need to be embedded in long-range planning and educational policies (Kallaway, 1997). The curriculum designers and policy makers have to determine through careful analysis what sorts of knowledge systems it wants to manage and resolve cultural learning issues. Cultural learning pertains to how people learn, how knowledge learned is transformed to adapt into multiple contexts, how knowledge is best passed on, preserved and presented, and how it evolves in a given environment. In the light of this narrative, it is clear that our young generation of South Africans should be educationally equipped at an early stage in order to become creative thinkers. This will only happen if the curriculum is negotiated in order to ensure that it serves the purpose for which it is intended: that IK and Western scientific knowledge worldviews be given equal status in the curriculum.

Kirk (1989) asserts that the curriculum is the point in which knowledge, interrelationship between teachers and learners, the economy, and political and social structures of society intersect and interact. The above concerns seem to suggest that IK must be given a bigger slice of the curriculum in order for South African learners to live sustainably in their environment. Schubert (1986) perceives the curriculum as content, as programmes for the planned reproduction of knowledge; as experience, as discrete concepts to be mastered, and as an agenda for social reconstruction. This statement brings out critical aspects of IK that must be included in the articulation of the curriculum philosophy for the Department of Education (DoE, 2012).

2.4 The contribution of IK towards the sustainable use of wild food plants

Knowledge of indigenous food plant species, their distribution, seasonal availability and preparation is widely distributed amongst ordinary people in most rural communities. However, the knowledge of wild food plants varies between groups (for example, among tribal groups) within specific communities (for example, between men and women, and between age groups) (Ngwane, 1999). These differences are an indication of cultural

diversity in most African countries. Observation by Mtshali (1994) led him to conclude that the Ndebele tribe, being cattle people, generally have limited knowledge of wild leafy vegetables compared to more sedentary agrarian tribes like the Shona and Tonga. Similarly, women tend to have more knowledge of leafy vegetables compared to men owing to division of chores (women being traditionally the cooks in the home), while men may be more versed in knowledge of indigenous fruit and edible roots. The elderly, who are considered repositories of IK (Mtshali, 1994; Ngwane, 1999), are usually knowledgeable on wild food plants compared to the younger age groups. There is a clear discrepancy in knowledge about food plants between rural and urban communities. People in rural communities are generally more knowledgeable about edible wild food plants throughout all age groups. In urban communities, knowledge of indigenous food plants is usually limited, particularly among those people who have been urban dwellers all their lives and have little link with the rural areas, and among young age groups.

2.5 Social implications of the consumption of wild food plants

The use of wild food plants is generally on the decline. Several factors are contributing to the decline in the knowledge and use of indigenous food plants. They include: lack of intergenerational knowledge transfer within communities. Youth possess little knowledge of wild food plants, particularly in urban environments (Mtshali, 1994, Ngwane, 1999). Oral knowledge systems have been replaced by written knowledge without the corresponding conversion of indigenous oral knowledge to written information. This has resulted in the loss of a wealth of valuable IK on food plants. The current education system in Zimbabwe hardly incorporates aspects of IK. Very little mention is made of indigenous food plants.

Related to this is the fact that students, particularly those in the rural areas, are exposed to two world views: that of the formal education system that is detached from their everyday environment and experiences, and that of the real world in which they live. This implies that the formal education system is not textually relevant to learners, and does not prepare

them to cope with and relate to their immediate environment (Mokuku & Janse van Rensburg, 1997).

The use of wild food plants is considered primitive, and associated with low standards of living (Sibanda, 1999; Shava, 2000; Asafo-Adjei, 2004). In addition, the use of wild food plants is associated with the HIV/AIDS scourge (pers. observ.). Recent studies that research the use of wild food plants in Zimbabwe discovered that people usually believed that those who frequently use wild food plants (and traditional cereals such as sorghum and millet) are mostly likely to be infected with HIV/AIDS. This is despite the nutritive advantages that these food plants can add to the diet of any person. This assumption might be a response arising from the media messages on HIV/AIDS that advocate the use of the above foods. Modern agriculture promotes the cultivation and use of popularized commercial food plant varieties at the expense of indigenous food plants. This has led to marginalization in the growing and improvement of indigenous food crops, making them insignificant components of modern livelihood systems.

Traditional diets have been replaced with a modern diet which relies on a few widely cultivated, exotic, commercial staple foods. This can be aptly described as the global homogenization of the human diet. This dietary shift has led to a subsequent decline in the use of wild indigenous food plants and a change in lifestyles. Unlike traditional lifestyles which had a direct and heavy reliance on the local environment, present-day lifestyles are characterized by a shift towards urbanization, with subsequent reliance on the easy availability of processed foods. Traditional livelihood systems have been eroded, and subsequently the use of wild food plants has declined.

2.6 The role of socio-cultural practices in the preservation of IKS

Local IK is the kind of knowledge that has developed and continues to develop through the generations. It is based on adapted experience of local culture as well as the dynamic environment (Raselino, 2003). Appleton, J.J., Christenson, S.L., Kim, D., & Reschly, A.L. (2006) maintain that local IK allows people to understand and cope with the agro–

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economic, ecological and socio-economic environment. This knowledge resembles local or traditional knowledge that can be transformed through a systematic process of observation, experimentation and adaptation. This knowledge is passed from generation to generation by word of mouth and cultural rituals, and has been the basis for agriculture, food preparation, healthcare, education, conservation and the wide range of other activities that sustain a society and its environment in many parts of the world.

According to SciDev (2006), IK is the complex body of knowledge, know-how, practices and representations that are maintained and developed by people with long histories of close interaction with the natural environment. It has been noted that IK is very important for the survival of the local people; hence when incorporated into the formal school curriculum it can preserve and conserve natural resources. According to Coles (1985), IK is an integral part of the local people, and failing to use it would have led to environmental disaster. The study conducted in Bostwana by Vanqa (1996) discovered that IK amongst the Batswana people (people who live in Botswana) developed out of their physical situation and social needs, hence helping them to take care of their environment. It has helped local people to develop environmental management systems that improve the quality of their lives (Appleton et al., 2006). IK is now recognized as the only knowledge system that is central to the issues of sustainable and equitable development. This means that it is managed by the users, and is holistic. Gough (2006) reported that IK systems provide the wisdom to manage the environments and environmental ethics to enhance local and relevant knowledge and skills to sustain environments without jeopardizing natural resources. The possession of environmental ethics helps people to live in harmony with nature and environment in a sustainable fashion (Gough, 2006).

2.7 Indigenous technology and the local knowledge in Africa

The evidence of indigenous technology can be traced from the Stone Age up to the current dispensation. In these times, man used various methods to shape stones, wood, bone, skin and iron to make tools for his survival. Stones were used during the hunting of

wild animals and for preparing some of the most delicious indigenous food of the time (Maluleke, K., Wilkinson, P. & Gumbo, M.T. 2006). This could have been the practice in many communities around the world, e.g. Aborigines in Australia and the Red Indians now known as Native Americans in the USA. Indigenous people used stones as weapons either to bring down animals or to frighten scavengers from a kill abandoned by one of the predatory carnivores (Maluleke, et al., 2006). In addition to stone, bone splinters were used as spear points and it was an important technology for a hunter (van Aswegen, 1990:8-9). After harvesting, stones were used as grinding machines for corn. In addition to stone instruments, wood was processed into the most valuable tools, e.g. ploughs pulled by oxen (Clemens, 1991:11; Corbishley, 1994:14).

It may be rare, especially in urban environments, to still use a wooden plough in the face of fast modern technology like tractors. On the other hand, in order to cook fine corn, indigenous people made fire by using a hard stick in a block of softer wood. This method was common to most African indigenous people before the dawn of improved energy technology. Wilkinston et al. (1989:16) concur with Hammond-Tooke (1993:42) about the observation of South African Swazi men making fire by rubbing dry sticks together. To them this was a fascinating discovery of IK at work. Traditional weapons found today in South Africa suggest that indigenous people were capable of developing powerful coordinated defence technology of their own. The traditional weapons called assegais and shields displayed during Zulu functions – stick fighting, traditional weddings and ceremonies, and, recently, protest matches – are still common evidence of the defence technology that was successful for Zulu people. Combined with the skill to use it, it proved its effectiveness during battles fought by Zulus. For instance, the Zulus defeated the whites who used guns during the battle of Isandlwana in 1879 (Barker, Bell, Duggan, Horler, Le Roux, Maurice, Reynierse & Schafer, 1989: 184).

In terms of entertainment, indigenous people used various materials such as wood, strings and animal skins to make a variety of musical instruments. Harrison (1992:29), in his research report, portrays boys playing with self-made wooden bicycles. Indigenous technology is still evident in recent years in showcasing indigenous music using

traditional musical instruments. Common examples include the reed instruments and the African drums commonly played during music festivals across the country, and recently in most heritage sites like Shakaland and Isandlwana. These technologies express themselves through art (Custer, 1995:223; Gumbo, 2003:7). No wonder artefacts are what technology produces. In this relation between technology and art, the artistic ability of indigenous people is articulated through rock painting, clay-pot making, clothing and beadwork. Rock paintings and engravings found in South Africa demonstrate the artistic ability and skill of the Stone Age indigenous ancestors (Shillington, 1989:8). According to Elliott (1988:14), Zulu women are known as pot-bakers because of their unique artistic ability to make various fascinating pots used for different activities. They skilfully mix clay on a flat stone usually used for grinding cereal. The base of the pot is made on top of the item made of grass known as "*inkatha*" in Zulu. It keeps the pot in the correct and stable position while its sides are being built and made smooth by another flat object (Elliott, 1988).

A stone is used to decorate the pot before it is taken for baking in the fire. From the fire the pot emerges either red or brown, and is very strong (Elliott, 1988:15). The third author in this article recalls how he and his playmates used to be fascinated by the skills of grannies on farms around Rooiberg where he grew up. These grannies willingly demonstrated their skill to them, applying it on the model animals like cows. African pottery is an indigenous technology that still thrives today. Currently there are many indigenous people, according to Shillington (1989), who make and sell clay-pots, reed chairs, baskets, and other decorated technological products for a living. The artistic expression of the technology in these products implicates the indigenous cultures that produced them.

In addition to rock painting and clay-pot making, the ancestors produced a rich variety of items of clothing made of skin (Andah, 1992:89). Elliott's (1988:12-18) work includes the portrayal of traditional dresses, which still remain popular during Zulu, Tswana and Swazi festivals, and so on. All these can be viewed and admired on cultural and heritage days. Van Aswegen (1990:34) notes that archaeologists and historians generally agree

that the cattle owners, agriculturalists, hunters and gatherers who came from the north in Limpopo were also the Iron Age people. One of the great innovations of their time was the technology to mine and process iron, copper and gold. This was evident from the remains of the iron smelting found from the smelting process in the form of kilns and waste materials (van Aswegen, 1990:32-34). Thus, there is ample evidence that indigenous people were knowledgeable in the technology for processing iron.

2.8 Ways and means of integration of indigenous knowledge within science subjects

Teachers' attitudes toward and beliefs about the value and potential contribution of IK to sustainable development define how they integrate this form of knowledge into the formal school curriculum (Gachanga, 2007). Some of the challenges in the integration of IK in formal education arise from teachers' lack of faith that such a curriculum can actually contribute significantly in addressing the socio-economic needs of the country (Dei, 2002; Gachanga, 2007; Mwenda, 2003; Semali & Kincheloe, 1999). Teachers' inability to integrate IK in their practice may also be resulting from limited knowledge on what aspects to integrate. Somjee (1996:6) notes that although teachers are entrusted with the responsibility of fostering IK in the learning institutions of Kenya, "there is no guidance on what aspects of culture are to be integrated into the curricula. The syllabus only tells teachers what they must do and should do, but does not explain how to do it", indicating the limitations that Kenyan teachers are bound to face when implementing such a curriculum. This finding is consistent with study conducted by Weibesiek, L, Letsekha, T, Meyiwa, T, & Feni, B. (2013) when they opine that local knowledge is valued by all, and is beginning to 'see its ways into the classroom' and has further strengthened the relations and community-based stakeholders to take a more active role and greater responsibility for the development of context-relevant teaching and learning materials.

In teacher education this means preparing pre-service and in-service teachers to reflect on their own philosophies underpinning their ideologies about education and ways in which these values support or inhibit their ability to integrate multiple ways of knowing and

methodologies into their own classroom practices (Dei, 2002; Mwenda, 2003; Semali, 1999; UNESCO, 2006). The focus is for teachers to adopt practices that embrace both Western and IK in ways that promote dichotomous presentation, foster relevance, and inculcate a sense of self-worth, and national pride among learners. As teachers develop a more culturally inclusive curriculum practices, they must confront the emerging challenges from within themselves and the environment in which they are operating. In order for teachers to effectively integrate IK into curriculum content, there is a need to transform individuals' perceptions of what constitutes legitimate and valuable school knowledge, learning, and teaching.

Teachers need to examine their practices and develop ways to authentically engage and legitimise forms of IK into the formal education system. As Mwenda (2003:222) asserts, 'It is time that teachers come to the realization that Western diagnosis for development does not reflect Africa's realities'. The purely Western models of education and economy are not capable of addressing the current socio-economic problems at the micro level, especially in the rural regions in Africa. Hence, there is a need to revitalize the presence of ethnic indigenous ways of knowing, pedagogy and practice in the educational system if South Africans are to redefine and re-shape their own socio-economic framework within their own terms of development at the micro level (DBE, 2012).

In the process of understanding what could be accepted in schools as universal valid knowledge and standards for industrialisation and economic development (Dei, 2002; UNESCO, 2006), the following questions are worth asking to guide the discussion: What knowledge is of worth and in whose interest does the knowledge operate? How can IK and pedagogy be integrated in a reciprocatory way with Western knowledge in the formal school system? Who counts as experts or innovators in this process? It is only when teachers address such questions critically that they may empower themselves and in turn be able to empower students' knowledge construction by building on the IK base that students bring with them into the classroom settings.

Unfortunately, many teachers prioritise Western ways of knowing and interpretation of the world over IK especially in the face of globalisation (Dei, et al., 2002; Shiva, 2002). Thus, to complement the integration of IK in formal education, it is important to inquire into teachers' perceptions and experiences of IK with a view to understanding their capability in developing appropriate pedagogical approaches and materials for implementation of such curriculum reforms. According Meyiwa, et al. (2013), the pluralistic approach to knowledge systems requires teachers to embrace their own logical and epistemological foundations and accept that one system of knowledge cannot act as a standard of measure for all knowledge systems.

Indigenous peoples are becoming increasingly vigilant in seeking to protect their traditional science and indigenous technology from being exploited by larger commercial interests. There are numerous cases of transnational pharmaceutical companies patenting, or laying claim to, even misappropriating, medicinal plants used traditionally by Indigenous people for many generations (Shiva, 2002). Indigenous people usually do not have the theoretical conception of 'owning' elements of nature, and likewise, companies do not realize that they are depriving Indigenous People of economic and traditional beliefs. It is essential that governments begin to adopt legislation that secures protection of IK within their borders. This is seen not only as a means of protecting Indigenous People, their cultural heritage and their traditional knowledge and practices, but the national interests of unity and prosperity, too (UN Leaflet No. 12, OHCHR, 2001).

2.9 Socio-economic practices towards preservation of IK

In recent years, it has been recognised that IK is making an important contribution to natural resources management systems, particularly in the developing world (Brokensha, Warren & Warner, 1980; Richards, 1985; Warren, et al., 1995). The main argument in this regard is the assertion that IK is relevant and dynamic and that, as it evolves over time within a particular culture, local communities possess the capacity to adapt to changing circumstances (Chambers, 1983). According to Adger (2000), possessing such knowledge and possessing the capacity to adapt and apply it in the face of changing environmental or socio-economic conditions, in other words the 'social resilience' of a

population is essentially the root of sustainable natural resource management. In this regard, IK is a panacea for rural development across much of the developing world. In recent years, African countries have evoked the debates on finding means of alleviating poverty and to improve the quality of education within the continent. To achieve this ideal, it is crucial to draw from indigenous and local knowledge in order to strengthen these initiatives particularly in rural communities where most households are female-headed (International Fund for Agricultural Development (IFAD), and (Olatokuma & Ayambode, 2009).

2.10 Partnership between schools and indigenous communities

Promoting partnership between the school and local (indigenous) communities includes, among other things, the availability of project initiatives based on IK practices. The study conducted at Cofimvaba by Meyiwa, Letsiekha and Wiebesiek (2013) demonstrates the real participatory indigenous knowledge research approaches in a school-based collaborative project in the Eastern Cape. This project shows that partnership is only possible if all relevant stakeholders such as district officials, principals, teachers, and various leadership structures such as School Governing Bodies (SGBs) are part and parcel of this collaboration. The results reveal that the input and incorporation of these persons and structures especially SGBs will enrich the in-depth integration of IKS into the main school curriculum. The integration of IK into the main school curriculum means that even those parents with low levels of education could be involved in the education of their children (Meyiwa, Letsiekha & Wiebesiek, 2013).

According to Zazu (2008), the role of IKS in enhancing and contextualising education was recognised by United Nations Educational Scientific and Cultural Organization (UNESCO) in 1978 at a meeting of one of the United Nations (UN) agencies, the World Intellectual Property Organization. The study conducted by Corsiglia and Snively (2001), Emeagwali (2003) and Letsiekha –Pienaar and Meyiwa (2013), focused on the documentation and study of IK, in order to benefit school curriculum. These studies promote partnership between the school and local (indigenous) communities. Letsiekha,

et al. (2013), asserted that in the South African context, such collaborative partnership would lead to linkages between the schools or education systems, the home, and the wider community.

2.11 Conclusion

The literature reviewed in this chapter has presented the theoretical framework and the background with regard to the integration of IK into the main school curriculum. The strategy in the integration of IK into the main school curriculum emphasised the three keys pillars, the ways teachers can use to integrate IKS within science subject as taught in schools curriculum; the partnership between the school and surrounding indigenous communities in the development of integration within the school curriculum and the role of socio-cultural practices in the preservation of IK. It is evident from the literature reviewed that the Department Basic Education needs to integrate IK into the main school curriculum so that the knowledge learners got at home will continue at school and be used effectively. The next chapter outlines and describes the methodology adopted in this study in detail.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This study adopted a research design that provided a clear plan and procedure to guide the research process. In this regard, this study chose the design which included the entire spectrum from assumptions made to the methods of data collections and analysis (Henning et al, 2005). This chapter seeks to give a comprehensive breakdown of the research design and the detail methodology procedure used for this study. According to van Der Walt and van Rensburg (2006), research methodology used in any study is regarded as the procedure followed by a researcher in gathering suitable data meant to answer the critical research question. This procedure produced quality research findings, which are presented in this study. This chapter gives a detailed account of the procedure by which this study has been, planned, structured and executed. The next section outlines the aim and the research questions designed to guide the research process.

3.1.1 Aims of the study

The fundamental aim of this study is to investigate the possible integration of IKS within the mainstream curriculum framework of the Senior Phase (grade 7 to 9). The researcher also seeks to find out whether or not parents see the value of IKS within the sustainable development paradigm.

3.1.2 Research questions

More specifically, this study sought to answer the following research questions:

1. What are the ways in which teachers can integrate IKS within science subjects as taught in Empangeni schools?
2. To what extent does the partnership exist between schools and the surrounding indigenous communities in the development of integration within school curriculum?
3. What is the role of socio–cultural practices in the preservation of IK?

3.2 Research design and methodology

This study adopted a mixed-method or stage-two approach, which involved collecting, analysing and interpreting quantitative and qualitative research data as a programme of inquiry (Cresswell, 2003). Stage one adopted the quantitative research approach, and stage two a generic qualitative research approach. This design aimed to employ triangulation of data in order to collect as much data on IK as possible while ensuring that the research data remained credible and reliable.
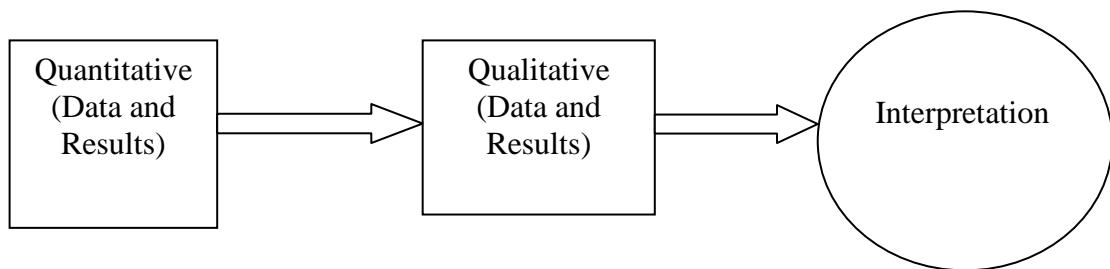
Figure 3.1: An exemplary sequential mixed-method design (Source: Cresswell, 2003)

3.2.1 Stage 1: Quantitative research

According to Cresswell, (2003) quantitative research approach is mostly guided by an objective and systematic process which collect numerical data to obtain information about the phenomena as seen in Figure 3.1. For the purpose of this research, the data was collected through structured questions (see Appendix C) to explore and describe the experiences of science teachers regarding the integration of IK into their science lessons. This quantitative data were used to guide the development of qualitative data sets which formed stage two of this study. The quantitative research instrument included a section (Section B) which dealt with the perception of teachers towards the inclusion of IK in the mainstream curriculum and teachers were asked to complete all 20 questions which were analysed by means of the SPSS (Statistical Package for Social Science). 35 science teachers who teach Natural Science, Agriculture, Technology subjects in the Senior Phase completed and returned the questionnaires.

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3.2.2 Stage 2: Qualitative research

Qualitative research design as explained by Giorgi (1997) requires the researcher to have an attitude of openness to allow unexpected meanings to emerge. This study purports to study the perceptions of teachers on how IK can be incorporated into the science curriculum. How can rural communities and parents play their role in ensuring that there is a partnership between them and the school?

This method of study intends to uncover various experiences and challenges faced by science teachers in their quest to incorporate IK into their science classrooms. This study expects to highlight curriculum perspectives that seek to recognise the value of IK and identify the common challenges teachers encounter during their teaching in relation to the infusion of IK, as well as their knowledge about opportunities for its inclusion.

3.3 Research sample

The researcher identified Emacekane at Ongoye reserve as the research site for this study for two reasons. First, the researcher was encouraged by the rich cultural tradition, the norms, rules, and customs of the local people. Second, the researcher is familiar with isiZulu which is the indigenous language spoken in this village. Since this area has a homogenous culture, the researcher believes that the information on IK provided by the respondents could be generalised to most groups in Kwazulu-Natal. The researcher attended *imbizo* (*imbizo* is the official gathering where people meet when their chiefs want them to discuss issues that will benefit the tribe) in order to identify the potential respondents in the area. Chiefs called their chief headmen to the *imbizo* to inform them about the purpose of the study. The researcher targeted two traditional leaders, two elderly men, two elderly women and four youth as participants. This sample was enough to generalise the views of the community but also for targeting people with a deep knowledge and understanding of IK and how it contributes to the quality of the environment. The participants were identified on the basis of age, experience, gender and leadership qualities. The sample also had a diverse generation mix.

The aim of employing network sampling was to use parents as pointers for identifying the next informants. It was assumed that parents had good ideas by which members of the community could provide rich contextual information related to the research questions. These parents were targeted to find out how they used traditional knowledge to preserve food in their households. These parents have a deep understanding of how to use IK to prepare soil for cultivation and when certain seeds have to be planted. They know how to preserve and transmit their traditional ritual practices such as examining the virginity of young girls during the reed dance ceremony.

3.4 Choice of schools and teachers

All the selected schools came from almost the same local area, meaning there was very little or no significant difference in the local conditions at the school. Teachers had same qualifications. All 35 teachers held four-year B.Ed degree in science education, which certified them to teach at the secondary schools (Senior and FET) according to the South African Qualification Authority (SAQA). The choice of teachers with the same professional qualification was not by design, but due to the fact that better-qualified teachers usually handle higher classes, where there is a choice. To access teachers in the schools, the researcher initially contacted the Department of Education District at Empangeni where the permission to scout for schools was granted. The District allowed the researcher to select schools of his choice and sought permission from school principals who have control over day-to-day teacher operations. Contacts with the Principals and teachers from 20 schools within the researcher's reach took place in early May 2013. The choice of schools, however, depended on cost of travel to the schools. Since I had to use my meagre resources for fuelling my car, shorter distances between schools were a better choice. However, shorter distances were also considered because of the need to move quickly between schools to facilitate a couple of observations in a day. After accepting to use their schools for study as indicated in their verbal consent forms in Appendix C, HODs of the first five schools where I conducted this study helped to connect me to the teachers and other schools. All science teachers who teach grade 7, 8 and 9 were invited to the HODs office as I explained the purpose of my study and why I

was looking for their participation. All the teachers were told that their participation would depend on their willingness to participate. One of the incentives was to gain early experience before the actual interviews took place. Interested teachers gave me their contact details so that when they had studied and were satisfied with the curriculum documents and were ready to begin with the study, they could communicate with the researcher to indicate their readiness to begin with interviews.

3.5 Data collection procedures

3.5.1 Stage 1: Quantitative data collection

For the purpose of this study, the researcher firstly applied for permission from the Department of Basic Education to conduct study in few selected schools. Data for this study were collected by means of questionnaires and semi-structured interviews. The interviews were recorded because they were long and sometimes difficult to capture. Furthermore, the researcher decided to have a heading to each interview because this would help in the better organisation of data and to retrieve segments needed for further review at any time (Merriam, 1998). Based on the view expressed by Cresswell (2007:118) data are expressed as a series of activities that are connected to each other. The next section discusses the approach that was used to collect qualitative data from both teachers and the members of the community.

3.5.2 Phase 2: Qualitative data collection

The study adopted a qualitative approach wherein 35 science teachers and 20 members of the community were recruited and interviewed. These participants voluntarily took part in the interview process. All the interviews took place in their schools so that it would be easier for teachers to have access to their documents and other material should they need them for referral. The aim of the qualitative approach was to explore experiences and challenges of science teachers towards incorporating IK in their teaching. In-depth unstructured interviews were conducted with the aim of capturing the exact description of experiences and to preserve the spontaneity of the participant. Probing was used as follow

up questions and was based on the nature of the responses of the participants. These interviews were conducted in both Isizulu and English, and each interview lasted approximately 20 to 25 minutes.

With regard to the community members, they were interviewed individually and through focused group in IsiZulu.

3.5.3 Interviews

Having completed watching, and listening, interviews were conducted to strengthen the collected data; all these procedures are a powerful tool for obtaining qualitative research data (McMillan, 2004). Interviews, according to McMillan (2004:2), are a 'more intrusive form of data collection procedure' that involves 'asking participants questions, and recording answers.' This strategy is essential to gather data from participants on issues that may not be directly observed. In this study, interviews took two forms. First, informal questions posed after the class and secondly, formal semi-structured interviews conducted at the end of the study. To help answer the three main questions in this study, ten questions were used in the interview protocol. The researcher asked seven questions at the beginning of the study, but added three more in order to learn more from the classroom experiences as shown in appendix E. Interviews formed a very rich source of data that proved or disproved the researcher's speculations during classroom observations. The process of interviewing began by informing teachers about interviews through a memo (see Appendix F). The memo informed the teachers about the interview and what was expected from them. They were asked to choose a convenient date for the interviews. However, it must be noted that plans do not always work. One of the teachers had an accident before the schedule time for interview, and so the researcher only managed to have an interview with her the following week. It was amazing that it worked. All interviews were conducted in quiet places to avoid distortions of recordings and disruptions of the interview. A digital recorder was used for audio recording, as was the case in the previous summer (2013) when this study began probing issues of IK practices relevant to science in South Africa. Before the date of interviews, teachers read

the questions that were sent together with the notification memo for the interview. They were also told to ask for clarification if they did not understand the questions, especially those used for probing issues.

3.5.4 Participants and classroom observation

As part of this study, it was important for the researcher to be engaged in a naturalistic observation to open more possibilities of describing the experience without limitations. Teachers were free to ask what they felt did not make sense as they taught. All teachers were told that their insights, struggles and successes were part of the lessons the researcher wanted to learn from the study. As a result, they did not shy away from expressing their experiences and needs. After all, they knew my background as a science teacher. Hence, I participated as an overt participant observer (Fraenkel & Wallen, 2006). I tried hard to suppress the power of my past position as a teacher by telling them to do whatever they felt comfortable to do because I was not interested in ideal practices but what they naturally felt comfortable to do. I participated in thinking through some of their problems in planning and teaching whenever they asked for help but also just observed at other times. Hence, I would say I took the role of a moderate participant observer, whereby I participated only when called upon.

3.5.5 Auto-Ethnography

The last but not least approach for data collection was auto ethnography. Patton (2002) describes auto ethnography as the latest and still emergent approach in research. Ethnography and auto ethnography fall on either extreme of the continuum of qualitative research. While ethnography emphasizes studying other people, in auto ethnography one studies 'his or her own culture and oneness as part of the culture' (Patton, 2002:84). This approach was employed because I have a rich background in the IK developments in South Africa as indicated in my position as a researcher.

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3.7 Data analysis and interpretation

3.7.1 Quantitative data analysis

In the quantitative analysis, the statistical analysis for discretion, comparing and variable relating was used. Returned questionnaire were analysed, and the frequencies, means and standard deviations are discussed in more detail in Chapter 4. Quantitative approach was the main focus of this study, as it may mainly be focused on the qualitative part, the participants lived experiences, and they can only be and how they could be encapsulated into the school curriculum. The qualitative data were used to finalise the interview protocols.

3.7.2 Qualitative data analysis

Qualitative data elicited through the use of the questionnaire and the semi-structured interview were analysed by means of identifying common themes, in the general description of participants' experiences. Qualitative data analysis approaches demanded that the researcher put the world in brackets, or free himself from his learned ways of perceiving the world, so that he will be able to conceptualise matters in their most original form. It envisages that his bracketing off of his own experiences enable him to better understand the experiences of the participants. The researcher in this study looked for meanings, meaning themes and general descriptions of the participants' experiences as they themselves find words to express their views if the questions are posed to them.

3.8 Ethical and safety issues

Leedy (2005: 101) states that there are four classes / categories of ethical issues, namely protection from harm, informed consent, right of privacy, and honesty with professional colleagues. Gumbo (2003) goes further, saying that it would be unethical to collect information without the knowledge of the participants, and their expressed willingness and informed consent. Confidentiality and anonymity are other ethical issues which must be taken into consideration. Thus, in this study, it was paramount importance to protect the identities of the respondents' information sources and ensure that the information

collected was reported honestly and in a way that does not divulge the source of the information. This means that the researcher ensures that the rights of all participants (interviewees) are respected, and in particular the right to non–disclosure of identity. He has carefully explains to the interviewees their right not to disclose their names, and that if they did not want to feature in the study.   The participants were informed that information that collected from them will be kept at the University of Zululand library as a resource. They will be told that they have a right not to respond to questions if they do not want to do so.

3.6 Challenges encountered during data collection process

It must be said that the majority of the participants were not reliable when it comes to honouring their interview schedule as discussed with the researcher. They sometimes pleaded ignorance about the time and readiness to face the interviewer. Other participants cited poor health or personal issues that demanded urgent attention (e.g. family responsibility) as the major reasons. It was disappointing to be told that this interview was no longer going to take place as planned without valid reason. In hindsight, these community members thought they were going to benefit from participating in the study having been told in advance that their participation was voluntary.

3.9 Conclusion

Chapter Three provided a detailed discussion on the choice of research methodology that was used to conduct this research study. The range of methods and approaches that were applied fall within the paradigms of mixed method study. This study shows how these methods were customised to suit the requirements of the study. The method of sampling, data analysis (frequencies, tables and graphs) and the choice of statistics and data analysis used were described in detail. The following chapter focuses on the findings of the surveyed and interview results including discussion on the integration of IK in the teaching of science subjects in the Senior Phase.

CHAPTER FOUR

DATA ANALSYSIS AND THE SYNTHESIS OF FINDINGS

4.1 Introduction

This chapter purports to unpack the three critical aims of Learning Outcome 3 (LO3) of the NCS for the Natural Sciences. An understanding of what the rationale, aims of the curriculum development are in answering the first critical research question for this study which is: What are the ways in which teachers can integrate IKS within science subjects as taught in Empangeni schools? This chapter gives a logical synthesis of how teachers integrate IK with the scientific worldview as they teach science subjects in South African schools. This section offers a critical synthesis of results collected by means of three research instruments i.e. questionnaires, interviews and observation. The views and perceptions of teachers, community members and learners were interrogated and critically analysed to provide an objective presentation of findings for the study. In the process of data presentation, particular attention was given to the quality of returned questionnaire responses to ensure that any bias was eliminated during the final presentation of results. Since this study used mixed methods, triangulation of data was used to ensure that all the required data were collected and presented in the final analysis. Data are presented by means of tables, graphs, percentages and themes. The first discussion focuses on the educational background of teachers who participated in the study.

4.2 Educational background of the respondents

The table below gives a realistic picture about of the respondents in terms of which grade they were teaching during the data collection. It is common knowledge that teachers rotate year after year, so it is very difficult to know which subject they are likely to teach at a particular time. The table is intended to show selected subjects that were identified to be fertile ground for integration of IK and science in the NCS/CAPS curriculum.

Table 4.1: General sample of teachers' teaching NS in the Senior Phase

Learning area/Subject	Grade 10	Grade 11	Grade 12	Total	Percent
				Frequency	%
Agricultural Sciences	3	3	4	10	29
Technology	3	3	4	10	29
Physical Sciences	5	5	5	15	42
TOTAL	11	11	13	35	100

The majority of teachers who participated in the study were drawn from the secondary schools across the Umfolozi Circuit. Their background knowledge and understanding of IK and science is diverse. However, since both the NCS and CAPS curriculum require that teachers should teach across the curriculum, it was necessary to solicit their perceptions about the infusion of IK into science. Table 4.1 shows that 29% of the participants were teaching agricultural sciences, but they were also teaching physical science in their respective schools. The majority of teachers who participated were males who seem interested in the subject under investigation. There was something unique about these respondents which ware closely linked to other aspects offered by physical science and agricultural practices in the surrounding communities. The majority of schools sampled for this study have an interest in integrating traditional/IK into the mainstream curriculum with a view to benefiting the surrounding communities. Their involvement is primarily motivated by the rural nature of the area and the socio-cultural background of the near nearby community. One of the critical objectives of the science curriculum as stated in the NCS is that "science education should help learners to be problem solvers".

The Technology teachers who participated showed great enthusiasm for the subject matter judging by the number of participants which was 29%. They felt that this kind of research is long overdue to debate issues of whether or not IK should be integrated into the main curriculum. They raised the issues of convergence between IK and science curriculum. The overwhelming majority of participants 42% came from Physical Sciences, which was pleasing given that the objective of this study was to interrogate the integration of IK into science curriculum. Their contribution offered a critical authentic overview of what form and shape IK should take. They seemed to understand the serious need for such voices as well as practical challenges that underlie the implementation of IK.

4.3 The views of participants about what ought to be learnt at school

Both members of the community (Elders) and students were able to suggest what ought to be learnt at school in order to infuse IK into the mainstream curriculum. During the school visits, the researcher had informal discussions with learners in grades 7, 8 and 9 to try and answer this question. The majority of grade 7 students unanimously felt that their knowledge can be effective in class only if their teachers can learn to work with indigenous experts for the purpose of translation and integration of IK-science. They strongly believed that teachers can strengthen their teaching by acknowledging that there are many ways of knowing. This sentiment was echoed by the Elders who were also convinced about incorporating IK into science, and were arguing for its consideration when the Department of Basic Education decides what should be taught in schools. Linked to this concern was the high failure rate for grade 12 in recent years which is an area of great concern, and the call for using IK in the teaching of science is fast receiving more urgent attention than at any other moment in history. The content offered in schools, as students understand it can only be effective when the teachers include both IK and science-related content knowledge as shown in the aims and Table 1.1. Students believe that the NCS should cover aspects like indigenous technology, handcraft, engineering, health and environmental issues. Important issues that can be relevant to students include constructing traditional huts, conservation of flora and fauna, food preservation and indigenous plants.

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The following section sets out to unpack the critical synthesis of collected data in order to make sense of the findings on whether or not the partnership exist between schools and the surrounding communities in developing IKS. This section reflects on the impact of curriculum changes. Our interviews with teachers give a critical synthesis of the current education system, noticing how continuous curriculum renewal has been taking place, and reflecting on the changes that have made to meet the demands of the society and the economy. Schools have to work in partnership with the surrounding communities to address some of the conceptual challenges manifesting themselves in the field of science and technology.

4.4 Theme: National curriculum documents

The national curriculum documents have wealth of valuable information that acts as guidelines for any suggestions regarding the IK-science integration. They state very clearly what components need to be integrated into IK−science. This study draws its existence from the previous schooling system which was ushered in under the shadow of the National Curriculum Statement (NCS), and founded in the principles of Outcomes-Based Education (OBE). As the NCS was phased out, the new curriculum framework called the Curriculum Assessment Policy Statement (CAPS) was introduced to strengthen the principles of the NCS. The principle of education for all transcends all these curriculum documents, and therefore they need to be used interchangeably in the current analysis.

Learners come from diverse background, and bring diverse IK accumulated over time into the classroom. Teachers often come into contact with these elements of IK from time to time, which in some instances present challenges during teaching and learning. They need to be carefully managed to avoid misconceptions and distortion of scientific information that come about as a result of IK. This challenge was better explained by some of the teachers who were aware of the potential danger of promoting IK blindly in

the name of integration. Their argument clearly articulates what ought to be done to bring IK into science.

> *Mina njengo thisha osemnkantshubovu kwezensayensi kanye nezobuchwepheshe, ulwazi lwethu lwesintu singaluqathanisa nolwazi lwesayensi ngalezizinhloso ezimbili ezilandelayo. Lokhu kuchaza ngokusobala ukuthi abantwana bethu isayensi nobuchwephesha abayifunda emakhaya, kanye nokunakekelwa kwezemvelo kufanele bakwazi ukukusebenzisa ezindaweni zangakubo kanye nasemphakathini. (Miss Mabuza, May, 2014)*
>
> {As an experienced science teacher, it is apparent that our learners are exposed to their indigenous and science knowledge during teaching and environmental education. This will have positive impact in their community.}

As an experienced teacher and member of this community, it is important to integrate IK and modern (Western) scientific knowledge. Learners come to class with prior knowledge which can be regarded as indigenous science and technology from home. Such knowledge should be afforded recognition during the process of teaching and learning. It is also important to encourage learners to use their IK to conserve and sustain their local environment in their community and at school. In the CAPS documents, these IKS and practices are carefully set out to harmonise with the science curriculum and are linked directly to the two main specific aims as they are articulated in Natural Sciences in the GET.

4.4.1 Organisation of Natural Science content knowledge that infuse IK

Specific aim number two gives a general overview of what kind of science content is needed when teachers deal with the theme *'Knowing the subject content and making connections'*. This specific aim seeks to outline the importance of pedagogical content knowledge (PCK), relate it to the familiar context while developing scientific, technological and environmental knowledge and be able to apply it in new contexts. The main task of teaching is to build a framework of knowledge for learners and to help them

make connections between the ideas and concepts in their minds; this is different to their just knowing facts. When learners do an activity, questions and discussion must follow and relate to previously acquired knowledge and experience, and connections must be established. The majority of teachers are aware of the importance of this aim in the context of teaching science. They concurred with this aim, but their major concern was how to integrate the two knowledge strands as required by the curriculum. From the above it is evident that even in the classroom teachers must ensure that they have to teach learners to integrate IK into modern scientific knowledge in their daily classroom activities in order to demonstrate the relevant PCK and connections.

Aim number three is to *understanding the uses of Science.* This aim seeks to develop the practical awareness learners who understand the uses of Natural Sciences and IK in society and the environment. Teachers have a responsibility to produce learners who can learn and apply scientific knowledge to solve problem. All teachers in this study agreed that they have a responsibility to teach science that relates to a learner's context in order to stimulate the love of science. However, the views of learners and Elders seem to ask for a more inclusive curriculum that can benefit their needs directly than what the present curriculum offers. They feel that issues such as improving water quality, growing food without damaging the land and building energy-efficient houses should be given priority by teachers in order to develop learners who understand the uses of science.

An appreciation of the history of scientific discoveries, and their relationship to IK and different worldviews is likely to enrich our understanding of the connections between science and society (DBE, 2011). It is also evident that learners come from different background when they interrogate the school curriculum. Although not all the specific aims and core knowledge/strands show the integration of IK into the main school curriculum in natural sciences, it is worth noting that some strands show a strong leaning towards integration, while others show a weak integration. The strands and content knowledge in all the tables were identified by the subject teachers as areas that need prior knowledge of IK when you teach science. The majority of teachers were keen to show the

researcher all strands that relate directly to IK. Table 4.2 below shows some of the strands which attempt to integrate IK into the main school curriculum.

Table 4.2: Organisation of Natural Sciences Content/ Core Knowledge

Grade	Strand	Content/core knowledge

9	Human Reproduction	• Reproductive systems: produces sex cells for the purpose of continuation of species.
		
		   o The main processes include growth, cell division, maturation, copulation, ejaculation, ovulation, menstruation, fertilisation, implantation.
		   o The main components include testeses, ovaries, uterus.
		   o Health issues include infertility, foetal alcohol syndrome, STDs.
		
		• Purpose and Puberty: puberty is the stage in the human life cycle when sexual organs mature for reproduction.

	Reproduction in Female and Male	• Stages of Reproduction:
		   o One a month , one of the ovaries releases a ripe egg in a process called *ovulation*
		   o in preparation for a fertilised egg, the uterus develops a thick layer of blood.
		   o If fertilisation does not take place *menstruation* occurs.
		   o Menstrual cycle is usually a 28 day cycle.
		   o During *copulation*, the erect penis is inserted into the vagina and semen is released (*ejaculation*).
		   o If fertilisation takes place, the fertilised egg is

		implanted in the blood layer in the uterus and pregnancy results.
		o The stage of pregnancy in humans (gestation is about 40 weeks.
		o Pregnancy can be prevented by using contraceptives such as condoms to prevent the sperm reaching the egg.
		o Condoms also prevent the transmission of HIV/AIDS and other STDs (sexually transmitted diseases) if used effectively.
9	Digestive Systems	Healthy diet • A healthy diet (eating plan) requires different components including proteins, carbohydrates, fats and oils, vitamins and minerals, fibre and water.

Many NS teachers who participated in this study are of the view that learners can make a positive contribution by infusing their IK into the teaching of science particularly at the Senior Phase level. Their experience reminds them how valuable their traditional knowledge can be linked to the curriculum knowledge. According to one participant, there are two people who can make or break the scientific understanding of the child: the teacher and the parent. As teachers, we sometimes ignore the traditional knowledge of the child during the process of teaching and learning. One participant who described his passion for integration made the following comment about the importance of IK in NS:

"Thina sikhule sihlolwa ngomama abadala. Lokhu kwakwenza ukuba amantombaza asakhulayo aziphathe kahle kuze kufike isikhathi sokuba athathwe ngokusemthethweni, ngakho – ke lokho kwakusiza kakhulu ukuvikela izifo ezithathelwana ngokocansi kanye nokukhulelwa kungakafiki isikhathi. Uma intombi isithathiwe yayingalali nowesilsa isinomi ikanjani, kodwa yayisoma,

ingalali ngisho nasekhaya kodwa babelaliswa entabeni kuze kufike isikhathi somshado." (Mama Zikhali, May, 2014).

{We grew up undergoing the virginity testing programme. This culture taught to respect our bodies, but also wait for the right time to choose boyfriends when we are a bit matured. This culture helped us to avoid STI and teenage pregnancy.}

The findings show that while teachers talk about the stages of reproduction when they teach NS they need to integrate the concept of virginity testing for girls as part of IK. This sentiment is seen as an attempt to develop responsible youth that take sexuality, HIV and STDs very seriously. If school girls and boys decide to start dating, they should do it responsibly and avoid the penetration (*ukusoma*) of the penis into the vagina. The importance of virginity testing is significant because it will encourage learners to appreciate the inclusion of IK in NS because it connects them to their knowledge from home and it takes them to their roots. NS teachers argue that this will be likely to create interests and make learners realise the importance of their culture.

"Intomabzana uma isithombile kwakuba umsebenzi kamama ukuba ahlahle nayo phansi ayitshele ngemithetho nezinto okufanele izenze nokungafanele izenze. Umama kwakufanele ayiphehle igazi elibi noma akhiphe impene, ingazidli izinto ezifana namaqanda, inyama yenkukhu, ufishi, ingawadli amasi ezinkomo zasekhaya uma isendaweni yayo njalonjalo, ukuze ingabi nothando labantu besilisa kungakafiki isikhathi. Ngesingami kubalulekile ukuba zonke lezizinto zethu zesintu zifakwe *ohlelweni lwezemfundo ukuze abantwana bethu bakhule bezazi futhi kuyosiza kakhulu ukwehlisa izinga lezifo ezithathelanayo". (Mrs Zibani, May, 2014).*

{Before a young girl gets to an adolescent stage, it was the responsibility of the parent to sit down with girl child and lay down the rules. There were certain food stuff like eggs, fish and meat that were to be avoided by young girls. According to tradition, avoiding to eat these kinds of food delay the girl child from developing certain hormones that will drive them to engage in sex early.}

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It is a responsibility of mothers to talk to their children at a very early about the merits and demerits of adolescence so that the work of teachers will be much easier. It is argued from the traditional knowledge point of view that certain food products such as poultry, pork and cow from domesticated animals should not be eaten by young girls and boys because they stimulate early adolescence. The Department of Basic Education encourages the inclusion of such traditional practices and beliefs in the curriculum, as it will reduce the high rate of STDs such as HIV/AIDS. One of the teachers who is also a member of the community welcomed the restructuring of the new curriculum document in-line with the IK in it. He shared his views on the IK of Emacekane by saying:

"I am fortunate to have grown up in this area called Emacekane. During my upbringing, I used to see young girls tested by Elders for their virginity in order to qualify to visit Umkhosi womhlanga (better known as the Reed Dance ceremony). To me this is an attempt to bring back or restore a culture of respect, virginity and humanity among the young girls in this area. The culture of circumcision in boys is practised today. Fathers in the house had the responsibility to instal the culture of (ubuntu) humanity in boys particularly at the puberty stage. In these meetings boys are told of the merits and demerits of having sex before marriage and respect for women."

The main finding from Table 4.2 seems to suggest that effective learning depends on teachers' ability to manage the interplay between indigenous and Western knowledge. Le Grange (2007) suggests that indigenous learners can perform exceptionally well in a science classroom without assimilating the associated values. A good scientist at school can be a traditionalist at home without any feeling of cognitive perturbation or dissonance.

4.4.2 Organisation of Agricultural Sciences Content/ Core Knowledge
I was so fortunate to speak to one of elder woman who works in the school garden.

"Thina sikhule silima amasimu sisebenzisa ulwazi lwethu lesintu sisebenzisa umquba wezinkomo ukukhulisa izitshalo zethu lokho bekwenza ukuthi ukudla esikudlayo kungasidaleli izifo ezinhlobonhlobo. Ngokwami ukubona ukufundiswa kwezolimo ezikoleni kubalulekile. Kufanele zibuye emasisweni ngokufundisa abantwana bethu ukusetshenziswa kolwazi lwethu lwesintu futhi kusenziswe nomquba wezinkomo ukukhulisa izintshalo. (Mr Zondo, May, 2014)

{We grew us working and using tradition methods of cultivation in the fields, such as manure to fertilise crops which is believed to prevent certain diseases. We need to go back to our roots so that the youth will lean from the good practices of the past}

When I grew up we used to cultivate fields using the cattle droppings to grow our cultivars. This was helpful because the food that we ate had no diseases. In my opinion, it is imperative to bring back the use of IK when it comes to cultivating crops. I was very glad to interview one of the experienced agricultural science teachers at Mr Hlongwana at Sihubela High School. He was proud to say:

"I was brought up in this area and so when I was brought up I used to cultivate fields using indigenous technology like a span of donkey. This was advantageous to us as people of Emacekane solely because there was no oil spillage which can damage the environment. The Department of Education attempts to include IK into the main curriculum in some of subjects such as the one I'm teaching although there are not specific lessons which address the integration of IK. Some of these themes appear in the table below."

"He continued: "We grew and harvested our crops and kept them in silos for future use. We also kept our grain seeds like maize in our huts in the centre of the fireplace until the next cultivation season and this indigenous practice was suitable and still relevant in this community"

Table 4.3: The organisation of Agricultural Science curriculum content knowledge

Grade	Topic/strand	Content and concepts
10	Indigenous knowledge	• The concepts of indigenous (traditional knowledge systems. • A comparison between and "scientific" knowledge past and present. • Indigenous knowledge used in agriculture (some examples of indigenous knowledge). • The constraints of using indigenous technical knowledge in agriculture. • Advantages of using indigenous knowledge in agricultural production. • The protection and management of indigenous knowledge systems in South Africa.
10	Agricultural Pollution	• The concepts: Agricultural pollution and different types of pollution. • The major kinds or types of soil pollutants (cause, effects and control measures). • Economic impact of soil pollutants on natural resources sustainability for agricultural production.
10	Animal Studies General importance economic value and classification, of farm	o Development and demonstration of animals. o General economic importance of livestock industry in South Africa with

	animals	reference to
		o Cattle (beef, milk, hides)
		o Sheep (wool, mutton, pelt and hides)
		o Goats (meat, mohair and hides)
		o Pigs (pork, pork products and bristle)
		o Horses, mules and donkeys (work, sport and recreation)
		o General by-products from animals (manure, bone meal, carcass meal blood meal etc.
10	Horticultural crops: Vegetable fruits, flowers and shrubs.	Flowers crops The basic climatic and soil requirements of the following main types of crops extensively used in South Africa. • Fynbos (diversity and agro – tourism) • Garden flowers (flowers as features) • Cut flowers (floral shops, festive seasons, special occasion. • Shrubs and indigenous crops: The basic climatic and soil requirements for the following shrubs: o Roibos, and o Home bush
11	Soil Colour and Soil pores	• Soil colour • The interpretation of the following soli colour. o Dark o Red o Light

			o Yellow
			o Greyish coloured, and
			o Mottled appearance

Learners come into the classroom from diverse background with diverse previous IK accumulated over time. The researcher was privilege to speak to the senior grade 9 teacher who said frankly:

> *Mina njengo thisha osemnkantshi mbovu kwezensayensi kanye nezobuchwephesha, ulwazi lwethu lwesintu singaluqathanisa nolwazi lwesayensi ngalezizinhloso ezimbili ezilandelayo. Lokhu kuchaza ngokusobala ukuthi abantwana bethu isayensi nobuchwephesha abayifunda emakhaya, kanye nokunakekelwa kwezemvelo kufanele bakwazi ukukusebenzisa ezindaweni zangakubo kanye nasemphakathini. (Mr Mthembu, April, 2014).*
> {As an experienced science teacher, I can compare the vast knowledge I have in two ways: I am convinced that our learners can become good scientists and excellent environmental scientist in order to work to improve their community.}

This means that learners come with their own indigenous science and technology from home. They must now learn to apply their knowledge of and care for the environment in their community and in school.

Science learnt at school should produce learners who understand that school science can be relevant to everyday life. Issues such as improving water quality, growing food without damaging the land and building energy-efficient houses are examples of applications.

An appreciation of the history of scientific discoveries, and their relationship to IK and different world views, enriches our understanding of the connections between Science and society (DBE, 2012:2).

4.5 Theme: The utilisation of IK innovations to enhance subsistence agricultural production

Most of the respondents have expressed pride in the fact that they have acquired many skills in plant cultivation, animal husbandry as well as plant and animal conservation. The most common method of land preparation includes the slash and burn method. The use of inorganic fertilizers and biocides in many indigenous communities is mostly limited; they constitute pollutants in the environment, while manure mainly from cows, are regarded as environmentally friendly, and is mostly preferred to enhance soil fertility. The interviews with community members who participated in the study reveal that they are unable to afford modern inorganic fertilizers during the planting season. Instead they make use of manure (compost or organic fertiliser) as it yields more production. Mrs Mzimela, who is one of the veterans in the use of indigenous techniques to enhance and improve yield stated that:

> *"...my experience in this field tells me that our ancestral magic to take note of crop rotation and planting cover crops was important"*

Plate 1: Span of donkeys preparing for field cultivation during planting season (Tillage)

The use of traditional knowledge is seen as a panacea to solve many problems of fertilising large fields in poor rural areas. The majority of villagers use both tractors, span of donkeys and oxen (see Plate 1) to cultivate their fields as part of subsistence agriculture. The picture below (Plate 2) shows how organic fertilizers, animal droppings and plant residues are used to enhance the quality of the soil.

Plate 2: Small-scale farmers preparing the compost from the harvested residues

The majority of women like the one seen in the plate below use these kinds of organic compost as fertilizers to grow crops such as spinach, cabbage and onions. These women are quite aware of the fact that these fertilizers are richer in mineral constituents compared to their Western counterpart. They also know and understand the positive impact of these traditional fertilizers on the environment as a whole. They do not cause any eutrophication if they are washed into the river system. Instead, they enrich the soil quality. The local communities understand what balanced nutrition means to their well-being and life expectancy.

Plate 3: Backyard fresh vegetable garden for subsistence farmers at Emacekane

Some of these subsistence farmers recommend crop rotation and planting cover crops to enhance the use of manure during the planting season. Some of the plants cultivated by rural women are food crops (*amadumbe*, sweet potatoes, etc.) and are recommended for their resilience to drought. These food crops are able to provide communities with quality food, and the remains are sold in the informal market. Some of the remainder of plant materials are equally preserved to feed livestock such as goats, sheep and poultry. This livestock also provides some of the nourishment needed by the community and serves as a source of income.

Plate 4: Small-scale farmers preparing the soil for cultivating amadumbe at a school garden

Plate 5: Small-scale farmers are using traditional hoe to clear the weeds school garden

The plate 4 and 5 show the partnership between the school and community. This partnership is an attempt to strengthen IK in the school curriculum. In the case of subjects like Agricultural Sciences, learners are taught scientific methods to control weeds by using chemicals. The above plates indicate the concern of traditional community of how certain cultivars such as *amadumbe* are planted and how to control weeds in a traditional method using hand hoe as a traditional method. These community members frequently visit school in order to showcase their skills and also share their knowledge with educators and learners of how to control weeds in the school garden. Their main concern was how to strengthen the incorporation of these traditional methods into the school curriculum.

4.6 Organisation of Technology content knowledge in the Senior Phase

Table 4.4: Organisation of Technology curriculum content knowledge

Grade	Focus	Content, concepts and skills
7	Design process skills	• Design: design brief, specifications, initial idea sketches choosing the best design, selecting materials. • Make: design plans, develop the manufacturing sequence; make the item/model. • Evaluate: learners evaluate both their solution stages and their final product. • Communicate: learners present their solutions; learners compile all notes and drawings into project in their workbooks. Design considerations • Fitness – for – purpose: Who is it for? What is it for? Will it do the job? Is it cost effective? Is it safe? Is it easy to use (ergonomics) Does it look good

		(aesthetics)? Will it affect society? Will affect the environment?
7	Structures	• Definition and purpose of structures to contain, protect, support, span. • Classification of structures: natural and man – made. • Types of structures: shell, frame, solid – learners complete a worksheets
7	Indigenous technology	• Learners investigate material and building techniques used by indigenous people for constructing housing in rural South Africa. Material used in such construction is typical readily available, appropriate and environmentally friendly

Table 4.4 depicts specific knowledge strands that should be learned by learners at school but using indigenous technology when teaching. In South Africa, learners learn a variety of indigenous technology at home taught by the elders and which are still relevant to modern school technology. The findings from the teachers revealed that learners learn about a variety of careers at an early stage from school science and technology. They learn how to design a house using sophisticated architectural design but before that they need to bring their IK to the technology class of how the traditional house is built. As technology teachers we need request learners to build a model of a traditional house as they see it in their homes. It then becomes easier to introduce the scientific logic of designing and building a house.

The following elements in Technology must be borne in mind:
- *Learners must be made aware of the relationship between technology, society and the environment.*
- *Learners should be made aware of different coexisting knowledge systems.*

- *They should know indigenous intellectual property rights.*
- *They should learn how indigenous cultures have used specific materials and process to satisfy needs, and become aware of negative effects on people's lives.*
- *Learners should be made aware of bias in technology and be able to express opinions that explain how certain groups within society might be favoured or disadvantaged by products of technology.*

I was so grateful to speak to one of Elder man Mr Mzimela from Emacekane about indigenous technology. He expressed his feelings by saying:

> *"Mina njengomsinsi wokuzimilela lapha endaweni yase Emacekane, thina sikhule senza izinto ezahlukehlukene eziwumsebenzi wezandla njengokubaza izinkezo, izinqoko ukwakha ocoyicoyi sisebenzisa isihlabathi." Lokhu kukhomba ngokusobala ukuthi ezobuchwephesha sizincele ebeleni. Ngokwami ukubona ukuthi kubalulekile ukuba abantwana bethu bafundiswe lobubuchwephesha ezikoleni. (Mr Mzimela, May, 2014)*
> {As an indigenes at Emacekan, I grew up loving the artworks or handcraft, doing things like curving traditional eating spoons, trays just to name the few. This was the clear indication that science was in our genes.}

The above specific aims vividly show that there is partnership and integration of IKS between the school and local indigenous communities. One senior experienced teacher, Mrs Kubheka echoed by saying that:

There is light in the dark channel, because for a subject like Natural Sciences IKS is valued although it is not enough. Other subjects do not value IKS.

4.7 Theme: Exploration of possible indigenous technology in the formal curriculum

The practical evidence of IK can be traced from many centuries to the current dispensation. The findings reveal some interesting examples of how people of Emacekane have been using IK to advance their technology over time. Many people are

still using stones (Plate 6) as a grinding machine for making maize porridge (*umcaba*) as well as peanut butter. Porridge made out of this technology has fibre believed to create unique taste and provide energy for indigenous people. They believe it prolongs their life span since it is full of roughage and fibre which is a source of energy and healthy lifestyle for Zulu people. One of the respondents who attest to this statement said that this porridge should be mixed with sour milk to prepare *amasi omcaba* or porridge with sugar solution to make *ugcanxu*. These grinding stones are usually kept in small rondavel or outside it for easy access to the user. The following image demonstrates the practical implementation of this technology by Zulu traditional women who participated in the study at Emacekane by showing how to use the *igovu* (wooden grinder) to grind peanuts into peanut butter which is sold in the nearby shops and school shop.

Plate 6: Grinding stone used to prepare *amasi omcaba*, millet and flower

This practice is highly respected among many Zulu communities as it highlights the power of traditional technology used in the past to prepare their most favourite meal and staple food. There were many participants who were able to identify with this practice

and their sense was that such technology should remain part of the school curriculum. Schools can learn from such practice because there is a lot that surrounding communities can benefit from infusing this knowledge to the learners. After showing the classification of indigenous technologies, Mr Mathenjwa commented that indigenous technologies have improved over time. For example, in other instances grinding stones were used to make millet or flour which taste different from the grinding mills. This explanation made me start reflecting on the objectives outlined in the NCS curriculum. To me, the NCS curriculum aimed to explore ways of improving existing technologies.

This knowledge from participants shows that certain traditional beliefs and values have made a significant contribution to the development of IK that can potentially promote the sustainable utilisation of resources and development. According to Gachanga (2007), there is a great possibility for teachers to integrate sustainable development knowledge into the formal curriculum. However, there are challenges arising from teachers' lack of faith that such a curriculum can actually contribute significantly in addressing the socio-economic needs of the country. This sentiment was shared by Mrs Mzimela, one of the science teachers at Emacekene High School who admitted that as a teacher she finds it very difficult to integrate IK into their practice because she had limited knowledge of what aspects of the curriculum to integrate.

> *The aspect about IKS in NCS requires teachers to combine indigenous with scientific knowledge as they deliver their lessons. Often times we find it very difficult to get specific method that can best integrate these two forms of knowledges during teaching (Mr Mzimela, April, 2014).*

This challenging aspect of IK integration was evident from many participants' responses during their interviews. One remarkable response that showed the teacher's frustration was when she said.

> *As a science teacher in this school, I was born from in this community and studied at the University of Zululand. I have a wealth of knowledge about indigenous*

technology, knowledge that I can share with my learners when teaching but it's always very challenging to integrate this part of my knowledge into the classroom practice (Mrs Mzimela, April, 2014).

I can share with you how I feel because there was every possibility and capacity provided by the DBE to integrate this form of knowledge into the mainstream curriculum implementation (Mrs Mzimela, April, 2014).

One can feel the need to foster this kind of knowledge in our education system, but there is no guidance on what aspect of culture are to be integrated into the curriculum except the rhetoric you always get from subject advisers (Mr Mathenjwa, April, 2014)

Another challenge is that the current syllabus shows us what we must and should do in following the specific work schedule, but there is no explanation on how to do it. According to Awuor (2013), the introduction of some of the IK themes pose a major limitation to teachers that they face when implementing such a curriculum. The interview held with a Geography teacher gave a unique sense of a desperate divide that can only be addressed by a planned collaborative relationship between teachers and communities particularly on issues of weather forecast. This question is pertinent for the indigenous communities of Emacekane. Teachers argue that modern science is more acceptable to the indigenous communities if it is integrated with what they already know. Scientific weather forecasts, for instance, may be more relevant to the communities if ways are found to integrate them in the IK they have relied on for generations to predict and cope with droughts, floods, and other natural hazards.

A classic case is the experience I have with farmers who usually consult the school for guidance and also listen to weather forecasts on radio presented by the South African Weather Services but still prefer to rely on their own traditional knowledge of when to start planting. The more the "scientific" forecasting

deviates from traditional knowledge, the less it is used for planning purposes by the indigenous communities. (Mr Mkwanazi, May, 2014).

4.8 Science teachers' views on how IK influences the learning of science

This theme seeks to gain a better understanding of teachers' insight into how science teachers perceive the influence of IK within the broader scheme of things. The specific question on this theme was, whether or not science teachers identified IK in their teaching as providing students with advantages or difficulties in their learning of science subjects. One of the most documented finding in science education with regard to this question has been the recognition that students' preconceptions often inhibit their learning of science because their pre-conceptions make more sense to them than any of the counter-intuitive concepts found in the science curriculum. This was evident in the interview findings when one experienced teacher flagged that hostility is deep-rooted in IK conceptions on the teaching of science subject. For example, Mrs Majozi argued that:

Learners are afraid of spiders, snakes, frogs and climbing mountains and even cutting down a tree growing on a grave. There are some taboos associated with these kinds of things and learners will not listen to you if you try to say for example, let's remove this tree because it grew up in a wrong place it does not matter: a tree is a tree no matter where it is found. (Mrs Majozi, April, 2013)

These inherent beliefs about IK as narrated by Mrs Majozi and other participants are likely to affect the students' understanding of science learning and teaching in schools if the syllabus requires the students to climb a mountain, or use snakes or frog to carry out experiments on them. The moment you start talking about science practical that will involve these kinds of animals; learners begin to give excuses not to attend that practical session. The narrative provided by science teachers who have been teaching for more 20 years gave a realistic account of preconceptions: if you want learners to study sewage, even if you provide them with gloves and gas masks, they will feel uncomfortable with handling and studying human refuse. They will give answers like, in our culture one who

handles faeces is referred to as a mentally challenged person, someone suffering from *ukuhlanya* (madness).

There were participants in the interviews who said that they see the value in the incorporation of IK into the mainstream curriculum. Three of the four participants described this explicitly as a positive move.

> *It is important, to be honest…the reality is that, when you start to lift up the hood and see what's under the engine, science— basically, anyone can do science. The nature of science itself is about discovery. Different cultures have their own ways of actually grappling with the environment. (Mrs Mzila, April, 2014).*

This was an interesting observation from this group of participants as they shape their thinking of the worth of this integration around a conviction that science is a cultural activity, and as such, cannot be divorced from the activities of human beings. Mrs Mzila broached this when she argued that *science as a human endeavour makes it becomes science* (Mrs Mzila, August 2013). From this point of view, science as a cultural activity admits of multiplicities, as opposed to a "hard science" perspective that would see modern Western science as the pinnacle of human rationality. This second, opposing, view was articulated by one of the participants as she wrapped her reservations around a double concern: one for the integrity of teaching of what was perceived as real science and teacher inadequacies in this regard:

> *I believe it would give Senior Phase teachers a further excuse to avoid teaching science because they could say yes, well I know — I can talk about what famous scientists have done from a social science perspective rather than doing the science. (Mr Zikhali, April 2014).*

This narrative underlines respect given for respective indigenous cultures from which the content material was to be derived:

[T]he way the syllabus is constructed could allow people to deal with science in a very superficial way and how other cultures use it could be treated in a way that wouldn't do justice to them. (Mrs Mdunge, April 2014).

One aspect of the proposal to incorporate indigenous perspectives into the science curriculum that the participants agreed on, however, was that this aspect of the curriculum could simply be sidelined:

On the periphery it will be look, this is how other cultures do this stuff but it's something you don't have to worry too much about. In many cases it could be core to a particular community, and I think that's the worry. It's just simply on the side. (Majozi, May, 2014).

4.9 Curriculum reforms: integration of IK into the science curriculum

This section seeks to explore whether or not effective partnerships exist between schools and the surrounding indigenous communities in the development and authentication of IKS for purposes of integration within the school curriculum. Second, it seeks to examine the role of socio-cultural practices towards the preservation of IK in schools and communities.

Research question number two, in this study sought to unravel issues surrounding such partnerships. For the purpose of the study, data analysis and presentation accrued from this study, yielded the following themes: practical implementation of IK and indigenous technologies into the curriculum, agro–ecological practice and IK and socio–cultural practices, learning across generation and integration of IK into the school curriculum,

The majority of teachers who participated in the study have many years of teaching experience in the field of science education. They all seem to share the sentiment that formal education needs to be complemented with traditional IK in order to address the need of rural schools. On the other hand, the other argument points out that formal

education which infuses tradition knowledge with the acquisition of academic skills enhance learning outcomes in the indigenous population. Teachers have emphasised the use of familiar learning styles and topics, such as local environmental knowledge to enhance the comprehension of subject content knowledge in science and technology in schools.

4.10 Theme: The overview of Indigenous Knowledge preserved in Emacekane

The people of Emacekane give the concept of relationships a significant priority as part of their custom and everyday reality. The focus group interviews held with traditional leaders and members of the community highlighted key values of *ubuntu* which encompasses respect, honesty, caring, gratitude, helping your neighbour in need, sharing, goodwill, collective responsibility, and working for the common good. These values need both members of the community and the school to work collaboratively to develop these attributes in children.

> *Sikhethelwe ukufundisa nokuhola umphakathi ngeqiniso silandela umthetho wekhosi kanye nenduna. Uma umuntu engahloniphi siyamqondisa simfake endleleni ukuze umphakathi uhlale ngokuthula'' (Focus Group, May, 2013).*
> {We were elected to teach and lead this community with integrity guided by the traditional laws from Amakhosi and Izinduna. When people do not respect our job is to put them in line so that the whole community can live in peace}

The elected traditional leaders took it upon themselves to ensure that these values are accorded the respect they deserve, and are held in high esteem by the community, sometimes by punishing disobedient behaviour. This is because it is regarded as abomination to behave in opposition to these values. In essence, all participants were aware of the importance of taking them seriously all the time otherwise their cultural identity would be questioned according to their knowledge.

In the same discussion, it became apparent that both the youth and the old respect their environment and they connect well with it. This was evident when participants talked

about the importance of conserving the natural environment in their area. They said this was 'given to them by nature: mountains, springs, rivers, grass and animals all belong to them and their ancestors. All these natural phenomena are a treasure to be protected because they believe they are connected to them in many ways. One participant was very brave to give a scenario of how they use the river to connect with ancestors, cleanse their sins and provide irrigation for their crops and for drinking.

> *Sinomfula omkhulu osipkakela amanzi okuphuza abantu nezilwane zethu ebusika nasehlobo. Uma kungasha wona singaba nenkinga enkulu kabi ngoba imfuyo yethu ingafa bese sihluleka ukodla izingane zethu. Lomfula uyigugu kithi ngoba sibhabhathiswa kuwo, siyakwazi ukuwusebenzisa ukuxhumana nabadala futhi (Mr Vezi, May, 2014).*
>
> {Our river is big and can provide drinking water for every living organism especially humans and animals in the dry and wet seasons. If this river experience water shortage, the whole community will experience huge problems related to the dying of livestock and the creation of poverty}

These participants made it clear how the fear of the unknown made them fear natural events like natural hazards, so their knowledge about how to predict these natural hazards is very important to them. A few selected Elders are able to predict when strong winds, cold, lightning, and rain will occur by studying the moon, stars and wind direction. It was made clear that Elders are important in their community when it comes to predicting natural events and hazards. The land and its political history are part of their lived experience. The importance of history to the community cannot be overemphasised. The participants argued that history is all they have as Africans to preserve through IK. However, this knowledge is slowly disappearing because of poor documentation and the lack of political will to build institution that can preserve it. The fragmentation of history has disrupted their way of life but has not completely severed their spiritual connections. They understand and live the interconnections of the social, the physical and the spiritual. Although disease and death, unemployment and poverty are a reality, the youth show that they have a future to live for – to serve the more vulnerable in their community.

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Many participants say that they take part in traditional practices such as *indlamu and ingoma* (song and dance) as well as poetry commonly performed at the traditional functions. Some of these traditional practices are encouraged by most schools in the Province of KwaZulu Natal with a view to preserving cultural heritage. The Elders explained the kinds of events that are likely to sustain tradition and culture and these are songs and dance which are performed in the community of Emacekane.

> *Imishado lapha isenziwa ngesintu lokhu okusho ukuthi izintombi nezinsizwa kumele zishaye ingoma, zisine izintombi uma seziphelezela umakoti. Nezinsizwa kumele zihaye ingoma zikhombise ukujabula ukuthi insizwa isiyathatha. Kusinwa kuze kuphele umcimbi ukukhombisa injabulo yokuthi imindeni emibili iyahlangana. (Mrs Zitha, May, 2013).*
> {Leading up to the traditional marriage/wedding, young women and men are supposed to prepare traditional songs to be sung during the traditional ceremony. Men are also supposed to sing traditional songs and dance in celebration of the marriage. This dancing and singing continues for the entire ceremony as a symbol of welcoming the marriage of two people}

These songs and dance are also practised and perfected in schools as part of cultural heritage particularly during the heritage month. In almost all the schools in Emacekane, teachers voluntarily organise learners who can sing and dance traditional music in order to participate in the competitions organised by the Provincial Department of Education as part of heritage celebration. In these celebrations, learners are expected to showcase their art of singing and dancing as performed in their community.

Traditional rites relating to the initiation of boys and girls as well as virginity testing for girls are also practised as also explained in science strand above. This indigenous practice is gaining popularity as the campaign intensifies to reduce the HIV/AIDS infections rate in our schools. The people of Emacekane maintain connection with the spirits of their departed relatives through communicating with them by the burning of incense. Practical

skills in Emacekane are gender-based. Men work with animal skins, wood and horns. Women work with grass, beads and clay. Both men and women take part in the construction of traditional huts.

4.11 The effect of IK on parents' involvement in learners' education

Parental involvement has a significant role to play in the initial teaching of a child, this should bring about the positive involvement in their children education. It came out clear that, parents are the first teachers to build a foundation for learners, as members of the community, and they have a wealth of IK to impart to their children. They are at the vantage space to impart IK related information informally, but also when they are given project to do at home. Many parents live in the community where different people with unique expertise reside, it is easy for them to identify those people in the community to offer their knowledge about the subject at hand. Some participants said they are willing to support their kids when it comes to school work as long they can offer something. One of the passionate parents was vocal on this aspect:

> *"as parents we can play a supporting role in the education of our children, remember we are the first people to teach our kids how to say sawuboma (greeting) and that impact is more significant. Therefore, the IK can act as an important link between the teachers and parents (schools and home). Schools provide scientific principles in the form of academic knowledge while the home will act as motivating structure by changing the attitude of these learners to love science. Both parents and learners can benefit from science" (Mr Mkwanazi, May, 2014)*

> *"I believe the personal touch is significant, when you work with your child closely, that make a big difference in the way we can impart knowledge in our kids. At least we will have a sense of what is taught at school. (Mrs Mzimela, May 2014)*

In a classroom in which there is co-participation, cooperative learning, and joint discovery, environments are created in which students are able to build upon the culturally-shaped knowledge and value systems they bring to school. Vygosky's analysis of spontaneous and scientific concepts provides a foundation for examining how children learn before they enter school and how this knowledge relates to concepts learned at schools. By spontaneous concepts, Vygotsky meant concepts that are acquired by the child outside of the context of explicit instruction. In themselves, these concepts are mostly taken from adults, but they never have been introduced to the child in a systematic fashion and no attempts have been made to connect them with other related concepts.

4.12 Theme: Challenges faced by teaches as they use instructional language

As teachers grapple with integration of IK, it became apparent that from the interviews the majority of participants experience challenges when it comes to constructing meaningful scientific terms and vernacular words that best represent scientific meanings. The response from senior teacher suggests that instruction in science largely depends on the use of words, both in the vernacular and in scientific terms. He believed that the home language (IsiZulu) should be fully developed by parents in order for the teachers to use it to explain scientific concepts in their subjects.

> *Sibhekana senkulu inkulu inkinga ngoba sisebenza emakhaya lapho kumele uqhamuke namagama azokwazi ukuchaza kahle i sayensi ngolimu lwesizulu. Lokho kuyinkinga futhi kusibangela izinkinga ngoba lezizingane zethu kulezizikole zasemakhaya aziqondi uma uchaza ngesingisi sodwa uma ufundisa isayensi (Mrs Mkhwanazi, May, 2014).*
>
> {As teachers we face a serious challenge when we are to explain scientific concepts in the vernacular because our learners struggle to understand English}

As a teacher, one should ask oneself "When teaching about indigenous technologies?" The integration of IK has brought a new dimension of operations into a science and technology class. Teachers have found themselves with new tasks that require new

knowledge and skills. One of the essential assets that teachers require to function well as they help learners to make the most out of their learning is knowing words that will relay appropriate meanings to learners. This becomes necessary since grade 7, 8 and 9 learners are for the first time is classes, where instruction is in English, as opposed to the vernacular which learners were used to in the lower grades. Since grade 7 is a transitional class, teachers are forced to code switch when they are teaching. The issue that sprang up from the participants was the use of appropriate words which can help learners understand science, and words in the vernacular that have scientific meanings. Selection of appropriate words by the teachers proved to be an issue worth discussing in relation to effects on teaching and learning. Hence, I turn to the issue of language in learning as played out in this study.

Kubalulekile ikusebenzisa isiZulu uma uchaza amagama. Singothisha, uma sifundis ngesingisi sodwa izinga lokuphasa livele lehle kakhulu. (Mrs Mathenjwa, April, 2014).

{It is important to clarify scientific concepts in Zulu. As a teacher, if you teach in English throughout without code switching, the pass rate in science will reach a bottom low level, I tell you.}

Something worth highlighting during the interview session was when participants confessed that the integration of IK in science and technology forced teachers to search for vernacular words that bear scientifically relevant meanings to fit explanations during instruction of indigenous technologies. Choice of appropriate words became necessary as teachers dealt with (a) concepts in science and technology, (b) measurements in investigations, (c), thinking about and helping learners talk about parameters for investigations. As teachers organised and taught lessons on indigenous technologies, they tried hard to choose words for instruction that they considered helpful but in some cases they could not precisely articulate meanings or explain ideas about indigenous technologies.

4.13 Theme: Participants' suggestions for school learning

After careful analysis of both students' and Elders' views one could make the following suggestions on what could be leant at school to improve the conceptualisation of IK. The Elders suggested that children should be taught practical skills at home such as crop farming and livestock rearing so that it would be easy for teachers to inculcate these skills as they are directly relevant to their life in Emacekane.

Sesifikile isikhathi sokuthi sifundise abantwana bethu umsebenzi wezandla ngaphambi kokuba beye esikoleni. Ngikusho lokhu ngoba thina bazali singadlala indima enkulu ekutheni abantwana bethu bakwazi ukuqhuqhuzeleka ukuba babe abalimi kusasa uma sebefundile. Izingane eziningi zifunde imfundo engaphelele ngoba aziwazi umsebenzi wasekhaya. (Ms Ngobese, April, 2014).

{The time to take charge of our children education has arrived so that they can learn practical skills before entering formal schooling. I am saying this because as parents we can play a pivotal role in inspiring our kids to take advantage of subject like Agriculture as a career after matric. Most of our children have acquired this kind of mismatch education because we do not participate in school affairs but we expect teachers to do the impossible.}.

"Kuyihlaya ukuthi thina bazali safundiwsa ukuzimela ngokuthi sizunde umsebenzi wezandla kepha asikwazi namuhla ukudlulisela lesisipho esihle kangaka kubantwana bethu sokusebenza ngezandla" (\Mr Zungu, April, 2014).

{It is an irony that as parents we know practical work from our parents but we are failing to pass on these same skills to our kids at a young age to use their hands. Maybe we are too sophisticated and we don't know who we are and where we are today}.

The community is concerned about the level of practical involvement at home and how it influences the practical value of schooling in its current form – where their kids lack hands-on application. The 'paper-based' knowledge acquired at school is seen as having little relevance for the community, nor does it seem to help students outside Emacekane.

Only two students from the school made it to a tertiary institution in 2012, and opportunities outside the village remain inaccessible to the majority. The question that begs urgent answers is how education, guided by the current curriculum documents, can be made to enhance life chances for the children in a context where communities are "not persuaded that education will change their lives" (Malcolm, 2008, p. 145).

In addition to learning practical skills, community members were unanimous on what should be taught at school and home, namely, respect. On this question, every community participants spoke of the impact of the continual dissipation of the culture of "respect" from the youth of today. On the question of how respect can be restored, they were all confused but some Elders recommended the following solutions in order to overcome this dilemma.

> *Sesifikile lesikhathi sokuba imfundo yethu thinadlu emyama sivume ukuthi inhlonipho ayifundiswe ezikoleni ukuze siphumelele. Uyazi wena mfana wami, zisehlula sikhona lezizingane mhlampe iskole singasilekelela* (Mr Zikhali, April, 2014).
>
> {This is the time our government must introduce respect in the school curriculum so that we are going to prosper as a black society. You know young man, our children are so unruly and disrectful, therefore it is my belief that the schools can play a meaningful role}.

The majority of the participants were quick to point out their personal experience about the absence of respect in their home and schools. It was evident that respect is not simply considered in its association with indigenous values. Respect is viewed as a strong determinant of students' success in school hence the explicit teaching of respect is viewed as likely to contribute to better performance.

> *Eyami ingane akaze iphase kahle nje ngijabule ngoba ayihloniphi lapha ekhaya kanye nasesikoleni (Mrs Zitha, May, 2014).*

{my chid lacks respect at home and at school, her performance is shocking and teachers complain about the lack of respect from her and in her work}

Students felt the need to question the relevance of the NCS/CAPS in the context of IK. This concern casts some doubt on the value of single ways of knowing, and advocates the use of many ways of knowing. Just as the case with the Elders, the important factor deciding what should be taught at school is relevance. The content that the students would like to learn more about includes both IK and science-based knowledge (Table 7.1). The students want to know more about environmental issues; manufacturing and technology; as well as practical skills. Issues specific to IK that the students want to learn more about include indigenous plants; constructing huts and preserving food. A lot of the suggestions about learning in environmental issues that the students make (Table 7.1.) are to do with issues that one would expect them to learn about Life Sciences. The students could have included these issues either because they had not covered them in class, or if they had, it may be that the content was not taught in a way that encouraged them to relate it to their lived experience.

The community of Elders highlighted the lack of interplay between the local schools and the surrounding community. They felt a strategy needs to be developed where each stakeholder can play a meaningful role. This has implications for the environment if students learn how every piece of paper is related to a tree. It is likely that the students did not know as this statement came as part of the things that students would like to learn more about.

In summary, the suggestions made by students and Elders in Emacekane about what could be included in the school curriculum are based on what the participants view as relevant for their context. The Elders suggest that young people should be taught practical skills as well as to be respectful. These suggestions should be incorporated into the curriculum content based on the perceived capacity of the school to do more than what is being done now. The community hopes that the schools can help fight the challenges that the community faces. The fact that this area is deeply rural, and students endure long

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distances, cold and rain when going to school, suggest that they do view school as an avenue to a better life. According to Elders, the school could serve the community more efficiently and effectively by addressing local challenges through the curriculum.

It was significant to note that teachers support the idea of integrating IK in the school science curriculum with the intention to empower students. They show a clear understanding of the differences between IK and science, and in some cases view science as "the ultimate truth". The teachers support IK-science integration as a means for students to understand science better. There is much that still needs to be done to enhance the level of IK in the next coming years, but at this stage we can do much with the few resources at our disposal. The ultimate goal behind this integration is improving the grade 12 results particularly in science.

I think IK should be included in the teaching of science. When we introduce principles, theories and laws of science, there must be a link with the IK they (learners) have, because sometimes when we are trying to make them understand a principle or theory, learners raise an objection: "But in our IK, you know that this cannot happen because of this or that". There is now a conflict between science and their IK. Nonetheless, I think we take account of learners' IK.

That means if we are introducing any (scientific) principle, we must make it answer the question of their knowledge and their conflict. Because some of their IK is just things that they believe in, you know, which sometimes are not true. Then you find that this thing which is not true makes them not to understand why science happens the way it happens. From there you have to convince them so that they can understand what the truth about science is and what is not true about their IK (Mrs Mathenjwa, Interview, 2013).

The IK that Mr Manzini can identify in connection with school science is in the form of community beliefs, for instance, about lightning. Students' beliefs on lightning are not compatible with school science, and make it difficult for them to both understand and accept scientific principles. The teachers propose greater opportunities for dialogue with

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community Elders. They are willing to liaise with Elders to find ways of negotiating knowledge spaces between local knowledge and school science. The teachers suggest integration that is facilitated through "coming together" (Mr Manzini); holding "discussions" (Mrs Mathenjwa); and "linking" IK and school science (Mrs Mazibuko). IK-science integration, in the teachers' view can be based on school-community knowledge conversations. The teachers commend the approach taken in this study (i.e. working with both the school and the community), and they think the study has presented an important example of that:

> *I learnt a lot when it comes to teaching Physical Sciences. The project helped a lot. It helped the learners to be able to do 'research' - to research from with the Elders. Information is in the community. They don't always need to go far away to the libraries to get the information (Mrs Mathenjwa, May, 2014).*

The teachers' suggestions for integration highlight ways in which 'research attitude' has shaped participant response in this study. The teachers realise the benefit of school-community collaboration in the study and they propose it for shaping the local curriculum. This finding is similar to the proposal for "community-centred curriculum" made by Keane (2006a). This study thus presented a bridge between the school and the community, which will hopefully last beyond the study. The summary of findings in the form of a community booklet written in both isiZulu and English contributes to that lasting relationship.

The teachers' proposal for dialogue with the community did not occur in isolation. In the various meetings, the Elders also suggested greater involvement in sharing the knowledge they have with the school. For instance, female Elders expressed willingness to teach students the processes involved in making reed mats, from harvesting the reeds, drying them and making the mats. The Elders report going to the school every year to pray for Grade 12 students before the Senior Certificate examinations – a symbol of sharing beliefs and deep-seated spiritual values. In response to the question of tangible benefits that the study would bring to the community, the School Governing Body and the

Traditional Council agreed on the construction of a traditional hut within the school premises. The building and setting up of the hut would serve as a permanent symbol for the bridging of indigenous and modern knowledge. However, in an unfortunate turn of events that cannot be detailed in this report because of ethical implications, the hut construction did not materialise.

From the point of view of the participants, there is room for integration of local knowledge and modern knowledge, as represented by school science. The participants' suggestions on how such integration can be done points towards the importance of creating spaces for dialogue. In the next section, I examine the curriculum documents that guide teaching of Life Sciences and Physical Sciences.

4.14 Summary

This chapter has analysed and discussed the focus group, interview data solicited from science teachers and the data from the analysis of curriculum documents in terms of the following themes: an overview of science curriculum, how to engage learners in teaching and learning, approaches to use when selecting and organising curriculum content, selection of themes, best approaches to teaching an integrated curriculum, and challenges facing the implementation integration of IK into science curriculum. Each theme has considered the actual and ideal practice of science in Empangeni District in South Africa.

CHAPTER 5

SUMMARY AND SYNTHESIS OF FINDINGS, CONCLUSSION, AND RECOMMENDATIONS

5.1 Introduction

The purpose of this study was to explore and document the perceptions of teachers, students and the rural community members of Emacekane in KwaZulu-Natal on the possible integration of IK into school science at the Senior Phase. This study derived its interest from the scantiness of information found across the national curriculum documents that seek to motivate for the valuing of IKS. Most of the information provided in this study was based on science subject statements, which made reference to IK. The availability of this information creates a significant challenge for teachers who should decide on what IK to include in science during teaching and learning.

This country is blessed with endless possibilities when it comes to IKS that could provide learners with a good entry point into the scientific world. In this regard, social constructivist teachers will take advantage of the opportunity to build new knowledge on learners' prior knowledge. This perspective will develop learners with strong scientific expertise in our community. Some of the opportunities provided by IK can open career opportunities and develop learners' entrepreneurial skills. It is a fact that the majority of traditional communities depend on indigenous activities such as subsistence agriculture, traditional healing and traditional art (music, dance) for survival and generating income. This study used the following questions as a guide to develop the critical argument as presented in Chapter 4.

1. What are the ways in which teachers can integrate IKS within science subjects as taught in Empangeni schools?
2. Does a partnership exist between schools and the surrounding indigenous communities in the development of integration within the school curriculum?

3. What is the role of socio–cultural practices in the preservation of IK?

5.2 Synthesis of findings in relation to research questions

5.2.1 Curriculum changes and adjusted curriculum content

Curriculum changes pose numerous challenges for teachers in any educational environment. Their understanding and adaptation to the new demands become limited. When the new curriculum for science in the Senior Phase was ushered in, teachers noticed the unique features of inclusion of IK as part of the new features. The DBE has considered the incorporation of IKS into the mainstream curriculum as an important consideration in developing interest in non-Western culture into an interest in science. According to Aikenhead (2006), the inclusion of non-Western culture into the curriculum can motivate learners to develop love for science. In the NCS, there is a promotion of science for everyday living which in real terms is ambiguous about what it means by its relevance to everyday life. This phrase looks interesting for curriculum implementers, but there is very little guidance on how it can be implemented in their teaching.

5.2.2 Participants indigenous knowledge that could be included in science

The participants recommended that practical skills should be developed as early as the Senior Phase so that learners can begin to appreciate science. Most participants made this observation as part of a comparison with the old system of education where learners were learning arts and crafts such as moulding various shapes using clay soil, and other forms of creative art. They argued that such practices could directly involve them in deciding on the kind of science that can benefit both the school and the community. The school can invite certain members of the community into a discussion forum where an IK indaba can be initiated to tackle these issues head-on.

5.2.3 How can integration be achieved in the curriculum?

Participants suggested local knowledge should be used as a springboard for learning science at school. They also made suggestions for teaching and learning in an integrated IK-science curriculum. The only way one can learn integration is by involving oneself in

hands on activities, and the orientation towards respect which will inculcate the formal scientific teaching in class. What also came out strongly was the concept of building partnership between the school and the surrounding communities. Teachers can initiate conversation with parents at their level of understanding so that they can contribute meaningfully in the development of IK-science integration. Students are keen to learn from the local environment where they have a better understanding about the relationship between IK and science. Outdoor activities were identify learners as the most critical component which could sustain enjoyment and enthusiasm for learning through culture.

What really emerged from this study was the feeling of optimism and anticipation that one day the schools will push for an inclusive curriculum that comprise a community-based, leaner-centred, socially relevant pedagogy which can function within the prescript of education for all. Community members who participated further requested the use of local environment which is likely to win the hearts and minds of many indigenous communities. Some participants conceded that these aspirations and ideas are very difficult to implement but the DBE can do more to succeed.

5.2.4 Lack of resources to promote IK

IK is informal everywhere in South Africa; these participants raised serious concerns about the lack of information on IK. The views of many teachers seem to be firm, which is to facilitate the inclusion of IK into science curriculum but their serious challenge is to outsource relevant information. Teaching is a very delicate job where knowledge can only be imparted when you have relevant material, a teaching strategy, teaching techniques and proper planning which you can acquire through proper training at an appropriate institution. According to Gravett et al. (2010), teaching is a challenging profession that requires properly trained teachers who can think and reflect before carrying out teaching instructions. In this case, teachers should be given enough space to acquire the requisite skills to integrate and take this new knowledge into the curriculum otherwise they are going to be burned out and leave the profession prematurely. The curriculum developers should remember that teaching is not just about transferring knowledge from textbook or from community members who understand IKS to the

students. In reality, teaching is the systematic organisation of material, content knowledge, PCK and adapting it to particular learning situation; it is about preparing learners to learn for lifelong learning.

5.2.5 Participants' belief systems and their influence in integration

Parents and teachers come from different backgrounds, so their understanding of what should be regarded as IK or not becomes a big question. Teachers argue that they have different views on the nature of science and some were questioning the feasibility of incorporating IK into science. The results reveal that some teachers have attended multi-racial schools and their understanding of IK is very limited while other hold very strong religious beliefs that question the very existence of traditional and IK existence. Some were not happy about their language proficiency when it comes to the vernacular if they are asked questions related to IK. It was clear from the interviews that some learners view teachers who incorporate IK in their teaching as bad teachers while other get inspired by such teachers.

When the participants were asked for their views on inclusion of IK into science, they said their religious beliefs prohibit them to talk about IK in their teaching. They said, there are occasions when you are supposed to make an example of an indigenous scenario, but it did not feel right. IK is seen as a very low level of sophistication and many participants believed that anything indigenous is evil and backward: it offends their religious beliefs. It is associated with witchcraft, using *umuthi*, talking to ancestors, performing rituals, burning incense and wearing traditional skin clothing. According to their religion, they are not allowed to come near traditional healer (*inyanga*) or talk to them. Visiting *isangoma* or *inyanga* is a form of sacrilege since they are believed to come in contact with evil spirits. *Izangoma* and *nezinyanga* are regarded as evil spirits that is why those participants do not want to have anything to do with them. Even if they could gain something from these people the fact remains, according to some participants, that they cannot be trusted because of the evil spirits they carry.

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5.2.6 The views of teachers about science (NS) and their role in society

The pre-planned interviews with the participants were interrupted by their constant missing of deadlines and their overwhelming sense of insecurity about the study of this nature. Some of the participants gave various reasons for failing to make themselves available as planned: unexpected appointments, not being properly prepared for the interview, family and religious belief, and general beliefs about IK. It was evident that IK is foreign to most of the teachers and they cannot relate it well to what they do at schools. Teachers think that science is ultimate and static. Many participants hold many misconceptions emanating from their lack of professional development in science. Some of these misconceptions are deeply embedded in the IKS, and can only be addressed through the integration of IK into the curriculum. The majority of senior teachers believe strongly in what they learn during their teacher training years and they think it cannot be challenged and represents real science for the class. After the interview, some teachers felt the need for professional development in the field of IK since it is a new field in science.

5.3 Conclusions based on data collected by means of documents, in-depth interviews, observation and focus group with rural communities

5.4 Recommendation

The data gathered for this mini research study was mainly qualitative in nature and was sufficient to collect relevant data about the inclusion of IK in the science curriculum. The amount of data that could have been collected if this study was bigger would have provided significant solutions to the societal problems we are currently facing on the curriculum field. Based on the nature of this study and the data collected, the following recommendations are made:

5.4.1 Provide clear professional guidance on how to integrate IK into science

Teachers are the frontrunners when it comes to new curriculum implementation; they always find themselves in the serious predicament of having to deal with untested

curriculum content. The role of the teachers is to empower learners so that they can benefit from their expert guidance. It was clear from this study that when a new curriculum is introduced, teachers have to divert their attention away from the core business, and try to understand the proposed changes. In this instance, a few lucky teachers managed to master the trade of integration of IK into science while others struggled for a very long time. Owing to the lack of PCK, these science teachers should be allowed to attend cluster meetings, where they can analyse the challenges and address them immediately. Well-resourced schools should adopt less privileged schools as part of the official mentorship strategy, where sharing of resources can be advanced. Teachers need to learn from other more experienced teachers through communities of practice (Hare and Wenger, 1991).

5.4.2 Establishment of IK data bank for teachers

In recent times, the DBE has kept on refining the curriculum to better prepare young South Africans to fit well into the world of work. The question on the teachers and community lips, where is the relevant material to address the identified strands in the CAPS and NCS. This study recommends the establishment of data bank or website that is properly managed by the DBE in being continually update for the benefit of teachers. Currently, there are a few individuals with a keen interest in making a contribution in the form of writing books, making DVDs, and developing websites and these individuals should be motivated to contribute more and inspire others to do the same. The time for keeping much information in the memory has past, now the stakeholders should begin to invest in indigenous knowledge and technology so that South Africans can benefit. There must be a strong partnership between institutions of higher education and schools so that research will be promoted to enhance the development of IK in schools. The study suggests not just any partnership, but one based of on mutual respect and a common vision of better science built on strong values.

5.4.3 The development of curriculum that is user friendly for teachers

The Department of Basic Education has the sole responsibility to assist teachers in their professional growth. Teachers in this study highlighted the need for a more decisive curriculum that is able to articulate learning outcome or specific aims for IK in the curriculum document. These specific aims can address many concerns that teachers pointed out in Chapter 4 regarding the absence of clear components that can be integrated in science curriculum. The results of this study have revealed that many teachers can play a more constructive part in shaping the curriculum as they are the front runners during the process of implementation. They recommended the need for the establishment of a task team to develop clear terms and conditions for addressing some of the glaring challenges posed by the integration of IK into science.

5.4.5 Area for future research

The sample size of this study was solicited from the Physical Sciences teachers of KwaZulu-Natal. It is therefore not representative of the entire population of teachers of this country. Similar studies are needed to be done in other provinces to validate the findings. The study considered it worth noting that the design and procedures for the data collection during the empirical study were confined to one district of five in the province. Of the sample of 40 teachers to whom questionnaires were distributed, only 35 returned their questionnaire, hence, Chapter 4 presents a small fraction of the entire population of teachers in the chosen district. Another significant aspect of the study that needs to be highlighted has to do with the procedure that was used for collecting qualitative data. The findings presented in Chapter 4 are based on the responses gathered from the sample of 16 science teachers teaching in the Senior Phase. Whilst these findings are significant about the integration of IK, they cannot be generalised to mean the same for the entire population.

The findings of this study should be understood within the limitations of the research sample and the district in which the empirical study was conducted. The findings were highly significant in this study as they highlighted crucial implementation gaps that need to be addressed for the effective implementation of IK into science curriculum, and future

curriculum changes in the district. These issues could also be further researched for the purpose of finding solutions as they were found to be a threat to the effective implementation of curriculum change in the teaching and learning of NS as part of the integration of IK into science teaching in the classroom.

5.5 Conclusion

This chapter has presented conclusions and recommendations drawn from the synthesis of findings based on data collected by means of an explanatory approach. These findings highlighted some major issues that impede the proper implementation of IK into science curriculum in South African schools. The conclusions drawn from this study could make a significant contribution towards the introduction of curriculum innovation and change because these findings are based on the perceptions and perspectives of teachers who are the frontline implementers of curriculum change in schools.

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P. O Box 568

Kwa – Dlangezwa

3886

Dear Participant

REQUEST FOR YOUR PERMISSION TO PARTICIPATE.

My name is Mhlonipheni Mkhwanazi currently studying towards a Master's degree in the Department of Mathematics, Science and Technology Education at the University of Zululand. I am conducting a research to explore the possible integration of indigenous knowledge systems (IKS) into the main stream curriculum at Empangeni schools in KwaZulu – Natal province.

The research will be conducted under the supervision of Mr W. D Mncube from the University of Zululand. I am hereby seeking your permission participate in this research.

I have included a copy of the standard ethics protocol for your perusal.

Thank you

Yours sincerely

Mhlonipheni Mkhwanazi

CONSENT FORM – PARTICIPANT

I…………………………………..give assent or not assent to participate in a research as stipulated in the request letter.

Signed …………………at……………………………..date (ymd)……………………
                                                                        P. O Box 568

The Principal

Dear Sir/ Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOL.

My name is Mhlonipheni Mkhwanazi currently studying towards a Master's degree in the department of Mathematics, Science and Technology Education at the University of Zululand. I would like to conduct a research in your school for the purpose of fulfilling the requirement of a Mini – dissertation in Science Education; my research topic is: The integration of indigenous knowledge systems into the main stream curriculum of Empangeni schools in KwaZulu – Natal province.

The research will conducted under supervision of Mr W.D. Mncube from the University of Zululand. I am hereby seeking your permission to approach science FET teachers in your schools in order to participate in this research.

I have included a copy of the standard ethics protocol for your perusal. Upon completion of the research, I undertake to provide the Department of Basic Education with a copy of the full research report upon completion. Should you require any further information, feel free to contact me on this number 0722007386.
Thank you

Yours sincerely

Mhlonipheni Mkhwanazi
 REPLY SLIP
To the Principal

Dear Sir

I hereby give you access to conduct your research at the school on the topic: Integration of indigenous knowledge systems into the main stream curriculum of Empangeni schools.

_____   _____   _____

Principal   Signature   Date

The Director

KwaZulu – Natal Department of Education

Provincial Office

P.O. Box 13051

Pietermaritzburg

3880

Dear Sir/ Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOL.

My name is Mhlonipheni Mkhwanazi, I am studying towards a Master's degree in the department of Mathematics, Science and Technology Education at the University of Zululand.

I would like to conduct a research in your school for the purpose of fulfilling the requirement of a Mini – dissertation in Science Education; my research topic is: The integration of indigenous knowledge systems into the main stream curriculum of Empangeni schools in KwaZulu – Natal province.

The research will conducted under supervision of Mr W.D. Mncube from the University of Zululand. I am hereby seeking your permission to approach FET teachers in your schools in order to participate in this research.

I have included a copy of the standard ethics protocol for your perusal. Upon completion of the research, I undertake to provide the Department of Education with a bound copy of

the full research report. If you require any further information, please do not hesitate to contact me on 0722007386.

Thank you
Yours sincerely
Mhlonipheni Mkhwanazi

Enquiries: Sibusiso Alwar	Tel: 033 341 8610	Ref.:2/4/8/1/111

Mr ME Mkhwanazi
P.O Box 2544
Esikhawini
3887

Dear Mr Mkhwanazi

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"THE INTERGRATION OF INDIGENOUS KNOWLEDGE SYSTEM INTO THE MAIN STREAM CURRICULUM OF EMPANGENI SCHOOLS"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 01 April 2014 to 30 March 2015.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Mr. Alwar at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Director-Resources Planning, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education (Empangeni District)

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 05 May 2014

OBSERVATION SHEET: CHECK LIST

Date: _____

Name of School _____

No	Items	Yes	No
1	Classroom		
1.1	Do the teachers integrate indigenous knowledge systems within science subject taught in school?		
1.2	Is indigenous knowledge integrated in the lesson?		
1.3	Is the teaching method integrating indigenous knowledge systems?		
1.4	Is there any partnership exists between the school and indigenous communities?		
1.5	Is there any role of socio – cultural practices towards preservation of indigenous knowledge systems in schools?		
1.6	Do the teaching materials integrate indigenous knowledge systems?		
2	Policies and Documents		
2.1	Does the school have a policy on integration of indigenous knowledge systems into the mains school curriculum?		
2.2	Does the subject policy include integrate indigenous knowledge systems?		

2.3	Does the subject frame work include indigenous knowledge systems?		
2.4	Does the work schedule include integrate indigenous knowledge systems?		
2.5	Does the lesson plan include integrate indigenous knowledge?		
2.6	Does educator's file have documents on integration of indigenous knowledge systems?		
3	School Premises		
3.1	Does the school have any indigenous garden?		
3.2	How does the garden help the school and learners towards learning science		
3.4	Does the school contemplate integrating indigenous knowledge in the main stream curriculum?		

NATUTRE OF SCIENCE AND INDIGENOUS KNOWLEDGE QUESTIONNAIRE

Please answer each item below. Write your ID number for follow – up purposes only.

Question 1

Two of the aims of Learning Outcome 3 (LO3) of the Revised National Curriculum Statement (RNCS) for the Natural Sciences are that:

(1) Science education should help learners become *problem solvers.*

(2) Learners should *integrate their traditional worldviews with the scientific worldview* taught in the science classroom.

(a) Do you agree with these aims? Explain

_____

_____

_____

(b) Is LO3 included in what you teach? Explain

_____

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The same RNCS also states that: (i) learners hold different forms of worldviews and (ii) that people (including scientists) use different ways of thinking and behaving in different situations e.g. they can use religious or other frameworks to interpret experience

(c) What specific difficulties do your learners normally have with the scientific way of thinking and how do you help them resolve such difficulties? Give specific examples.

_____

_____

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QUESTION 2

Some people claim: "Science is problem solving". People who have this view often think that problem solving, and science, develop in three stages: (1) *recognition of the problem;* (2) *try solutions and (3) eliminate errors.*

When successful solutions are found, two things can happen:

   (3) The successful solution is *learnt or retained* and (5) it results in a new *expectation* (or hypothesis, or theory) that is used, later, to try and solve similar problems.

(a) Do you agree with these views of what science is? (Please give specific reasons).

   _____

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(b) Which description best describes the science <u>you teach:</u> (i) science is problem–solving activity, or (ii) science is knowledge. (Please give examples to clarify your answer).

   _____

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   _____

(c) Should a learner in some circumstances be encouraged to ignore a problem, even if it is of interest to him/her? (Please explain, give reasons or examples of such circumstances, if any.

   _____

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QUESTION3

Examine carefully the basic assumptions underlying integration of science and Indigenous Knowledge Systems

(IKS) in the Table below and tick off which applies to either science or IKS.

Item	Statement	Science	IKS
3a.	Space is real and has definite dimensions.		
3b.	Regularity of events in nature depends on how the beings behave.		
3c.	A Supreme being created in universe.		
3d.	Space is real and has definite and indefinite dimensions.		
3e.	Time is real and has a continuous, irreversible series of duration.		
3f.	Matter is real and exists within time, space and the ethereal realm.		
3g.	Our sense perceptions are not the only means of understanding nature. In fact, certain experiences defy sense perceptions.		
3g.	Nature is real, observable and testable.		
3h.	All events have natural causes.		
3i.	Humans are capable of understanding nature.		
3j.	Language is an important tool that can be used to explain, predict and even create natural phenomena.		
3j.	Sense perceptions are the only valid and reliable means to understand nature.		
3k.	Nature is real, partly observable and partly unobservable.		
3l.	The universe is orderly, partly predictable and partly		

	unpredictable		
3m.	Language is an important tool than can be used to describe, explain but not to create natural phenomena.		
3n.	The universe occurred by chance and undergoes continuous evolution.		
3o.	Humans are capable of understanding only part of nature.		
3p.	Regularity of events in nature can be taken for granted.		
3q.	Time is real, continuous and cyclical.		
3r.	Events have both natural and unnatural causes.		

3s. in view of the way you have categorised the two sets of assumptions above, do you think that the goal of LO3 to integrate science and indigenous knowledge system is realistic? Explain: _____

_____

QUESTION 4

Science teachers are dealing with different fields of science. In addition, they are dealing with indigenous knowledge.

(a) Should teachers emphasise or de – emphasise the boundaries between the different fields of science such as Biology, Physical Science, Earth Science, etc.?

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(b) Should teachers clarify the boundaries between science and indigenous knowledge systems?

_____

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(c) In your view, what distinguishes a scientist from an indigenous knowledge expert?

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QUESTION 5

Some people believe that the following are characteristics of scientists and science:

(1) Science bears the marks of the scientist who made it.

(2) Scientists are creative.

(3) The work of the scientists is influenced by their emotions and personality.

(4) The most important tool in scientific work is the scientist.

(a) Express agreement or disagreement with the four statements above and give reasons and an example for each in the Table below

Statement number	Statement	Agree	Disagree	Reasons with examples
1.	Science bears the mark of the scientist who made it.			
2.	Scientists are creative.			
3.	The work of scientists is influenced by their emotions and personality.			
4.	The most important tool in scientific work is the scientist.			

(b) How applicable are the following to indigenous knowledge and an IKS expert?

Statement	Statement	Agree	Disagree	Reasons

				with examples
1.	Indigenous knowledge bears the mark of the expert who made it.			
2.	Indigenous knowledge experts are creative.			
3.	The work of an indigenous knowledge expert is influenced by their emotions and personality.			
4.	The most important toll in an IKS is the expert himself/herself.			

(d) If a teacher tells you that some learners are "just not cut to be scientists".

What will you say to him/her? (Please provide a reason to support your statement).

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QUESTION 6

(a) Which of the following instructional methods do you consider to be critical for integrating science and indigenous knowledge?

Tick the *ten most critical (Top ten)* instructional methods for integrating science and IKS in the 3rd column, then *rank* them in the 4th column from the most critical = 1 to the least critical =10.

Item	Instructional methods for integrating science and indigenous knowledge	Top ten	rank
6.1	Frequent use of provocative, argumentative or inquiry – based questions.		
6.2	Using holistic or an integrated instructional approach.		
6.3	Using as much as possible concrete materials to illustrate concepts or principles.		
6.4	Emphasising 'showing' or modelling rather than lecturing.		
6.5	Involving learners actively in problem – solving activities.		
6.6	Developing or extending lessons to include current issues such as HIV/AIDS, genetic engineering, drugs & sports, plastic surgery, etc.		
6.7	Starting lessons with learners' ideas before presenting the scientific view.		
6.8	Do not present indigenous knowledge as primitive science that is under development.		
6.9	Clarify that indigenous knowledge can co – exist with science that it should not be replaced by it, and has not been replaced by it.		
6.10	Reject the claim that science works in the physical		

	world while indigenous knowledge is only concerned with the social and spiritual worlds.		
6.11	Assess each knowledge claim with its own assumptions and standards rather than using science to judge indigenous knowledge as true or false.		
6.12	Teach science using ways that are also used to teach indigenous knowledge e.g. informal conversation and learning through observation and imitation.		
6.13	Making lesson people oriented rather than information oriented.		
6.14	Emphasise cooperative learning rather than competitive learning.		
6.15	Provide learners ample opportunities to investigate and present their findings.		

(b) If the RNCS assertion that learners cross the border from the culture of their homes to the culture school science and vice versa is valid how can they be helped see the whole to the a holistic rather than in a segmented or a disjointed manner?

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(c) How do you personally 'navigate' the two distinct worlds, namely, science and IKS?

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RESEARCH QUESTIONS

Is the partnership exists between schools and the surrounding indigenous communities in the development of integration within school curriculum?

Surname   and   name
      :…………………………………………………………………………

Location
      :…………………………………………………………………………

Phase   :……………………………………………………………………..

Age
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Gender:………………………………………………………………………….

PARENTS

1. Do you have any form of partnership with the school?

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2. Describe this partnership briefly.

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3. Are you aware of any progress currently running in your school to promote indigenous knowledge?

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4. What do you understand about the concept integration? Are you aware that you have contribution in the development of integration within school curriculum?

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5. Do you have a good relationship with the teachers when it comes to promotion of indigenous knowledge?

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6. As a member of community, how would you allow your children to be involved in all cultural activities of the school?

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TEACHERS (PARTNESHIP QUESTIONS)

1. Give me a brief overview of what do you understand about the partnership that exists between school and community?

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2. Do you engage community in issues of indigenous knowledge?

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3. Outline indigenous progress that you develop in collaboration with the community.

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4. Do teachers integrate indigenous partnership from surrounding communities into the school curriculum?

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5. Do the surrounding indigenous communities form any partnership with the school to promote integration of indigenous knowledge systems?

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6. How would you form partnership with school in order to advise educators in the development of indigenous knowledge?

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7. Share with me what kind of the technology should be incorporated when they are teaching?

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What is the role of socio – cultural practices towards preservation indigenous knowledge?

1. What do the surrounding indigenous communities do for the school to promote socio – cultural activities?

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2. What indigenous technologies do the learners bring to school from their communities in order to promote IKS in school

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3. Are these technologies relevant in the classroom situation to promote teaching and learning?

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4. Do the teachers encourage learners to bring indigenous technologies such as trap (unoxhaka), bows and arrows (Umcibisholo)when they are catch mice to conduct experiments?

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5. How does the school use indigenous knowledge to promote andstrengthen socio –
cultural practices with local community?

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6. Does the school curriculum explicitly express the importance of cultural needs for
socio – economic development of the learners?

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7. Do you have any examples of classroom practices that reflect social and cultural
context and practices in your subjects that are related to learners' experiences?

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8. In your view, what socio – cultural practices do you think should be included in the
your subject to promote curriculum integration of IK and science?

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9. Dothe policies of the Department of Basic Education acknowledges/addressesthe integration of socio – cultural approach in the science curriculum? If yes, explain how?

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10. Does the new National Curriculum Statement, CAPS cater for socio – cultural indigenous knowledge systems that are relevant to the community?

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11. What attitude do you as a teacher show when you are to incorporate indigenous knowledge concepts in your lesson, such as classroom management, the use of indigenous resources and background regarding socio – cultural roles?

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12. What indigenous practices do local communities render to school when they are to mitigate natural disasters such as drought, erosion and floods?

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13. Share with me some of the indigenous technologies that you

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14. Are there any socio – cultural projects that your community collaborates with the schools? If yes, name them.

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15. Are there any socio – cultural workshops held annually to empower members of the community about their roles in the development of indigenous knowledge that can enhance the curriculum in schools? If yes, name them.

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16. Are there any socio – cultural workshops held in school annually to empower teachers discuss and develop indigenous knowledge that will integrate the community? If yes, name them

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17. Does the school have gardening whereby the local communities have access to use socio – cultural indigenous knowledge to upgrade both teachers and learners? If yes, give socio – cultural practices they render to school.

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