Nguni Fermented Foods: Working with indigenous knowledge in the Life Sciences - A case study

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ABSTRACT

This study examines learning interactions around indigenous ways of knowing associated with fermented grain foods (the making of *umqombothi*) and the concept of alcoholic fermentation in the Grade 11 Life Sciences curriculum. As an environmental education study it also investigates the cultural significances of the fermented grain food and how learners might make better lifestyle choices.

The inclusion of indigenous ways of knowing in the Life Sciences curriculum (FET band) created spaces and opportunities for the use of both knowledge's in socio-cultural context and the structured propositions of the learning area in order to construct knowledge. This stimulated learners` understanding of fermentation and also led to a valuing of social context as well as the cultural capital embedded in the indigenous ways of knowing.

The study suggests that parental involvement contributed to this valuing of intergenerational ways of knowing. Learners also deliberated how colonial interpretations of *Nguni* culture and the religious beliefs of Christians had served to marginalise and foster a widening urban rejection of *isiXhosa* cultural practices related to fermented foods. In their learning and discussion, learners developed new insights and respect for *isiXhosa* fermentation practices (*ukudidiyela)* that bring out the food value and nutrition in the grain.

The data illustrates that lesson activity that drew on relevant Learning Outcomes and Assessment Standards to integrate Indigenous Knowledge practices in a Life Sciences learning programme, served to enhance learner understanding of alcoholic fermentation. They also document a revaluing of cultural heritage and learners bringing up the problem of alcohol abuse in the community. Curriculum work with Indigenous Knowledge thus not only assisted learners to grasp the science but to use this alongside a valued cultural knowledge capital to deliberate and act on a local concern.

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CHAPTER 1: Introduction

Science teaching can only be made meaningful and exciting when learners are actively involved in the process and when real life experiences are taken into consideration (Ngcoza, 1999:1).

1.1 Introduction of the chapter

This chapter presents the background of the research study, the research goals, the context of the study and a brief overview of the chapters.

1.2 Background of the research study

As a Life Science educator in previously disadvantaged schools in South Africa for ten years I have noticed that learners' interest in the Science field is deteriorating. Even learners who are presently doing Science are not as motivated as they should be. This lack of motivation is having a negative effect on the Grade 12 Biology (Life Sciences) results in our schools and also on the number of learners registering for Higher Grade Biology (Life Science).

Kuiper as cited in (Ngcoza 1998:30) believes that "school science has been for the most part de-contextualised and deprived of the human interactions which constitute a science culture". This implies that there is a need for school science to be contextualised. With this in mind I thought of ways that could encourage my learners to be interested in the Life Sciences. Ngcoza's (1998) view is that poor presentation of the subject by educators is one of the reasons for learners to be bored in class and also for learners to regard Science as difficult. His perspective further motivated me to find the reasons for my learners regarding Life Sciences as difficult.

I know from personal experience that it can be difficult to admit that some of one's teaching may not be that exciting, but it is a challenge that we as educators will have to face if Life Sciences are to be better taught. For me this implies that as an educator I have a challenge of making Science meaningful and exciting to learners, so that learners are motivated and actively involved. Ngcoza suggested that educators have to actively

involve learners in science programmes and activities and also consider real life experiences when teaching learners. Aikenhead (1997 as cited in Ngcoza 1998:2) suggests that science should be seen as a social process laden with values and beliefs. If so, it means that teachers must constantly be aware of what knowledge base each individual learner has and should always strive to make science relevant to the learners' everyday social and cultural lives.

In order to make science relevant to the lives of learners I teach, I thought that it is important to understand the community of Grahamstown, so as to be able to find ways of motivating these learners and also to find ways of encouraging their conceptual understanding of the Life Sciences. This encouraged me to develop a contextual profile of the socio-cultural practices of Grahamstown East community, which is where this study is, conducted (Hanisi, 2004). From the contextual profile I discovered that 98% of the learners, educators and parents of the school relate to *isiXhosa* customs. It was particularly notable that the customs and values of cultural heritage are important to people of Grahamstown East.

Yet research that have been conducted on English second language learners indicates that these learners have a tendency of feeling inferior and tend to neglect and not value their culture (Kimbugwe, 2001). There is also a tendency for learners to think that there are two worldviews i.e. the school and home. So I thought about this study as a way of bridging the gab between the two worlds so as to enhance learners understanding of themselves, their background, their communities and also the understanding of Life Sciences.

During the development of the contextual profile, I discovered that the making of *umqombothi* (traditional beer) was common for most cultural rituals in Grahamstown, Eastern Cape. I noticed that many members of this school community had lost knowledge associated with indigenous fermented foods. As an *isiXhosa* speaking woman who grew up in Peddie in a family practising the cultural rituals, I know about the making of *umqombothi*. As a Life Sciences educator, I later discovered that there is science involved

in the process, which learners` are not given an opportunity to explore so as to have better conceptual understanding of alcoholic fermentation. With this in mind I engaged a group of learners in a science education activity where they had to do a demonstration on alcoholic fermentation. From this activity I discovered that my learners were unable to relate alcoholic fermentation to *isiXhosa* cultural practices especially the making of *umqombothi*. I decided to explore the process of making *umqombothi* as an example of a contextualised and known practice by including it in the teaching of alcoholic fermentation in the Life Sciences.

1.3 Research question and goals

This study is mainly focussing on finding ways of developing lesson plans that integrate intergenerational ways of knowing and contribute to the valuing of cultural heritage through the Life Sciences curriculum in Further Education and Training (FET) phase.

With the implementation of the National Curriculum Statement (NCS) in 2006 for Grade 10, and Grade 11 in 2007, I have seen it as imperative for this study to be conducted. The National Curriculum Statement is based on the constitution of South Africa which encourages inclusivity in the education system. The NCS also brings the need for a new and comprehensive change of content and style in all the learning areas in the FET phase. One of the principles of the NCS is about valuing the indigenous knowledge systems. By infusing the indigenous ways of knowing, NCS recognises that the indigenous knowledge systems (IKS) in the South African context that are embedded in the philosophical thinking, social and scientific practises that evolved over thousands of years (South Africa Department of Education, 2004).

The NCS also encourages educators to be curriculum developers, so as to be able to develop lesson plans and learners support materials that are relevant to their specific context, as it encourages socially constructed knowledge. In order to achieve the requirements for the Learning Outcomes, this study is investigating how situated intergenerational ways of knowing that are associated with fermented grain foods can be used in learning activities to understand science concepts in Grade 11 and also to

investigate the cultural significances of these fermented grain foods so that learners could make proper lifestyle choices for sustainability and value their cultural heritage.

The aims of this study are:

1. To investigate how ways of knowing associated with *Umqombothi* and other fermented grain foods can be used into meaning making activities with Grade 11 Life Sciences learners.
2. To probe and examine how valuing of indigenous knowledge has developed within the learners.
3. To develop learning support materials for the Life Sciences curriculum FET band (grade 11) based on the Learning Outcomes and its Assessment Standards.
4. To prepare a lesson as a way of piloting the learning support materials.

With a view to:

- Finding ways that could improve learners' understanding of the Life Sciences.
- Exploring the intergenerational ways of knowing related to the Life Sciences that could allow learners to appreciate and evaluate different scientific perspectives.
- Developing learning and teaching support materials that could encourage teachers in Grahamstown to implement the NCS for the Life Sciences.

1.4 Context of the study

In order to achieve these goals I conducted a case study at a Senior Secondary School in Grahamstown with Grade 11 Life Sciences learners and TWO parents. Grahamstown East was inhabited by *isiXhosa* speaking people since the end of the 18th century as more *isiXhosa* speakers were crossing the Fish River in search of grazing land and opportunities for hunting.

When the military garrison which brought into being the white Grahamstown was established in 1812, more blacks moved into town from the surrounding farms and a

location was established for the *amaXhosa* and Khoi. Since then until presently the Grahamstown East is encountering problems with low literacy and large class sizes with poor facilities and provisioning in most township schools, especially after the period of rapid urban expansion in this small university town in the Eastern Cape. The urbanization coincided with increasing freedom of movement that accompanied the downfall of the pass laws of the apartheid state. As a result, a number of migrants were farm workers displaced by a shift from agriculture to game farming and tourism.

Presently, up to seventy percent of people living in the townships and squatter settlements in Grahamstown are unemployed. The unemployed in the township community are primarily dependent on government old age pension grants and child support grants provided for young mothers without work. Poverty levels are high with at least one employed person supporting 6-8 others and families of up to 10 people living off state grants. Levels of people 'affected by and infected with' HIV-AIDS increases dramatically. Some of the elderly former farm workers tend small garden plots and many of the unemployed sell home brewed beer. Alcohol abuse and teenage pregnancy are a problem amongst learners in many of the schools.

The implementation of the National Curriculum Statement in schools that are in this area should strive to find ways of addressing these environmental issues as education is a tool for social change.

1.5 Overview of the study

This study is composed of six chapters.

Chapter One gives a brief introduction of this study, by discussing the background of the study, the research question and its goals, the context of the research and also an overview of the study.

Chapter Two begins by reviewing the literature on the education transformation of South Africa, which led to the inclusion of indigenous ways of knowing and environment as key concerns. This chapter also gives attention to the development and use of lesson

plans and learner support materials that infuse indigenous ways of knowledge. Lastly the chapter also examines literature on fermented grain foods to review the history of sorghum and maize, grains used to make *Umqombothi* (traditional beer).

Chapter Three outlines the research design decisions made in the development of a research process for investigating how lesson plans that engage intergenerational ways of knowing that contribute to a valuing of cultural heritage through Life Sciences can be developed. This study is an interpretive case study. The chapter justifies the methodology adopted and the methods chosen in this study. It also explains how questionnaires, a demonstration of the making of *umqombothi*, observations, semi-structured interviews and focus group interviews are used as data generating techniques in this study. Lastly, the chapter explains how the data was analysed, and gives an insight into the ethics of the research and how trustworthiness and validity of the research was evaluated.

Chapter Four presents data gathered on the process of developing lesson plans. The chapter presents evidence on the mobilization of learners` prior knowledge, the demonstration conducted by parents and evidence on the exploration of cultural significances of *umqombothi* with learners as background research used to develop lesson plans and learner support materials.

Chapter Five focuses on the key considerations for lesson planning to infuse indigenous ways of knowing into the Life Sciences. The discussion in this chapter is based on the evidence in chapter 4. This is basically the second layer of data analysis and is discussing the mobilisation of prior knowledge using worksheets, group discussion, class presentations, and participant observation on the process of making *umqombothi*. It also includes parental and learner's involvement and the engagement with Learning Outcomes and Assessment Standards as required by the NCS.

Chapter Six opens up by a brief summary of the study followed by the recommendations on key aspects to consider when planning lessons with an Indigenous knowledge focus. Lastly the chapter discusses recommendations for further research.

CHAPTER TWO: Literature Review

The vision of science in the 21st century should be a science that can appreciate interconnectedness and interdependence: a science that can decipher the meaning of words like `responsibility` and `ethics` in the use of scientific knowledge; a science that can comprehend the fact that science is a product of culture or cultures and that its diverse manifestations must be recognised: and a science that can be seen by all to be a shared asset. (Odora Hoppers, 2002:10).

2.1 Introduction

This study examines the Life Sciences curriculum and the recent inclusion of indigenous knowledge and environmental concerns. I open the chapter by contextualising the recent education transformation of South Africa. This was a major event that led to the Revised National Curriculum and the inclusion of both indigenous knowledge and the environment as key concerns. The chapter thus examines the literature on the environment and indigenous knowledge so as to probe how these relate to the Life Sciences Curriculum. In doing so, it gives attention to both lesson planning and support material (LSMs), as these are key concerns for the inclusion of indigenous knowledge and environment in the curriculum.

The chapter also examines literature on fermented grain foods to review the history of sorghum and maize, grains used to make u*mqombothi* (traditional beer). Care is taken to review what is known about fermented grain drinks today but to keep this separate from the indigenous knowledge in the traditional ways of making u*mqombothi*.

2.2 Education transformation, Environment and Indigenous Knowledge

Since the first democratic elections in South Africa in 1994, there has been a significant change in the education and training landscape in South Africa. The move from international isolation to democracy created urgency for change and social redress in South Africa. The past curriculum supported "race, class, gender and ethnic divisions and it emphasized separateness rather than common citizenship and nationhood" (Taylor, 1999:110). The past curriculum also encouraged detachment of learners from their local realities, as schools were not encouraged to create practices and cultures that ensure

[1]participation of all learners irrespective of cultures, race, language, economic background and ability. Therefore the new South Africa, as a post-colonial democratic state characterized by modernization, globalization and multiculturalism, is striving to achieve new socio-economic goals set by a democratic state. In order to achieve these, South Africa needs to improve the education system as Hattingh (1999) notes how education is seen as a tool to open up spaces for social change. This view is shared by Taylor (1999:110) who states:

> The new curriculum is striving towards achieving a prosperous, truly united, democratic and internationally competitive country with literate, creative and critical citizens leading productive, self-fulfilled lives in a country free of violence, discrimination and prejudice.

Today schools, colleges, technikons and universities have been opened to all races. The education system of South Africa is also striving to be inclusive in other ways as well, particularly to encompass the views that have been excluded in the past from institutional knowledge systems to encompass the diversity of cultural, racial, ethnic, and religious practices of all people. This has brought to the forefront of educational debate a concern about the knowledge of indigenous people like the *Nguni*. These changes in South Africa continue to also be influenced by the international debates over sustainability in the environment, a concern that has also given close attention to local and indigenous knowledge.

2.2.1 International influences on curriculum changes in South Africa

Internationally the role of education in achieving sustainable development has been a focus of ongoing deliberation over the past years, since the 1977 Tbilisi Principles for Environmental Education (UNESCO-UNEP, 1978), which prioritized perspectives that embrace culture and history in addressing today's pressing environmental issues. The 1987 World Commission on the Environment and Development advised that indigenous communities were "repositories of accumulations of traditional knowledge and experience" (WCED, 1987:114); the Rio Earth Summit in 1992, the UNESCO 1997

[1] Nguni people – refers to Xhosa ,Zulu, Swazi and Ndebele cultural groups

Conference on Education for Sustainable Development held in Thessalonika, the World Conference on Science in 1999, and the ICSU all urged governments to promote understanding of indigenous knowledge systems. Conference participants also requested the sciences to respect, sustain and enhance indigenous knowledge. They recommended that scientific and indigenous knowledge should be integrated into interdisciplinary projects dealing with links between culture, environment and development (UNESCO, 2001 as cited in Masuku 1999). At the 2002 World Summit for Sustainable Development the importance of action, commitment and partnerships in education for sustainable development was emphasized. It is thus no surprise that one finds today a concern for indigenous knowledge in the South African National Curriculum Statement and this being linked to an emphasis on the environment and sustainable development.

In line with these international developments, the South African education authorities are recognizing the important role of environmental education enabling sustainable development through a range of initiatives, including the development of the national curriculum, professional development, and development of learning and teaching support materials (Lotz-Sistka & Raven, 2001; Janse van Rensburg & Lotz-Sisitka, 2001). Consequently, a number of research initiatives have been conducted to emphasise the role of environmental education to enable sustainable development.

South Africa's commitment to improve environmental management and environmental issues has begun to manifest itself on a number of fronts and the government has committed itself to sustainable development through the development of a range of new policies. A key dimension of these policies is the recognition of the role of environmental education processes and capacity building in addressing or responding to environmental issues. According to O'Donoghue (2001), environmental education has a key role to play in enabling citizens to improve environmental management practices in all walks of life, and to make sustainable lifestyle choices.

Taylor (1999: 113) believes that there is a need to recognize the value of traditional knowledge first, because they believe that it is critical to define the identity of individuals

and to build the sense of self worth of citizens who not only value their own heritage but also respect the differences exhibited by others. Thus the value and potential role of traditional knowledge and its link to recognizing cultural heritage was recognized by the Department of Education and they put cultural heritage and traditional knowledge into the curriculum.

In addition, apart from reasons for including environmental education in the curriculum because of a concern for the environment and a desire that South African citizens learn to care for the environment, the Department of Education has included indigenous knowledge in the environmental curriculum because the role of indigenous knowledge in the approach to environmental care and environmental education (EE) has been adopted in recent years. This led to the inclusion of environmental education in the education system of South Africa which recognizes that education can enable the development of environmental and ethical awareness, values and attitudes, the skills and behaviour needed for sustainable development (DEA&T, 1998:63).

2.2.2 Environmental education and indigenous ways of knowing

Thus, O`Donoghue and Neluvhalani (2002) suggest that "much of the capital of indigenous knowledge has been overlooked or overshadowed against the conventional wisdom of institutional knowledge, and fragments of the past and present indigenous knowing reside in many everyday contexts". They further pointed to historical evidence of how intergenerational ways of knowing were often overlooked and marginalised in the past by people who were in authority. This entailed that the situated intergenerational ways of knowing of the people of South Africa be excluded in the curriculum.

A number of researchers on indigenous knowledge believe that marginalisation of indigenous knowledge is associated with indigenous knowledge being considered primitive, inferior and barbaric. O`Donoghue and Neluvhalani (2002: 123) state that the Southern African histories are full of cases where indigenous people and their practices

were regarded as uncivilised against the more enlightened precepts of the West. Indigenous knowledge and western knowledge have thus come to be seen as opposites. But Le Roux (1999) believes that exploring indigenous knowledge processes is one of the options that could be used in order to know more about a particular environmental issue. Western knowledge can reveal an understanding of indigenous knowledge and visa versa. Taylor (1999:110) states that

> The two way relationship between indigenous and western knowledge can provide important pedagogical tools for inducting learners into the art of formal discourse and or the practical application of formal knowledge to problems in the real world.

This shows that learners can use indigenous knowledge in meaning making of the western science, but most scientific ideas are abstract and detached from the learners' reality, especially in the context of this study, where fermentation and decomposition are seldom related to indigenous practices, nutrition and health. The present curriculum (NATED 550) is content based and it doesn't create opportunities for infusion of the indigenous ways of knowing. Bringing in both Western science and traditional practices and contextualising science in processes such as these might also help learners develop a more conceptual understanding of Life Sciences and to be able to plough back what they have studied in class into their context.

Thus the Department of Education has called for the re-discovery of the past (DoE, 2003d). Furthermore, the President of South Africa Mr. Thabo Mbeki has called for an African Renaissance, which would include a new focus recovering some features of traditional African cultures. O'Donoghue and Neluvhalani (2002) state that the overlooking and marginalisation of indigenous knowledge systems was not solely a thing of the past, there are also recent cases they illustrate where indigenous knowledge has been appropriated , which implies that re-appropriation of indigenous knowledge is presently a rich capital. Asafo-Adjei (2003) states that the re-discovery process could come through curriculum development work and would need the integration of intergenerational ways of knowing with the aim of gaining historical insights into the indigenous practices of the past. He further suggested the possibility to "locate" back into

the past and re-appropriate indigenous knowledge (Giddens, 1991) through learning and research. O'Donoghue and Neluvhalani (2002:22) describe appropriation as a:

> ... useful concept for probing the politics of knowledge creation. It allows one to engage in processes of oversight, transformation and marginalisation through which much contextual knowing was lost and changed in the politics of human meaning making.

For this study I understand appropriation as a concept of finding out about contextual knowledge and events that have been deliberately, or through oversight, marginalised in the past. As educators it is our challenge to engage the past. There is a need to recognize the value of the indigenous ways of knowing as we could re-discover things that are of relevance in our history and work with these in the present, so as to contribute to the valuing of cultural heritage.

I see the recognition and intellectual activation of indigenous knowledge today as an act of empowerment by indigenous people. Furthermore, Masuku van Damme and Neluvhalani (2004:354) state that within these perspectives, society would be able to learn from traditional wisdom to manage complex ecological systems. A challenge for environmental educators is to make sure that there is a re-appropriation of indigenous knowledge that is of value and to reveal the wealth and richness of indigenous knowledge (language, experiences and teachings) that have been excluded in the past. Asafo-Adjei (2004) has indicated that environmental educators can overcome the challenge by bringing indigenous knowledge back into the Agricultural Sciences curriculum. This study is a follow-up to Asafo-Adjei's (2004) study and a response to Masuku (1999), O'Donoghue and Neluvhalani's (2002) studies.

Asafo-Adjei's (2004) study explored ways of mobilising indigenous knowledge in Agricultural Sciences. In his study ' From *imifuno* (wild food plants) to *umfino*', he involved learners in his school context, by encouraging learners to interview community members to find out how these plants are grown and used. He used the information that had been reported back by learners to develop an agricultural sciences learning programme.

Masuku's study explored and developed guidelines for the use and development of indigenous knowledge resource materials for meaningful learning. In her research she displayed the role of indigenous knowledge within Environmental Education processes where she discovered that indigenous knowing and experiences could provide solutions to some of the ever–intensifying global environmental problems. As a result one of her recommendations was for educators to incorporate activities in their lessons which "encourage students to investigate practises within their communities." My study will be examining ways of overcoming the challenge that educators are faced with in integrating into the Life Sciences indigenous ways of knowing that contribute to a valuing of cultural heritage.

2.3 Life Sciences curriculum and indigenous ways of knowing

The National Curriculum Statement within the Further Education and Training (FET) band (DoE, 2003d), which will be implemented in 2006, is aiming to improve the education system of this country by redressing the imbalances of the past apartheid era. The following timeline shows the steps that curriculum transformation and redress has followed at the FET level since 1994. (DoE, 2005:5).

- 1995 – The establishment of the National Education and Training Forum (NETF) and the introduction of the Interim Core Syllabus.
- 1996 – The establishment of the new SA Constitution (Act108).
- 1997 – Report of the National Committee on Further Education and the publication of Language in Education Policy.
- 1998 – Introduction of Curriculum 2005 for GET and White Paper 4 providing the formal policy framework for transforming FET.
- 2000 - Publication of new Norms and Standards for Educators
- 2001 – Council of Education Ministers deciding to develop NCS for FET.
    - Schools adopting the NATED 550 syllabi for FET.
    - Publication for Education White Paper 6 on Special Needs Education.
- 2002 – Draft NCS submitted to various stake holders for comment.
- 2003 – NCS published for FET

- 2004 – Minister of Education announces that implementation of the NCS for FET will begin in 2006.

The NCS emphasises the relationship between human rights, social justice, inclusivity and a healthy environment. This curriculum statement has been conceptualised as a way of fostering cultural change in South African societies, as a result it envisages a learner "who is confident, independent, literate, numerate, multi-skilled, compassionate, with respect for the environment and the ability to participate in society as a critical and active citizen" (DoE, 2003d). This is a challenge for educators in the FET band, as they have to implement the NCS in 2006.

The NCS further lays a foundation for the achievement of the aims of the South African Constitution by spelling out the principles and values that underpin the curriculum. One of the principles of the NCS, which this study is based on, concerns the "Valuing of indigenous knowledge systems" (DoE, 2003a, b, c, d). Indigenous knowledge systems in the South African context refer to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. This principle acknowledges the rich history and heritage of South Africa as important to fostering the values contained in the Constitution (DoE, 2003a:4). The NCS further states that in the South African context the recognition and value of indigenous knowledge is imperative for asserting the dignity of the great majority of people of South Africa (DoE, 2003d).

The main aim of integrating intergenerational (indigenous) ways of knowing into the Life Sciences curriculum is to transform the education system to make it a capacity building place. Van Wyk (2002) states that science and technology educators ought to integrate the social and academic aspects of learning to be able to contribute to an increasingly globalised world. He further states that "teaching science within a narrow definition that excludes the learner's context is to ignore what catalyses learning within the learner's environment". Kimbugwe (2001:15) also states that the gap between western science and traditional science should be closed as this gap is detaching people from their

environment. The idea of a gap between knowledge context and real context of the every day highlights the importance and the urgency of engaging indigenous ways of knowing into the Life Sciences curriculum.

Intergenerational ways of knowing are handed down from the previous generation to the next generation and in most cases orally. Science is recognized as a set of practices and frameworks within all knowledge systems that can be equitably compared (Turnbull, 1997:551). To merely relate science and other knowledge systems is not enough, there is a need to compare, contrast and identify ways in which the knowledge systems are complementary to each other. This implies that the fields of scientific ideas and intergenerational ways of knowing can be worked with so that science concepts, local understanding and the local environment intersect in the creation of relevant ways of knowing and doing things in daily life.

Odora Hoppers (2002:10) refers to "science as a product of culture" and she mentions the importance of recognising its diverse manifestations. This means that indigenous ways of knowing as cultural ways and understandings should be integrated into the science curriculum so as to place learners in a position to embrace and celebrate their identity instead of doubting themselves and even being ashamed of whom they are. This meaningful cultural interaction between indigenous and scientific ways of knowing might also enable students to feel authentic, connected and prepared to learn. Integrating intergenerational ways of knowing into the Life Sciences will be explored in this study as a way of making the curriculum relevant to the context of learners.

2.3.1 Constructivism as a theory underpinning the curriculum

Cornbleth (1990) states that a curriculum is what occurs in the classroom; that is an ongoing social process which involves an interaction of students, educators' knowledge and their environment. Cornbleth further states that in order to understand the curriculum in practice, one has to attend to its context because the context shapes the curriculum, and that the context is both structural and socio-cultural. She believes that the structural context can be considered from the individual classroom, school organisation to the

national education level and the way programmes are structured. By socio-cultural context she refers to the demographic, historical, social, political and economic conditions, traditions, beliefs and other cultural dynamics (Cornbleth, 1990). Grundy (1987) suggests that curriculum is constructed within actual learning situations with students. This implies that learners should be encouraged to bring in and share their experiences in the learning situation.

Stables (1998) also suggests that the ability of learners to actively discover the significance and meaning of their local environment to them and others in order to develop an understanding of how to contribute to social change through action is very important in education. He further states that learners in interpretive settings bring in their social experiences and interact with others to find their own meanings. Successful meaning making occurs when learners are able to actively engage in environmental learning experiences based on the object being interpreted. Learners deal with a world already rich in meaning, intentionality, symbolism, and interpretation. Not only do they monitor a reinterpreted reality, but their forms of thought are also derived from common sense (Atiti, 2003:41).

O'Donoghue and Neluvhalani (2002) refer to this as a "social habitus" that we all have as people because our lifestyles, values and expectations that have developed through our experiences play a vital role on the way we make meaning. Learners draw on cultural capital derived from classroom settings and their 'social habitus' (Bourdieu, 1993) that we all have as people to make meaning in interpretive learning. Learners need to be encouraged to find meaning by relying on their prior knowledge and experience. Making meaning helps learners with the critical thinking skills and action based skills they need to solve their own problems and the problems facing their communities.

Shava (2000) recommended that educational approaches should be contextualized so as to enhance the self-esteem of African mother tongue learners who are often regarded as not brilliant in the classroom. The inclusion of situated intergenerational ways of knowing in the Life Sciences curriculum (FET band) will create spaces and opportunities

for the use of both structural and socio-cultural context in order to construct knowledge. This will help learners to understand the scientific concepts and that they have relevance and will also lead to a situational understanding of the learners` social context and cultural capital.

Kimbugwe (2001) states that constructivism proved to be an important tool in closing the gap between different cultural ideologies and views. Social constructivism has been chosen as the philosophy underlying the design of Curriculum 2005 so as to incorporate the co-values of democracy that are characterized by equity, non-racism and non-sexism. Learners' culture influences their interaction with educators and the way they construct knowledge in the classroom (Kimbugwe, 2001). Hence educators have a responsibility of understanding the different cultural views that learners bring to the classroom, so as to be able to help learners construct knowledge in the classroom.

One of the principles of constructivists learning theory is that learning takes place in contexts relevant to the learners. O` Donoghue (2001) argues for active knowledge construction processes and he notes that knowledge should be constructed in a meaningful context through active learning processes. He further acknowledges a need to provide active learning opportunities for learners. This implies that provision should be made for learners to actively search for information, to critically examine and question issues and develop insight and competence to make better environmental management and lifestyle choices (O` Donoghue, 2001).

This type of practically engaging learning in context is known as situated learning. The concept of 'situated learning' indicates that knowledge must be situated in a relevant context where society, culture and language that shape learning interact. Lave (1988) argues that situated learning is often unintentional rather than deliberate and it needs social interaction and cooperation. Lave further states that learning should not be seen as the acquisition of knowledge alone but as processes of social participation. This implies that learning includes the relationship between people and develops in the conversations and situated interactions of which people are part.

According to Jensen and Schnack (1997:175) for learners in schools to be able to act in a critically informed and active way they require understandings, values and skills. Within schools, learners may be involved in active decision making and action to improve environmental quality in a number of ways. These ways range from personal lifestyle adjustments that could help learners improve their lifestyle choices to reduce the scope of many environmental problems. In my view, teaching learners about alcoholic fermentation should include discussion about the effects of alcohol in communities especially in communities where the alcohol abuse is one of the issues that need urgent consideration. Discussions involving learners or learners coming up with ideas could encourage them to improve their lifestyle choices which could lead to the reduction of alcohol abuse.

The learners' informal ideas and their conceptual framework usually build over time in their local surroundings and are embedded in their cultural backgrounds. Learners' culture influences their interaction with educators and the way they construct knowledge in the classroom. Rogoff (1998) argued that it is not only book learning and propositional knowledge that is the most important form of learning but more experiential approaches to learning as well. She further claimed that through close interaction with adults children come to learn by experience, therefore learning is a social activity. The experiential learning is expressed by language, so language practices are an important part of knowledge.

2.3.2 Language

One of the principles of constructivism states that learning involves language (Moll, 2001), which implies that quality and accessibility of the language we use in learning activities influence learning. Barba (1995) advocates that learners` use of their mother tongue in small group settings to encourage them to bring their home learning to class and combine it with school learning. Although evidence that relates language with knowledge construction is not conclusive, studies on the use of both languages (English and *Nguni* language) approach that were carried out by Rollnick and Rutherford

(1996:102) among Swazi speaking learners and Muwanga-Zake (1999:53) among *isiXhosa* speaking learners, indicates success in helping their learners understand the implications of concepts. This implies that although English is the language of teaching and learning, English second language learners should be allowed time to use both languages approach, as learning is a social and language based activity. From these studies it transpired that the use of mother tongue does not automatically mean that home experiences will be combined with school learning but the use of mother tongue may facilitate the process.

Mtshali (1994), Masuku(1999) , Ngwane (1999) and Asafo-Adjei (2004) carried out studies that demonstrated how indigenous knowledge could contribute to the development of environmental education, a subject that has been integrated into the national curriculum statement. In these studies the both languages approach was used when referring to names of some common plants. For indigenous knowledge systems it is imperative to use a both languages approach because some of the translations are not exactly concise. For example, this study is examining concepts that are embedded in the process of making *umqombothi*. For the *Nguni* people they are not brewing, but they make or do *umqombothi*, as the doing process is important culturally and forms part of the ritual (honouring ancestors).

2.4 Lesson development

This study is based on Learning Outcomes 1, 2 and 3 of the Life Sciences curriculum statement (FET band). Learning Outcome 1 requires that:

> A learner is able to confidentially explore and investigate phenomenon relevant to Life Sciences by using inquiry, problem solving, critical thinking, draw conclusions, assess the value of the demonstration process and communicate findings". (DoE 2003a:37)

Learning Outcome 2 requires that:

> A learner is able to identify concepts, and models of Life Sciences in the context of everyday life. (DoE 2003a:37)

Learning Outcome 3 requires that:

> A learner must be able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the interrelationships of science, technology, Indigenous Knowledge, environment and society. (DoE 2003a: 37)

In order to achieve the requirements for these Learning Outcomes this study will investigate how situated intergenerational ways of knowing that are associated with fermented grain foods can be used to understand science concepts in Grade 11 and also to investigate the cultural significances of fermented grain foods so that learners could make sustainable lifestyle choices and value their cultural heritage.
Engaging in intergenerational ways of knowing into Life Sciences could expose learners to different worldviews and allow them to appreciate, compare and evaluate different scientific perspectives. South African educators have to think of how they would strategically construct opportunities and spaces in which they will be able to recognize and build on learners` background knowledge and experiences so as to make sure those learners are able to engage and make meaning.

As indicated above one of the motives for introducing indigenous knowledge into the curriculum was to address a number of environmental issues and risks in various contexts that directly affect the education system and life experiences of learners. But, what then follows is the need for the development of lesson plans. In order to develop lesson plans (learning unit planner) there is a need for an approach that is enquiry-based, open-ended and responsive to context as environmental issues and risks are different in every context (National Environmental Education Policy –General Education and Training, NEEP-GET, 2004).

It is imperative to develop lesson planning for a healthy environment, because the Constitution of South Africa indicates that it is the right of every South African citizen to an environment that is beneficial to his/her health or well being. The Bill of Rights emphasises the need for sustainable use of resources for the health of both current and future generation and a better quality of life for all (NEEP-GET, 2004). Education as a tool for social change is one excellent channel for implementation.

When developing lesson plans with an environmental focus, teachers have to consider the following (NEEP-GET: 2004): lesson plans have to:

a) Focus on the curriculum requirements.
b) Focus on learning.
c) Contribute to school improvement and community links.

Lesson plans should be developed with Learning Outcomes and Assessment Standards in mind and educators should use creativity and originality when interpreting how and what to teach. The Learning Outcomes and Assessment Standards emphasise participatory, learner centred and activity- based education that encourages learners to acquire higher order thinking skills that go beyond recall, recognition and reproduction of information, to the evaluation, analysis, synthesis, production and application of ideas (NEEP-GET, 2004). This implies that lesson plans (learning unit planner) should be developed based on the Learning Outcomes and Assessment Standards so as to meet the required standards of the NCS.

Teachers have a challenging responsibility of mediating environmental learning with learners in their environments. Meaningful environmental learning can involve finding information about issues, exploring these issues through experiences in the environment and taking action based on what we know, for a better world, all of which contribute to better environmental management and better life style choices (O`Donoghue, 2001). This allows learners to be involved in the active exploration of an issue, rather than just being the passive recipient of information provided by the educator.

2.4.1 Lesson plan (Learning Unit Planner) to mobilise Indigenous Knowledge

As a way of developing lesson plans that mobilise indigenous ways of knowledge it is important to consider the following aspects:

- To make sure that there is a potential to mobilise indigenous knowledge in the context of the Learning Outcomes one is using for the specific lesson.
- To understand strategies that can be used in that specific lesson to mobilise indigenous knowledge.

- To know the learners very well so as to be able to accommodate the cultural diversity when planning for the lesson.

This study seeks ways of developing lesson plans that mobilise intergenerational ways of knowing that contribute to a valuing of cultural heritage. From the contextual profile I developed (Hanisi, 2004) it is stated that most learners at the school practice and respect their cultural rituals. The contextual profile opened up opportunities for me as a researcher and educator to understand learners' backgrounds.

2.4.2 Outcome-based education (OBE) and the NCS

OBE as an approach, which underpins the NCS, needs a new approach to learning and lesson planning. In OBE the processes of learning are as important as the content. In OBE teachers are responsible for lesson planning, which is based on their learning programmes and work schedules, and teachers are guided by the policy documents in order to do this. OBE involves resource-based learning approaches as different learning and teaching support materials (LTSMs) are needed in relation to different outcomes and also the different contexts in which learning takes place. Materials and resources-based learning approaches are considered important as different LTSMs help educators and learners to be able to address issues in different contexts. LTSMs are used to scaffold and support learning in the classroom. In OBE teachers have the challenging responsibility of mediating learning with learners in their environment.

2.4.3 Learning and Teaching Support Materials

Czerniewicz, Murray and Probyn (2000) viewed learning and teaching support materials as educational materials that can be used to promote environmental learning in various contexts. They further state that learning and teaching support materials should be used effectively in the context of learners and local environmental issues and risks such that they can give guidance to teaching and learning interactions. Lotz –Sisitka and Raven (2001:46) emphasize the importance of critically looking at the reasons for developing the materials and also how they are developed in relation to the learning process as these reasons may help environmental educators to understand the pedagogical assumptions

and approaches which inform and underpin the learning and teaching support materials they use. For example, in the booklets (Beer, Ants and Ancestors; Trees, Goats and Spirit; From Grain Pits to Silos) that were produced by Share-Net for adult based education (later developed for curriculum use) developers used knowledge and skills of local people to interpret the environment. In these materials the developers were looking at how rural people were living on the land and how they utilise their resources. This challenged readers and people using these materials to critically look at the way they live presently, challenge their values and try to find out whether their present practices are the most appropriate to ensure a sustainable future for human kind. The developers of these materials used indigenous knowledge as a lens to interpret the natural and cultural environment for/with learners.

Czerniewicz *et. al* (2000) stated that research plays an important role in the development and adaptation of materials as it helps the developers to go beyond narrow assumptions about learning. This research informs and shapes the content of the learning and teaching support materials to be developed. For this study research forms an integral part of planning for material development, so as to ensure the development of high quality materials that are useful and relevant to the context.

Czerniewicz *et.al* (2000) also argued that material developers often adapt ideas from other materials and contextualize these in relation to the particular focus of their materials. Context provides guidance so that examples and information that are contextually relevant can be included. This borrowing of ideas saves time, helps to share expertise and experience across the region and also prevents re-doing the same thing, but developers should guard against "uncritical adoption" of materials as it has been discovered that people tend to adopt models, frameworks and diagrams without critically looking at their meaning or relevance to the text and purpose of the material (Czerniewicz *et.al,* (2000). This leads to ineffective use of LTSMs, whereas it is imperative to make sure that materials are used effectively.
As is the case in this study, one of the objectives in developing learning and teaching support materials is to provide learners with information and possibilities for action and

participation that can enable them to understand and respond to environmental issues and risks better. According to Czerniewicz *et.al* (2000) the purpose of learning and teaching support materials influences their design and it is important for developers to understand how this happens, by looking at different kinds of materials that are developed for different purposes. Another aspect of considering how context may influence the design of materials involves being able to adapt to changes in context. This study is looking at developing LTSMs that are relevant to the context of the learners in the present era, so that learners could understand scientific concepts embedded in the process of making *umqombothi* and to value their cultural heritage.

When the developer is thinking about purpose, context and relevance in the design of materials Czerniewicz *et.al* (2000) believe that it is helpful to consider the policy of the country, strategies and protocols as these can provide support and background information to make the learning and teaching support materials relevant to the country's context and its priorities. For this study I have reviewed the National Curriculum Statement and the guidelines for FET advocacy as these may influence the development of these learning and teaching support materials.

Material developers (see section 2.3.2) also need to consider the role of language in learning in the material developing process, particularly in the multi-lingual environments in Southern Africa, as language influences the development and adaptation of learning and teaching support materials. Critical analysis of the materials developed by Share-Net illustrates that the developers understand that the ways of knowing are often context specific and language is important. In these materials there are words written in *Nguni* mother tongue and their stories are place based.

Masuku~ van Damme (1999) recommended that the child's home needs to be recognised by teachers and resource developers as a context where learning takes place. She further states that there is a need for the content learnt at school to be relevant to the context and environment of the learners and teachers should learn and understand where their students are coming from. She states that this move might encourage parents to take a

positive and active role in the teaching and learning of their children, and this could also bridge the gap between home and school as learning environment. Mbanjwa (2002) also encouraged the use of LTSMs to explore issues in the learners` local context. This implies that it is imperative for parents and homes to be used as sources of information as the developers design materials.

Vygosky introduced the concept of a zone of proximal development(ZPD). This concept refers to the gap between what an individual learner can do alone or without the help of a teacher and what they can achieve with the help and instruction of a more knowledgeable person (Capel *et al* as cited in Atiti 2003). The Vygoskian concept of the 'Zone of Proximal Development' suggests that through a process of scaffolding a learner can eventually do without the help of a 'significant other' (Capel *et al* as cited in Atiti, 2003). This implies that educators should encourage learners to use their prior knowledge and demonstrate what they are able to do, and the teacher could then challenge learners to increased levels in terms of scope and depth in a particular grade by either asking questions that could help learners expand their knowledge of the topic and or by referring them to, and encouraging creative use of LTSMS that could increase learners' level of understanding.

In the LTSMs, the learning activities should be designed to encourage learners to become actively engaged in a learning process, by starting with challenges to establish what learners already know. Through the scaffolding questions, the LTSMs could enable learners to undertake further investigations and share information with others who might be more knowledgeable than the learner. This could increase learners' levels of understanding, beyond their existing levels of understanding.

Learners could aspire to higher order learning goals, i.e. analysis of knowledge in addition to acquisition of simple information. It is assumed that analysis and application of knowledge is facilitated by active learning. Active learning is being promoted by certain kinds of learning activities like group work, discussion among learners, use of practical materials, working with examples drawn from learners` experiences. The

LTSMs should include activities so that learners can be involved cognitively, or there will be no learning.

This study is aiming to respond to Masuku's (1999) recommendations and is a follow-up on Asafo Adjei's (2004) study, as this study incorporates lesson activities which encourage learners to investigate indigenous knowledge within their communities so as to bridge the gap between home and school learning environments and to encourage parents to play an active role in the learning of their children. One of the goals for this study is to investigate how indigenous ways of knowing associated with *umqombothi* can be used within curriculum activities. The following section looks at fermented grain foods as *umqombothi* is one of the *Nguni* fermented grain foods.

2.5 Fermented grain foods

Grains are edible starch seeds of grasses. They account for over half of the world's food energy. Grains generally lack the toxins so omnipresent in the pulses, and nutritional deficiencies of species such as maize and sorghum can be alleviated through fermentation (Pance and Nesbitt, 2005:45)

This research takes place in an area which is mainly inhabited by *isiXhosa* speaking people. *AmaXhosa* belong to the group of Southern African people collectively called the *Nguni* (Maylam, 1994:20). The *Nguni* economic base was broadly centred on herding, cultivation and hunting.

Maize and sorghum were some of the plants that were mostly cultivated by *Nguni* people. But Maylam (1994:33) claims that maize was not an indigenous crop of *Nguni*, but that it spread into *Nguni* territory from the east coast of Africa. Van Wyk and Gericke (2000:16) state that the maize plant originated in Central America. It is believed that maize was introduced to Africa by early explorers and traders and it has been in cultivation in Southern Africa since 1500AD. Maize is more drought resistant than sorghum so this may be one of the reasons for the Nguni people to cultivate maize more than sorghum. By 1635 maize was being grown in what is today known as the central Transkei region of the Eastern Cape. Pance and Nesbitt (2005:45) suggest that grains need processing in

order to improve their nutritional value. *Nguni* people used fermented foods so they malted sorghum so as to make sorghum beer. Although they are not clearly stating the reason for using fermented grain foods, malting was a way of processing their food, and this in effect helped improve its nutritional value as Pance and Nesbitt suggest.

Historically, the basic crop of the Southern *Nguni* was sorghum. Van Wyk and Gericke (2000:14) and Zen and De Wet (1982:133), claimed that sorghum was an important source of food and an indigenous staple food and source of beer that has been cultivated in Sub-Saharan Africa for at least 3000 years. They further believe that the crop originally developed in Ethiopia. They further claim that the major advantage of sorghum is its ability to produce some grain even under drought conditions, when the maize crop would totally fail. Sorghum and maize are often consumed in fermented form, e.g. beer, porridge dumplings, bread and whole grains.

Fermented beverages have played an important part in the evolution of human cultures and *umqombothi* produced by the fermentation of sorghum and maize may be among the most ancient of these beverages, which are probably largely "anthropocentric" in origin (Cambray, 2005). In small societies alcohol beverages are produced and consumed at a restricted local level, but as societies become more complex, trade in beverages occurred (Dietler, 1990). The evolution of the modern wine and beer industry has occurred as a result of the scientific elucidation of the traditional production systems associated with theses beverages, allowing the beverages to make the transition from traditional to commercial production systems producing beverages of a consistently marketable standard (Van Heerden, 1996; Van Wyk & Gericke, 2000).

Zen and De Wet (1982), Fox and Young (1983) and Pance and Nesbitt (2005), state that in Southern Africa African beer or sorghum beer, which is also known as *utshwala* (*isiZulu* and *isiNdebele*), *hwahwa*(*Shona*), *joala* (*Sesotho*) and *utywala- umqombothi* (*isiXhosa*) is a very popular traditional drink. Zen & De Wet, (1982), Fox and Young, (1983), Van Heerden, (1996), Van Wyk and Gericke, (2000), Pance and Nesbitt, (2005) stated that the Nguni use malted beers as a traditional drink.

2.5.1 Nutritional vitality of *Umqombothi*

The nutritional value of sorghum beer (*umqombothi)* was identified by the CSIR, who showed that *umqombothi* could make a very positive contribution to the diet of the consumer (Van Heerden, 1996:3). Extensive studies showed that *umqombothi* is a rich source of vitamin B and minerals. Vitamin B and minerals are essential requirements of the body as they regulate many body functions such as energy synthesis, muscles building, blood, teeth and bone formation. The alcohol content of *umqombothi* is low and is about 3-4%. (Soga, 1931; Zen & De Wet, 1982; Fox & Young, 1983;van Heerden 1996; Van Wyk & Gericke, 2000; Pance & Nesbitt, 2005). Cambray (pers. comm., 2005) has the same opinion on this and he further stated that because of its low alcohol content one has to consume a lot of *umqombothi* to get drunk.

Umqombothi has a protein content of about 5 grams per litre. Van Heerden (1996) and Cambray (pers.comm. 2005) stated that *umqombothi* also contains lactic acid. Van Heerden (1996) stated that research indicated that foods containing lactic acid can protect the consumer against degenerative diseases. He also claimed that lactic acid in products such as *umqombothi* helps to prevent infections that cause diseases like typhoid, typhus and gastro-enteritis. These diseases may occur when water supplies are contaminated. He further recommended the use of *umqombothi* especially if only sorghum is used to make *umqombothi* as fermentation enhances the food value of sorghum. The next section reviews the importance of *umqombothi* as a cultural drink for the *Nguni* people.

2.5.2 Cultural vitality of *Umqombothi*

According to McAllister (1987:329-330) "*umqombothi* soothe (*ukuphulula)*, bless (*ukusikelela*) and put things right (*ukulungisa*) at home". Most Nguni people believe there is a close connection between umqombothi *and* ancestors. Ancestors are thought to be present whenever people are gathered to drink *umqombothi.* There is a belief that ancestors are taking a keen interest in their homes and their dependants. According to McAllister (1987) the *Shixini* people believe that if one is not making *umqombothi* at regular intervals this may result to misfortune. Neglecting to make *umqombothi* indicates neglect of the ancestors and they may respond by appearing in dreams to request

umqombothi or send misfortune. Conversely, carrying out the obligation to make *umqombothi* regularly ensures continued blessings and good fortune. This could help to improve health at home and things that were troubling would improve.

The process of making *umqombothi* is highly technical and, needs experience, skills and good judgement. To make good quality *umqombothi*, one need to use good quality maize, plenty of *imithombo*, maintain a relatively high standard of hygiene, and have lots of time available. The process of making *umqombothi* is a co-operative process that involves a number of people. It is a very sociable, community event (McAllister 1987). Every time people make and drink *umqombothi* the central values, beliefs, norms, and moral principles of society are made explicit, and social organizational principles are also dramatized (culture and society).

2.7 Conclusion

In this chapter I have discussed the educational transformation of South Africa that has led to the inclusion of indigenous knowledge into the National Curriculum Statement. I reviewed some of the literature on lesson planning and learner and teaching support material development, as these are concerns that will influence the inclusion of indigenous knowledge and environment into the curriculum. Issues relating to the relevance of intergenerational ways of knowing and its relationship to an indigenous practice such as the making of *umqombothi* and its potential place in lessons in the Life Sciences curriculum were also examined. Literature on fermented grain foods, cultural and nutritional vitality of *umqombothi* has been reviewed.
The next chapter discusses the methodology and methods used in this study.

CHAPTER THREE

Research design decisions

3.1 Introduction

This chapter outlines the research design decisions made in the design of a research process for investigating how can lesson plans be developed that engage intergenerational ways of knowing into the Life Science curriculum (FET). It explains the process used to generate data, which are relevant to the research focus, and the aims and goals that influenced the research design decision made to guide the research process.
In this chapter data analysis, data interpretation, ethical issues, validity and trustworthiness of the findings are discussed.

3.2 Research methodology

An interpretive orientation is used for this study. Terre Blanche and Kelly (1999) describe the interpretive orientation as a perspective that describes and interprets people's feelings and their experiences in human terms. Cantrell (1993:101) suggests that this paradigm "emphasizes an understanding and interpretation of complex interrelations between social structures and the meaning people give to phenomenon", which implies that interpretive orientation, focuses on the meaning which people make of their reality. Terre Blanche and Durrheim (1999) suggest that the interpretive orientation endeavours to make sense of feelings, experiences and social situations by studying their natural setting.

In this study I investigate the *Nguni* people's indigenous ways of preparing fermented grain foods using *umqombothi* as a focus. The significance of fermented grain foods in their social setting is explored with a view to integrate this into the curriculum, as a way of contextualizing the curriculum in the everyday realities of the learners. This is based on Cornbleth`s view that curriculum is a contextualized social process. This orientation enabled me to investigate how indigenous ways of knowing that contribute to a valuing of cultural heritage can be used in curriculum activities in Grade 11 Life Sciences.

3.3 Case study approach

The research is an interpretive case study investigating a process that attempts to mobilize indigenous ways of knowing in the Life Sciences curriculum activities. According to Bassey (1999:30), a case study is a "study of a singularity conducted in depth in natural setting". Patton (1990:54) further states that a case study become very useful where one needs to understand some people, problem or unique situation in depth and where one can identify cases rich in the sense that a great deal can be learned from the examples of the singularity in question. According to Stenhouse (1983) there are four styles of case study, namely ethnography, evaluation, educational and action research. Stenhouse (1983) argues that the purpose of the educational case study is to improve practice. Hitchcock and Hughes (1995: 323) suggest that a case study can be used to develop a new theory or to improve or evaluate the existing professional practice. For this study a case study is used as a methodology of researching a process that could help to improve my teaching and learning practices, by including local knowledge in ways that enhance learning in the life science curriculum, as Stake (1995) argues that one tends to study a case that is of special interest and look for details on the case being examined. As a Life Science educator in South Africa in the present era it is my special interest to find ways that could improve learners' understanding of the Life Sciences by exploring intergenerational ways of knowing related to the Life Sciences that could allow learners to appreciate and evaluate different perspectives.

Yin (1994) states that a case study is a research strategy that is used in many situations to contribute to our knowledge of individual, group, organizational, socials and political related phenomenon. This research is striving to find ways of improving learners' understanding of the Life Sciences and also to help them to make informed lifestyle choices for sustainability by understanding the cultural significances of fermented grain foods. For this study lesson plans and learner support materials based on the NCS (FET band) are developed so as to enhance teaching and learning. To provide descriptive rich information for this case study I used a number of data generation techniques, namely questionnaires, observation schedules, face-to-face semi-structured interviews, and document analysis. To complement the data, it was necessary for me to use data sources

such as written work of learners, field notes, and photographic evidence. I discuss these data generation techniques in the next session.

3.4 Data generation techniques

3.4.1 Orientating questionnaires

I started the study with an orientating worksheet (refer appendix B) with my learners to ascertain their prior knowledge on fermented grain foods. Masuku (1999), and O`Donoghue and Neluvhalani (2002) states that understanding the learners' prior knowledge is an important requirement to find ways of mobilizing indigenous knowledge in the curriculum contexts. Cohen, Manion and Morrison (2000:248) suggest that less - structured questionnaires are more suitable for a case study as they can help to capture the specificity of a particular situation.

Figure 3.1. Learners completing questionnaires

Here I captured what is already known as a starting point from which to teach learners the concept of fermentation so that they are ready to make observations in phase II. By doing this I was preparing learners to work and make observation in groups using what they know to make sense of what they see during observations. After the analysis of the questionnaires we had a short discussion in class based on the responses of the learners.

3.4.2 Learners observing the process of making fermented grain foods

Observation schedules were provided for learners to use as a guide as they were observing the preparation of *Nguni* fermented grain foods. Patton (1990:205) suggests that observations help one to be close to a situation and be able to get a first hand experience so as to help in the understanding of the situation. At the end of the process learners were asked to write a demonstration report on the preparation of *umqombothi* (traditional drink prepared through fermenting grains) to meet the requirements of Learning Outcome 1. A tape recorder was used to capture the discussion during the process. Photographs were taken during the process of making the fermented grain drink (*umqombothi*)).

Figure 3.2. Learners and a parent during the demonstration

From the demonstration I hoped that learners would be able to observe the process and be able to identify the known from the unknown so as to be able to probe more from their parents.

3.4.3 Interviews

3.4.3.1 Interviews by learners

During the process of making *umqombothi* learners interviewed parents who were making *umqombothi*. Yin (1994) suggests that interviews are one of the most important tools to generate data for a case study. Through interviews learners investigated reasons behind some of the steps that are followed during the process and the cultural

significance of fermented grain foods from parents. Learners also conducted interviews with the community members as a way of gathering more data on the cultural significances of *umqomb*othi.(refer appendix E4) I gave them guiding questions to assist learners and guide the discussion between learners and parents and asked them to probe more information from the community members.

3.4.3.2 Focus group interviews

I conducted focus group interviews with learners immediately after the demonstration so as to validate some of the issues that emerged during the demonstration. I developed an interview schedule (refer appendix E3). Cohen *et al.* (2000:297) state that focus group interviews are useful where a group of people have been working together for a common purpose. They further state that the focus group interviews have a potential for discussion to develop thus yielding a wide range of responses. A tape recorder and field notes were used to gather information during focus group interviews.

3.4.3.3 Interviews with parents

According to Yin (1994) interviews allow a researcher to investigate and prompt things that we cannot observe and that through interviews we can probe an interviewee's thought, values, prejudices, views, feelings and perceptions. Cohen and Manion (1994) further state that an interview is inter-subjective, as it allows participants to discuss their interpretations of the world in which they live. However, Cohen and Manion and Morrison (2000) reveal that the disadvantage of the interview is that it is prone to subjectivity and bias on the part of the interviewer. This is a challenge that I think it is natural but I can overcome it through triangulation. After the process of making *umqombothi* I conducted a face-to-face semi-structured interview with the parents who were preparing the *Nguni* fermented grain foods. Terre-Blanche and Durrheim (1999) refers to a face to face approach of conducting interviews as a process of getting to know each other intimately so that we can be able to understand how they think and feel. For these semi-structured interviews I developed an interview schedule based on the questions I had as they were making *umqombothi*. Semi-structured interviews are sufficiently open ended and enable questions to be re-ordered expanded and further

probing can take place (Cohen *et al* 2000). I used this data generation technique as a way of getting in-depth information or probing for more information about ways of making *umqombothi,* the reasons for the methods they followed and the cultural significances of *umqombothi* (appendix). I conducted these interviews with these parents as a way of member checking and used interviews for triangulation. These interviews were conducted in *isiXhosa* as the women were not comfortable speaking English although they can easily understand English. A tape recorder was used during these interviews in order to capture all the information. Interviewees were given the tapes to listen to their responses for member checking. The interviews were translated into English in the process of transcription. The translations were validated by a bilingual critical friend. Interviews were analysed so as to influence the next step.

3.4.4 Learners work

At the end of the demonstration learners had to write a full scientific report on the process of making *umqombothi* as a requirement for Learning Outcome 1 of the Life Sciences curriculum (refer appendix H1). At the end of the lesson on alcoholic fermentation, learners' reflections in their note books were analysed. Learners were also engaged in an individual activity, so as to be able to assess Learning Outcome 2 (refer appendix H 2 for the activity).

3.4.5 Field Notes

According to Cohen *et al.* (2000), field notes are important as they give first hand information on the incidents related to the experience. Therefore rough notes were taken during the demonstration and after each data generation technique. These notes helped in recalling and extrapolating on whatever came out during data generation. Field notes were also used to earmark events and put bits together for analysis of the data.

3.4.6 Document analysis:

Content analysis of the following documents was done in order to develop lesson plan and learner support material for this study.

- National Curriculum Statement life Sciences (FET),

- Scientific literature of fermentation.
- NEEP document on lesson planning for a healthy environment

Critical analysis of the documents guided me develop lesson plans as Patton (1990) suggests that documents prove valuable not only because of what can be studied from them, but as a way of stimulating more questions to the researcher.

As a way of probing how the situated intergenerational ways of knowing have contributed to a valuing of cultural heritage I developed a learning unit planner and learner support material on alcoholic fermentation using fermented grain as a focus (appendix F and appendix G). I developed learner support material, which I used as a supplement when I was teaching the lesson.

3.5 Data analysis

In this study, data generation, analysis and interpretation occurred throughout the research. This was because this interpretive study had phases that informed the next phase which implies that I had to analyse the data generated after each data generation technique to be able to take emerging issues further to the next stage. This process helped me to be able to rectify mistakes I sometimes made in the field.

In order to analyze and make sense of the data, I drew on grounded theory (Glaser and Strauss 1967) and inductive analysis. According to Patton (1990) inductive analysis begins with specific observation and construct towards general patterns. He further states that theories about what is happening in a specific context are supported directly by the experiences. The grounded theory approach is concerned with "the discovery of the theory from the data" by reading the data intensely, coding emerging trends and patterns, developing a set of categories and subcategories, comparing and interrogating the emerging themes. For this study grounded theory was used in order to generate theory more systematically by using clear coding and analytical methods.

The first phase of data analysis was the analysis of the questionnaires from learners that were probing their prior knowledge on fermented grain foods, alcoholic fermentation, links between alcoholic fermentation and the making of *umqombothi* and cultural

significances of *umqombothi*. I organized the data based on these subcategories and the outcomes of the analysis informed the demonstration that was done by parents making *umqombothi* (refer SQ1; SQ10).

After the demonstration learners conducted interviews with parents and also with community members, so as to probe more on the making of *umqombothi* and the cultural significances. I also interviewed parents and conducted focus group interviews with learners. I transcribed, coded and analyzed the data. This helped to reduce the enormous amount of data I generated, and helped to make sense of the data generated.

As a way of building on the activities discussed above I developed a lesson plan. In order to develop a lesson plan for a healthy environment I did curriculum analysis. I had to make sure that the lesson was in line with the NCS for FET. I also used findings from the questionnaires, demonstration, and interviews so as to inform the development of a learning unit planner. The NEEP-GET documents clearly state that learner's prior knowledge is imperative for effective development of lesson plans.

As a way of preparing the lesson I developed learner support materials that could be a supplement during the teaching process for effective learning. At the beginning of the lesson learners had to discuss the process of making *umqombothi* in groups of four and each group had to report on its topic. This was a way of probing their prior knowledge and encourages them to participate in the lesson. Discussions in groups, presentations and as well as whole class discussions encouraged participation and subsequently meaningful learning. The photos were also taken during these activities. Reflections from a critical friend and from learners were analysed. The table below shows the summary of the categories for the analysis of the data.

Table 3.1. A summary of categories and sub-categories.

Category	Sub-category
Probing prior knowledge	• Knowledge of the process of making *umqombothi* • Knowledge of alcoholic fermentation • Ability to relate alcoholic fermentation with the process of making *umqombothi* • Cultural significances of *umqombothi*
Demonstration	• Parental involvement and knowledge transfer • Language use • Relevant concepts • Link to Learning Outcomes
Cultural significances	• Cultural significances • Environment and sustainability
Developing the lesson plan	• Building on the activities • Curriculum analysis
Teaching lesson	• Prior knowledge • Use of learner support materials • Active learning • Environmental learning

3.6 Ethical issues

Bassey (1999) considers three ethical values as very important in order to ensure a meaningful and acceptable research process, i.e. respect for persons, respect for truth and respect for democratic values. In order to consider these ethical values I explained the purpose of the research to the respondents and participants. I wrote letters to the principal, school-governing body and parents to ask permission to conduct the research and also to ask Grade 11C (23 learners) to participate in the research (refer appendix A 1, 2, and 3). I had a meeting with the School Management Team to explain the research process, objectives and to clarify the role of the learners and how I intended to involve

parents in this study. I had to make sure that they understand the nature of the study (Cohen et al 2000). I asked for a permission to take photos and use them in this study and also gave them assurance that I would only report information that was in the public domain.

3.7 Validity and Trustworthiness

To ensure validity of this study I used reflexivity, different forms of gathering data, triangulation, thick description and face validity (Patton1990). Lather (1986) suggests that triangulation is a critical method in establishing data trustworthiness. According to Cantrell (1993:100), triangulation involves cross checking and interpretation drawn from different sources, methods and perspectives. This view is shared by Hitchcock and Hughes (1995:323) who maintains that it can help the researcher to establish the validity of the findings by cross- referencing for instance different perspectives obtained from different sources. It is in this light that prolonged and repeated interviews were conducted with the hope of minimizing the researcher's subjectivity and be able to identify similar and different information, i.e. interviews by learners of parents and community, interviews by the researcher of parents, focus group interviews with learners. These methods were used to ensure trustworthiness of the data and interpretations (Fien 1992, cited by Atiti, 2003:104).

Verification of the data generated through the focus group interviews with learners and semi-structured interviews with parents was also used to ensure validity and trustworthiness. In order to validate the data and knowledge created, a process of interpretation, re-interpretation and self correction of data with research participants was used. In the case of the parents who were making *umqombothi,* they explained the process and I tape recorded what they said. Learners interviewed them and I also interviewed them. I gave them the tapes to listen to their responses and confirm their responses; Cohen *et al* .2000) refer to this as respondent validation. Kamarovsky (1981 as cited in Lather 1986:65) states that it is imperative to use self- corrective techniques to ensure data trustworthiness as that will minimize the misrepresentation of our personal interpretation.

The advice from Lincoln and Guba (1985 as cited in Bassey1999:75-77) of spending a lot of time with the data, focusing on particular features of the case and keeping a systematic record of the data and research process was of good help for this study. This also contributed towards my familiarity and understanding of the data.

3.8 Discussion of the methodology

3.8.1 Challenges

Conducting this research was not easy. In this section I would like to discuss the following challenges I had to overcome as I generated the data: time and language used.

3.8.1.1. Limited time and access.

This was done on part-time basis. I did not have as much time as I would have liked to have had for the study. Although I was given permission to conduct research with grade 11C for this study, the demonstration was part of Life Sciences curriculum. For the making of *umqombothi* I had to make sure that the process did not disturb the tuition. So I had to organize such that the demonstration was conducted after school.

3.8.1.2 Language

For this study English was the language used. English is also the language of teaching and learning in South Africa (Eastern Cape Province). English is a second language for me and for the learners and parents. As an *isiXhosa* speaking person I could easily reach out for parents who preferred to use their mother tongue when narrating their ways of making *umqombothi*. Using mother tongue meant that important information was not omitted. Also after transcribing the tapes (as they were in *isiXhosa* and I had to translate them into English) I asked one of my colleagues to help me, to make sure that I've done correct translation of the *isiXhosa* words.

3.9 Conclusion

In this chapter I have described how I made research design decisions with a view to fulfil the aims and objectives of this study. I have explained reasons for choosing the interpretive case study and various data generation techniques I have used for this study. I also explained the analysis of the study and how I created categories and subcategories.

The next chapter presents findings on the process of developing learning unit planner that is an integral part of the study.

Chapter 4:
DEVELOPING AND TEACHING A LESSON PLAN THAT INTEGRATES IK INTO LIFE SCIENCES

4.1. Introduction

This chapter reviews the research process used to inform lesson planning in order to integrate indigenous ways of knowing within the Life Sciences curriculum. It also reports the phases in which the data was generated through the following research activities:

Phase 1 – Exploring the realities of indigenous practices: Investigating the making of *umqombothi* to document IK, its cultural significance and to look at how learners make sense of this experience (4.2)

- Learner questionnaires as worksheets for exploring the learners' prior knowledge of the making of *umqombothi* (4.2.1).
- An observation schedule for documenting a demonstration by a member of the local community on the making of *umqombothi.* (4.2.2).
- A focus group interview with participants to document the learners understanding of cultural significance of *umqombothi* (section 4.2.3).

These data were used to inform a learning programme (lesson plan and learning support materials) that was developed for the Life Sciences curriculum.

Phase 2 – Researching the curriculum realities: Using the data from phase 1 to develop a lesson plan and to design materials for continuing work with IK in the Life Science curriculum (4.3).

- Document analysis of Policy and curriculum planning materials so as to assess how indigenous knowledge on fermented foods resonates with the curriculum. (4.3.1).

The data and the information on *umqombothi* generated in phase one was used to design learning activities and materials for a lesson that was implemented with the learners (4.3.2).

Phase 3 – Implementation and review of the lesson plans and materials developed for working with IK in the Life Science curriculum (4.4).

- Review of the lesson using photographic record, personal diary, notes from critical friends and learner comments (4.4.1).
- Assessment of Learning Outcomes with evidence in the student's work (4.4.2).

The planned learning sequence in the lesson plan involved identifying the learner's prior knowledge on *Nguni* fermented grain food, an demonstrational of the making of *umqombothi* and a discussion on the cultural significance of *umqombothi*. This then informed the development of the learning unit planner and LTSMs, which is discussed in last part of the chapter.

The review of the lesson planning and implementation process is centred on the synthesis of evidence related to the inclusion of indigenous knowledge in the Life Sciences curriculum.

4.2 Phase 1 – Investigating the making of *umqombothi*

This phase involves questionnaires as worksheets for students to probe and document the shared experience and knowledge (prior knowledge) they have on the making of *umqombothi*. In a similar way I used an observation schedule to document the demonstration of the making of *umqombothi* by members of the local community. During the demonstration, discussions were tape recorded and at the end of the demonstration semi- structured interviews with both parents and learners were used to clarify some of the points that emerged in the discussion. Students also conducted semi- structured interviews with community members to document more on the cultural significances of *umqombothi*.

4.2.1 Questionnaires as worksheets for students to probe and document their prior knowledge.

Responses of learners from questionnaires were categorized so as to assist further analysis. Table 4.1 shows the categories and subcategories emerging from the analysis of questionnaire data.

It is notable that there were some learners who did not know how to make *umqombothi*. For some of these learners the lack of experience appears to be because of their religious affiliation; their families are not practicing traditional cultural rituals so they were not exposed to the process of making *umqombothi*. Some learners, especially male students, had no experience of *umqombothi being made* in their homes. They saw it as women's thing. These male learners knew about the equipment and ingredients that are used to make *umqombothi*, but were unable to give a clear step by step explanation of the process. Another group of learners, especially females, had a clear understanding of the process. These learners experienced the making of *umqombothi* as part of their upbringing.

Table 4.1. An initial analysis of learner's responses from questionnaires

Categories and Subcategories	Percentage responses of learners
Knowledge of making *umqombothi*	
Know equipment	75 % of the learners
Knowledge of the method	58 % of learners
Significances of *umqombothi*	
Connecting people with ancestors (superstitions)	98 % of learners
Way of acknowledging norms and values	16 % of learners
Negligence cause misfortune and obeying ensures blessing and good fortune	82% of learners
Fermented grain foods(e.g. sour bread)	
Have knowledge about most kinds	100% of learners
Know some indigenous ways of preparing them	100% of learners
Have knowledge about alcoholic fermentation	
Yes but basic	33% of learners
Ability to make connection between alcoholic fermentation and the process of making *umqombothi.*	
Yes	33% of learners

The questionnaires required learners to demonstrate their knowledge about other fermented grain foods. Learners could name a number of *Nguni* fermented grain foods such as *amaRhewu*, *isonka*, *ipapa emuncu* and others. Learners also gave details of methods of preparing some of these fermented grain foods. *AmaRhewu* and *isonka* were the popular ones. All learners were able to explain the making of *umqombothi*; this may be due to the fact that they are the common fermented grain foods.

Learners also had to demonstrate on their ability to show the relationship between fermentation and the process of making *umqombothi*. Only 33 percent of learners

indicated a fair knowledge of alcoholic fermentation but they had a very poor understanding of the relationship/ link between fermentation and the making of *umqombothi*. 77 percent of learners did not know about alcoholic fermentation and also could not link alcoholic fermentation with the process of making *umqombothi*.

This illustrates that learners from the same context may have different prior knowledge. Learners are unique and the varieties of background need to be considered for enhancing learning. These learners are from the same area, but they have different opinions on socio-cultural issues and practices. Some of these differences, as noted earlier, are due to their religious backgrounds.

Analysis of the questionnaires also indicates that most boys were aware of the cultural significances of *umqombothi* but were unable to explain the process of making *umqombothi*. This was due to their culture as women are regarded as people who are responsible for cooking and anything related with food. Male students were also not interested in the making of *umqombothi*, they indicated that culturally as males they have to be called to make sure that *umqombothi* is mature and to come and drink.

The challenge I had to overcome was to encourage learners who are not practicing cultural rituals due to their religious affiliations and boys to be interested in the making of *umqombothi*. Initially I assumed that all learners would be interested in the making of *umqombothi* but mobilizing learners` prior cultural knowledge gave me an idea that my assumption was inaccurate. It is important to be certain about the learners` prior knowledge.

The responses from these questionnaires gave me a clear guidance for the development of observation schedule to be used by the learners during the demonstration in the curriculum module. From their responses I could identify their background knowledge. This gave me confidence about proceeding with the lesson planning. I also discovered that not all of them knew the process, so I had to draw up observation schedules so that, at end of the demonstration, these learners would have a common understanding of the process and a better conceptual understanding of alcoholic fermentation. These questionnaires also informed the lesson plan as I had to give learners a clear understanding of alcoholic fermentation. The fact that there are

learners who are not aware of alcoholic fermentation challenged me to be certain that at the end of the lesson all learners would meet the requirements as stipulated by the Learning Outcomes.

The observation schedules were designed to encourage learners to observe the process accurately and also for them to give a clear description of the process. A clear description was encouraged so as to promote logical thinking and reasoning by the learners. With the observation schedules learners would also be able to co-operate to submit the report at the end of the demonstration.

Analysis of the observation schedules would help the educator to identify problems encountered by learners during the demonstration and be able to identify the challenges the learners faced during the demonstration that could inform the development of the lesson.

4.2.2 Observation schedule to document a demonstration on the making of *umqombothi.*

The demonstration of making *umqombothi*, was conducted by 2 female parents from the community. This was done to show the importance of involving parents directly in their children's education, and not only indirectly in attending meetings. The goals being that they can know how valuable they are or might be to the education of their children. During the demonstration, learners were participant observers. They observed the demonstration and the girls helped with the mixing and straining, while the boys helped with the carrying of big pots and big dishes in and out of the class.

Figure 4.1. Learners filtering sediments of *umqombothi.*

From the interviews conducted after the demonstration both the parents involved indicated that experiential learning was the way they used to learn in the olden days. They also indicated that it is how they learnt to make *umqombothi*. During the interview parent (P1) commented:

> *Zange ndiyiyele esikolweni lento, ndafunda kumakhulu wam nodade wam omkhulu. Umakhulu wam wayeyinjinga ekwenzeni umqombothi.* [I never went to school for this, I learnt this through working and helping my grandmother and bigger sister doing it. My grandmother was very good in doing this.]

During the demonstration parents were speaking their mother tongue *(isiXhosa)*; as a result learners could more easily understand the process being described and were consequently more actively involved. The observation schedules were in English and learners had to respond in English on their worksheets. Analysis of these indicated that most learners gave a short description of the demonstration as English is their second language. I expected observation schedules to encourage accurate observation by learners as they had to give a clear description of the process and also I encouraged them to ask questions from parents if they did not understand something. The analysis of the observation schedules indicated that learners did not write notes on the discussion between them and parents. Fortunately I managed to capture the discussion on the tape recorder. Without the tape recorder, I would not have had the information from the demonstration. The use of a tape recorder and photographs helped to capture the process for later lesson planning. It would be more valuable if I was using a video camera. This indicated that learners would need the support of an observation schedule. For example, in the discussion (from the tape-recorder) the effect of temperature on the process was discussed (section 4.2.3), but none of the students noted this on their observation schedules yet it is a key part of alcoholic fermentation.

Learners asked the reason for adding more sorghum malt after cooking. Parent (P1) 's response was that the sorghum is used to stimulate fermentation. Learners also understood that parents did not pour hot water on the sorghum or maize malt because the heat would inhibit fermentation (from the tape recorder). The use of malt was discussed with parents as they were busy with the demonstration. Analysis of the transcribed notes from tape recorder and the student write up (worksheet) indicated a

conceptual understanding of some of the facts but there was a need for the lesson to make more direct links to develop their understanding of the Life Science concepts.

On day four of the demonstration, *umqombothi* was not fermenting and parents asked learners to put a glowing splint inside the cask. If the splint kept on glowing and learners were told to close the cask and wait for another 24 hours as *umqombothi* was not yet mature. Learners asked parents the reason for using a glowing splint and they were told that when *umqombothi* is mature and bubbling, the splint will stop burning because of the bubbles from the mature *umqombothi.* Another test for maturity was the tasting method, where the parent indicated that a bitter taste implies that *umqombothi* is mature. Parent (P2) also indicated that when tasting *umqombothi,* it is important to taste before straining, so as to use the sediments *(intsipho)* in the taste test. If the sediment is sticky then *umqombothi* is not ready, if its dry then *umqombothi* is mature. P1 indicated that it is also useful to look at the colour of the foam on the cask, if the foam is brown with large frothy bubbles then *umqombothi* is mature, and if it's white, then *umqombothi* needs more time.

Figure 4.2. Learners with glowing splint testing for the maturity of *umqombothi*

After 24 hours the participants again checked whether *umqombothi* was mature or not. On this day, there was brown foam with large frothy bubbles in the cask. A glowing splint was inserted into the cask, and it immediately stopped burning. Parents told learners that *umqombothi* was now ready, and the girls could proceed with the straining process. Learner 4 asked for the reason for the splint to stop glowing, and parents responded as follows:

> *Ugwebu olu luphuma emqombothini libangela ukuba umcinga lo ucime, xa umqombothi ungekalungi njengayizolo, ugwebu luye lungawucimi umcinga.*
> [Bubbles from the fermenting beer inhibit the flames from the splint, when

umqombothi is not yet mature like yesterday then the splint keeps on glowing as there are not enough bubbles].

The *isiXhosa* explanations from the parents were making sense, but learners were unable to take the explanations and interpret them using the scientific concepts in the curriculum. *IsiXhosa* responses that were given by parents to learners' questions were correct, as parents were using their indigenous ways of knowing to explain the practices for which they did not need scientific knowledge. The knowledge associated with the pattern of practice can be explained with scientific concepts but this is not necessary in the successful making of fermented sorghum beer, this indicates that as a teacher I have to build in the science in my lesson planning to meet the Assessment Standards. At the end of the demonstration learners had to do a write-up so as to meet the requirements for Assessment Standard of Learning Outcome 1 of Life Sciences grade 11.

4.2.2.1 Analysis of learners' first round of work

The learner's first round of work for this study was the write –up of the demonstration. The analysis of their write-ups indicates that learners were able to assess the value of the demonstrational process and communicate their findings. The evidence from these reports showed that learners were able to:

- give a relevant heading for the write up of the demonstration
- write the aim of the demonstration
- name the equipment used for the demonstration
- Write-up the sequence of activities.

The analysis of the write–up indicates that these learners could not explain the results and were not able to draw scientific conclusions (refer to appendix H 1). From their write–up it is also clear that these learners had to improve in their use of language. Learners needed to develop skills in scientific writing and be able to present findings and draw conclusions. Some of them were able to identify inconsistencies but most of them could not.

This indicates that these learners were skilled observers and thus met the minimum requirements for Learning Outcome 1. There was however, a need for the

development of more activities for making links between Indigenous Knowledge practices and scientific concepts (refer appendix H1 for the sample of learner's first round of work).

4.2.3 A focus group interview to document the cultural significance of *umqombothi* to the learners

During the focus group interviews learners indicated that it was a challenge to respond to the observation schedule as they could not give English names for some of the *isiXhosa* names e.g. *Umgquba* (dry cow dung); *Ifatyi* (cask) etc.

The effect of temperature on the process of making *umqombothi* also came out from the focus group I conducted with learners and the parents. In all these phases it emerged that *umqombothi* should be kept in a warm, shaded place, P2 commented during demonstration.

> *Kubalulekile ukubeka ifatyi phezu komgquba uyigqume kakuhle, kuba xa igodola ifatyi umqombothi awulungi kwangethuba, awuyithandi ingqele umqombothi.*
> [It is important to put the cask on top of dry cow dung and properly cover the cask, as low temperature may delay fermentation process];

Focus group learner 1 (FGL1) stated that her mother put old blankets below the cask and put dry soil around the blanket as dry cow dung is scarce in their area. FGL2 stated that when it is really cold her granny makes *umqombothi* in the kitchen (cooking place) where it is warm.
This implies that the observation schedules, tape recorder, focus group interviews, and the write up showed a need for a lesson to introduce alcoholic fermentation using scientific ideas.

From focus group interviews with learners and with parents it has been indicated that the use of a glowing splint to determine whether *umqombothi* is mature or not is the common way in the Grahamstown area. In western science the reigniting of a glowing splint is the indicator for the presence oxygen and the flame being doused is a simple demonstration to indicate the presence of carbon dioxide. From this I expected

learners to be able to identify the gas released during fermentation, but learners were unable to explain this.

During focus group interviews with the learners I asked learners to think about ways of identifying different kinds of gases, and told them to think about the kind of gas which caused the glowing splint to cease, so as to prepare for the lesson on alcoholic fermentation. I gave them this as home work because I could see from them that they do not associate the answer with what they know in class, they thought that there was something else which would give these results (field notes).

4.2.3.1 Exploring cultural significances with learners

As a way of exploring the cultural and health significances of *umqombothi,* interviews were conducted by learners with community members and I interviewed the parents (refer appendix D1). The cultural significances also came out from the questionnaires that were answered by learners probing their prior knowledge (see section 4.2). By using differing and overlapping research methods in this way I was able to work with the learners as co-researchers whilst tracking and clarifying the key things that I would need to know for lesson planning and the development of the learning materials in phase 2.

Learners were guided on the ways of conducting interviews and encouraged to draw a semi-structured interview schedules before interviews. I also encouraged each learner to interview two community members of different sex and age group. The interviews give an insight that *umqombothi* is important culturally as most *isiXhosa* speaking people believe that it is the way of connecting them with their ancestors and most of the cultural rituals that are being exercised by *isiXhosa* people are always accompanied by the making of *umqombothi* .From the interviews, respondents indicated that *umqombothi* encourages people to acknowledge and keep their norms and values (refer table 4.1). When *isiXhosa* speaking people are drinking *umqombothi* during their cultural rituals they have a sitting arrangement, they also have to wear specific attire which is a symbol of respect and honoring the ancestors. *Umqombothi* is also used during cultural celebrations. The respondents also indicated the cultural significance of making *umqombothi* as a way of connecting people with their ancestors. Some of them believe that being connected to ancestors is of help even for

health reasons (response from learner's interviews, interviews with demonstrators). P2 also stated that *umqombothi* is important as they sometimes use the froth from the fermenting mature *umqombothi* as yeast to make a dough or to make *amarhewu* (which is another fermented grain drink made from maize-mealie).

The interviews also give an insight into the low alcohol content of *umqomboth*. The learners were told that it is wise for people to consume a small amount, so as not to get drunk. They motivated this by referring to their cultural rituals where all family members are given a chance to have a sip of *umqombothi* before other invited people. When I asked the parents (demonstrators) whether is this not a way of encouraging young people to drink alcohol, their response was that a sip of *umqombothi* is not dangerous as it does not cause anyone to become a drunk.

These responses also give an insight on the fact that maize-meal, maize and sorghum are used during the making of *umqombothi* and as grain foods they give energy to the body. (P1; P2; SI4; SI15). From interviews it was also stated that nutrients and vitamins in sorghum and maize help to nourish the bodies of people drinking *umqombothi* but parents could not explain how this happens. I noted this in my field notes as it was an opportunity for me as a Life Science educator to develop a lesson integrating indigenous knowledge in the Life Science curriculum. From the explanations in practice to the complementary understandings that scientific ideas can provide I had to explain how these could be used to deepen insights on the importance of fermentation in enhancing the food value of sorghum.

4.3 Phase 2 – Lesson planning and indigenous knowledge in the Life Sciences curriculum

Following on from the exploratory activities reported above, I developed a lesson plan to work with indigenous ways of knowing and scientific ideas side-by-side within the Life Science curriculum.

4.3.1 Document analysis to inform lesson planning.

In order to develop a lesson plan I analysed the Life Sciences NCS (FET) and also a document on the development of lesson plans (NEEP-GET) which gave me a lesson plan format that I adopted for the research. The lesson plan was developed based on Learning Outcome 2 and 3 and its Assessment Standards as stipulated on the NCS of Life Sciences Grade 11. Learning Outcome 3 of Life Sciences NCS (FET) states

> A learner must be able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the interrelationships of science, technology, Indigenous Knowledge, environment and society.(DoE 2003: 37).

This implies that learners should be aware of the existence of different viewpoints based on scientific beliefs, ethics, values and attitudes in a multicultural society and be open-minded towards all view points. Also learners should value their cultural heritage.

Assessment Standards for this lesson required learners to explore and evaluate scientific ideas and indigenous knowledge of past and present cultures. This lesson is also integrated to Consumer Studies (the nutritional value of fermented foods) and Physical Science (concepts) through the critical analysis of the curriculum statements of these learning areas. This lesson was also linked with the previous lesson, which was the lesson on lactic acid fermentation. Lactic acid fermentation is the anaerobic respiration in the muscles of animals. The following lesson would be a practical on alcoholic fermentation using yeast cells. (Refer appendix F for a learning unit planner)

4.3.2 Design of the learning activities and materials

The NEEP-GET document states that learner's prior knowledge is imperative for effective development of lesson plans (NEEP-GET, 2004). I noted that this was especially the case when lesson plans are developed to mobilise indigenous ways of knowing. Findings from the questionnaires, demonstration process and interviews were then used to inform the lesson planning.

The introductory part of the lesson was an activity where learners could work in groups and each group to discuss one of the following topics:

- Discuss the apparatus used and the method of making *umqombothi* (from questionnaires and demonstration)
- What is the effect of temperature on the process of making *umqombothi* (from demonstration?)
- Explain various ways of identifying whether *umqombothi* is mature or not (From demonstration)
- What are the cultural significances of *umqombothi* (from interviews and questionnaires?)

The main aim of this discussion was to consolidate learners` knowledge. The topics they were to discuss are the topics we previously dealt with through questionnaires, demonstration and interviews. These activities were used to identify what learners already knew, so that there could be effective planning of activities for learners to attain the Learning Outcomes and to be able to provide appropriate support to learners. These topics were to achieve Learning Outcome 3 as stipulated above. Assessment Standards for this activity required learners to describe different ways in which resources are used and applied to the development of products, and report on their impact on the environment and society (DoE, 2003a).

An educator's duty was to facilitate the group discussions. After each presentation by the group reporter, the whole class would ask questions before proceeding to the next presentation, so as to encourage active learning and learner participation. The presentation by various groups would be used as a starting point to develop the lesson as the educator explains to learners the process of alcoholic fermentation.

At the end of the lesson learners would work as individuals so as to achieve Learning Outcome 2, which required learners to identify concepts, and models of Life Sciences in the context of everyday life.

The learners' materials were designed so that learners could compare fermentation, the making of *umqombothi* and the making of wine. The learner support materials also gave a detailed process of converting pyruvic acid to ethanol and carbon dioxide (refer appendix F2).

4.4 Phase 3 – Lesson implementation and review

The classroom was set up so that learning could take place individually, in groups or as a class.

Activity 1 required learners to work in groups, and also discuss as a class (section 4.3.2).

Figure 4.3. Learners discussing as a group

Learners had to choose their groups; as a result there were friendship groups.

Each group selected a reporter to present what they were discussing.

Figure 4.4. A learner presenting after group discussion

After each presentation the whole class was engaged in a discussion, because learners needed more clarity from the presenters. This was a way of reminding them about the previous activities, so as to be able to show the connection between the process of making *umqombothi* and alcoholic fermentation.

4.4.1. Review of the lesson

Photographic record, field notes, notes from critical friends and learner comments were used to review the lesson. During the introductory part of the lesson, during which learners were working in groups, the educator was moving around to listen to the discussions of various groups. This was a way of making sure that learners were discussing the topic and also an opportunity for assessment (field notes).

Figure 4.5. Show educator as an assessor and a learning mediator.

Figures 4.2 and 4.5. Shows two groups with learners actively involved in the discussion. They have assigned themselves different roles to play in the group and are also sharing information they have from their previous involvement in the activities. This is supported by a critical friend's reflection that says

> The learners` group working skills were enhanced through brainstorming sessions and discussions.

The probing of learners` prior knowledge was done successfully during the lesson and it was also a good way of encouraging learners to be actively involved.

Learner 1 reflections:

> This lesson helped me to understand more about the things that we do in our homes and get to know scientific ways that are functioning during the process of making these things.

Learner 2 reflection:

> I was very comfortable with alcoholic fermentation because we did the demonstration about it, it is something that is done every now and then in the houses so we were discussing something that we know.

Learner 3 reflections:

> The group I was with was good, and they were answering questions asked by other groups. The lesson was enjoyable and interesting simply because I knew how to make *umqombothi*, I've seen it several times.

Learners 4 reflections:

> The lesson today was neither easy nor difficult, because we were all cooperating in our group and supporting each other. I feel that I understand alcoholic fermentation.

The informal discussion was facilitated by the educator and was carefully monitored. Most learners were participating in the discussion. This discussion gave me an opportunity to identify areas of strengths and weakness of the learners, and to develop the lesson based on that.

The critical friend's reflections:

> The teacher created a conducive atmosphere to support learners when she opened a class debate on the learner's indigenous knowledge.

There were misconceptions in some of learners ideas e.g. one of the groups stated that black label (a kind of beer) reduces dandruff. During discussion learners encouraged each other not to abuse alcohol, they stated that although *umqombothi* is important for

cultural rituals, but that does not mean people must abuse alcohol. The discussion on cultural significances of *umqombothi* ended up encouraging learners to make good lifestyle choices and not abuse alcohol.

One of the ideas that were important was that learners stated that at their homes mothers usually skim off froth from the mature *umqombothi* and use it to make dough for bread and also to prepare other fermented grain foods like *amarhewu*. This statement was one of the statements used as the educator was developing the lesson, based on the fact that the froth is used to make dough because it has a high concentration of yeast cells, which is the natural occurring yeast which causes *umqombothi* to ferment.

Reflections on my field notes and also from my critical friend indicate that I did not allocate enough time for the topic on the lesson plan; as a result I needed more time. The introductory part of the lesson took 45 minutes and I had to develop the lesson on the next day. This implies that the lesson took 2 lessons whereas according to my lesson plan, I planned for 1 lesson. The activity by learners was the reason for me not to have enough time, and I could not interrupt the discussions as it seemed interesting to learners.

On the next day I developed the lesson on alcoholic fermentation based on learners` presentations. As a way of developing the lesson, I explained food substances in sorghum and maize meal. I also explained the process of alcoholic fermentation until the products (ethanol, carbon dioxide and energy).During the lesson there was time for learners to discuss the effect of temperature on:

- the process of making *umqombothi*
- The rate of the reaction
- Bacteria and yeast cells.

During the lesson learners were actively involved, listening and they sometimes interrupted by asking questions. Field notes, learner's reflections and reflections from a critical friend indicated that the lesson was very interesting. Learners participated well and were actively involved. Learner 3`s reflection indicated that some of the reasons for the lesson being interesting was the fact that the lesson was based on their

culture and their every day lives: they were so amazed to link Life Sciences with *umqombothi* as they always think that those are total different things.

There were a number of important issues that were raised by learners during the lesson, of which some of them had to be postponed for the next lesson and some of learners' questions encouraged integration of learning areas. E.g. Learner 4 asked about the effect of lightning on the process of making *umqombothi*. In his reflections the learner also indicated this effect of lighting as his concern, and we had to discuss this issue further the next day.

This was a continuation of the demonstration, so linking the demonstration with the theory was interesting; working as a group, and having time to discuss things they were not sure of, helped to motivate them and encouraged them to be confident of their knowledge (field notes). Learners indicated in their reflections that the lesson helped them to understand the process of making *umqombothi* more and more. This could help them to be able to guide and help at their respective backgrounds when they make *umqombothi*.

Learner 5 reflections:

I had discovered a new world of the process of making *umqombothi*. I had a cultural belief that it depends on the person who is making *umqombothi* for it to be matured, but I was completely wrong. Biologically or Scientifically I was proven wrong.

Learners also indicated that the lesson on the integration of intergenerational ways of knowing into the Life Sciences helped them to value their cultural heritage as it showed how important it is.

Reflections from the critical friend indicated that the lesson was a success based on the following observations:

- Educator's ability to ascertain learners' prior knowledge. So that learners can have opportunities to discuss the indigenous ways of knowing
- Educators ability to create a conducive atmosphere for learning, so as to motivate learners to be involved in discussion that are taking place in class.
- Educator's ability to develop lesson from learners' prior knowledge.

4.4.2 Assessment of Learning Outcomes with evidence in the student's work

During discussion I assessed the learners' strengths and areas where they needed support. This helped to develop the lesson so that it improved the learners' understanding and enabled them to reach their full potential. The discussion was the requirement of Learning Outcome 2 (see section 4.3.2.)

At the end of the lesson learners worked as individuals so as to achieve Learning Outcome 2, which requires learners to identify concepts, and models of Life Sciences in the context of everyday life. (Refer appendix E2 for the activity)

From the class activity they were engaged, they were able to show a clear understanding of alcoholic fermentation, and were able to show the link between alcoholic fermentation and *umqombothi*, as they wrote *umqombothi* as one of the drinks that is produced at the end of alcoholic fermentation. They were also able to know the reactants and products of alcoholic fermentation, which was one of the problems shown in the questionnaires.

The last question required learners to discuss the effects of alcohol in the human body. Analysis of this indicates that these learners are exposed to the disadvantages of alcohol. All of them gave only 2 to 3 points on the advantages of alcohol. The points they had about disadvantages of alcohol illustrates their exposure to alcohol abuse. These are some of the points they wrote;

- It damages lungs, liver, brain cells
- It causes loss of memory and people end up doing things they regret later
- It is the main cause for people to be bankrupt.
- It causes loss of appetite and weight.

Analysis of these and of the discussion we had in class indicates that there is a need for more information and activities that include the community on alcohol abuse. This shows a problem learners have in their background on the effect of alcohol. The lesson was incomplete as there seems to be a need for more discussion based on what could be done to reduce alcohol abuse in the community, and also for learners to suggest programs that the school could be involved in or initiate so as to help all those

who are affected. This would be a way of helping learners to identify further investigations, action taking and information seeking.

4.5 Conclusion

This chapter gave an overview of ways that could be used to develop a lesson plan that integrates indigenous ways of knowledge into the Life Sciences and contribute to the valuing of cultural heritage. According to the data analysis it is very imperative to probe learners` prior knowledge, conduct a demonstration, explore the cultural significances of *umqombothi* with learners, and involve parents or community members so as to be able to develop lesson plans and learner support material (learning program unit) that mobilize indigenous ways of knowing into the Life Sciences.

The next chapter provides a more in-depth discussion on the key consideration for lesson plan (learning program unit) development to integrate indigenous ways of knowing into the Life Sciences.

Chapter 5

KEY CONSIDERATIONS FOR LESSON PLANNING TO INTEGRATE IK INTO LIFE SCIENCES

5.1. Introduction

This chapter discusses the research findings on lesson planning to integrate indigenous ways of knowing into the Life Sciences and reviews processes that contributed to the valuing of *Nguni* cultural heritage. The key considerations examined are the mobilizing of prior knowledge through worksheets and the observation of an indigenous practice (the making of *umqombothi*), group discussions and report-back class presentations. Also examined are data on parental and learner involvement and the extent to which the engagement with Learning Outcomes and Assessment Standards of the NCS were met.

The experience of working with indigenous knowledge in the curriculum questions my initial tendency to treat it as a commodity to be integrated alongside other knowledge. Contrary to this, the research concludes that the knowledge imbedded in indigenous patterns of practice came in as a capital of prior knowledge and learner experience for meaning-making interactions in curriculum activities. This allowed for a reflexive learning engagement using the practices of intergenerational rural life and the learning area knowledge of the curriculum to explore the challenges of modern life.

This research cannot claim to have conclusively clarified all of these processes but it has opened up the need for further work to examine how prior knowledge in the patterns of indigenous practice might be understood and brought into learning interactions within the Life Sciences.

5.2 Mobilizing prior knowledge

Probing learner's prior knowledge and understanding cultural values/views that learners bring to class was a challenge in the study. Questionnaires were used as a way of trying to engage (mobilizing) learner's cultural capital so as to teach Life Sciences that coincide with intellectual interest and socio-cultural setting of learners.

Analysis of questionnaires indicates that learners bring a number of ideas to class (refer section 4.2). Indigenous knowledge is often handed or passed on to the next generation through modelling practice and animation and not through written word, so when dealing with indigenous knowledge it is a question of looking at what learners know through experience in everyday life (prior experience and knowledge). Masuku (1999), & O'Donoghue and Neluvhalani (2002) state that understanding the learners prior knowledge is an important requirement to find ways of mobilizing indigenous knowledge in the curriculum contexts. Roschelle (1997) as cited by Maselwa (2004:22) also suggests that if the learner's prior knowledge is neglected; both the learner and the educator can miss their intentions, as the educator can miss the opportunity of allowing learners to re-construct knowledge. In this study questionnaires as worksheets were designed for learners to probe and document the shared experience and knowledge (prior knowledge) they have on the making of fermented grain foods. The following issues emerged from the analysis of the questionnaires.

5.2.1 Differences in context and learner background

It was surprising to me that 25% of learners did not know anything about *umqombothi* or of its cultural significance because of their religious backgrounds. This clearly indicated that learners from the same context had very different prior knowledge. Learners are unique and the varieties of background need to be considered for enhancing learning (see section 4.2.1.).This further indicates that although these learners are from the same area, they have different opinions on socio-cultural issues. Kimbugwe (2001) in his study on the integration of indigenous knowledge of medicinal plants into learning area unit discovered that religious backgrounds that are against the use of medicinal plants could hinder the integration process. The attitude of these learners confirmed Odora Hoppers' view about children of Africa being cut off from their roots and moving from one cultural track to another (Odora Hoppers, 1993:105). This need not be the case when all perspectives are engaged as prior knowledge and when a practical engagement with indigenous patterns of practice opens up how things were, are and might be in the sustainable lifestyles that learners consider most appropriate in the world today.

In this study also most boys were aware of the cultural significances of *umqombothi* and also the equipment that are used but were unable to explain the process of making *umqombothi*. They indicated that in their culture women are regarded as people who are responsible for cooking and anything related with food and as males they have to be called to make sure that *umqombothi* is mature and drinkable. This is based on the role that various members of African families play; where males believe that as the head of the families they have to do hard work (e.g. cultivating land) and females to cook (from both parents interviews). Isichei (1997:6) discovered a similar situation amongst the Dinka where the role of the man was to herd the animals and the role of the woman was to provide food. Due to this cultural belief male learners showed lack of interest in the making of *umqombothi* and the challenge was for the educator to stimulate their interest in the process.

O`Donoghue (2001:180) suggests that educators should encourage the natural curiosity and a strong desire to understand the world of the children they teach. As an educator and researcher I had to encourage learners who were not interested to be involved in the demonstration process. O`Donoghue (2001 :181) also suggests that science education is about creating opportunities for different ways of seeing things (world views) to emerge and the educator should facilitate the process in which learners merge the different ways of knowing. In this case mobilizing prior knowledge through the questionnaire and interactions opened up spaces for me as an educator to understand my learners. This challenged my assumptions of learners` prior cultural knowledge and their interest in intergenerational ways of knowing, as initially in this study male learners were not interested (see section 4.2.1).

As a way of mobilizing learners` prior knowledge, learners were asked to show the connection between alcoholic fermentation and the making of *umqombothi.* 67% of learners who knew the process of making *umqombothi* could not link it with alcoholic fermentation, 33 %of learners could connect the two although they did not have correct information about alcoholic fermentation. Ausubel as cited in Taber (2001:110) states that "If a learner holds frameworks of understanding that are at odds with the accepted knowledge, the alternative framework way acts as suitable anchors for new knowledge". Maselwa (2004) also states that "the prior knowledge that learners bring to class does not have to be accurate". This is challenging educators to

put ideas across correctly and accurately recognizing learners` prior knowledge and to stop focusing on the ideas they want to put across to their learners as Maselwa (2004) suggests that educators should try to refine learners` prior knowledge and not try to replace learners' understanding with their own. My intention in the lessons thus became to engage learners and to challenge them to clarify the making of *umqombothi* as a process of alcoholic fermentation and using scientific understandings to value cultural knowledge.

For this study the lesson of alcoholic fermentation was developed based on the discussion by learners in class (see section 4.3.1). The educator guided learners to make meaning by starting from the known (*umqombothi*) and moving to the unknown (alcoholic fermentation). During the class presentation learners could easily explain ways of making *umqombothi*. They had concise information from the demonstration. Learners also discussed ways of identifying carbon dioxide as a gas released at the end of alcoholic fermentation. This discussion was focusing on integrating intergenerational ways of knowing into the Life Sciences curriculum e.g. during the demonstration parents used a glowing splint to make sure that *umqombothi* is mature. Scientifically a glowing splint is used to identify carbon dioxide as the gas, as carbon dioxide does not promote combustion. This was a surprise to me and provided a key link between indigenous knowledge and science, notably how they are about the same thing and came to usefully 'meet' in the learning interactions. What was most important was how the bubbles that put out a splint were an indicator of maturity in the indigenous knowledge system. This served as a bridge to the carbon dioxide as an indicator of alcoholic fermentation in science. Here both served to enrich an understanding of fermentation in foods and the cultural significance of this in an African context.

This study reveals that ascertaining learners` prior knowledge helps them to make judgments concerning their own knowledge and skills and also builds confidence (see section 4.3.1). This study indicates that mobilizing prior knowledge can help educators to understand learners so as to be able to encourage them to construct and reconstruct knowledge around the content of the learning area.

5.3 Parental involvement

In this study two parents were involved in the demonstration and also learners interviewed local community members about the cultural significances of *umqombothi*, where learners could probe more on the interest the communities have on the cultural rituals, and their beliefs based on the importances of *umqombothi.* (They believe that it is a way of connecting people with ancestors (superstitions), a way of acknowledging norms and values, others believe that negligence causes misfortune and obeying ensures blessing and good fortune). The responses of the community members indicate that they know very well about the significances of *umqombothi* as they are similar from the responses I obtained by interviewing demonstrators. This is based on Kimbugwe's (2001) suggestion that integration of indigenous knowledge requires educators to consult with the custodians of the knowledge in the area. Moreover, Cornbleth (1990) states that it is imperative to contextualize the curriculum to be able to take into account the interest, needs and aspirations of the local community and not only to focus on learners own life and realities. Masuku (1999) also supports the involvement of parents as she states that teaching and learning of indigenous ways of knowing should not be confined to school, because environmental issues and indigenous ways of knowing are learned more from parents at home. In Masuku's study, learners suggested that parents/elders be invited to schools to discuss environmental issues and indigenous ways of knowing, she observed this as a way of minimizing logistics. The experience of working with the parents had me conclude that the involvement of community members is imperative as it contributes to the valuing of intergenerational ways of knowing.

Furthermore, Kachilonda (2005) in his study investigating the local community contributions to the Malawi College of Fisheries curriculum, he stated that "local knowledge is practically orientated and is rooted to the experiences and realities acquired after years of involvement in fishery." This also transpired in this study as the women who were demonstrating stated that they did not go to school in order to learn how to make *umqombothi.* They learnt this through observing and helping adults when they were doing it (see section 4.2.2). This implies that indigenous knowledge that people have is practically orientated and is handed over from generation to

generation through practice and not through written word. Involvement of parents in this study was so imperative as a result learners could reconstruct knowledge through participation observation. The value of parental contribution to education of learners and language were issues that emerged.

5.3.1 Parental contributions to education of learners

During interviews, both parents who were asked to demonstrate the making of *umqombothi* (see section 3.3.) commented that:

Parent 1:

> *Bendiyoyika lento yokuzakwenza umqombothi esikolweni. Ndicinga ukuba ingaba bazakundiva na abantwana xa ndicacisa. Kodwa emva kosuku lokuqala ndabanamandla kwaphela ukoyika.*[I was so scared to come and do this demonstration at school. My main problem was whether these kids will be able to understand what I am saying, but after the first day I was relieved.]

Parent 2:

> *Eyonanto ibindoyikisa mna yimibuzo yabantwana ukuba ndizakukwazi na ukuyiphendula.* [My main problem was questions from these learners. I was worried of the fact that I may not be able to answer their questions.]

This evidence shows that initially parents had a fear of conducting the demonstration as it was their first time. On the second day, however, they were comfortable as they could see how valuable their involvement was. In this way the parents that demonstrated the making of *umqombothi* were soon at ease and the learners were comfortable to interact with them.

Singh *et al.*'s (2004) believe that parental involvement in schools is crucial (irrespective of social class) in the enhancement of learners` success. In their study they discovered that parents who played little or no role in their children's education contributed to a poor performance of their children in class. Singh *et al* `s study affirms the view that input of the community is crucial in the development of school curriculum.

Parental involvement in this study also contributed to the encouragement of active participation by learners, as learners indicated that they wanted parents to see them working hard. Furthermore these also encouraged learners to respect their parents, as they would know that their parents are of value to the community including the

school. This is based on the response from interviews where parents (demonstrators) indicated how impressed they were to know that they can have valuable things to teach their children. This was also a way of empowering parents, so that they understand how valuable they are to schools and they can contribute more to the education of their learners.

5.3.2 Issues that arose when learners interacted with parents

5.3.2.1 Parents explanations

Parents and learners were engaged in discussions during the demonstration, as parents had to give a clear description of the reasons for the steps they followed when making *umqombothi*. These discussions also stimulated learners to think critically and re-appropriate their prior knowledge, especially for those who know the process back home. Learner 9, for example, asked parents for the reason in putting more malt into the porridge and not cook the porridge again. Learner 3 asked the reasons for cooling the porridge before adding more malt. As a response parents told them that re-cooking that would inhibit fermentation (see section 4.2.2.). Responses that were given by parents as learners were asking questions were making sense but parents used their indigenous ways of knowing to give explanations that could also be explained in a scientific way. The reason for not heating the malt is because the malt contains yeast cells that stimulate fermentation, and high temperature would kill those cells and cause the inhibition of fermentation. Learners were unable to take those explanations and interpret them scientifically so as to understand the concepts (in the above case it is the effect of temperature on bacteria cell). This implies that although parental involvement contributed to the valuing of intergenerational ways of knowing, this was a challenge as learners could not link indigenous knowledge with the Life Sciences, so there was a need for an activity that engaged learners in integrating indigenous knowledge into Life Sciences

From interviews (SI1, SI5, P1 and P2) it was stated that *umqombothi* gives energy and also may help people suffering from diabetes. When more was asked based on this idea, the answer that was given was that *umqombothi* is made of maize-meal and sorghum. So both these grain foods give energy. O'Donoghue and Cambray (pers.comm., 2005); and van Heerden (1996) indicate that fermentation is important in enhancing the food value of sorghum. Sorghum has low food value when compared

with wheat, but fermentation breaks down sorghum to release vitamin B and enzymes that help the stomach to digest grain. Van Heerden further states that extensive studies that were conducted showed that *umqombothi* is a rich source of vitamin B and minerals. Vitamin B and minerals are essential requirements of the body as they regulate many body functions such as energy synthesis, muscles building, blood, teeth and bone formation.

As an educator I notice that it is my duty to make sure that learners use science to explain these. I thought this could provide a progression in the lesson plan from the explanation in practice to the complementary understandings that scientific ideas can provide and how these could be used to explain and deepen insights on the importance of fermentation in enhancing the food value of sorghum. This also helped the learners to understand factors affecting the rate of the reactions and alcoholic fermentation (see section 4.3)

5.3.2.2 Language

In this study parental involvement encouraged the use of both languages (*isiXhosa* and English) in class, as parents who are custodians of indigenous knowledge in this area expresses themselves in *isiXhosa*, and this challenged learners to translate some of isiXhosa words to English. For example,

> Mrs Mgcuwe speaking: *Xasiqalisa ukudidiyela sisebenzisa amanzi ashushu.Sigalela amanzi abilileyo,kumealie mealie.siyayitshisa imialie mealie, siyiyeke, siyigqume, simenteshe imithombo,imithombo kufuneka ilingane ne mealiemealie.*

Learners note from the observation schedule:

> When starting the making of *umqombothi* we boil water, mix the boiling water with maize-meal, heat and leave it for few minutes. For the time being, we must measure the sorghum (*imithimbo*), as the measurements must be equal to that of maize-meal.

The above discussion (transcribed from the tape) is in *isiXhosa*, but learners had to write observation schedules in English. In the focus groups with learners, learners indicated that they were so comfortable with the use of both languages, especially when they had to complete observation schedules as they had to do it in English, which was a challenge. Learner 1, 2, and 4 (from semi-structured interviews) stated that the use of both languages helped them to improve their language use, as before

the study learner 4 did not care about knowing some of the English words for Xhosa words like *umgquba, ifatyi*, etc. The use of both languages and ability to translate some of the *isiXhosa* words that are so imperative in their culture also encouraged learners to value their cultural heritage, as most *isiXhosa* speaking people tend to neglect their culture.

Moll (2001) states that learning involves language and the quality and accessibility of the language used in learning activities influence learning. In the studies by Mtshali (1994), Masuku (1999), Ngwane (1999), Shava (1999) and Asafo Adjei (2004) both languages approach was used when referring to names of some common plants because they claim that some of the translations are not precise. The issue of language for learning is the current issue in the national challenge for education transformation. I found that maintaining the use of both languages was important for the bridging of ideas between indigenous ways of knowing (local knowledge) and the scientific concepts of the curriculum. Here valuable information in practice and propositions were able to grow together as the learners translated words and ideas between Xhosa and English. The loss of meaning in certain phrases was also important in learning interactions. The *Nguni* people do not talk of brewing *umqombothi*, but making or doing *umqombothi.* The doing includes the ancestral significance of the cultural practice and the making relates to the knowledge and skill of those involved. It cannot be said that the Xhosa have one way of making but they do share the ancestral aspects of the cultural significance of doing in the sense of making and drinking *umqombothi* as a spiritually significant ritual.

5.4 Learner involvement

The involvement of learners during the demonstration (figure 4.1) encouraged them to participate more fully in the lesson and to integrate indigenous knowledge into the Life Sciences. Through these discussions and individual activities learners were able to identify alcohol abuse as one of the environmental issue affecting their community (see section 4.4.2). More involvement of learners with this topic engaged them in discussions on finding ways of addressing the issue. In order for learners to take control over their own lives learners need to be active, autonomous, and creative beings in classrooms and who respect and recognize themselves (HSRC, 2005:103).

Structuring of activities and fostering of school - community interactions were identified as issues that encouraged learner's involvement.

5.4.1 Structuring of activities, and supporting learners to engage meaningfully with the activities

The structuring of the observation schedule, interview activities, group discussion sessions, and report-back presentation was done to support learners to engage in meaningful ways in the learning activities (see sections 4.2.3; 4.3; 5.5.1.). According to Moll (2001:33-34), relevance of any topic to learners can emerge through teacher's mediation such as this. Learners, especially males, initially showed lack of interest (see sections 4.2.1. and 5.2.1), but became motivated and inspired through a developing involvement in the process. The experience of working with these structured processes of learner support had me conclude that educators need to be inspired and to be positive so as to encourage learners to be actively involved in the process of mobilizing indigenous knowledge. It was a challenge to integrate indigenous ways of knowing and the concepts of the curriculum. This is not something that simply happens without an enthusiastic teacher.

Malcolm *et al* (2003) in their study to see how teachers and learners from Cape Flats area used local knowledge in their science classroom produced evidence that "the use of everyday knowledge in the science classroom increases the levels of engagement of learners and that learner enjoy making links between their experiences when curriculum is designed to facilitate such links". In this study the active participation of learners in the whole process (see sections 4.2.2; 4.2.3; 4.4.1 and figures 4.1; 4.2; 4.3) enabled them to uncover the significance and meaning of their cultural heritage and to explore the possibilities of change. Through discussions in class, for example, opportunities were created for learners to consider different life style choices. Topics that emerged were the effects of alcohol on the human body (see section 4.4) and what might be done to address some of the problems of alcohol abuse in the community. Moreover the involvement of learners in these activities created opportunities for them to understand the difference between fermentation that releases minerals and other nutrients with low content of alcohol as in traditional *umqombothi* and other kinds of alcoholic drinks that have much higher levels of alcohol. Here the progression from doing something and then working to understand fermentation

seems to be better than teaching fermentation so that learners understand only its role in brewing.

This shows that it is important for educators to make sure that activities are well structured and to support learners during activities, so that learners can engage meaningfully with the activities.

5.4.2. Fostering school-community interactions

Learners` participation developed from activities to ascertain their prior knowledge and to explore issues that needed clarity. Some of these issues were explained during demonstration and class discussions (see sections 4.2.2; 4.2.3; 4.4.1). At the beginning of the research (worksheets) learners knew different ways of mixing sorghum with maize meal so as to make *umqombothi*. During the demonstration, demonstrators challenged them to give reasons for mixing the way they did, and the possible effects of using other methods. At the end of the demonstration community members were invited to come and drink *umqombothi*. This gave learners an opportunity to observe some of the cultural significances (e.g.) people are not allowed to drink *umqombothi* standing; people have to sit or kneel down (P1, P2, SI9), as every time people drink central values, beliefs, norms, and moral principles of society are more explicit. *Umqombothi* drinking brings together social practice and cultures and relates them to each other. Moreover during the drinking process there was an interaction between learners and community members which gave learners a chance to interview parents to deepen and reconstruct their knowledge on the cultural significances of *umqombothi*. The school community interaction contributed to the valuing of cultural heritage.

5.5 Evidence from demonstration / observation and discussion activities

As a science educator I found that the practical work played an important role in the learning of scientific ideas. I came to understand that practical work is about trying to understand relations between evidence and theory and also to stimulate and challenge the learners. Hodson (1990) states that one of the ways for effective learning during practical work is the use of demonstration within a social constructivist approach to

learning, and also the use of practical work in a traditional classroom. The demonstration in this study was conducted in the classroom and demonstrators and learners were actively involved.

5.5.1 Pedagogical value of the demonstration

In order to encourage learners to make accurate observations and descriptions during demonstration, they were given an observation schedule. This served to support the development of their logical and critical thinking skills and also to develop their ability to co-operate. Hodson (1990) suggests that the effectiveness of practical work lies in the nature and content of the activities. Inviting parents to demonstrate was a way of making the situation more real arousing the learners' interest so that at the end of the demonstration they arrived at the principles of alcoholic fermentation and value their cultural heritage (see section 1.4. for the main objectives of choosing this topic). There was time for discussion during the demonstration so that learners could make their ideas explicit. For example

> Parent: *Hayi akukho ngxaki. Ipholile intlama kugalelwe imithombo leya ibimenteshiwe.Sh.....Kufuneka lefatyi inentlama siyibeke phezu komgquba, lentlama igqunywe ilungiselelwe ukuba ihlale ishushu.* [There is no problem; the dough is cool now, so we can add the sorghum malt we measured. Sh.....Now we must put this cask on the dry cow dung, so as to keep it warm.]
>
> Student C: *Yintoni ebangela ukuba ibekwe phezu komgquba?*[Why do we have to do that ?]
> Parent: *Umgquba uyasithisa. Uzakuyinceda ukuze ibile ngethuba.*[Dry cow dung would keep it warm, so that it matures.]

The above discussion created opportunities for learners to understand the effect of temperature on the rate of fermentation.

The demonstration was before the lesson because it was important for me as an educator to make sure that all learners knew how to make *umqombothi*, so as to build from what they already know. According to Hodson (1990) "it is important to put theory and theoretical speculation after observation". He suggests that it is the developing conceptual structures that give meaning, purpose and direction following practical experience and it is not the practical experience that provides the conceptual

structures. I agree with Hodson's view that it is important to start with the conceptual understanding before engaging learners to a demonstration whereas the aim of this demonstration required me to go from demonstration to understanding.

In section 4.2.2 it is stated that the analysis of the observation schedule indicated that learners had poor writing skills. The use of a tape recorder and photographs helped to capture the discussion during the demonstration. Furthermore after the demonstration learners were still unable to integrate indigenous knowledge into the Life Sciences. This shows that laboratory activity alone does not ensure learners understanding of the concepts. Wilson and Stensvold (1991) also discovered that learners can be involved in a laboratory exercise and not understand the related concepts. From this study it transpired that although the demonstration gave learners opportunity to reconstruct their indigenous knowledge, there was a need for a lesson on alcoholic fermentation, so that learners could integrate western science with their local knowledge.

5.6 Engaging with Learning Outcomes and Assessment Standards

For this study the researcher critically analyzed the NCS and identified Learning Outcomes and Assessment Standards that create opportunities to integrate indigenous ways of knowing into the Life Sciences.

5.6.1 Contextualizing Learning Outcomes and Assessment Standards through a focus on IK

The analysis of the NCS for this study was based on Cornbleth's view of "curriculum as a contextualized social process". She believes that it is important to attend to the context to be able to understand curriculum in practice. This study is focusing on integrating indigenous ways of knowing into or within the Life Sciences curriculum. The Life Sciences Curriculum Statement has 3 Learning Outcomes and this study is focusing on the three Learning Outcomes. In order to meet the requirements of these Learning Outcomes learners were engaged in the following activities:

Activity One:

The demonstration by parents enabled learners to make observations, measure trends and record information on the observation schedules. Learners also had to write a report of the demonstration. The analysis of the reports showed learners' ability to construct meaning to give relevant headings; write the aim of the demonstration; note apparatus and write the method in sequence. This also articulates the learners' inability to explain findings and draw conclusions (see section 4.2.2.1).This implies that there is a need for learners to be engaged in activities that meet the requirements of this Learning Outcome so that they have a chance to improve in their skills. Learning Outcome 1(which this activity was based on) states that teaching and learning should focus on exploring and investigating environmental, biological and technological systems in everyday life, using inquiry, problem solving and critical thinking skills. This Learning Outcome involves the use of demonstrational and data – handling skills (DoE, 2003).

Activity Two:

At the end of the formal lesson on alcoholic fermentation learners had to work individually on an activity that could help to assess their ability to understand concepts on alcoholic fermentation (refer appendix H 2 for the activity). Analysis of the first questions of the activity gave me an idea that they managed to meet the requirements of this Learning Outcome in this activity as they showed a conceptual understanding, and also through discussion in class about the making of *umqombothi*, they showed an understanding of alcoholic fermentation in their context.

The last question required learners to discuss the effects of alcohol on the human body. Analysis of this question implies that these learners are exposed to alcohol abuse as they all related to the effects of alcohol abuse. Through discussion in class learners encouraged each other not to abuse alcohol as they were well informed about the process of alcoholic fermentation and the significances of *umqombothi* in the *Nguni* culture. There was a need for further enquiry on the topic, as I had to organize another class discussion based on their responses on this question. This follow-up activity was for learners to critically reflect on their responses and give suggestions of possible actions and some practical things that could be done to reduce alcohol abuse in their community. Further engagement on this issue would help learners to develop

abilities to respond to environmental issues and risks (in this case alcohol abuse) and be able to make good life style choices. O`Donoghue (2001) suggests that it is imperative for educators to make provision for learners to actively search for information, to critically examine and question issues and develop insight and competence to make better environmental management and lifestyle choices. This means that there was a need for these learners to be given an opportunity to take action on this environmental issue, but that was beyond the scope of this study. This activity was based on Learning Outcome 2 which requires learners to identify concepts, principles and models of Life Sciences in the context of everyday life. Learning Outcome 3 requires learners to evaluate the past and make informed decisions about the present and future use of science and technology in society and about environmental management and life style choices for sustainable future (DoE 2003). The processes that were covered in this study to develop lesson plans that integrate indigenous ways of knowing into the Life Sciences curriculum and contribute the valuing of cultural heritage enabled learners to compare scientific ideas and indigenous ways of knowing of the past and present *Nguni* culture. The learners support materials that were developed guided learners to compare the making of *umqombothi* to the industrial production of wine (refer appendix G).

Cornbleth (1990) defines curriculum as an ongoing social process which involves an interaction of learners, educator's knowledge and their environment (see section 2.3.1.). This study reveals that the interaction between learners, educators and environment is very important so as to open up spaces for learning. In this study learners interacted with each other in class, with demonstrators, with community members which enhanced their ability to learn. Cornbleth (1990) further believes that the structural context and the socio- cultural context shape the curriculum.

In order to integrate indigenous ways of knowing it is imperative for educators to develop skills of analyzing and interpreting the NCS. The analysis of the NCS Life Sciences showed that it is important to understand Critical Outcomes and Developmental Outcomes, so as to be sure that the Learning Outcomes as they are implemented address knowledge, skills, values and attitudes (DoE, 2003). In order to meet these requirements learners had to construct and reconstruct knowledge about the process of alcoholic fermentation and also to know how to make *umqombothi*,

wine and other fermented foods. These learners also had to understand about the acceptable standards and norms of the society, in this case most of the people in this school's community believe in the cultural rituals (Hanisi, 2004), so the cultural significances of *umqombothi* could help learners understand some of the things their society regards as important. The last question of the individual exercise gave opportunities for learners to analyse the behaviour of people around them.

Through this study learners managed to improve in the use of the following skills: observation, listening, communication, presentation and group work. From this study I discovered that the Learning Outcomes and Assessment Standard of the Life Sciences create opportunity for a contextualized curriculum. The process of implementing Cornbleth's view is challenging, but its worth it because it helped to enhance the learners understanding of alcoholic fermentation.

5.6.2 Evidence of learning in relation to curriculum requirements (LO& AS)

During the development of the lesson plan for this study only three Learning Areas were integrated (see section 4.3.1) This was due to the fact that only one educator did the lesson plan and did not have adequate knowledge of other learning areas as a result she could not articulate relevant Learning Outcomes from other Learning Areas. I think this challenge could be overcome by teachers planning lessons as a group from various Learning Areas or an educator to analyse the curriculum statement of various Learning Areas, so as to be able to do curriculum integration successfully. Lotz-Sisitka and Olivier (2000:90) agree with this from the study they conducted of teachers as curriculum developers and discovered that "curriculum integration is an important consideration for environmental education processes that will enable learners to respond to environmental issues". Further engagement of learners with this topic would enable them to respond to alcohol abuse which they discovered as the environmental issue their local community is faced with.

5.7 Conclusion

In this chapter I have discussed key issues that need to be considered for lesson planning to integrate indigenous ways of knowing into the Life Sciences and contribute to the valuing of *Nguni* cultural heritage. These issues emerged from the second data analysis of this study. The key considerations include the mobilizing of

prior knowledge using worksheets, group discussion and class presentations, observation of the process of making *umqombothi*, parental and learner involvement and the engagement with Learning Outcomes and Assessment Standards as required by the NCS.

The following chapter is deliberates the recommendation on the key things that one could focus on when planning a lesson with an indigenous knowledge focus.

Chapter 6

Conclusions and recommendations

6.1 Introduction

I begin this chapter by restating the research question and considering it against a summary of the study. In doing so I reflect more closely on the findings emerging from the different phases of the research process. Lastly the chapter considers recommendations on the key things that the research highlights for planning a lesson with an indigenous knowledge focus in the Life Sciences.

6.2 Research question

In this case study I was investigating the question of how lesson plans can be developed to engage indigenous ways of knowing in the Life Sciences curriculum (FET band) and how this might contribute to a valuing of indigenous cultural heritage. The aim of the research was to:

- To investigate how ways of knowing associated with *Umqombothi* can be used in curriculum activities with Grade 11 Life Sciences.
- To develop lesson plans for the Life Sciences curriculum FET band (grade 11) that would probe how learning activities on fermented grain foods contribute to a valuing of indigenous cultural heritage.

With the above aims I hoped to find ways that could improve learners` understanding in the Life Sciences, to explore the intergenerational ways of knowing related to Life Sciences that could allow learners to appreciated and evaluate different perspectives and to develop learning and teaching support materials that could encourage teachers within my context to implement the NCS Life Sciences in 2006. Furthermore at the end of this study I hoped learners would be able to make good lifestyle choices.

6.3 Synthesis of the study

The answers to these questions began to emerge as I structured this study in a learning cycle that takes the learners everyday knowledge (prior knowledge) into account and use it in building more formalised structures(teach fermentation) and links the formal knowledge (fermentation) back to a particular context in learner's lives(making of *umqombothi*). I started the study with an orientating worksheet (as a semi-structured

questionnaire). Using this, my learners had to share and probe (ascertain) their prior knowledge on fermented grain foods (see section 3.4.1). Through this I captured a sense of what was already known as a starting point from which to begin to teach learners the concept of fermentation in the curriculum and also to help develop an understanding of cultural heritage and so that they might value the cultural significances of *umqombothi*.

The next step was to develop observation schedule and to ask two women from the community to come to school and demonstrate the making of *umqombothi*. Observation schedules had to be developed such that all learners are able to develop an understanding of the process of making *umqombothi* and to draw on scientific concepts from the curriculum to show an understanding of fermentation and its significance. This was followed by interviews as a way of probing some of the issues that emerged from the demonstration. I conducted focus group interviews with learners and the parents involved. The learners also conducted follow-up interviews as part of their research process with community members to explore cultural significances of *umqombothi*.

All of the data generation activities outlined above were used to inform the design of a learning unit planner to integrate indigenous ways of knowing into/within the Life Science curriculum. The lesson plan(learning unit planner) was developed based on Learning Outcomes 1, 2 and 3 and its Assessment Standards as stipulated on the NCS of Life Sciences Grade 11(refer appendix F). Learning and teaching support materials were also developed so as to enhance learning as they were designed so that learners could compare fermentation, the making of *umqombothi* and the making of wine and also give a detailed process of converting pyruvic acid to ethanol and carbon dioxide (refer appendix G).

The lesson was implemented so as to be able to critically reflect on the process of developing lesson plans that engage intergenerational ways of knowing and contribute to the valuing of cultural heritage.

Deliberation during the study made it possible for learners to show their competency, that they respect their identity, they respect their cultural knowledge and values and that they incorporate their knowledge about fermentation into their knowledge of making *umqombothi.* More engagement with this study would guide these learners to cope be able with the exigencies of living (see section 4.4.2).

6.4 Recommendations on key things to consider when planning lessons with an IK focus

6.4.1 Mobilizing prior knowledge

When planning a lesson with an Indigenous Knowledge focus I noted that it is important to start by mobilizing the prior knowledge of learners. Learners are exposed to multicultural issues that are mostly affected by the modernity and social discourses, and as educators one of our jobs should be ascertaining and working with the learners' prior knowledge so as to enhance learning. This is challenging the teacher's assumptions of learners` prior cultural knowledge and interest in Indigenous Knowledge and was also found to be very time consuming.

This study indicates that mobilizing prior knowledge can help educators to understand learners and to encourage them to construct and reconstruct knowledge around the content of the Learning Area. At the beginning of this study I gave learners questionnaires as a way of ascertaining their prior knowledge. Before the lesson I also gave learners an opportunity to discuss ideas as a way of mobilising their prior knowledge and also assessing their understanding.

Masuku (1999), O`Donoghue and Neluvhalani (2002) state that understanding the learners prior knowledge is an important requirement to find ways of mobilizing indigenous knowledge in the curriculum contexts. Furthermore Roschelle as cited in Maselwa (2004:1) suggests that educators should not miss learners` prior knowledge as this could lead to learners missing the educator's intention.
Based on the above ideas I recommend that educators should mobilise prior knowledge especially when infusing intergenerational ways of knowing into the curriculum. From my experience, this was challenging as it was time consuming as

there were ideas from learners that needed urgent consideration before procceding with the study that I did not expect initially.

6.4.2 Parental involvement

A key starting point in this study was that it is important for educators to involve community members as the custodians of Indigenous Knowledge. In this study parental involvement contributed to the valuing of intergenerational ways of knowing, this is the major objective for integrating Indigenous Knowledge into the Life Sciences. I recommend that educators make sure that they involve parents who are experienced and knowledgeable as they integrate Indigenous Knowledge into the NCS.

6.4.3 Working with the OBE curriculum framework (LO, AS) and assessment of learning

This is the core point when developing lesson plans. A challenge for educators is to understand the Critical Outcomes and the Developmental Outcomes, so as to implement Learning Outcomes and Assessment Standards with ease.

Cornbleth (1990) states that curriculum is a contextualised social process, and there is the socio-cultural context that needs to be considered so as to understand the curriculum in practice. Working with Learning Outcomes and Assessment Standards requires time, commitment and an in-depth engagement with them, so as to be able to interpret them meaningfully in ways that are contextually relevant (Asafo Adjei, 2004). The idea of following Cornbleth's view to consider the socio-cultural context could help the education system respond to learners' and community needs. In this study this was done by encouraging learners to value their cultural heritage and encourage learners to make good life style choices and discourage alcohol abuse.

Language

In this case study the use of both languages in integrating Indigenous Knowledge must be maintained so as not to lose the valuable information of what is being said, as there might be loss of meaning if certain phrases are translated. E.g. the *Nguni* people are not brewing *umqombothi*, but they are making or doing *umqombothi* because they believe that the making is also very important culturally not the drinking only.

6.5 Limitations and research reflections

This study was conducted in a classroom where all of the learners are *isiXhosa* speakers; this means that these findings do not provide any conclusive evidence on lessons to integrate indigenous ways of knowing in the curriculum. Multicultural classrooms may pose many more challenges to educators than those I faced in conducting this case study. Conscious of these limitations I intend to continue my work with indigenous knowledge practices and community knowledge in my teaching.

It must also be noted that this case study was undertaken to a research design that blended the use of conventional data gathering tools (observations and interviews for example) and an enquiry pedagogy in which the participants were co-researchers. Although this contributed useful insights and created a co-operative learning environment involving parents, pupils and teacher, an analytical rigor of reliable data extraction gave way to an inter-subjective rigor of exploratory co-engagement. This has contributed to rich and diverse perspectives emerging in the study but more work needs to be done to critically interpret the findings more conclusively. I am particularly excited about how the co-operative engagement of the participants as a learning community reflected *isiXhosa* processes of community engagement around local concerns. I thus also intend to further probe culturally situated processes of critical research as opened up in the ideas of '*Eziko-Sipheka Sisophula*' described by Goduka (2005:478). A more detailed review of these community-based processes has to remain beyond this study but the situated research design did enable me to work on data gathering instruments that harmonised with a co-researcher approach that I wanted to achieve for the exploration of indigenous knowledge work with my learners and members of the local community.

6.6 Conclusion

Stake (1993:85) states that results from a case study are not generalisable, primarily because of the small sample size and unique character of the context. However, results of this study clearly indicate a link between prior knowledge as theorised in lesson planning and the local knowledge as cultural and experiential capital. This had me draw the generalised conclusion that the cultural dimensions of prior knowledge

need to be more fully explored if we are to integrate indigenous knowledge in work with the concepts of the Life Sciences curriculum. Here I found that things were actually the opposite of what I had expected when I started this study. Indigenous and scientific knowledge actually harmonised side-by-side rather than being opposed in any way. I had always felt that they were different but I found that they are complementary as both refer to things in the world. This has allowed me to conclude that working with indigenous knowledge as prior knowledge, might assist the learners not only feel that it is their cultural knowledge but to come to value this more where scientific ideas allow explanatory insights that they can use to engage local problems.

The intent of this study was to investigate ways of developing lesson plans that integrate Indigenous Knowledge and contribute to the valuing of cultural heritage. I started this study with a quotation from Ngcoza (1999) where he states that "Science teaching can only be made meaningful and exciting when learners are actively involved in the process and when real life experiences are taken into consideration". I strongly agree with this view especially at this era of our education system. This study shows that learners experience meaningful learning as they were actively involved, and this motivated them to take part in the study, and as they became more involved they become more excited about the idea. Real-life experiences are also taken into consideration in this study; this helped to foster school –community interactions, so that learners are also able to plough back to their community the knowledge they gain from school and are also encouraged to make good life-style choices.

I started this study by mobilising prior knowledge on *Nguni* Fermented grain foods; this was followed by activities that integrate indigenous knowledge into the Life Sciences. From this study the process of integrating indigenous knowledge into Life Sciences enhanced the learners' understanding of alcoholic fermentation, encouraged learners to evaluate their cultural heritage and also motivated learners to consider better life style.

In conclusion, I have found this research study very demanding but worthwhile. Doing this study has been a journey worth travelling. The experiences gained during the journey helped me to improve my practices as an African Life Sciences educator. I now have an added dimension for approaching my teaching to support more

meaningful learning practices, which I hope will help me face and overcome the challenges that we face in the struggle towards sustainable livelihoods through more effective education.

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APPENDIX A

Appendix A 1

176 Ext 4
Joza
Grahamstown
6139
19 January 2005

The Principal and SGB
T.E.M. Mrwetyana S.S. School
Grahamstown

Dear Principal

RE: PERMISSION TO CONDUCT A CASE STUDY RESEARCH AT SCHOOL

I kindly request your permission to conduct a case study research at your school. As a requirement for my Masters of Education at Rhodes University, I have to conduct a case study research. I have chosen this school as I am part of this community.

My research will be focussing on working with indigenous knowledge in the Life science curriculum (FET). I will be asking two parents to conduct a demonstration of *umqombothi* at school, as it is the focus of my study. I am also asking you to allow me to work with grade 11 C learners. I will be glad if you can invite me in one of your meetings so as to explain more about this research.

I hope that my requests will be strongly considered.

Yours sincerely

Nosipho Hanisi (Mrs)

Appendix A 2

176 Ext 4
Joza
Grahamstown
6139
19 January 2005

Mzali Obekekileyo

Ndicela imvume yokuba umntwana wakho athathe inxaxheba kuphando nzulu ngezemfundo endizakuthi ndilwenze esikolweni afunda kuso. Oluphando nzulu lumalunga nendlela zokuvundisa ezithi zisetyenziswe kwaXhosa(umz) ukwenziwa komqombothi, irhewu,isonka samanzi nezinyeke. Nangendlela esinokuthi sidibanise ezindlela nedlela abaMhlophe abavundisa ngayo.

Ngethemba lokuba isicelo sam siyakwamkeleka.

Ozithobileyo
Hanisi Nosipho(Mrs)
.....

Mna ..... Umzali ka .....
Ndinika imvule yokluba umntwana wam athathe inxaxheba kuphando nzulu ngezenfundo oluzakuthi luqhutyew ngu Mam`u Hanisi esikolweni afunda kuso.

Signature
Parent.....Learner .....
Date .....

Appendix A 3

176 Ext 4
Joza
Grahamstown
6139
19 January 2005

Mzali Obekekileyo

Ndicela undincede uzokufundisa mna nabafundi bam indlela ekwenziwa ngayo umqombothi. Lomqombothi sizakube siwenzela uphando nzulu malunga nendlela zokuvundisa ezithi zisetyenziswe kwaXhosa.Oluphando nzulu ndilwenzela izifundo endiziqhuba ne Rhodes University.

Ngethemba lokuba isicelo sa siyakwamkeleka

Ozithobileyo
Nosipho Hanisi (Mrs)

Appendix B

FERMENTED GRAIN FOODS

WORKSHEET

1. Write a detailed process of making *umqombothi*.

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2. What were the cultural activities on which *umqombothi* was previously used?

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3. Are there any changes that are observed on the methods that are presently used compared to those that were used some years back?

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4. What do you think are the main reasons for the changes mentioned in 3 above?

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5. Do these changes have any negative effects on the cultural heritage of the Xhosa people?

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6. What are other fermented grain foods that you know?

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7. Do you know how they are prepared?

If yes, give a detailed explanation of the method.

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8. Why is it important to make *umqombothi*, when one is having a cultural ritual at home?

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9. What is alcoholic fermentation?

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10. What are the substances that are used (reactants) during alcoholic fermentation?

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11. Name the substances that are produced (products) of alcoholic fermentation.

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12. Is there any connection between alcoholic fermentation you've explained above and the process of making *umqombothi* you know?

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13. If there is a connection, what is it?

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Appendix C

FERMENTED GRAIN FOODS OBSERVATION SCHEDULE

Day 1

Name: _____ Date: _____

Who is making *umqombothi*? _____ Where? _____

Name the equipments that are used?

_____

_____

What are the ingredients that are used?

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What are the measurements that are taken?

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Write clear descriptions of the steps that are taken to make *umqombothi* and give reason(s) for each step.

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Appendix D

TRANSCRIPTION OF THE PROCESS OF MAKING UMQOMBOTHI

Participants: Mrs N. Mgcuwe, Miss Siga, Mrs Tata , Grade 11 students of Mrwetyana S.S.School

Mrs. Mgcuwe and Mrs. Tata are parents making *umqombothi* for this study. Mrs Mgcuwe is a speaker.

Day 1

Mrs Mgcuwe speaking :Xasesizamisa sifuna amanzi ashushu.

Sigalela amanzi abilileyo,kumealie mealie.siyayitshisa imealiemealie, siyiyeke siyigqume,simenteshe imithombo,imithombo kufuneka ilingane ne mealiemealie.

Student A.: Ingaba lamanzi uwagalelayo nokuba angakananina ?

Parent: Ewe nokuba angakananina

Siyiyeke siyigqume silinde ide itshe.

Student A; Uthatha ixesha elingakanani ukutshisa umileiemealie?

Parent : Inokuba uthatha I 30 minutes nangaphezulu

Okubalulekileyo kukuba itshisekile.

Student B: Ezizigaqa azizokuba nangxaki xasesipheka?

Parent : Hayi akukho nto.

Sizakugalela imothombo apha sigalele namanzi.sh.....Simisa amanzi athi akubila sizamise sigalele

Student C: Yintoni ebangela ukuba singagaleli amanzi abilileyo kwimithombo?

Parent: Utywala buzakuba muncu xasigalele amanzi abilileyo kwimithombo.

Student C :Xaugalela imithombo ku maize-mealie oshushu ayibangeli ukuba utywala bubemuncu na?

Parent : Hayi kaloku siyayipholisa intlama ngokugalela amanzi abandayo.

Parent : Galela amanzi abandzyo kwintlama emva kokulinda imizuzu, kufuneka uyicubhe kungabikho zigaqa. Into ebangela izigaqa kukuba amanzi esitshise ngawo umealiemealie ebe mancinci. Kufuneka uyicubhe ziphele izigaqa.

Student A: Ingaba ezizigaqa azizukwenza ngxaki xa sele kuphekwa izidudu?

Parent : Hayi akukho ngxaki. Ipholile intlama kugalelwe imithombo leya ibimenteshiwe.Sh.....Kufuneka lefatyi inentlama siyibeke phezu komgquba, lentlama igqunywe ilungiselelwa ukuba ihlale ishushu.

Student C: Yintoni ebangela ukuba ibekwe phezu komgquba?

Parent: Umgquba uyasithisa. Uzakuyinceda ukuze ibile ngethuba.

Student D: Lamanzi abandayo ebegaleliwe awazukuyenza ukuba igodole lentlama?

Parent : Hayi umgquba nezinto zokugquma zizakuyifudumeza intlama.

Student D: Xanizamisile kuzakuthiwani ngoku?

Parent : Ngoku sizakuyishiya lentlama ifudumele silinde , ukuze ngomso siyipheke.

Day 2

Parent : Simisa amanzi abile sakugqiba sigalele intlama sizamise ide ijiye, siyiyeke ibhadle

Silinda iHours ezintandathu nangaphezulu sibhadlisa isidudu de sivuthwe. Emvakoko sisikhuphela ezityeni sizichake ukuze ziphole msinyane izidudu.

Day 3

Parent: Namhlanje izidudu zipholile,siyazikhuphela efatyini, sigalele imithombo elingana naleya besiyi galele izolo elinye, sizamise de yonke into idibane.

Student D: Kuqala besiyiphekile imithombo, sizakupheka kwakhona ?

Parent : Hayi asizukuphinda sipheke, ngoku senza utywala, sifuna ibile.

Student C: Izolo bekududuma, kuthiwa xakududuma utywa abulungi xa ingafakwanga ikomotyi okanye isaucer, ingaba besizifakile ezozinto apha?

Parent: Buzakilunga lonto ayizukubangela ukuba bungabili utywala buzakubila.

Student : How many days ezizikuthathwa bobutywala ukuze bube ready

Parent: Nagnomso okanye ngomso mnye, buya xhomekeka. Bugqityiwe sizakulinda debubile.

Student C: Xa kufakwa utywala abanye abantu, bahluza intio phaphi kokuba babupheke bangayipheki ukuze bayidibanise xa befaka utywala,(Igwele,iderhe, umlumiso) Khange siyenze thina linto apha, ingaba akuzukubakho nto

Parent : Andiyenzanga mna lonto kubakaloku niyabhala, kodwa buzakubila utywala.

Day 4

umqombothi is not yet ready because of the cold weather we still have to wait for more time. We've done the process of checking the gas which is released; the gas is not stopping combustion on this day because it is not yet carbon dioxide. We've to wait for another 24 hours. (Check photos)

Day 5

uqombothi is ready to be served. WE have done the process of checking the kind of gas released during fermentation. The gas does not promote combustion.
Parents invited around the school and learners had a chance to interview parents about cultural and health significances of umqombothi.

Appendix E

Appendix E 1

Mrs Hanisi interviewing Mrs. Mgcuwe about the preparation, significances and nutritional value of Umqombothi.

Venue: T.E.M. Mrwetyana School

Date : 22 April 2005

Me: I want to know as you know how to make *umqombothi* who taught you how to make *umqombothi*?

Pa: My sister taught me how dot make *umqombothi* by letting me help her as she was god in doing this. I had a chance to see the process step by step.

Me: When she taught u how to do *umqombothi*, did she tell u measurement that you are supposed to use or what?

Pa: Measurements, you know is from experience and there is no recipe book, as you do it you improve the way of doing it. It is just estimation.

Me: Why are you covering the cask as you make *umqombothi.*

Pa: *umqombothi* is covered to keep *umqombothi* warm.

Me: Why is it important to keep it warm?

Pa: Warm/ heat allows *umqombothi* to ferment fast, if its cold it takes a long time for *umqombothi* to mature,

Me: I hear you mama, Long ago moss, there were no shops selling *Imithombo*. How did people make *imithombo*?

Pa: Long ago we used to do malting, by putting grains into water until they are properly covered for 3 to 4 days. . Take grains out of water after 4 days a nd put then in sacks. Properly cover the sacks with even plastics, so that no light is entering the sacks. After few days check whether the grains have germinated or not, when they germinate take them out and dry them, then its malt. You can grind that if you like.

Me: Where did you get maize-mealie.

Pa; my parents use to by maize-mealie, but my mother sometimes she used *isingqusho* to make maize-mealie.

Me: Do you think is there a different between *imithombo* that we buy and *imithombo* made from home?

Pa: *Imithombo* that were made at home were very good as compared to the one we by from shops. Old mother say that the home made malt have shoots showing that the

process of germination have been properly done, but the one we by in shops is different, but it help to ferment *umqombothi*, there is no problem.

Me: How do you make sure that the fermentation process is complete and *umqombothi* is ready for drinking?

Pa: By tasting *umqombothi* and by putting a burning match, if it stops burning, that means *umqombothi* is ready,

Me; on health purposes are there any comments that u can make about *umqombothi*?

Pa: No, because I do not know any problems with *umqombothi* in the health of humans.

Me: what is the effect of putting cups and saucers in the cask where there is *umqombothi.*

Pa: Saucers or stones protect *umqombothi* against lightning, and lighting makes *umqombothi* sour.

Me: What really happens?

Pa: When lighting enters into the cask with *umqombothi* and without saucers then *umqombothi* becomes sour, but I don't exactly know what happens.

Me: Why do *amaXhosa* do *umqombothi*? How many times per year in a family do they have to do *umqombothi*?

Pa: So many times, one can not count; it depends on the situation of the family, because we do *umqombothi* for various reasons, like

Umqombothi is done when:

- One of the family members is dreaming of the late family member asking for a drink or something else.
- Family members just what to ask the ancestors not to forget them and are calling ancestors (*Umthayi*)
- As a drink for father and his friends.
- There is a wedding ceremony
- Circumcision ceremonies.
- After the death of one of the family members(after a week or so)
- *Intlamba-peki* (etc)

Me; Ok I agree, when I talked to students about *umqombothi* they indicated that at their homes, parents give them *umqombothi* to drink. Doesn't that encourage them to

use alcohol a lot in their life style, because they told me that even an infant is given *umqombothi* to drink when its rituals.

Pa: No that does not mean kids must drink until they get drunk, because the level of alcohol in *umqombothi* is very low, so they are just given a sip, and that is too little to make some one drunk. Kids these days don't even like *umqombothi*, they drink other kinds of alcohol drinks.]

Me: Thanks a lot for your time and response that will help this research.

Appendix E 2

Mrs Hanisi interviewing Mrs. Tata about the preparation, significances and nutritional value of Umqombothi.

Venue: T.E.M. Mrwetyana School

Date: 22 April 2005

Me: I want to know as you know how to make *umqombothi* who taught you how to make *umqombothi*?

Pa: I used to see when my grand mother, my mother's mother was good at this and she also asked me to make it in her presence.

Me: When she taught u how to do *umqombothi*, did she tell u measurement that you are supposed to use or what?

Pa: No, She had a measuring dish, of which she used to measure for me. She used to tell me to take so much of maize-mealie and so much of sorghum and I developed ways of measuring from there. She told me to mix maize-mealie with cold water, take boiling water and mix with the mixture, to make *umphokoqo*. Cover the mixture for about 15 minutes. After 15 minutes pour cold water into the mixture to cool the mixture and pour *imithombo*(malt) into the mixture. It is important to make sure that the mixture is cool before adding *imithombo*, don't ever put *imithombo* into hot mixture because it will not mature. After adding *imithombo*, cover it and leave it until the next day. The next morning the dough ferments, if it's ready to be cooked, then boil water in a pot and put the dough into the pot to make porridge. Leave the porridge in the fire for sometime (e.g.) If I started making porridge at 9 am let it simmer until 1 pm, then I *phaka* them into dishes let them cool. As I cool them, make sure that they do not mix I put them in separate dishes and not very close (*sa-sa-sa*) to each other, to prevent them from warming each other.

On the next day I mix the porridges into the cask, and take sorghum malt (a measured amount) and mix with the porridge .Cover the cask. Initially in the container I put *igwele*. I put *umgquba* below the container, so that the mixture can be warm. *Umgquba* is used to make the mixture warm, so that it can ferment.

When making *igwele* make sure that it ferment, before mixing with the mixture, because if it is not fermenting , then your *umqombothi* will not be mature. When making *umqombothi* it is important to consider the weather, Put washed stones into your mixtures to prevent thunderstorms and lighting from them. If you are not putting

stones or saucers into the cask and there are thunderstorms and lighting then *umqombothi* will not be fine, it will be sour.

Me: Do stones have something to do with thunderstorms and lighting's effect on *umqombothi*?

Pa: Yes, stones prevent thunderstorms and lighting from spoiling *umqombothi*, because when there are thunderstorms there is also lighting which enters the cask and be unable to leave, so if there are no atones then *umqombothi* will be sour. If it happens that *umqombothi* becomes fine, it may happen than some people who will be drinking *umqombothi* will get sick, they may have epilepsy.

Me: I hear you mama, Long ago moss, there were no shops selling *Imithombo*. How did people make *imithombo*?

Pa: Long ago there were fields, so [people use to plough fields, and get maize and sorghum. People used to take those grains and sort them, Put the grains in water for 5 days.

Me: Lots of water.

Pa: Yes lot until the grains are totally immersed in water. Drain water after 5 days, take sacks not the plastic ones, those that are brown that were used long ago. Put maize into the sack and properly cover the maize with sacks, so that maize can be warm. The grains must stay there for 6 days. After 6 days when u open that ,notice that they germinate, When its germinating , then its *imithombo*, then u uncover the germinated grains, and put it outside to get dry. Make sure that it is properly dry. When its properly dry u grinds it and your malt (*imithombo*) is ready.

Me: Do you think is there a different between *imithombo* that we buy and *imithombo* made from home?

Pa: Yes. The malt that we used long ago was very good, as result people say the malt we used to and make *umqombothi* helps to lower the blood pressure. People like me who have high blood pressure used to drink *umqombothi* to lower the pressure, but the *umqombothi* we make these days does not do that any more, because it is firstly made from gains grew in the presence of fertilizers and those fertilizers have an effect on that. As a result people drinking *umqombothi* these days have hangover, which was rare in the olden days. And they get drunk too much. But the level of alcohol is lower in *umqombothi* that other kinds of beers (e.g.) *valantyontyo, jikeleza* etc.

Me: Mh-Mh-Mh- Ok, I hear u, now lets go back to the process of making *umqombothi*. Initially you mix maize-meal, with malt, after fermenting you cook the

dough, but on the second time, u just mixes porridge with *imithombo* and you do not cook again, why?

Pa; you are supposed to cook in the second time because the malt this time is used as a yeast, it is to stimulate fermentation.

Me: How do you make sure that the fermentation process is complete and *umqombothi* is ready for drinking?

Pa: Long ago, I'll always refer to olden days, it was males who have to say *umqombothi* is ready, not females. So males would taste *umqombothi*, after seeing the brown foam in top of the cask, not the white foam. And also when tasting one would notice that in side the mouth *intsipho* are not sticky but the are like powder, then *umqombothi* is ready.

Me: Why do *amaXhosa* do *umqombothi*? How many times per year in a family do they have to do *umqombothi*?

Pa; Its difficult to count the number of times, because it depends on the reasons for making *umqombothi*. *Umqombothi* is done when:

- One of the family members is dreaming of the late family member asking for a drink or something else.
- Family members just what to ask the ancestors not to forget them and are calling ancestors (*Umthayi*)
- As a drink for father and his friends.
- There is a wedding ceremony
- Circumcision ceremonies.
- After the death of one of the family members(after a week or so)

There are many cases; it will take me a whole day to explain this.

Me; Ok I agree, when I talked to students about *umqombothi* they indicated that at their homes, parents give them *umqombothi* to drink. Doesn't that encourage them to use alcohol a lot in their life style, because they told me that even an infant is given *umqombothi* to drink when its rituals.

Pa: No, it's not like that, family members are being called to come and just have a sip, not to drink the while jug so as to get drunk. That is *ukushwama*.

Me: can you explain *ukushwama*.

Pa; This is base don the idea that family members have to taste what they have prepared for other people first before giving to visitors, so that, if there is a poison then , they could be the one to be affected not guests.

Me: the reason I am asking this is because I am looking at the present generation of which most of them are abusing alcohol. Aren't they being encouraged by parents and their ritual to drink?

Pa: There is no such, it's just that our kids like to demonstration and do silly things, because they are also abusing drugs, and who told them to use drugs? When its ritual they are given a chance to take a sip, and are not told to go to taverns, which is affecting their parents.

Me: Thanks mama, Thanks for your time and your excellent response.

APPENDIX F
LEARNING UNIT PLANNER

Learning Unit Topic: Fermentation

Learning Area	Learning Outcomes	Assessment Standards
Life Sciences	**LO1**: Scientific enquiry and Problem-solving skills	**AS 3**: A learner is able to confidentially explore and investigate phenomenon relevant to Life Sciences by using inquiry, problem solving, critical thinking, draw conclusions, assess the value of the experiment process and communicate findings".
	LO2: Construction and application of Life Science knowledge.	**AS 3**: A learner is able to identify concepts, and models of Life Sciences in the context of everyday life.
	LO3: Life Sciences, Technology, environment and society	**AS 2**: A learner must be able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the interrelationships of science, technology, Indigenous Knowledge, environment and society
Consumer Studies	**LO3**: Responsible use of resources	**AS 1**: Make judicious food choices in terms of the resources available to the household.
Physical Sciences	**LO1**: Scientific investigation	**AS2**: Learners to collect data, discuss, compare and draw conclusions
Language	**LO1**: Listening. Learner will be able to listen for information and enjoyment, and respond appropriately and critically in a wide range of situations.	**AS1**: Learners to listens and respond to questions.

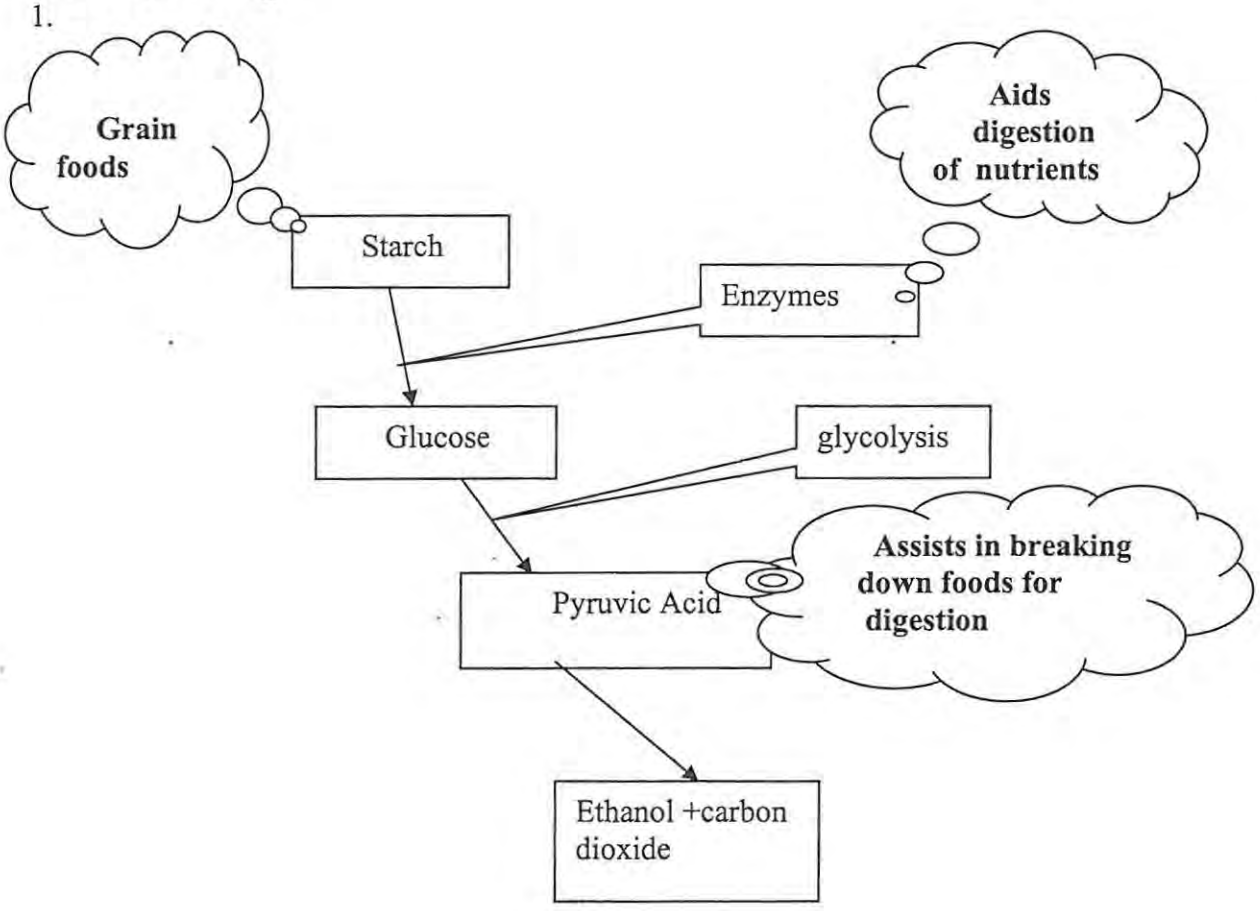
	LO2: Speaking. Learners will be able to communicate confidently and effectively in spoken language in a wide range of situations.	**AS3**: Learners to take part in small group discussions, where one person reposts back on what others have to say.

Duration: 2 weeks

Looking back at: Anaerobic respiration – Lactic acid fermentation
Looking forward to: Aerobic respiration

Core Knowledge

1.



2. Effect of yeast cells
3. Effect of temperature
4. Ways of identifying carbon dioxide as the product of alcoholic fermentation
5. Effects of alcohol in the human body.

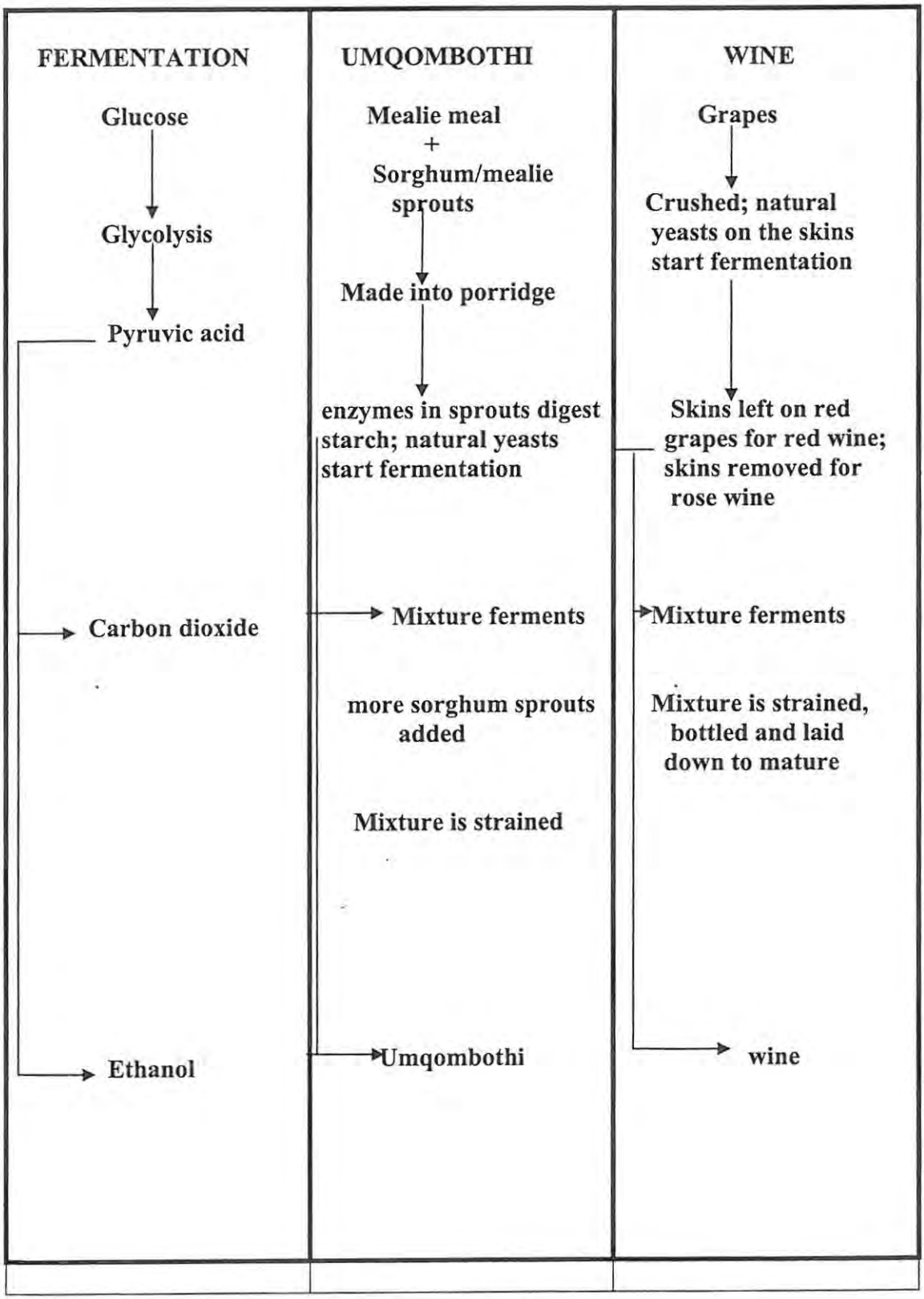
	STEPS	ACTIVITIES	TIMING
	Introduction "Tuning in"	1. Learners to answer an orientating worksheet to probe their prior knowledge on fermented grain foods and fermentation.	1. One lesson
	Body "Finding Out"	2. Parents to demonstrate the making of *umqombothi*. Learners observe the process. Observation schedule be given to learners, so as to guide them during the demonstration.	2. Four lessons
		3. Learners to do a write –up of the demonstration.LO1,AS1	3. One lesson
		4. Learners to interview community members about the cultural significances of *umqombothi*.	4. one lessons
		5. Learners in groups of 4 to 5 discuss	5. half a lesson
		6. One learner from each group presents the group deliberations. After each presentations, other learners ask questions	6. One lesson
		7. Educator facilitates a discussion on alcoholic fermentation using learning and teaching support materials.	7. One lesson
		8. Learners to do a class activity to assess their understanding of fermentation	8. Half a lesson
	Conclusion "Report and review"	9. Learners to discuss the effect of alcohol in a human body. Learners also discuss ways of taking action and campaign about alcohol abuse. This is followed	9. 4 lessons

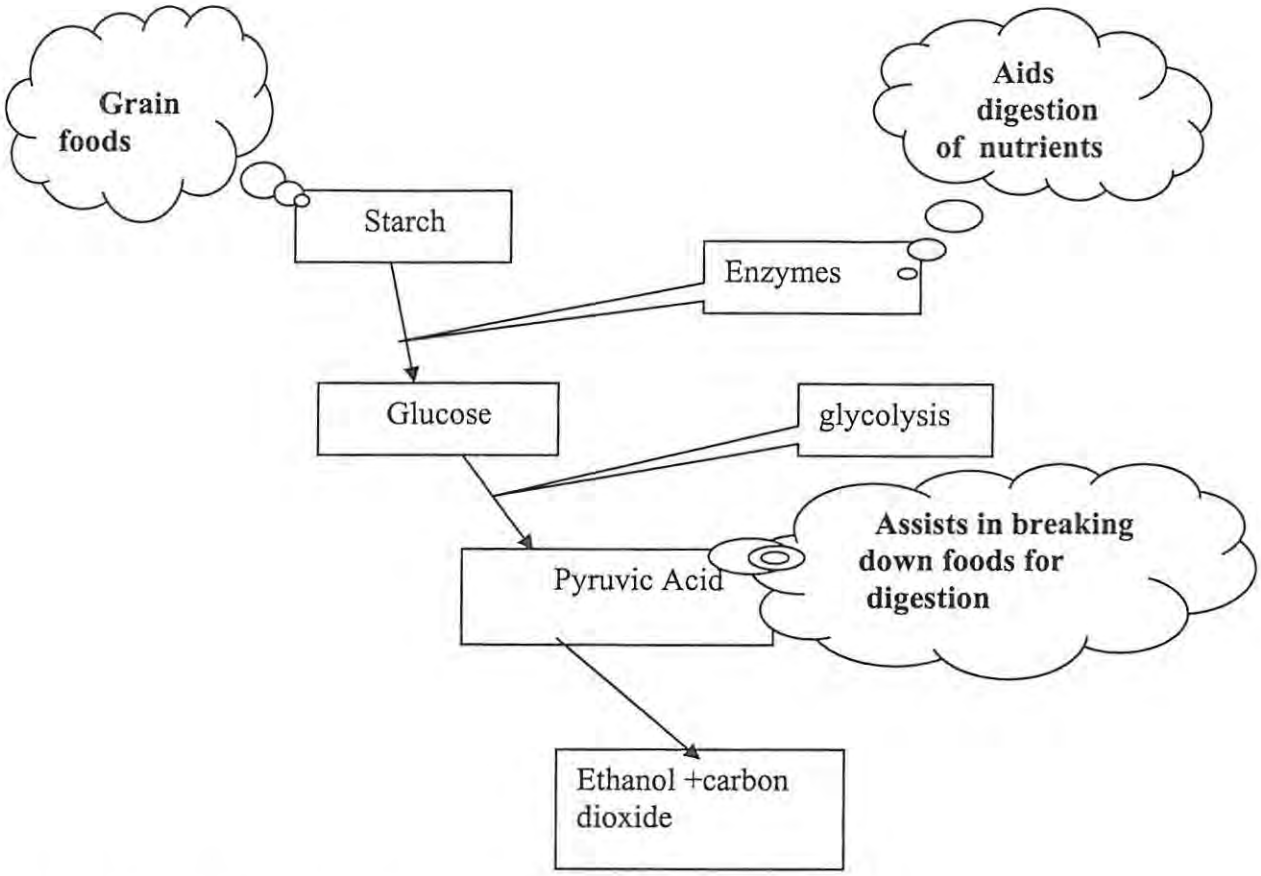
		by reflection session where learners evaluate the effectiveness of the campaign	
	Resources Needed	**Assessment Strategies**	**To reflect on**
Introduction 'Tuning in'	Worksheet	**Baseline Assessment** to establish learners' prior knowledge. Teacher assesses	Analysis of learners responses, so as to inform the next lesson plan
Body ' Finding Out'	Observation Schedules, Learning and Teaching Support materials	**Formative Assessment** to monitor and support teaching and learning, Teacher assesses	Analysis of the observation Schedules and the transcribed notes from the demonstration. Also the focus group interviews with learners and the semi-structured interview with both demonstrators.
Conclusion ' Report and Review'		**Summative Assessment** to provide overall picture of learner progress. Teacher assesses	Discussion with learners and the activity as individuals.

PLANNED ASSESSMENT TASKS FOR RECORDING: Teacher assessment using rubrics
EXPANDED OPPORTUNUTIES: Learners to campaign around the Grahamstown East community (alcohol abuse)

APPENDIX G
Learning and Teaching Support Material

Fermentation and the making of *umqombothi* and wine





Chemistry of fermentation:

Grain foods have starch and other nutrients e.g. minerals, vitamin B etc. Starch as a carbohydrate is acted on by yeast in a malting process using maltase and other enzymes to break down starch into glucose, thus enzymes aid in the digestion of nutrients. **Glycolysis** is the sequence of reactions that converts glucose into pyruvate with the concomitant production of a relatively small amount of ATP. Glycolysis can be carried out an-aerobically (in the absence of oxygen) and is thus an especially important pathway for organisms that can ferment sugars. For example, glycolysis is the pathway utilized by yeast to produce the alcohol found in beer. During glycolysis glucose releases energy which is taken by ADP +P to form an energy carrier ATP. This implies that energy is released. Glucose is the source of energy. The product of glycolysis is pyruvic acid which assists in the breaking down foods for digestion. In the absence of oxygen in plants, each pyruvic acid releases carbon dioxide and hydrogen atom to form ethanol. Hydrogen atom is carried by the hydrogen carrier (NAD as NADH). Therefore carbon dioxide and ethanol are the by products of fermentation.

Value of fermentation to Human body:

Fermented foods

- promotes the growth of friendly intestinal bacteria that aid digestion and support immune function including an increase in Vitamin B12, omega -3 fatty acids, digestive enzymes, lactase and lactic acid and other immune chemicals that fight off harmful bacteria and even cancer cells

(www.mercola.com/2004/jan/3/femented_foods.htm)

Report brief

Write a report on the process of making *umqombothi*. Your report should cover the following issues:

- Method of making *umqombothi*, including the ingredients used.
- How the presence of carbon dioxide (CO_2) is investigated.
    - Apparatus used for investigation.
    - Steps taken for the investigation i.e. explains the investigation.
    - Conclusions of the experiment.

APPENDIX A1

Ntjoko. Andiswa Grade 11c

Experiment

Aim :-

To make fermented grain drink (umqombothi)

Equipment /Apparatus :-

5 kg of mealimeal
10 kg of sorghum
Boiling and Cold water
5 kg of maize malt
Fire
Big dishes
Cask (fatyi)
Drum and big point
Izamisa (big wooden spoon)
Blankets.

METHOD :-

DAY 1.:-

-We mixed hot water and meali-meal together and we put a piece of paper above it, to cover it to get boiled. And we put it for almost 30 minutes to boil up together. And after 30 minutes we put cold water and mix them together with meal-meal that you have putted in before and we rubb it so that it don't have balls (izigaqa). After it has cooked down without any fire and putted in sorghum (imitshobo) and mix them up together and we corvered it up and we put on top of it a cupboard to cover it up and a blanket.

DAY 2:

- After we putted in the ingridients together we boiled water and pour it in to make the fermentated grain to be thick. And we corved it.

up. We cooked it on fire.

DAY. 3:

- We looked at it to see if it is coming up well and we didn't put in anything else, we corvered it up and took photos.

DAY. 4:

- We looked at it and we corvered it and we corvered it again and didn't do anything. And it is not boiling up.

DAY 5:

- We filter / strained it to make the alcohol at last. After we finished it we tasted the alcohol and took photos and it was the last day of the experiment of making fermentated grain drink.

OBSERVATION

DAY :1.

- Cask must be kept warm.

DAY :2.

- Mixture ferments and we cooked it.

DAY :3.

- Porrage was cold.

DAY .4:

- There were no bubbles on the cask so the carbon dioxide wasn't released.

DAY .5:

- It boiled up and we realesed carbon dioxide and alcohol.

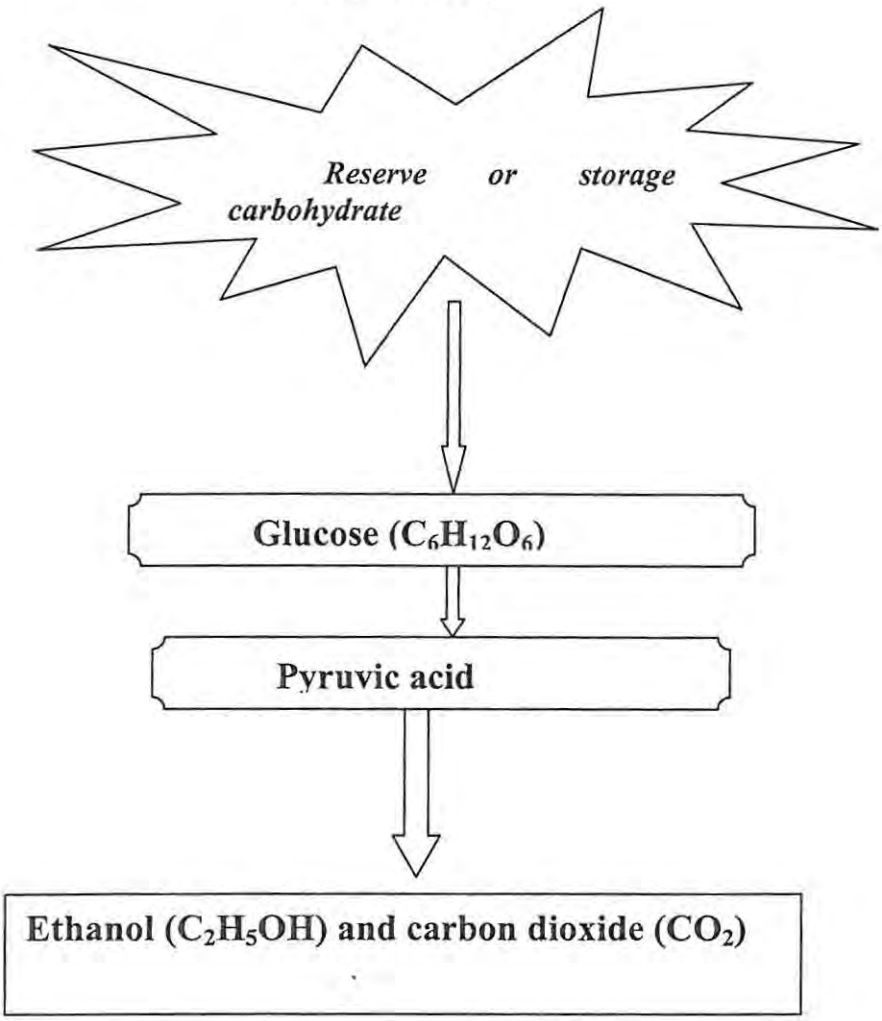
CONCLUSION:

- Glucose $\xrightarrow{\text{glycolysis}}$ pyruvic acid + 4H + energy
- Pyruvic acid + ~~2H~~ $\longrightarrow$ ethanol + CO_2 + very little energy

- During the process of making fermantated grain drink (umqombothi), the malt reacts with glucose (meali-meal) to produce ethanol and CO_2.

APPENDIX H2
Class Activity

LO 2, AS 1



1. Name the metabolic process illustrated by the above schematic representation. (2)
2. In which group of organisms does this metabolic process occurs? (2)
3. Is this process an anaerobic or aerobic process? Explain. (4)
4. Write any **two** factors that affect the rate of the making of *umqombothi*. (2)
5. Describe **two** ways that are used to identify carbon dioxide. (10)
6. Name any **three** food substances or drinks that are produced through this process. (3)
7. Discuss are the effects of alcohol in the human body? (15)

Biology :

Grade : 11

APPENDIX I

The lesson was very successful because the educator mobilised the learner's prior knowledge. The lesson started from what the learners already knew before it moved to the unknown.

Most of the discussions from the learner's prior knowledge was from their indigenous knowledge. The learners' groupworking skills were enhanced, through brainstorming sessions and discussions. Learners were given an opportunity to use their communicating skills when they reported on their brainstorming.

The teacher created a condusive atmosphere to support learning where she opened a class debate on the learners indigenous knowledge. ie how the making of 'umgombothi' differed in different societies. learners were free to ask questions.

The introduction of the new knowledge was easy to the learners because the teacher linked to it to what learners already knew.

All the learners were actively involved in the lesson, it was learner-centred. It was a successful lesson because the learning atcomes with the use of the assessment standards, were achieved.

APPENDIX I 2

PETER XOLANI GRADE 11C

BIOLOGY

REFLECTION

DURING THIS ACTIVITY I THOUGHT I WAS GOING TO HEAR THINGS THAT I ALREADY KNEW, BUT I WAS SUPRISED TO HEAR ABOUT MANY THING THAT I NEVER EVEN THOUGHT OF.

FIRSTLY I ONLY KNEW ONE SIMPLE & OBVIOUS METHOD OF TESTING IF UMQOMBOTHI HAD MATURED OR NOT: THE TASTING METHOD: BUT LITLE THAT I KNEW THERE'S A MATCH STICK METHOD WHEREBY YOU LIGHT A MATCH-STICK AND STAND IT OVER THE CASK, IF IT BLOWS OUT IT'S READY, IT DOESN'T IT'S NOT.

THOSE ARE JUST SOME OF THINGS I LEARNED.

AFTER THAT LESSON I FELT A BIT CONFUSED BECAUSE I HAD DISCOVERED A NEW WORLD OF THE PROCESS OF MAKING UMQOMBOTHI. I HAD A CULTURAL BELIEF THAT IT DEPENDED ON THE PERSON WHO IS MAKING UMQOMBOTHI FOR IT TO BE MATURED, BUT I WAS COMPLETELY WRONG. BIOLOGICA OR SCIENTIFICALLY I WAS PROVEN WRONG.

BUT THERE'S ONE THING THAT STILL BUGS ME, WHAT ARE THE EFFECTS OF LIGHTNING TO UMQOMBOTHI?