Chapter 1

1.1 Introduction

South African National Curriculum Statements state that Indigenous Knowledge System (IKS) should be included in the school science curriculum. Inclusion of IKS in the science curriculum is a requirement of the Department of Education (2003) as it states that the Life Sciences curriculum recognizes the richness of Indigenous Knowledge Systems and their contribution to transforming and instilling pride in the learner. Indigenous knowledge features in Learning Outcomes 2, which is about 'Construction and Application of Knowledge', and 3, which deals with 'Technology, Environment and Society' (DoE, 2003). The inclusion of IKS in school science is part of what Jegede and Aikenhead (1999) call the development towards 'science for all'.

The inclusion of IKS in the curriculum creates a challenge for the science educators who have to identify various aspects of IKS and work out how to integrate them into the school science curriculum. One of the challenges is caused by the denial of the existence of IKS that can be integrated with school science by some educators (Manzini, 2000). The other notable challenge is the identification of the relevant IKS that can be integrated into the school science. It should however be realized that there is 'science' in IKS (Ogunniyi, 2007) and this 'science' component of IKS can be relevant for integration with the school science. The science component of IKS is the focus of this study.

Jegede and Aikenhead (1999) claim that some learners (mostly those who are non-Western) cross boarders in the process of learning school science. The claim assumes that the school science is different from the learners' everyday experiences. Part of their everyday experience is imbedded in IKS. The inclusion of IKS in science lessons will help learners as they learn science since the subject content matter will be relevant to their lives. In this regard there is need for educators to be assisted in identifying the components of IKS that can be integrated with school science.

The hypothesis in this study is that there is science in IKS that can be integrated with the school science. For example, in teaching "Evolution" to a grade ten class a group of learners with a rural background claimed that their elders have told them that human beings originate from a reed that grew in a river. To them a human being was once a water-living organism. This links well with the claims made under 'The Theory of Evolution' that mammals were once water living organisms. Such interventions of traditional stories in science lessons become a testimony that learners bring to the science lessons some indigenous knowledge. It is important for science educators to be aware of IKS and relevant components of IKS that can be integrated with school science when ever possible.

The example of 'evolution' given above indicates that IKS and culture are held together. According to Dzama and Osborne (1999) African culture and African worldview have an influence in the science classroom. Jegede and Aikenhead (1999) agree with this claim and further argue that the culture of school science is alien to learners (non- Western) who have to move from their daily experiences to the world of science. This means that there are some differences between African worldview and the scientific worldview. The inclusion of IKS in the school science might be a way of solving the problems that are associated with the differences that exist in the worldviews. Jegede and Aikenhead (1999) observe that the inclusion of IKS to school science will result in school science being 'science for all'. Learners of various ethnic backgrounds might then identify with the school science.

According to Dzama and Osborne (1999) African culture and African worldview have an influence in the science classroom. Jegede and Aikenhead (1999) agree with this claim and further argue that the culture of school science is alien to learners (non- Western) who have to move from their daily experiences to the world of science. This means that there are some differences between African worldview and the scientific worldview. The inclusion of IKS to school science might be considered as means of incorporating other ways of knowing to school science. As observed by Jegede and Aikenhead (1999) the non- Western science learners view school science as abstract and often experience

problems in the science classrooms. This might explain the incidents of high failure rate by many Black South African science learners at Matriculation level.

The high failure rate in science subjects in South Africa is well known (van der Flier, Thijs and Zaaiman, 2003). The inclusion of IKS might create the harmony that is lacking. The identification of IKS worth including in the school science curriculum might be difficult in South African communities since the country is multicultural. However, Mbiti (1990) observes that African worldviews tend to be the same for most of peoples of Africa.

1.2Aims

The aims of the study are to:

1. determine what 'science' component of IKS science educators are aware of.
2. find out the educators' attitudes towards the integration of IKS in school curriculum in Grades 12 in ten schools within Johannesburg.

1.3 Rationale and Background

Grange (2007), Jegede (2002) and Mosimege (2005) observe that IKS has a role to play in the science classroom**.** The South African NCS Curriculum demands that IKS be included in science lessons. The call to include IKS in science curriculum has created a need to investigate the aspects of IKS science educators consider relevant to integrate in the school science. There is need for educators to come up with a contextualized interpretation of IKS that will suit their school environments.

IKS as defined by Jegede and Aikenhead (1999) Ogunniyi (2007), and Odejobi and Aladejana (2007) tends to be very inclusive. The definition of IKS creates a challenge for working out the components of IKS that may be integrated into the school science curriculum in Gauteng, South Africa. Gauteng is urbanised and consists of people from various ethnic backgrounds. As IKS has been linked to culture, beliefs and traditions

(Ogunniyi, 2007; Mosimege, 2005 and Aladejana and Odejobi, 2007) one would think that it becomes complex to work out relevant IKS in Gauteng because of its multi-ethnicity of its people.

Jegede and Aikenhead (1999) view the inclusion of IKS as a way of achieving leaner centeredness, which is in line with the requirements of Outcome Based Education. They observe that IKS affects learners as they learn science. They also note that non- Western science learners construct scientific concepts side by side with minimal interference and interaction with their indigenous knowledge. The process of learning science by Western science learners involves acquisition of scientific concepts that are assimilated and accommodated along side their everyday experiences and perceptions (Jegede and Aikenhead, 1999). The inclusion of IKS in the school science in Gauteng might provide science learners opportunities to construct scientific concepts in the same manner as the Western learners do.

Many people dispute the existence of science in IKS because 'science' in IKS exists alongside the other forms of cultural knowledge and beliefs (Abimbola, 1997). Dzama and Osborne (1999) claim that the IKS is a result of an African worldview, which views existing things as described by a single concept or system in nature. The assertion made by Dzama and Osborne helps to explain the complexity of IKS and the 'science' in IKS The other complexity of 'science' in IKS as observed by Dzama and Osborne (1997) is that the African worldview explains complex phenomena through the anthropomorphic lens and that the physical entity is not separated from the mental events. This is another factor that makes the African worldview different from the scientific worldview. Dzama and Osborne (1999) also claim that Africans have a sense of cause and effect, but it is superstitious rather than mechanistic and materialistic. On the other hand American Association for the Advancement of Science (1990) claims that science is a process for producing knowledge and that the process depends both on making careful observations of phenomena and on inventing theories for making sense out of those observations. The definition of science given by American Association for the Advancement of Science

(1990) justifies the existence of 'science' in IKS as IKS relies mostly on knowledge built through observations and making sense out of such observations.

Is IKS being integrated to School Science?

Dzama and Osborne's above augment suggests that it is difficult to integrate IKS in school science. This might be the cause of confusion with regard to the components of IKS that are to be included in the school science and this might be the cause why educators are reluctant to consider integrating IKS with the school curriculum (Ogunniyi, 2007). If IKS is integrated at all, this is mostly done in relation to Learning Outcome Three (Technology, Environment and Society) of the Science School Curriculum. IKS as defined by Onwu and Mosimege (2004); Ogunniyi (2007) and Odora Hoppers (2002) is too broad. This calls for the identification of the components of IKS that can relate to school science. The "science" in IKS might be the relevant component.

1.4 Limitations of the Study

The small sample size cannot be a fair representation of the population of educators in Gauteng. One group of ten educators from a section of a District is a small representation of science educators of Gauteng.

1.5 Ethics

The participants in this research project were informed in detail about the project. Their participation was voluntary. Consent was sought from the Gauteng Department of Education, Gauteng Department of Education- Ekurhuleni District, schools participating, science educators, learners and learners' parents. All participants expressed willingness to participate in the study. The names of the schools and participants will be kept anonymous.

Chapter 2

Literature Review

2.1 Introduction

The inclusion of IKS in school science in Gauteng can be a reality when the educators have a common understanding of what IKS is. The other factors that can contribute to the success of integration of IKS in the school science curriculum are the successful identification of 'science' in IKS. The integration techniques of IKS in science lessons are yet another skill that the science educators have to acquire. The literature review seeks to establish the existing research gap in the research about the interpretation of IKS by science educators in Gauteng schools in South Africa. The relationship between the nature of science and the 'science' in IKS will also be addressed.

2.2 IKS Related Literature

The National Curriculum Statements require that IKS be included in the curriculum, however the IKS that should be included has not been clarified (Ogunniyi; 2007b). Due to the diversity of IKS I believe that science education researchers have to identify the components of IKS that can be integrated well in science curriculum. It is important to investigate this aspect of IKS to link it with the school science curriculum. It is this linkage that can be used to strengthen learners in science classroom as it might make learners identify themselves with the school science. There is a need to investigate indigenous knowledge that science learners bring to the classroom and to establish its effects in learning Ogunniyi (2007). Ogunniyi (2007) states that IKS includes science, technology, religion, language, politics and other socio- economic systems in this definition of IKS there is need to investigate the nature of science that is a component of this knowledge system.

Learners whose culture is different from the nature of school science are considered by Aikenhead and Jegede (1999) as disadvantaged in the science classroom. Lee and Fradd

(1998) claim that the attempts to improve performance in science and mathematics have to consider students' socio-cultural background. By the same token Brown (2004) and Lemke (2001) claim that to understand the achievement of disadvantaged students in science and mathematics requires one to analyse the socio-cultural factors that include their cultural identity, and conflicts. Lee and Fradd (1988) also realize that one of the major obstacles for the learners belonging to a disadvantaged socio-cultural background is that they operate within a hidden curriculum which is embedded within the socio-cultural factors that they operate within. Jegede and Aikenhead (1999) consider such learners as outsiders to the school science curriculum. Their assertion is that the infiltration of the aspects of this hidden curriculum to the science classroom becomes a barrier in learning. There is need to investigate the science knowledge that is embedded in the learners' socio-cultural background. Jegede and Aikenhead (1999) and Cobern (1998) observe that the social context of learning, as well as the effect of the learner's socio-cultural background in the teaching and learning of science, should be taken into consideration. In this regard Jegede and Aikenhead (1999) propose for a multicultural approach to school science.

The school science has been influenced by Western worldview and there is need to integrate the other forms of knowledge (Jegede and Aikenhead, 1999). The need to integrate IKS in school science has to be seriously considered to make learning to be more meaningful. The process of integrating IKS to school science should start by identifying the components of IKS that can fit into school science. Agrawal (2002) proposes that, first, the identification and separation of useful knowledge should precede the inclusion of IKS. One might call this particularization of IKS (Agrawal, 2002). This might involve the identification of 'science' in IKS. This research seeks to establish what science educators consider to be the relevant components of IKS that can be integrated to the school science.

2.3 The School Curriculum, IKS and Science Educators

DoE (1997) indicates that the government considers IKS as a body of knowledge that can be integrated to school science and the incorporation of IKS into the school curriculum. There have how ever been little efforts to assist the educators to identify the IKS that is relevant to school science. The inclusion of IKS in science curriculum is further discussed by in the National Curriculum Statements (DoE 2001, 2002). Such consideration of IKS in science curriculum has to be complemented by structures that are put in place to assist educators in implementing the IKS related policy.

Ogunniyi (2007) observes that one of the main reasons why The NCS calls for the inclusion of IKS in the science curriculum is that IKS systems tend to reflect the wisdom and values that the indigenous people have acquired over a long period of time. If such values and wisdom are incorporated in school science learners might find school science relevant to their everyday experiences. Ogunniyi (2007) believes that parts of this knowledge might have been lost during the colonial and apartheid eras. If this is the case then most of the current crop of science educators might not be aware of the IKS. The issue might not only be that they are not aware of the IKS but might be that they doubt its value and that IKS should be included in the school science. Jansen and Christe (1997) observe that generally the educators have willingly adopted Curriculum 2005 and the NCS. The reason why most science educators have ignored IKS might be that they lack exposure to IKS related issues (Ogunniyi, 2007). Fakudze (2004) and Gunstone and White (2000) believe that the educators' attitude towards inclusion of IKS in school science is a result of the colonization of their culture. If this is the case then there have to be some drives that will target changing the educators' attitudes with regards to the inclusion of IKS in school science. This is part of the evidence for the influences of the past education systems to the implementation of new curriculum packages. Manzini (2000) thinks that educators are aware of what is required of them in terms of the inclusion of IKS in school curriculum; it is only that they do not think critically about the concepts, aims, and resources. Manzini (2000) thinks that the science educators merely

attempt to transmit the curriculum without considering the various essential components of the curriculum requirements.

Jansen and Christie (1999) make an observation that the C2005 policy statement failed to assist teachers to approach the issue of integrating IKS with the school science. This might be due to the fact that there is no elaboration on the IKS that are to be part of the school science. The failure by the policy statement to clarify IKS issues might have led to the current dilemma the science educators find themselves in.

2.4 The Nature of Science and the 'Science' in IKS

Abd-El-Khalick; Bell and Lederman and (1998) claim that Nature of Science (NOS) refers to the epistemology of science, as it is a way of knowing. According to Abd-El-Khalick, et al (1998) the NOS consists of values and beliefs that are inherent to scientific knowledge and its development. Matthews (1998) argues that scientific knowledge is simultaneously reliable and tentative. According to Matthew (1998) one derives power from possessing some form of knowledge, but if such knowledge becomes abandoned for other newly coming knowledge a problem arises. This is a claim that the NOS is not static as it is bound to change with knew knowledge. In this regard Abd-El-Khalick et al (1998) observe that the history of science reveals both evolutionary and revolutionary changes. The observations above are a claim that the nature of science changes with time. Acceptance of other forms of knowledges like IKS might bring such changes to the NOS especially the school science.

According to Alebiosu (2001) every traditional society of the world possesses a form of science or technology which is employed in indigenous practices geared towards the satisfaction of basic needs. Ogunniyi (1986) and Samuel, (1996) observe that such science and technology may be useful even in the face of modern science and technological advancements. Alebiosu (2006) argues that instead of rendering them obsolete in societies, indigenous science and technologies can be refined and integrated in the knowledge and techniques of formal science. Samuel (1996) observes that

indigenous science and technologies constitute direct experiences with the immediate environment and with the natural world. According to Howes, Jones and Josenthal (2004) indigenous sciences and technologies may be useful to teachers and learners in enriching classroom science experiences and thereby facilitating teaching and learning. This is a realization that there is 'science' in IKS and a call for the inclusion of the 'science' in IKS in the school science.

The existence of science in IKS should not be doubted as Matthew (1998) observes that science is a basic part of the human experience. He goes further to claim that whether or not most people know it, science has relevance for everyone. Alebiosu (2006) observes that the uniqueness of Western science to other sciences is that Western science is the objective testing of hypotheses with data collected from an experiment, and in this case the experiment is the environment. Alebiosu (2006) further asserts that Western science is based upon the principles of repeatability and predictability. The science in IKS as observed by Alebiosu (2006) arises from questions about the interactions between human beings, their environment and the spiritual world. The observation by Alebiosu (2006) seems to suggest that the 'science' in IKS might not be easily separated from the other components of IKS in some cases.

'Science' in IKS Indian Experience

Balasubramanian (2004) observes that there is 'science' in Indian IKS. In this regard Balasubramanian (2004) observes that indigenous knowledge is the technical, social, organizational and cultural collective memory of human responses to the complexities of life. Balasubramanian (2004) also observes that indigenous knowledge generated large-scale economic productivity for Indians. Maundu (1995) also shares this observation by claiming that India's indigenous technologies were very sophisticated. According to Maundu (1995) India's IKS related to design and construction which is similar to the modern technologies. The existence of 'science' in IKS is also qualified by Maundu's, (1995) assertion that one of the earliest industries relocated from India to Britain was textiles and that it became the first major success of the Industrial Revolution. This is a claim that India's IKS has some influence to what is perceived as western science and

that the Indian IKS fuelled the Western Industrial Revolution. This could have been possible due to the genuine nature of the 'science' in India's IKS, as it has been reflected. Maundu (1995) further claims that rust-free steel was an Indian invention through its 'science' rich IKS. According to Maundu (1995) another important Indian contribution to metallurgy was in the isolation, distillation and use of zinc and that through India's IKS that is rich in 'science' Indians pioneered many tools for construction.

The existence of 'science' in IKS in India is more evident in health and medicinal issues. Maundu (1995) argues that there is collaboration of traditional healthy knowledge systems with modern knowledge in many areas that relate to health issues. He observes that in some cases, modern medicine is used as a main line of treatment with traditional system offering supplementation and long term care. The examples projected from the India's IKS are a testimony enough of how genuine the 'science' in IKS is and is proof that IKS can indeed be integrated in school science.

'Science' in IKS- The Zimbabwean Version

Mutandwa and Gadzirayi (2007) from the Zimbabwe's perspective, argue that IKS covers the whole range of human experience, which include physical sciences and related technologies. Mutandwa and Gadzirayi (2007) acknowledge the existence of 'science' in IKS and observe that IKS is seen as holistic body of knowledge that includes quiet a good range of disciplines. In Zimbabwe the strong linkage between IKS and the holders is found in agriculture, land and environmental management (Mutandwa and Gadzirayi, 2007). The example given is that the traditional religion of the Shona of Zimbabwe is closely connected with tribal leadership and with ideas of land ownership and land fertility (Mutandwa and Gadzirayi, 2007). In the Shona systems land management includes technical knowledge such as how to build and farm terraces, as well as religious taboos and sanctions (Mutandwa and Gadzirayi, 2007). The claim by Mutandwa and Gadzirayi (2007) makes it to be complicated to separate the 'science' component of IKS from its other components such as religion. According to their view IKS should be taken in its holistic nature and there is no need to isolate its components. This study seeks to

identify what science educators consider to be ‘science’ in IKS and the assertions above are pointers that the ‘science’ is integrated in other components of IKS.

‘Science’ In IKS in Other African Countries

Odora Hoppers (2008b) observes that there was large- scale iron making in Benin. She also claims that iron making involved the design of furnaces that were made from termite clay. Odora Hoppers (2008b) also observes that there was some form of astrological development in Western Africa, which can be dated as back as 300 years before the birth of Christ. All the described technologies are testimony that there is abundance of ‘science’ in IKS and that the ‘science’ in IKS is closely related to what makes the NOS.

Odora Hoppers (2008) asserts that African indigenous medicine is well established. Such medicines include plant science, psychotherapy, knowledge of anaesthetics and antiseptics and painkillers (Odora Hoppers, 2008). Interestingly Odora Hoppers (2008) also claims that Indigenous African medicinal knowledge included obstetrics knowledge of medicines for facilitating abortion, retarded labour, and surgery including Caesarean sections. Once more the claim asserts the existence of ‘science’ in IKS.

Odora Hoppers (2008) argues that the Nigerians through their indigenous knowledge produced textiles of various design and that in their textiles there is evidence of usage of cotton and silk. This is evidence enough that the Nigerian women had some form of scientific indigenous knowledge that they used to process cotton and silk material. This once more serves as evidence that there is ‘science’ in IKS of many indigenous communities. There is need for the unearthing of the ‘science’ in IKS, as it might be the means of integrating IKS in school science curriculum.

‘Science’ in IKS and Religion

Mbiti (1990) observes that the African Traditional Religions include beliefs, ceremonies and rituals. One wonders whether the religion and science components of IKS can be treated as separate components of IKS. Mbiti (1990) also notes that ignoring religious beliefs and attitudes and practices will lead to misunderstanding of African behaviour. According to Mbiti (1990) it becomes difficult to separate religion from the other components of IKS. This is an assertion that religion has influence in people’s attitudes and such influence may be at most times make it difficult to separate religion from the indigenous knowledge. This implies that the infusion of IKS to school science would allow some religious views’ in the science classroom.

Roth and Alexander (1997) and Cameron; Rollinick and Doidge (2005) observe that many first year university students in South Africa come to university with prior knowledge and that this prior knowledge is usually at conflict with the western worldview, which is the foundation of the science. This prior knowledge might be from the religious inclination. Roth and Alexander observe that students who bring along religious influenced interpretations of natural phenomena tend to face problems in science learning. The observation by Roth and Alexander (1997) seem to suggest that religion has no space in the science classroom. And that influence of religion might be considered as affecting the conceptualization in the science classroom. Barrett (2000) regards the nature of science as being mechanical, the emphasis being on the unprejudiced observations and the deliberate setting up of experiments. This description of science makes it to be so different from religion though according to Roth and Alexander (1997) if one was brought up in a household where science and religion were part of the daily life, it is easy to bring the two disciplines together. While there seems to be some religious influence amongst the indigenous people maybe there is need to separate their religion from the knowledge systems that they possess.

Substantive differences

Agrawal, (1993) and Geertz (1983) observe that there are differences between indigenous and Western knowledge with respect to their history and distinctive characteristics. Agrawal (1983) claims that the presumption that indigenous knowledge is concerned with the immediate and concrete necessities of people's daily livelihoods, while Western knowledge attempts to construct general explanations and is one step removed from the daily lives of people, does not hold water. Geertz (1983) argues that IKS also encompasses non-technical insights, wisdom, ideas, perceptions and innovative capabilities. This is testimony of the existence of 'science' in IKS. In this regard Aikenhead (1996 and 1997), Baimba, Katterns, and Kirkwood (1993), George (1995), Hewson (1988) and Jegede (1995) claim that science may be conceptualised as a subculture of western societies. They view science as a way of thinking being guided by the western world. The acceptance of the cultural view of science should consider the diversity of the world cultures and include the science knowledges from these cultures.

2.5 Literature Review Related to Theoretical Framework

This research project is underpinned by social constructivism and Community of Practice theories. Socio-constructivism can be defined according to Noddings (1990) as an approach according to which individual knowledge relies on its social construction. Especially relevant in this research are the communication processes occurring in situations where a group of persons try to solve a problem. In this case the problem is identifying 'science' in IKS. The social world of a learner includes the people that directly affect that person, including teachers and friends (Vygotsky, 1978). Accordingly, learning designs should enhance local collaboration and dialogue but also engage other stakeholders. With regard to IKS related issues the other stakeholders might be the custodians of IKS. Teaching strategies using social constructivism as a referent include teaching in contexts that might be personally meaningful to students and this will lead

them to develop a shared meaning of the phenomena (Vygotsky, 1978). In this regard teaching in context will be taken to include IKS in school science. The IKS that is to be included in school science would be identified through small group collaboration.

According to Noddings (1990) social constructivism is not a theory of instruction but also a theory of knowledge and of learning. Noddings (1990) further claims that social constructivism also defines knowledge as being temporary, developmental, socially and culturally mediated. Such a claim of knowledge is an acknowledgement of the need to change the school science through the inclusion of IKS. Noddings (1990) observes that learning from the social constructivism is understood to be a result of concrete experience, collaborative discourse, and reflection. Collaborative discourse is one of the main methodologies employed in this research project. von Glaserfeld (1993) claims that constructivism is being guided by environmental adaptations and the existence of people whose behaviour is guided by rules of the subculture in which they belong. von Glaserfeld (1993) further claims that constructivisms considers knowledge as being temporary as it changes with the ever incoming new forms of knowledge. Noddings (1990) argues that the social constructivist position is post epistemological since it projects such a different relationship between knowledge and the "real" outside world. von Glaserfeld (1993) agrees with this notion as he states that constructivism is better viewed as a theory of knowing than as a theory of knowledge.

As viewed by von Glaserfeld (1993) the socio-constructivist approach focuses on the individual's development with respect to the social interaction, without really differentiating or identifying the underlying factors that enhance collaborative learning. Socio-cultural theory's key feature is that higher order functions develop out of social interaction (Vygotsky, 1978). The common aspects between the two theories are the relationship between social interaction and the individual's cognitive development (Vygotsky, 1978). This approach is derived from Vygotsky's zone of proximal development (Vygotsky, 1978). In this approach, the learning process takes place through changes that are mapped out through social interaction.

Vygotsky (1978) and Noddings (1990) view the Zone of Proximal Development as the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance (or in collaboration with more capable peers). It is in this premise that the research project seeks to establish the nature of IKS that can be included in school science through engaging educators in some form of collaboration with some more capable peers (facilitators in seminars). The collaboration of the educators on IKS will allow those who are new in the field to acquire the useful knowledge on IKS from those who are well experienced.

Kinginger (2002) supports the use of Vygotsky's zone of proximal development in educational situations. She argues that Vygotsky's model of a process of cognition emergence has given direction to a more 'prospective educational emphasis. Her argument for the advocacy of the ZPD is that it encourages learning. Such a model suits the research undertaken in this study, as in Kinginger's terms, this ZPD goes a long way towards supporting the science educators' implementation of policies such as the call for the inclusion of IKS in the science curriculum. The outcome of viewing Vygotsky's model of learning as a collaborative dialogue process is that it allows an assessment of educational potential, which includes mediating the content (in this case IKS that can be included in school science) and the ability of science educators to identify the sources of IKS.

The research project sought to place science educators who are involved in the study in a community of practice. Community of practice according to Lave and Wenger (1991) is a term that describes a group of people who share an interest, a craft, and a profession. As observed by Lave and Wenger (1991) the group can evolve naturally because of the member's common interest in a particular domain or area, or it can be created specifically with the goal of gaining knowledge related to their field. In the case of this research the common interest is to identify the IKS relevant to school science. It is through the process of sharing information and experiences with the group that the educators participating in this study will learn from each other, and have an opportunity to develop themselves

personally and professionally (Lave and Wenger, 1991). With regards to this study the community of practice is designed to share and create knowledge.

Wasko and Faraj (2000) describe three kinds of knowledge these being ‘knowledge as object’, ‘knowledge embedded within individuals’, and ‘knowledge embedded in a community’. Lave and Wenger (1991) agree with this notion as they claim that Communities of Practice have become associated with finding, sharing, transferring, and storing knowledge. Davenport and Prusak (2000) view knowledge as those valuable context-based experiences that can not easily be captured, codified and stored. This might be the case with IKS.

Community of practice is also viewed by Thomas, Kellogg and Erickson (2001) as an involvement in knowledge management. This is seen primarily as a problem of capturing, organizing, and retrieving information (Thomas, Kellogg and Erickson, 2001). According to Davenport and Prusak (2000) the community of practice is considered as a rich potential source of helpful information in the form of actual experiences which are in this case the identification of IKS relevant to school science. This means that engagement of science educators in collaborative seminars might improve their understanding of IKS and the need for its integration to school science.

According to Schneider (2006) the theory of community of practice can also guide efforts to inform potential partners in improving science teacher education. If science educators form a community of practice, then, according Wenger (1998), this community will find it useful to interpret policies and implement them accordingly. With regards to this research it would be policies that relate to the inclusion of IKS in school science.

Ogunniyi (2007b) observes that science curriculum requirements (inclusion of IKS) indicate a series of changes in teaching and learning of this area of subject. Therefore, collaboration of science educators will assist them to cope with the demands of curriculum changes. In this regard collaborative dialogue on IKS related issues might enlighten them on what to consider as IKS and what components of IKS are worth integrating with school science. This research focuses on the ability of science educators

to identify the 'science' component of IKS and it is envisaged that collaboration might assist educators to accomplish the task. The research is focused on the ability to work in teams, the willingness to seek and accept criticism, and the development of critical thinking on IKS related issues. Therefore, collaboration of science educators will assist them to cope with the demands of curriculum changes. In this regard collaborative dialogue on IKS related issues might enlighten them on what to consider as IKS and what components of IKS are worth integrating with school science.

Kyle (1999) claims that school science should be pluralistic in nature by including other sciences. He says that educators should acknowledge that multiple knowledges exist. According to Kyle (1999) Western and non-Western cultures are similar. Kyle's observations are in line with the call for the inclusion of IKS in the school science curriculum. Kyle (1999) asserts that the inclusion of other forms of knowledge in school science will not change the face of what is school science today but will expose the learners to alternative knowledges.

According to Jegede and Okebukola (1991) and Okebukola (1986) the cultural background of the learner may have of an effect on science education than does the subject content. The integration of IKS in the science curriculum might make such effect to be positive since IKS includes some cultural components (Ogunniyi, 2007). On the same premise Okebukola (1991) argues that attempts to nationalize Western science curricula are likely to be ineffective because of the disconnection between the students culturally based view of the world and the view provided in the science classroom. It is envisaged that the integration of IKS in the science curriculum will address the disconnection between the learners' cultural worldview and the school science worldview.

Okebukola (1986) suggests that in developing countries the process of encultration into a Western science view involves the ultimate devaluation of students' traditional values and practices. He asserts that enculturation into a Western school view has some effect on the status of students' traditional worldviews. He also argues that a Western school view

is of limited practical viability in relation to traditional values and practices. In this regard one can then say learners are exposed to a scientific worldview while they are in possession of their own African worldview. The inclusion of the science in IKS might be the means that will bridge the school science worldview and the cultural worldview of the learners.

The inclusion of IKS in the science curriculum would result in what Ogawa (1995) calls a multi- science view of school science. He suggests that there are three different types of science, personal science, indigenous science and Western modern science. Ogawa (1995) views 'science for all' as meaning Western science. According to Ogawa (1995) the western science is exclusive of other sciences. His argument for multi-science is built upon the realization that the multi- science approach will be inclusive of other sciences and learners from all ethnic backgrounds will identify with the school science.

The call for a multi- science through the inclusion of IKS would suggest that the science curriculum should focus on the 'science' component of IKS as part of the subject content. Such consideration of 'science' component of IKS would mean that IKS present a critical framework for thinking and knowledge construction, which would be complementary to the Western science that has influenced the school science for a long time (Ogawa, 1995). Given the diverse multicultural composition of our classrooms, Odora-Hoppers (2000) offers a broad perspective of IKS that may be useful to assist educators on what could be a rather complex task. IKS is characterised by its close link with the culture and history of a people including their civilisation, and forms the backbone of the social, economic, scientific and technological identity (Ogawa, 1995). It is these knowledges that are referred to as indigenous knowledge (Odora-Hoppers, 2000).

2.6 Science Educators and the Inclusion of IKS in School Science

Manzini (2000) observes that educators seem oblivious of the cultural bias of the present curriculum. According to Manzini (2000) educators do not think critically about the concepts, aims, approaches, and resources the inclusion of IKS in science curriculum advocates. Manzini (2000) argues that science educators merely try to transmit the curriculum. It is most likely that the present day science educators are a product of a school science that was incompatible with IKS. To such science educators the inclusion of IKS in science curriculum is interference with the traditional school science. It might be through collaboration with other science educators that one might build a working definition and identification of IKS. Science educators in South Africa have different ethnic background. The interpretation and identification of relevant IKS by people whose worldview differs can be best addressed when such people collaborate. The differences in ethnic background are also found amongst the schools in Gauteng. This difference would assume that there are many forms of IKS at any science classroom in Gauteng schools. The question that rises in a situation like Gauteng is whose IKS is worth including in the science curriculum?

Mito Meeting (1996) observes that IKS can act as a powerful tool in a learning environment to teach students. The paper argues that learning environments need to be adapted to help learners learn science through their indigenous communities' knowledge. This could be done through the recognition of learners' culture and values. The incorporation of IKS in school science might make learners feel ownership of school science knowledge. Allowing learners to feel ownership of science knowledge is equivalent to respecting their culture. Respect of one's culture might act as motivation to learn.

Odora Hoppers (2002) argues that to bring IKS into science means that the learners' underlying ontologies need to be explored and given respect. She observes that the Western science from which school science draws has an epistemology, which is dualistic, materialistic and mechanistic. The lack of dualism, materialism and mechanism

in IKS might be the reason why many people feel that IKS cannot be part of school science. The lack of trust in IKS has led to Soudien and Nekwheva (2004) to advocate for the construction of an authentic African knowledge paradigm. To suggest the construction of an authentic African knowledge paradigm is a positive step towards acknowledging IKS as another body of knowledge.

Odora Hoppers (2002) claims that when exploring relevant school science curricula aspects of Afro-centric worldviews emerge. She claims that the African worldviews are not only perspectives formed into a set of beliefs but are expressions of authentic knowledge systems and ontologies that shape and guide perception and thinking. Odora Hoppers (2002) observes that IKS is knowledge equivalent to other forms of knowledges. In this regard IKS has a role to play in the science classroom. According to Odora Hoppers (2002) there is an element of IKS in today's school science as the Afro- centric worldviews always emerge in school science issues. There is therefore need to highlight such worldviews and link them to the processes of integrating IKS to school science.

2.7 Summary

It is clear that the policy that regards the inclusion of IKS to school science has not been fully implemented. The reasons for the drawbacks in integrating IKS to school science might be the lack of support mechanisms for the science educators. The other reason might be the lack of research on the IKS components that are relevant to school science. The reviewed literature acknowledges IKS as an authentic body of knowledge that can be integrated in school science and also projects IKS as being a multi- dimensional body of knowledge. This research seeks to identify the components of IKS that educators consider to integrate in school science. The various definitions of IKS given indicate that there is 'science' in IKS but do not address the nature of this science and how relevant it is to the school science. This research project seeks to investigate what educators consider to be the science component of IKS. The reviewed literature also indicates that the call to integrate IKS in school science has not been adequately responded to by

educators. In this regard the attitudes of educators towards the inclusion of IKS in school science need to be investigated.

Chapter 3

Research Design

3.1 Introduction

The search for the site and population to use in this research was not much of a problem. After a short period of being a relief science educator in one of the schools at Ekurhuleni North made me to be part of a science educators' cluster group. The only challenge that faced me was to invite them to be part of my research. It was the educators' desire to explore the many approaches towards making science accessible to their learners that made it easy for me to establish myself within the group.

3.2 Sites, Population and Subject

The GDE Ekurhuleni North high schools were ideal for this research to cut on travelling costs and the administrators of the District were so willing to assist with the logistics to carry out this research project. The ten schools that participated in this project belong to the same cluster that meets on specific days for moderation of School Based Assessment Programme. The cluster was a fair representative of former model 'C' schools and township schools. The cluster is also made up of a fair representation of educators from different ethnic background.

Population: The cluster has ten science educators five of which come from former model 'C' schools and the other five are from the township schools. The ethnic distribution of the group was as follows:

Table 1 Participants and their Ethnic Groups

Ethnic Group	Whites	Indians	Blacks
Number	3	2	5

The White science educators are made up of two Afrikaans females and one male educator. The White educators teach at former model 'C' schools and have taught Life

Sciences and Physical Sciences in South Africa for a period of years that range from eight to fifteen. All The White educators hold degrees from various South African universities. The five Black science educators consist of two Zimbabwean, one being Ndebele which is an offshoot of the Nguni tribes of Southern Africa while the other is a Shona. The other Black male educator is a Ghanaian and has worked in several countries including those in overseas. The two Zimbabwean educators hold degrees from the University of Zimbabwe while the Ghanaian educator holds a degree and teaching qualification from Cuba. The two Black females are both South Africans (of Tswana and Xhosa tribes). The two female South African hold Advanced Certificate in Education from Universities of South Africa. (See Appendix 2 for more details of participants.)

Sample: 3 science educators chosen from the ten members of the cluster were interviewed.

3.3 Research Questions

1. What specific IKS content that could be included in school science, are science teachers aware of?
2. What are teachers' attitudes towards the inclusion of IKS into school science?

3.4 Research Method

Qualitative Research

The research project combined a participative case study and survey that was carried out involving the Life Sciences and Physical Sciences educators selected from both former model C and township schools of Ekurhuleni District. In this case ten educators were selected from the two types of schools.

Case Studies

The case study is research that investigates a few cases, and most often just one, in considerable depth (Opie, 2004). According to Casley and Lury (1987) an essential feature of a case study is that it provides in-depth, detailed analysis. Opie (2004) further states that case studies are studies of particular individuals but they could also be of individuals participating in groups. Manion (1994) agrees with this notion by stating that the case study researcher typically observes the characteristics of an individual unit. According to Bassey (1999) the value of a case study lies in the potential richness of the data, and the extent to which the researcher can convey a sense of how the case functions and that case studies present research or evaluation data in a more publicly accessible form than other kinds of research.

While the case study has been chosen for its strengths that have been discussed this research follows a participative case study in the sense that the researcher is directly involved in the case study proceedings.

The focus group in the case study are the science educators that belong to Ekurhuleni North Cluster in Gauteng Province of South Africa. The focus group was chosen to elicit perceptions, feelings, attitudes and ideas of participants about a selected topic (Puchta and Potter, 2004 and Ogunniyi, 2007). This was done with the hope to enhance participants' active involvement in that participants are generally guided in discussion to generate rich understanding of their experiences and beliefs.

One more interesting point about focus groups is that the researcher works with people who share something in common (Puchta and Potter, 2004). For example, the science educators are generally faced with the same dilemma- that is – of making science content to be accessible to their learners. The assumption is that if they share something in common, they are likely to express themselves freely and in an informal way. Cohen and

Manion (2000) observe the principle that a group should have homogeneity of background and should feel free to talk openly in front of each other. Unlike individuals' interviews, in focus groups the researcher can access a number of people within a short space of time (Cohen and Manion, 2000). This serves to avoid a waste of time, especially when all participants honour their interview appointment as observed by Cohen and Manion (2000)

Surveys

According to Patton (1990) there are two major types of surveys that are used by researchers: descriptive and analytical. In descriptive surveys researchers are interested in discovering the current situation in a given area. Patton (1990) describes the analytical surveys as attempting to describe and explain why certain situations exist. Opie (2004) claims that in an analytical survey approach there are usually two or more variables are examined to test research hypotheses. According to Patton (1990) and Opie (2004) the results of an analytical survey allow researchers to examine the interrelationships among variables and to draw explanatory inferences. In this research the two types of surveys described above are used as being integrated in the Case study. This research is an analytical survey within a case study. It involves the analysis of attitudes towards the inclusion of IKS in school science curriculum and the change of such attitudes as a result of involvement in reflective seminars.

Advantages of research surveys

Patton (1990) claims that surveys are an efficient way of collecting information from a large number of respondents. Very large samples are possible. According to Opie (2004) statistical techniques can be used to determine validity, reliability, and statistical significance. Patton (1990) further observes that surveys are flexible in the sense that a wide range of information can be collected. According to Opie (2004) surveys can be used to study attitudes, values, beliefs, and past behaviors. This might lead surveys to be standardized, and relatively free from several types of errors. Opie (2004) also claims that

surveys are relatively easy to administer. There is an economy in data collection due to the focus provided by standardized questions (Opie, 2004). This means that questions of interest to the researcher are asked, recorded, codified, and analyzed.

Disadvantages of using research surveys

Patton (1990) observes that research surveys depend on subjects' motivation, honesty, memory, and ability to respond. According to Patton (1990) subjects may not be aware of their reasons for any given action. They may have forgotten their reasons. Patton (1990) also claims that subjects may not be motivated to give accurate answers. According to Patton (1990) structured surveys, particularly those with closed ended questions, may have low validity when researching affective variables. Opie (2004) observes that survey question answer-choices could lead to vague data sets because at times they are relative only to a personal abstract notion concerning 'strength of choice'. For instance the choice 'moderately agree' may mean different things to different subjects, and to anyone interpreting the data for correlation (Opie, 2004). Even yes or no answers are problematic because subjects may for instance put 'no' if the choice 'only once' is not available (Opie, 2004).

This research sought to collect data through the analytical survey approach within a case study. It involves ten educators drawn from Ekurhuleni District of Gauteng Province.

3.5 Research Instruments

Two instruments have been used in this study: a semi- structured interview and a questionnaire.

Questionnaires

The questionnaires were designed to direct the focus for the interviews were to follow. The questionnaire is given in appendix (1)

Semi- structured interviews

According to Opie (2004) semi-structured interviews focus on a list of key themes or questions that the interviewer wants the respondent to address. The semi-structured interview does allow for the respondent to add new information but they should attempt to dominant than others in having their opinion heard (Opie, 2004).

Prior to the semi- structured interviews taking place it was necessary to clarify one's own thinking and theoretical priors (for example, by reviewing the literature on reasons for IKS and its integration to school science) to design the types of questions that would need to be asked in order to explore the reasons for this curriculum change. The initial questions were constructed after reviewing the policy that relates to the inclusion of IKS to school science and coming up with one's own unanswered questions. For example, why the need to consider including IKS in school science now? What will it achieve? The resulting questions were then found to fall naturally into a few main headings. The three interviewees were selected from the group of ten educators that participated in this research. This was done initially in response to a request by one of the interviewees who wanted to assess the types of questions he would be required to answer before the actual interview. The other interviewees were selected as means of follow up to issues that rose in the questionnaire.

The Collaborative Reflection Approach

The study used a collective case study methodology (Stake 1995) to interpret the ideas and actions of ten science educators and a facilitator participating in a collaborative

action research project during the 2009 academic year. The focus of this study is on providing detailed description and analysis of each teacher's expressed views, their interpretation of IKS and the 'science in IKS and to identify any changes in their development over the duration of the project. The techniques used required the capture of educators' oral and written contributions (Miles and Huberman, 1994). While various methods were used to collect data from each participant (interviews, questionnaires, response to seminar tasks), the focus of this research is to highlight the rich discussion and reflection, which occurred during three collaborative meetings throughout the project. The general intentions for the meetings were to identify the educators' understanding of IKS and 'science' in IKS, critically examine and reflect upon their willingness to integrate IKS in school science, and collaboratively reflect on the processes and products stemming from their collaborative action research project. All dialogue from the meetings was audio recorded and later transcribed for analyses.

3.6 Data

The collected data were from the responses from the questionnaires, semi- structured interviews and collaborative meetings. The data were analyzed using a coding process. According to Freeman (1998) codes can be generated using two main approaches: a priori and grounded. A priori codes were generated from the conceptual framework, research questions, and key variables. In contrast, grounded codes were generated from the data themselves (from the collaborative meetings) and described using *in vivo* descriptors, then selected and applied in a constant and comparative method (Glaser, 1992). Data displays were used, when appropriate, to enhance the analytical process (Opie, 2004). Coded data were clustered and then categorized to identify themes and patterns.

3.7 Validity and Reliability of the Research Methods

According to Golafshani (2003) validity is the most important characteristic of a data collection process. Validity looks at whether the data collection process measures what it was meant to address (Golafshani, 2003). Winter (2000) observes that data collection process is valid to the extent that a person's performance on it is really and truly an indication of the extent to which the respondent possesses the characteristic which the data collection process is attempting to measure. Golafshani (2003) also states that besides being a measure of the data collection process validity also measures the truthfulness of the results. Validity in this study is ascertained through triangulation. Opie (2004) observes that triangulation the important feature of triangulation is that it controls bias and helps to establish valid propositions. To enhance the validity of the data analysis, triangulation was accomplished by using multiple sources of data (e.g. interviews, questionnaire, and collaborative meetings). Furthermore, the three collaborative meetings of the educators in this study brought about an achievement of a reputable level of data trustworthiness (Opie, 2004).

3.8 Qualitative Aspect of the Study

Credibility

Golafshani (2003) describes credibility in research as the criteria that involve establishing results of qualitative research that are credible or believable from the perspective of the participant in the research. Since from this perspective, this qualitative research is to describe or understand the interpretation of IKS and ‘science’ in IKS by science educators the participants are the only ones who can legitimately judge the credibility of the results.

Transferability

Opie (2004) describes transferability as the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings. From the

qualitative nature of this study, transferability is primarily the responsibility of the science educators in transferring the findings of this study to their classrooms and other related situations.

Dependability

Opie (2004) observes that dependability of the results of a qualitative research rests upon the same results being obtained should the research be redone under similar conditions. In order to estimate reliability in this research the collaborative reflection method was used. This involved three science educators' seminars. (Golafshani, 2003) observes that the idea of dependability, on the other hand, emphasizes the need for the researcher to account for the ever-changing context within which research occurs. The collaborative reflection method in this research is responsible for describing the changes that occur in the setting and how these changes affected the way the research approached the study.

Conformability

Opie (2004) claims that qualitative research tends to assume that each researcher brings a unique perspective to the study. In this study the procedures for checking and rechecking the data throughout the study were documented. Participants in the reflective seminar group made reflections at the beginning and end of each seminar.

Chapter 4

Field Work

4.1 Pilot Study

After drawing up the project proposal a pilot study in the form of a questionnaire and informal After discussions on the existence of 'science' in IKS were carried out with Msc (Science Education) students and science educators of a school in Johannesburg. The involvement of Msc (Science Education) was carried out at Wits Marang Center for Mathematics and Science Education. This involved Msc second year students who were also carrying out researches of similar type. One of the Msc students was by chance a science educator at one of the schools within the Johannesburg CBD (Berea). He volunteered to distribute the questionnaires amongst his fellow science educators at this school. He also took the responsibility of collecting the responses from them. Conducting a pilot study allowed for the refining of the questionnaire and restructuring of the preparations for seminar discussions. The piloting of the questionnaire amongst the described groups facilitated the changing of few questions whose responses indicated that the questions were not clearly framed.

The school that was used as the pilot school invited me (after seeing the questionnaire) to have some informal discussion about the nature of IKS and the 'science' in IKS. In this forum four science educators that were drawn from Natural Sciences, Life Sciences and Physical Sciences were involved. The group was made up of one White and three Black educators. The discussion was held at the school's staffroom as the School's Management Team was informed of the proceedings. It is at this meeting that the tension between the need to include IKS in curriculum and one's ethnic background was reflected as the participating White educator questioned the authenticity of IKS. She showed some worry over the IKS from other ethnic backgrounds other that the Blacks being neglected or overlooked in policy implementation.

The purpose of the study was explained to the participants in detail and told that their responses in both the questionnaire and the semi- structured interview needed to be their own positions. This was done in order to eliminate biased responses or responses that are meant to please the researcher. The participants were also informed of the potential benefits in participating in IKS seminars.

4.2. Main study

Ten science educators of Ekurhuleni North, District 6 were chosen. These are the educators who form the administrative cluster of the district. This group consists of science educators from different backgrounds as discussed before. The difference in ethnic background was an initial desire of this research project. The group of educators participating in the study was assured that their participation in the study was not going to affect their integrity as this was by no means any way of assessing their capability of interpreting and implementing the curriculum.

The principals of the participating schools were informed of the purpose of the study and that it involved interpretation of the new curriculum and the involvement of their educators would improve their engagement with the curriculum. As there seemed to be the need to visit some of the participating schools' classes' consent from parents and learners were also sought.

4.2.1 Distribution of the Questionnaire.

The questionnaire was distributed at a cluster meeting organized by Life Science/ Physical Sciences Departments of District 6 of Ekurhuleni North. At this forum the educators were made to be aware of the nature of the research project; how they will be involved and how they are envisaged to benefit from the project. They were also informed that their participation is voluntary and may withdraw at any stage should they feel doing so.

4.2.2 Semi- Structured Interviews

The semi- structured interviews were designed to be a follow up to the responses in the questionnaire. The interviews were done after the respondents of the questionnaire had returned their responses. Three educators whose responses needed a follow up through the semi- structured interviews were identified. These were the educators who expressed that they were totally opposed to the inclusion of IKS to the school science curriculum; those who showed enthusiasm in the idea of IKS inclusion in the school curriculum and those who expressed that they had no idea what IKS is.

4.2. 3 Collaborative Seminar meeting 1

The seminar was held on a Tuesday (1 September 2009) after school hours and it lasted for forty- five minutes. The targeted group members were all present, as they had met on the same day to moderate School Based Assessment tasks. (See appendix 2). In this seminar the participating educators strategized how they would meet and also laid out a plan of the issues that would be discussed at this and other collaborative meetings. The Black science educators showed interest in investigating the nature of IKS as they claimed that this was not the first time they were confronted with IKS issues. The Black Ghanaian educator claimed that he had met IKS in textbooks and hoped to learn more about it.

Participating educators were asked to write down what then thought IKS was. Members were then requested to read their responses to the group. Responses of the members were recorded down in writing. The responses ranged from complete denial of IKS to wanting to know more about IKS and it inclusion to school science (see appendix 3)

Participating educators expressed their desire to investigate what the communities and learners they work within consider being the IKS. In this seminar participating educators agreed to define IKS as:

> "The knowledge that people of the community and living in the same era use to sustain their life and explain natural phenomena"

4.2.4 Collaborative Seminar 2

The second collaborative seminar kick started by one of the participants reading out the deliberations of the first seminar. Participants were reminded that they had tasked each other to investigate the nature of IKS that their science learners might have. It was agreed that the investigation was to be done through casual discussions with the learners of various ethnic background. Participating members reported their findings from the communities. As being the procedure the findings from the communities were the foundation of the discussions.

The participating science educators were then requested to write about their views with regards to the inclusion of IKS in science education. In this task educators were given ten minutes to express their views on the inclusion of IKS in the school curriculum after which they were asked to stick their write-ups on the board. Each view was discussed at length with the educators trying to explore the influence of each response. The write ups showed that some educators were still in confusion on what to consider as IKS. This is evidenced by such statements as:

"I do not understand anything about IKS"

being made by one participating science educator. However some educators especially the Blacks appreciated the existence of IKS, hence such statements as:

> "IKS is the knowledge of a group of people that reflects how they explain natural events and the world around them"

There are some educators who viewed the issue of IKS' inclusion in science education from the political point of view. Such statements as:

> "IKS is another way of confusing science just like Black Economic Empowerment. Science education will soon be confused"

is a testimony to this.

While the existence and authenticity was still questionable to some educators (especially the Whites) a few participants appreciate the existence of 'science' in IKS. The examples of 'science' in IKS that were given were however not of scientific background. Such examples as:

> "Water is associated with ancestors. When one is possessed by some ancestry spirits he/ she have to go to a river where he/she will meet the snake water. The person has to wrestle the snake till it is dead. The skin of the dead snake is part of the regalia that the new sangoma/ nyanga will wear."

are an indication that what educators might consider as 'science' in IKS might actually be some beliefs. It was however appreciated that the use of tree parts for medicinal purposes is part of 'science' in IKS. The indications were that while the participants were eager to uncover the 'science' in IKS this was not going to be easy. One educator noted that there was going to be difficulties in working out the IKS of a people while operating outside the communities of such people. His observation was that science educators are not the ones to come up with the IKS to integrate to school science, but rather the communities should offer their IKS to schools for consideration.

The discussions that followed indicated that the participants had laid down the foundation of exploring the 'science' in IKS. The White science educators showed interest in knowing more about IKS and the 'science' in IKS. The interest shown by the participants gave this research project some hope for continuity.

4.2.5 Collaborative Seminar 3

In this seminar educators met to identify the 'science' component of IKS. In this seminar participants were asked to list down examples of the existence of 'science' in IKS. The examples suggested were then discussed. There were many examples of 'science' in IKS that individual members of the group brought forward. One science educator gave an example of indigenous veterinary practices which involved the control of pests in animals using herbs by Ghanaian communal farmers. The herb commonly used was claimed to be Tithonia diversifolia. Interestingly one White educator claimed that the same herb is

considered to be an invader plant in Helderburg farming communities and is now used as green manure. At the mention of green manure and the use of the herbs, one Indian science educator observed that the White communities have their own form of IKS though they would hardly admit that they have. This led to a heated debate with the White educators claiming that their own IKS has been already incorporated into science and forms the bulk of what is taught in schools today. This was disputed by the rest of the participants who argued that all communities have a form of IKS that is different or somehow close to the nature of science.

The Black science educators claimed that there was 'science' in crop and animal breeding. Their observation was that the selection of seeds and breeding animals involved some form of genetics. There was debate with regards to the use of cow urine to speed germination and to protect some crops. Some participants felt that some practices were merely done out of beliefs without a substantive reason while others felt that since the practice sustained a people's life there was some scientific background behind such practices. One White science educator observed that the cow urine like all other bovine urine is acidic in nature and that acids are used in scarification which is a process that speeds seed- germination. The use of cow urine for speeding seed germination was accepted as a form of 'science' in IKS.

The areas that were looked at were medicine, textile, pottery, construction, mineral extraction and processing, food production and preservation, agriculture and environmental conservation and water sources and purification. The group agreed to the practices of the communities in the listed areas and to send their findings to one elected as secretary who will then compile the findings into one document. The document will then be sent to each participating member.

4.2.6 Lesson Observation

One of the science educators from Zimbabwe and is a participating science educator invited the group to observe his efforts in integrating IKS. The lesson was to be held at

the beginning of 2010 as the invitation was made when it was already towards the end of the year. The agreed date was set to be Friday 22nd of January 2010. All members of the group accepted the invitation as they thought it was the means of breaking through the mystery of integrating IKS to school science. Permission was sought from the authorities of the school, the parents and the learners. Members of the group were advised that the lesson observation was a generosity of a colleague as means of enlightening the group how to go about the exercise of integrating IKS in science lessons and that did not involve the critiquing of the teaching style of the educator. The group adopted and modified a PGCE (Wits) lesson observation instrument (of 2006) that they were going to use in critiquing the lesson. The designed instrument is given overleaf:

Table 2 Lesson Observation Document

IKS Integrated Lesson Observation Instrument			
Subject:	Date:		Educator:
Grade	Topic		LO AS
Lesson Objectives			
Topic Breakdown:			
Aspects of IKS to be integrated:			
Description of how IKS will be integrated:			
Educator's Activities			
Learners' Activities			
Lesson Analysis (Indicate by **X)**			
Did the educator Manage to identify the IKS that relates to the topic	Yes	Not at all	Not Clear
Did the learners Identify themselves with the IKS	Yes	Not at all	Not clear/ Could not tell
The integration of IKS resulted in	Total confusion in the flow of the lesson	Made learners understand the concepts better	There was no effect
Learners considered the aspects of IKS as	Another form of knowledge	Primitive knowledge of	They were skeptical of the

		the past	IKS
General comments about attempt of integrating IKS in the lesson			

(Adapted from Lesson Observation Form developed by Wits PGCE Department)

CHAPTER 5

RESULTS AND ANALYSIS

5.1 Introduction

This chapter deals with qualitative results of the main study. The comparison of the results across the research instruments will be made to draw conclusions. I have also attempted to analyse the changes in attitudes and acceptance of IKS as an authentic body of knowledge by the participants. The influence of seminars in bringing about these changes is also analysed.

5.2 Questionnaire Results

All the participants were requested to fill out the questionnaire individually (Appendix 1). Three participants were then selected for interview. The participants who were selected for interview had shown responses that needed to be pursued for further clarification of issues that they had raised.

The Responses for Question 1 of the Questionnaire

All the participants attempted to define IKS. Some of their responses did not acknowledge IKS as a body of knowledge that can be integrated in school science. The general definition of IKS is that it is a collection of indigenous people's beliefs, culture and customs. Two participants defined IKS as the knowledge that communities accumulated over a period of time and that this knowledge sustained communities' lives. The definitions of these two educators, however, present IKS as knowledge of the past as shown below:

> "IKS is knowledge that our forefathers used to meet their daily needs such as acquisition of food, shelter, health and protection."
> "IKS is knowledge that was employed by communities in the past to define their world. IKS facilitated the people's interaction with their environment. It allowed people of the past to make meaning of the world around them."

The other participants viewed IKS as being composed of religious beliefs, myths and taboos. One of such responses is:

> "IKS is made up of religious beliefs that are linked to explain the presence of the Supreme Being and his control of the universe, witchcraft acts, myths and the taboos that were means of facilitating living in harmony as communities."

Mbiti (1990) agrees with this assertion as he claims that the African religious beliefs are a component of indigenous knowledge. The participating educators tend to view IKS as knowledge of the past. This is an indication that while educators might be appreciating the existence of IKS there might be some resistance towards its inclusion in school science. The fact that one views IKS as being made up of religious believes might lead to some conflicting ideas as to what is to consider as 'science' component of IKS.

Responses to Question 2 of the Questionnaire

The responses to question 2 of the questionnaire reveal that the participating educators are concerned with the content part of the sciences in policy documents. Three participants claimed to have read about the need to include IKS in school science from the policy documents. The rest claimed that they have met the inclusion of IKS in school science in various textbooks that they use but have not read it from the policy documents. This is may be an indication that there is little effort made by the policy planners to help educators interpret and implement the new policies. The unawareness of educators of the requirements of the policy with regards to inclusion of IKS might be due to the fact that educators are more concerned with the examinable aspects of the curriculum in policy documents.

The participants generally feel that there are few elements of IKS that can be included in school science as they consider IKS to be the knowledge of the past. The participants claim that inclusion of IKS in school science will negatively affect their teaching as components of IKS are not examinable. Educators claim that the concerns of the Department of Education about poor science results at Matriculation level will not be solved through the inclusion of IKS in school science. This is an indication that educators

mostly teach for the examination purposes. One participant claimed the IKS is a primitive way of interpreting natural phenomena. 'Primitive' in this context was used to refer to ancient and non- scientific system of interpreting natural phenomena. Two of the participants observed that inclusion of IKS in school science will lead to confusion in the science classroom. One participant observed that the inclusion of IKS to school science will make learners identify themselves with the science content and this will improve the performance of learners in school science. The educator however could not identify the components of IKS that could be included in school science.

While the inclusion of IKS in school science is a policy requirement participants observe that the Department of Education has not supported the educators in implementing the policy. They observe that while they were given elementary training in OBE there was no mention of IKS and its inclusion to school science. This assertion was also made by Ogunniyi (2007) who observed that the delay in inclusion of IKS to school science was due to non- educator support drives by the policy makers.

The participants also observed that there have been some efforts by the textbook writers to include IKS to school science but this was only limited to traditional means of diagnosing and curing diseases. Three of the participants also claimed that efforts to include IKS in textbooks have been limited to Learning Outcome three of the National Curriculum Statements (*Applying Life Sciences in society*).

Two Black science educators who responded to the questionnaire claimed that the inclusion of IKS in school science will benefit learners in learning science while the other 3 Blacks, two Indian and three White science educators claimed that IKS in school science will create confusion in science lessons. The two Black educators who claimed that IKS will benefit the learners in science lessons went on to observe that IKS is another way of explaining phenomena and provides a foundation for science. All the respondents whose claim was that IKS will confuse science learners also went on to view IKS as being a primitive way of explaining phenomena and that IKS has no place in science classrooms.

All the respondents to the questionnaire claimed that there has been no effort of assisting them to integrate Indigenous science in school science curriculum from the policy makers. The educators who claim that they have read about the need to include IKS in school science from the NCS document observe that there is lack of elaboration on what aspects of IKS are to be included in school science curriculum and that the document does not indicate how IKS can be included to school science. One white respondent claimed that the inclusion of IKS in school science is only mentioned in few sentences in the curriculum documents which might mean that the inclusion of IKS in school science should not be taken seriously.

The responses of the educators might be revealing that while the NCS calls for the inclusion of IKS in school science, the call has lacked support from the policy makers. The inclusion of IKS to school science has not received the necessary support to see its implementation take off at schools.

5.3 Interview Results

One science educator interviewed claimed that when policy calls for the inclusion of IKS to school science it actually calls for African IKS in exclusion of other ethnic groups' IKS. This science educator also observes that the science in IKS can not be isolated from other components of IKS such as religion. This is also observed by the other educators who were interviewed. On the other hand the Black science educator interviewed observed that there is abundance of IKS that is ready to be included in school science. Both the Black and White science educators agree that the 'science' in IKS can not be separated from the other components of IKS such as religion. This observation is also shared by Abimbola, (1997) who claims that 'science' in IKS exists alongside the other forms of knowledge. The Ghanaian science educator on the other had claims that he is not clear what to consider as IKS worth including in the school science. He however supports the notion of including IKS in school science. The Indian science educator claimed that she hardly knows anything about IKS. In all the interviewed science

educators there seems to be a revelation of lack of support from the policy planners with regards to the inclusion of IKS in school science. With regards to lack of support given to educators Jansen and Christie (1999) observe that that the C2005 policy statement failed to assist teachers to approach the issue of integrating IKS with the school science. On this note the interviewed Indian science educator had this to say:

> "There are a lot of curriculum changes. The department of Education does not make any effort to help us educators understand how to cope with changes."

There seems to be political issues that occur with the notion of the inclusion of IKS in school science. The Ghanaian science educator observes that science learners ought to be liberated from the Western dominated school science while the White science educator interviewed is viewing the need to include IKS in science education as an agenda to exclude the Whites from the education system. From the interviewed Indian educator's perspective IKS has to be included in science only if it is meant to benefit the learners. The Indian educator also observes that the policy can not claim that there should be the inclusion of IKS to school science if there was no relation between IKS and school science.

The two Black science educators interviewed proclaim that there is plenty of 'science' in IKS and that the 'science' in IKS can be integrated to school science. It is interesting to note that while the two Black science educators assert that there is lot of 'science' related issues in IKS they can not readily pick up the relevant examples. On the other hand the White science educator interviewed claims that if given a choice she would not bother to integrate IKS into school science as she hardly regards it as an authentic form of science knowledge.

5.4 Questionnaire and Interview Results

The respondents of the questionnaire appreciate IKS as a body of knowledge; however they hardly consider IKS as current knowledge. Some science educators regard IKS as a set of religious beliefs; myths and some forms of taboos. This is an indication that they do not appreciate IKS as an authentic body of science knowledge. The responses to the

questionnaire indicate that there is likely to be some resistance from the participating white educators to include IKS in school science. The striking common feature in definitions of IKS given is the appreciation that IKS sustained a 'people' and that it facilitated the explanation of the natural phenomena. The other notable portion of the definition of IKS given by a number of participants is that IKS is very inclusive as it is made up of various categories of knowledge forms. This is in line with the definition of IKS as given by Aikenhead (1999) Ogunniyi (2007), and Odejobi and Aladejana (2007) who both claim that IKS is a holistic body of knowledge that include some forms of economics, culture, religion and science.

The responses to the questionnaire are also an indication that some of the participating educators are not aware of the policy requirements with regards to the inclusion of IKS in school science. There also seems to have been lack of support from the policy planners to assist educators in interpreting and implementing the policy. Their unawareness of the need to include IKS in science might create a notable challenge in identification of the IKS that is relevant to school science (Manzini, 2000). The two Black science educators who have shown enthusiasm in integrating IKS with science education did not show any signs of indicating the awareness of the IKS that could be included in school science. Their unawareness of what to IKS to include in school science is indicated by their failure to provide examples of what IKS consider to integrate into school science. I note that even when the participating educators seem to have diversified views and interpretation of the need to include IKS in school science they are willing to learn more about IKS and the need to include IKS to school science.

One respondent observes that the inclusion of IKS in school science is a means of emancipating learners from the Western dominated science. Such an assertion seems to be politically inclined. The politicisation of the need to include IKS in school science is also reflected in interview response of one White educator who observes that the need to include IKS in school science is a way of closing indigenising the science curriculum and excludes the other ethnic groups besides the Blacks. This educator goes further to suggest

that the inclusion of IKS to science education is similar to the Black Economic Empowerment.

It seems that the challenges that educators face in integrating IKS into school science are similar to those that relate to changes in the curriculum. Educators see the need to include IKS in school science as curriculum change. In this regard the inclusion of IKS in school science faces similar resistance as the changes in curriculum does. These challenges are a result of what Agrawal (2002) claims to be the failure to identify the relevant IKS by the policy makers before calling for its inclusion to school science. One might view the challenges as being due to the rejection of the new curriculum by some educators Manzini, 2000). The call to include IKS in school curriculum was packaged together with the other curriculum changes that have not been received so well by the educators (Manzini, 2000). One would realize that from the onset the participants' definitions of IKS vary. The variations might mean that what they will consider to include to school science will also vary from one individual to the other. Such variations might be due to lack of efforts to facilitate common interpretation of the policies by the policy planners and policy advisors within the South Africa's Department of Education.

At the onset of the study there seems to be varying perceptions amongst different groups on what to consider as IKS. The Black educators accept the existence of IKS and show willingness in integrating it with the school science. Interestingly the same Black educators seem not to be ready to include IKS in school science. Their uneasiness is revealed by their lack of capability of identifying the aspects of IKS that could be included in school science. The Black educators however do appreciate the existence of 'science' in IKS as one interviewed had this to say when asked about the existence of 'science' in IKS:

> "What is science? This is knowledge that explains matter, processes and reasons behind occurrence of events. Well this is my layman's definition of science. IKS does the same thing. Therefore IKS is another form of science.

On the other hand the White educator interviewed seems not to be clear whether to accept the inclusion of IKS in school science. This educator perceives the need to include IKS in

school science as only involving the Black people's IKS and the one interviewed made the following observation:

> "Dumi you are surprising me do you think when they say include IKS they mean everyone's IKS? No. They actually mean the black people's IKS**.** This is unfair the policy makers ought to have moved out of the shadow of apartheid and consider everyone as equal"**.**

Once again such a statement is an indication of the influence political views have on issues that involve the inclusion of IKS in school science. Some of the participating educators perceive the need of inclusion of IKS in school science as means of indigenising the school curriculum. The term 'indigenous' has featured a lot in political arenas such that its usage in curriculum issues is easily linked to other political utterances. These educators generally feel threatened or excluded from the call to include IKS in school science.

5.5 Seminar 1 and 2 Results

Once again at the first IKS seminar the participants had varying attitudes on the inclusion of IKS in school science. There was a claim by the White educators that the major concern was that the inclusion of IKS in school science was never explained in detail to the educators. Some of the participating educators felt that the call to include IKS in school curriculum will entail teaching about the myths and believes of African religion which includes witchcraft.

The Black educators participating in this study tended to support the idea of including IKS in science education but were however not clear on what aspects of IKS to consider relevant to school science. One educator noted that there has been some efforts by textbooks writers to include IKS in school science but that, however was limited to certain topics. It was interesting to note that even though there were mixed feeling about the inclusion of IKS in school science all the participants were willing to deliberate on IKS issues. The willingness to deliberate on IKS issues might be an indication that should the inclusion of IKS having been elaborated well enough in policy documents educators

might have developed a positive attitude towards its inclusion in school science. One might also think that the negative attitudes displayed against the inclusion of IKS in school science is due to not knowing what IKS is and what aspects of IKS are to be included in school science.

In the previous IKS seminar members had been asked to respond to the following questions as part of their home work:

1) What is your definition of IKS?

2) Is there 'science' in IKS?

3) Are your learners aware of the existence of IKS?

This being the second IKS seminar it was interesting to note that some educators were still doubtful of the existence of IKS. Such responses as:

> IKS is a primitive way of interpreting the world.IKS is another way of confusing science just like Black Economic Empowerment. Science education will soon be confused. I do not understand anything about IKS.

The responses might be an indication that the reason why some educators doubt the existence of IKS are based on one's ethnic background as the above responses are from the White science educators and one Indian educator. All the Black educators gave responses that are an indication of the acceptance of the existence of IKS. The responses from the Black educators were as follows:

- IKS is the knowledge of a group of people that reflects how they explain natural events and the world around them.
- IKS is the knowledge that people living as communities develop over a long time. IKS makes people meet their daily needs and enables them to survive.

There is a feeling that the inclusion of IKS in school science might compromise the quality of school science. The participating educators show concerns with regards to the religious component of IKS. Some educators think that IKS might lead to many

misconceptions as the ‘science’ in IKS can not be separated from myths and religious beliefs.

5.6 ‘Science’ in IKS Results

It was easy for the Black educators to accept the existence of ‘science’ in IKS but when they were asked to give some examples of what they consider to be the ‘science’ component of IKS, some of the examples that they gave were not what one would consider to be ‘science’ in IKS. The examples given are an indication that the ‘science’ component of IKS cannot be easily isolated from the rest of IKs components The range of examples given included the following:

- Amongst the African people death is an act of witchcraft.
- Lightning is an act of witchcraft.
- All forms of illnesses are caused by witchcraft.
- Rain is controlled by some special sangomas
- Being barren is a curse and its only women who are barren.
- Albinism is a curse.
- Inheritance from parents to offspring is through blood.
- Dominance and recessive is explained through strong and week blood of the parents.
- IKS science is built upon the macroscopic world and the supernatural world
- Indigenous people had a way of focusing the weather.
- The idea of genetics and inheritance is only explained through phenotypic expressions.
- The bulk of science in IKS is demonstrated by medicinal solutions to diseases.
- Environmental conservations are through taboos eg. Some certain trees are not supposed to be cut down for fencing and firewood.

The above list is an indication how IKS is confused with myths and taboos that a group of people living as a community might have developed over a long time. In the examples given some aspects of what the educators consider as IKS are indeed aspects of IKS, but that belong to religion. This might indicate that the ‘science’ in IKS might be inseperatable from religion. The failure of educators to identify ‘science’ in IKS might be an indication that educators are not yet ready to include IKS in school science.

One educator observed that while there is a lot of ‘science’ in IKS the nature of the ‘science’ in IKS can not be extracted from the entire body of IKS. He further observed

that at most a time there is no relevant scientific language that can be used to express the 'science' component of IKS. The educator claims that it is not also easy to siphon the 'science' in IKS by interviewing the custodians of the IKS but rather one need to be part of the community he or she intends to extract the 'science' in IKS from. The educator observes that most of the science in IKS is acted out than it is spoken. This observation might be implying that the 'science' in IKS has not been presented in a special scientific language that is unique from the rest of IKS components. In this regard it becomes different to represent IKS in terms of its components but rather should be taken as one holistic body of knowledge. This would mean that the definition of IKS through its components by Ogunniyi (2007b) does not imply that IKS could be broken down into its components. The definition might be serving to identify what IKS is.

On the other side White educators consider the call to include IKS in school science as means of changing the curriculum. Some participating educators are very sceptical about the call to include IKS in school science as they the call as means of eventually changing the school science. This view might be a result of the policy document not elaborating on what to consider as IKS and deliberating on how it is to be included in school science. Of interest is that even though there are conflicting views about what to consider as IKS and the 'science' in IKS the group showed more willingness to work together on IKS issues. It is as if the participants are agreeing to disagree that they finally come up with some consensus. One White educator tried to work out a compromise between school science and IKS. He suggested that the participants should appreciate that there is science that exist outside laboratories. According to him Indigenous people have a way of meeting their daily requirements through their own forms of science. The educator observes that this is science that was developed through observing repeated occurrences.

5.7 Learners and IKS

While the Black educators appreciate the existence of IKS and are happy to include IKS in school science they claim that their learners do not want to associate themselves with IKS. It is a case where learners define IKS as knowledge of the Stone Age people. This

indicates that the identification of IKS as a primitive body of knowledge of the past as being held by the White educators is also shared by the learners across the various ethnic groups. All the educators observe that urbanization has resulted in learners wanting to associate with what they view as modern at the expense of their own forms of knowledge. One Black educator observed that while the learners in denial of possessing IKS if you engage them in some discussions some aspects of IKS tend to be reflected. This supports the notion raised by one Black educator earlier who claimed that a community would not readily pour out its IKS but would demonstrate it as they perform their daily chores.

The deliberations at the second seminar reflected the uneasiness of the educators with regards to including IKS in science curriculum. While some sections of the participants demonstrate willingness to integrate IKS in school science their contributions show lack understanding in terms of what components of IKS to consider including in school science.

5.8 Results from Seminar 3

The theme for the Seminar 3 was to unpack the 'science' in IKS, making a comparison of 'science' in IKS and working out the relevance of 'science' in IKS with school science. The participating educators picked up examples of 'science' in IKS as related to food production and preservation, cure and prevention of diseases. In food production educators noted that while in the western science seed production is under the influence of the science of genetics in IKS it is controlled by the phenotype expressed in the seeds leads to seed selection. The educators realised that the 'science' in IKS functions at macro level whereas the Western science functions at both micro and macro level. Seminar 3 managed to close the differences that educators of different ethnic backgrounds had in other seminars as the White educators were seen putting some efforts in identifying the 'science' in IKS. One White educator brought along an example of 'science' in IKS in the form of a weed that is being used as green manure by some White commercial farmers. Of interest to this contribution was that while one White educator had the notion that IKS is some form of primitive knowledge of the indigenous people,

this contribution was a sign of attitude change. The rest of the participating educators also showed some attitude change as they made correlation between the drying of meat using salt with such school science concepts such as osmosis.

The continuation of the search of 'science' in IKS led the participants to compile a table as shown below:

Table 3 Document Compiled for 'science' in IKS

'Science' in IKS	Its relation to Science		Relevance to school science
	Examples	Relation to modern science	
Medicine	Mosquito Fern – (*Azolla caroliniana*) Use of plant parts (roots, barks and leaves) to prepare medicines	The smell of the plant resembles that of eucalyptus which is used to manufacture eucalyptus oil.	Gaseous Exchange- Respiratory Infections NCS Grade 10
Textile	Weaving and use of tree extracts to make dies	Mixing of chemicals as in chemistry	Matter and Materials,& Chemical Change NCS- Physical Science FET Band
Pottery	Use of finances in burning posts	Thermal control	NCS- Physical Sciences-: Effects of temperature on chemical change and reaction
Construction			
Mineral extraction and processing	Iron smelting in making weapons	Metallurgy	Chemical Reactions NCS Physical Science FET Band
Food production and preservation	Selection of seeds for the next harvest, selection of bull from calves,	Genetics- phenotype. Anatomy of Reproduction on castration	NCS life Sciences- Tissues, Cells and Molecular Studies
Agriculture and environmental conservation	-Crop rotation Mixed farming eg maize crop with legumes- - indigenous indicators to determine cropping season pr - Indigenous ways to propagate plants; seed storage and processing (drying, threshing, cleaning, and grading); preparation and care; farming and cropping systems	Nitrogen Cycle- Nitrogen fixing bacteria.	NCS Life Sciences: Environmental studies

	crop harvesting and storage and food processing. and marketing; and pest-management systems and plant-protection methods;		
Water sources and purification	Uses of sunlight purify water.	Effects of heat energy from the sun on pathogens	NCS Natural Sciences: Light energy
Reproduction and fertility	Indigenous methods of pregnancy prevention using menstrual cycle. Enhancing sexuality using herbs		Reproduction- NCS Life Sciences Grade 12
Origin of humans	This was considered to be on religion side		
Fire	The discovery of fire is claimed to be related to force to friction	Law of conservation of energy. Energy converted due to friction	NCS GET Natural sciences-Energy

Group members felt that extracting 'science' from IKS is very difficult. One Black educator suggested that 'science' in IKS should not be isolated from the IKS as this will tend to change the nature of IKS. He observed that IKS should be treated in its holistic nature and not as fragments. One White educator who had earlier rejected the existence of 'science' in IKS suggested that the IKS to be included in school science should not be identified by educators as most of science educators are not aware of the IKS of the learners. The White educator suggested that the issue of IKS was rather a community issue and not an educators' task. This was disputed by a Black educator who claimed that the struggle that they experienced in identifying the 'science' in IKS is that the group embarked on this task out of the communities that they operate within. One of the two Indian educators participating in the seminar observed that schools should not be isolated from the communities. She suggested that the elders of the community are the custodians of IKS and that may be in future we should invite such people to our meetings.

The major findings from the third seminar were that the components of IKS can not easily stand separate from each other as the definition of IKS given by Ogunniyi (2007)

seemingly suggest. The other notable outcome from the seminar was that educators are not yet ready to identify the IKS that is relevant for integrating with school science and that this task could be best done through the involvement of the community.

5.9 Lesson Observation Results

The observed lesson was an extension of a seminar discussion where one educator had shown confidence and readiness in integrating IKS with school science. The observed was a Life Sciences and the topic was Genetics. The educator asked learners about how communities describe the passing on of traits from parents to offspring. Learners gave varying responses such as:

- Traits are passed on to the offspring in the blood
- The parent whose blood is strong passes on the traits to the offspring
- The first born in the family has to have more of father's traits.

The educator proceeded with the lesson by asking learners to further clarify by what they call 'blood' and most of the learners indicated that the term blood in this instance relates to gametes and therefore by strong blood they actually mean the sperm and the ovum. The educator's approach was that of probing and brain storming leading his learners to explain the terminology further till when he blended the knowledge that the learners reflected with the genetic concepts. He explained that since genes are at micro level it becomes difficult for communities to relate to them as they do not have access to the machinery that will expose them to the micro- level of science.

Earlier on educators had indicated that their learners do not want to associate with IKS and are in denial that it is an authentic body of knowledge. The lesson observed contradicted this as learners were revealing some knowledge of IKS. Some educators observing the lesson agreed that the educator managed to identify the IKS to blend with school science while others thought that the form of IKS identified was likely to lead to misconception especially with the use of the term 'blood' to represent genes.

Chapter 6

Discussion and Conclusion

Introduction

This chapter discusses the results and draws conclusions from the analysed results. The chapter seeks to explore how the research questions have been answered by the study. The efforts of the educators trying to come up with IKS relevant to school science individually and as a group are discussed. The chapter also discusses the results in reference to the set theoretical framework and the research method used.

6.1 Answering Research Questions

1. **What specific IKS content that could be included in school science, are science teachers aware of?**

The participating educators came up with meaningful definitions of IKS but initially failed individually to identify the specific IKS content that could be integrated with school science. The individuals tried to give examples of 'science' in IKS but the examples given were far from being science. The participating educators resolved this by agreeing to claim that the 'science' in IKS could not be treated separately from other IKS components such as religion. This view is held by Mbiti (1990) who observed that components of IKS could not be treated as separate entities independent from each other. As the group worked together to solicit for the 'science' in IKS they were able to come up with relevant examples of 'science' in IKS. The examples were mainly linked to the Life Sciences Curriculum. The participants also managed to produce a working document of relevant 'science' in IKS that is directly linked to the Curriculum. There seems to be some limitations in integrating IKS with school science

2. **What are teachers' attitudes towards the inclusion of IKS into school science?**

The results of this research indicate that the participating educators' attitudes towards the inclusion of IKS vary. One group (mostly Black educators) is willing to include IKS in school and hope that the inclusion of IKS in school science is reconciliation between their culture and school science while the other group (mainly Whites and Indians) feels threatened as they consider the move as changing the face of the school science. The participating educators were able to voice concerns and discussed different prospects with regard to the need to integrate IKS in school science. This is a reflection of Manzini (2000) who observes that educators do not think critically about the concepts, aims, approaches, and resources the inclusion of IKS in science curriculum calls for. There was existence of dividing racial lines as initially the views of Blacks and Whites with regards to the infusion of IKS in school science tended to contradict, however the group was so small to reflect more on this contradiction. The possible racial divide on IKS issues could be further investigated. Of special note is that when the educators were engaged in collaborative seminars there developed some attitudinal changes as the group developed similar conceptions towards the need to include IKS in school science. The attitude changes were shown by the group striving to come up with relevant IKS to include in school science.

6.2 IKS Relevant to School Science

While the participating educators brought some examples of IKS that they thought is relevant to school science their general feeling was that there are some limitations in the inclusion of IKS in school science. The observations made by the participating educators contradicts Balasubramanian (2004) who argues that indigenous knowledge is the technical, social, organizational and cultural collective memory of human responses to the complexities of life. In this regard the educators could not explore in detail the 'technical aspect of IKS. The educators noted that few school science themes can

accommodate the ‘science’ in IKS and most of these are of biological nature. The limitations of IKS that may be included in school science might be due to no- exploration of learners’ underlying ontologies (Odora Hoppers, 2002). The educators noted that while the NCS calls for the inclusion of IKS in school science the external examinations have not accommodated the IKS. This raises some fear as the educators felt that the inclusion of IKS in school science might not assist the learners in passing examinations.

The educators also noted that the language of IKS might bring about misconceptions in school science. The demonstrational lesson that was observed brought about the misconception issue. The learners claimed that according to their communal knowledge traits are passed on from the parents to the offspring through blood. The educators observed that this will confuse blood with genes. The educators noted that the language of IKS makes IKS not to be ready to be included in school science. It was noted that the language of IKS is not different from the everyday language of the communities. This observation is in line with what the participants noted earlier that the ‘science, in IKS can not be separated from the other components of IKS.

6.3 The Collaborative Seminars

As noted earlier educators who were initially confident that IKS could be included in IKS were not readily able to come up with relevant IKS to include in school science. The other participating educators thought that IKS was not relevant for school science. As educators participated in collaborative seminars they managed to bring about examples of IKS that could be included in school science. The educators who were initially claiming that IKS can not be included in school science ended up appreciating that there could be IKS that could be included in school science. The educators suggested that identification of IKS that is relevant to school science could be made easier through engaging the custodians of IKS in such seminars. This indicates the power of collaborative approach in assisting the educators to interpret and implement the policy related issues. A similar observation was made by Ogunniyi and Hewson (2008) who noted that as educators engage in argumentation perceptions of curriculum related issues change.

6.4 Results and the Theoretical Framework

The Community of Practice and the Social Constructivism approach were the theoretical frameworks that guided this research project. Through the use of the collaborative approach a community of educators was created. Some of the participating educators initially had no idea of what IKS is. There is a group of participants who was denying the value that IKS has to science education and a few educators had an idea of what IKS is and appreciated its value in the science classroom. Through participating in the organised seminars all the educators acquired a positive attitude with regards to the inclusion of IKS in science curriculum. The educators through the collaborative approach worked out some meaningful examples of IKS that could be included in school science. The participating educators were prepared to consider including 'science' in IKS in school science even though finding suitable examples still proved to difficult for the whole group.

6.5 Limitations of the Research

The major limitation in this study was the size of the research population. Ten educators from one province and one district can not make one make general conclusions on such a study. The other limitation was that of time frame. This research was limited to a short time frame due to the nature of the course study. As such no tangible conclusions could be drawn from such a study.

6.6 Conclusions

The call to include IKS in school science was not supported through the provision of adequate training by the policy makers. This has resulted in educators making speculations in what to consider as relevant IKS to include in school science. While some educators appreciated the readiness of IKS to be included in the school science they are

not capable to come up with relevant IKS which would be useful in the classroom situation on their own. Some political issues arose with the call to include IKS in school science. This relates to the usage of the term ‘indigenous’ as some ethnic groups feel excluded.

The greater part of the research revealed the power of Collaborative Seminars in assisting educators to appreciate IKS as a body of knowledge that can be included in school science. Collaborative Seminar approach also assisted educators in building up a resource that can guide them in integrating IKS with school science.

6.7 Directive for Further Research

Further research could be carried out with a larger population size and in different contexts. This will make the results obtained to be authentic. Issues that rose in this research such as the perceptions educators from different ethnic backgrounds towards the inclusion of IKS in school science need to be investigated further. The other issue that needs further investigation is the inclusion of the custodians of IKS in identifying relevant IKS to include in school science.

Appendix 1

Questionnaire

Dear Science Teacher.

The questionnaire that you are kindly requested to take part is an instrument that is used in a Msc (Science Education) programme which is being conducted under the supervision and guidance of the University of the Witwatersrand.

You are kindly requested to fill this questionnaire. It is designed to determine the educators' interpretation of IKS that can be integrated in school science. It is also designed to investigate the science educators' attitudes towards integrating IKS in school science. Your views will be solely used for this research and will and will be treated with great confidentiality.

Through the design of this research you will be invited to attend seminars that are designed to help educators come up with packages of IKS that are relevant for integration in school science lessons. At these forums you will be able to built lesson programs that include IKS in school science.

It is highly recommended that you take part in such an activity that seeks to make your work as a science teacher an easy task. There is no doubt that you, your school and your science learners will benefit from this research project.

Let us give it a start by going through the questionnaire below. You are requested to give your genuine opinion in each item.

Questionnaire

i. Gender……
ii. Race……
iii. Type of school teaching at……
Eg former model C, Township School, Independent School
iv. Years of experience as a science educator……..

1. What is your definition of Indigenous Knowledge Systems?.....
.....
.....
.....

.....
.....

2. Curriculum 2005 requires educators to integrate IKS in science curriculum. Do you think that this is a move in the right direction? YES/ NO.
    a. If YES why do you say so?.....
    .....
    .....
    .....
    .....
    .....
    b. If NO give reasons of saying so……
    ……
    ……
    ……
    ……
3. Which components of IKS do you think are worth integrating with the school science?.....
    .....
    .....
    .....
    .....
4. What are your reasons of selecting the above components of IKS?.....
    .....
    .....
    .....
    .....
5. In what way are Science Textbooks assisting you in integrating IKS in science school curriculum?……
    ……
    ……
    ……
    ……
6. Which of the following do you think would result from integrating IKS in school science? (Cross out your choice by putting **X)**
    A. IKS may confuse learners learning school science
    B. IKS provides a platform for learning science
    C. The two types of knowledge (Science and IKS) are not related therefore integrating them will be meaningless.

7. In your opinion IKS is
    A. Primitive way of explaining phenomena and has no place in science classrooms.

B. IKS has no place in the science classroom.
C. Is another way of explaining phenomena and provides a foundation for science.

8. From your above response do you think there is need to include IKS in school science lessons? Yes/ No
9. Explain the reasons for the response given in the above question……
……
……
……
……
……

10. Have you ever received any form of support on integrating IKS in school science? (YES/ NO)
11. If (YES), how did it assist you in matters that relate to IKS and science learning (please explain)……
……
……
……
……
……
12. If (NO) please explain how you have dealt with IKS integration in science curriculum……
……
……
……
……
Any other comments you wish to make……
……
……
……
……
……
……
……

Thank you for taking part in this exercise.

Appendix 2

Demographic Information of the Research Participant

NB. Participants' names are pseudo names that hey preferred to use during the course of the study

Mrs Wassermans

Mrs Wassermans is an Afrikaans science educator who is above fity- five years of age. She holds a Bachelor of Education degree and Further Diploma in Education from Rand Afrikaans University. She has taught Life Sciences (Biology) in Model 'C' schools for more than ten years. She continues to teach Life Sciences and Natural at former model 'C' up to this date. She enjoys the experience of having taught the Sciences during apartheid and at post- apartheid era. She has been a Cluster Leader for Life Sciences where her duties involve being the supervisor at School Based Assessment moderation. Mrs Wassermans is a Head of Department for Sciences at her school.

Mrs Pretorius

Mrs Pretorius (above 50 years of age) is an Afrikaans science educator who holds a Bsc degree (Rand Afrikaans University) and a Diploma in Education from UNISA. Pretorius has taught Physical and Life Sciences during apartheid and post- apartheid era. She has taught the sciences at townships and model 'C' schools for the past 17 years. Mrs Pretorius has been involved in curriculum change committee activities where she served at train the educator programme during the introduction of Outcomes Based Education (OBE).

Mr Tuckos

Mr Tuckos holds a British citizenship and has lived in Greece and Cyprus. He is above forty- five years in age and holds a Bsc degree (from a university in UK) and a PGCE from University of Stellenbosch. He has taught Physical and Life Sciences in Independent Schools and various Gauteng Department of Education schools for the past 15 years. He is currently the Head of Department for Sciences at his current school.

Mrs Pilay

Mrs Pilay is an Indian Science educator whose age is between 30- and 35. She holds an Advanced Cerificate in Education from UNISA, Bachelor of Education Honours from University of Johannesburg and is currently reading Masters in Education at Wits. She has taught Life Sciences and Physical Sciences at former model 'C' schools for the past 10 years. She is currently the acting Head of Department at her current school. Mrs Pilay is currently researching on "Teaching Evolution to a Grade 10 Life Sciences class"

Mrs Naidoo

Mrs Naidoo teaches Life Sciences at a township school. She has taught both Physical sciences and Life Sciences at township and former model 'C' schools for the past 12 years. Mrs Naidoo is 48years of age and holds a Bachelor of Education degree from the University of KwaZulu Natal.

Mr Mammata

Mr Mammata holds a Ghanaian citizenship and has taught sciences in various countries that include Cuba and UK. He is 54 years in age and has taught both Physical and Life Sciences in South African schools for the past 5 years. Mr Mammata holds a Bsc degree from Cuba and a PGCE from Hull University in UK. He is currently involved with Lab Track a SAASTA science organization based in Observatory in Johannesburg where he serves as a facilitator.

Richard Ndlovu

Richard Ndlovu is a Science Educator who comes from Zimbabwe. He is 40 years old. Mr Ndlovu holds a Diploma in Education and Bachelor of Education awarded by the University of Zimbabwe. He taught Sciences for 8 years in Zimbabwe and has taught Life Sciences, Physical Sciences and Mathematics for 6 years in South Africa. Mr Ndlovu is currently teaching at a former model 'C' school.

Mr Kucherera

Mr Kucherera is a Zimbabwean who has taught Life Sciences for the past 7 years in South Africa. Before then he had taught General Sciences for 12 years and Cambridge Advanced Level for 3 years in Zimbabwe. Mr Kucherera holds a Bsc and Graduate Certificate in Education from Zimbabwe. Mr Kucherera is 42 years old and teaches at a Roman Catholic school.

Mrs Tsatsi

Mrs Tsatsi is a South African science educator who teaches Life Sciences at a township school. Tsatsi is 32years old and holds an Advanced Certificate in Education (UNISA). Tsatsi has taught Life Sciences (Biology) for the past 10 years at the same school.

Mrs Mboxela

Mrs Mboxela was born in 1959 and holds a bachelor of Education (Honours) degree from UNISA. She has taught Life Sciences in the same school for the past 15 years. Previously she taught at schools in KwaZulu Natal for 6 years. Mboxela is a Head of Department for Life Sciences at her current school. Mrs Mboxela is also a respondent to a questionnaire that is on IKS being administered by University of Johannesburg research team.

Appendix 3

IKS Collaborative Meeting 1, 2 and 3

Date: 1 September 2009
Time: 1430hrs- 1530hrs
Venue: Dawnview High
Present: Mrs S. Tsatsi, Mrs Wassermans, Mrs Pretorius, Mr D Moyo, Mr R. Ndlovu, Mrs S Pillay, Mrs Mboxela, Mr F Tuckkos, Mr S Mammata, Mrs O Naidoo and Mr G. Kucherera.

The above educators belong to a cluster under Ekurhuleni North. They occasional meet to moderate School based assessment and have accepted invitation to participate in IKS related seminars which are part of a Msc research project

Agenda

- Introductions
- Spelling out the purpose of the proposed seminars
- Group participation in the research project (consent letters)
- Questionnaires and interviews
- IKS issues

All the members of the group agreed to participate in the research project that is being conducted by Mr Dumi Moyo. It was realised that though it is his personal research project towards Msc degree the participants will benefit a lot from it. Mrs Wassermans noted that some clusters of schools organise breakfast meetings over weekends where subject teachers share worksheets and discuss matters of interest to their subjects, it was accepted that this seminar was the beginning of such regular meetings, Principals of the schools will be request to support the idea.
Members agreed that they will:

- Respond to the questionnaire that Dumi will distribute.
- Participate in the other activities of the research project without bias.
- Continue to work together on curriculum related issues.
- Work out means of establishing a newsletter that will be distributed to members and those with interest to the group's activities

.

IKS Issues

Dumi drew the group's attention to the issues of IKS as being mentioned by the NCS 2008 Life Sciences Subject Statements. The responses from the members were as follows:

Mrs Pretorius

It is worrying that the department of Education will just through issues to schools without bothering to explain to us. Now what is this Indigenous Knowledge System about? Where do we find it and what do we do with it.

Mr Mammata

IKS is now featuring in textbooks. Long time ago in Ghana where I come from there was a talk about the knowledge that learners bring from home. We discovered that most of it contributed to the misconceptions that the children have. May be it will work the other way in South Africa.

Mr Moyo

May be we should start by working out what IKS is. From there then we will select those aspects of it that we can use in our science classrooms.

Mrs Naidoo

Dumi tell us more about it. You seem to have an idea. Some of us do not bother to read the policy documents. We only pick what matters for the examination purposes. May be we are wrong.

Mr Moyo

I am not a member of this group to tell everyone what I think I know, I am here because I also want to learn from everyone. Now there is a challenge. We have to work out our own understanding of IKS.

Mr Ndlovu

People this is straight forward we as people have our own ways of knowing. Our forefathers did not open books to know. There were no schools but they knew things. May be this is what is called IKS. The problem real is about giving names to what is already there. It is the name that confuses us.

Mrs Wassermans

Are we saying science can be mixed with traditional beliefs? This is not serious, how can we teach about witchcraft and people flying using brooms. Have you ever read Daily Sun stories? I personally can't be part of this. This means that I will have to withdraw my membership.

Mr Moyo

We need you Mrs Wassermans. Those ideas that you have will give us a good start of understanding issues around IKS. I propose that as it seems that today we have no time we write about what we think IKS is. Next time as we meet we will begin by sharing our definitions. From there then we will have our own common definition of IKS.

Mr Tuckkos

This sounds interesting can Dumi then phone us as a means of reminder.

Members of the group agreed to e mail Dumi their responses to the questionaire

IKS Meeting 2

14 September 2009

Venue: Englendale High

Time: 1600hrs- 1730hrs
Present: : Mrs S. Tsatsi, Mrs Wassermans, Mrs Pretorius, Mr D Moyo, Mr R. Ndlovu, Mrs S Pillay, Mrs Mboxela, Mr F Tuckkos, Mr S Mammata, Mrs O Naidoo and Mr G. Kucherera.

Agenda

1. Reflection on the previous meeting
2. Members read out their homework
3. Comments on each individual's homework.
4. Tasks for the next meeting

Reflection (by Dumi Moyo)

> The general feeling amongst the members is that IKS is in existence. It exists in an unrefined form. IKS needs to be developed before it is incorporated in school science. It is difficult to isolate IKS from the entire African culture. Each ethnic group has its IKS therefore we should consider the Indian IKS, Western IKS, African IKS and the Afrikaans IKS. There seems to be confusion over IKS, myths and religion. The Afrikaans White educators seem to be skeptical about the idea of including IKS in school curriculum. A Black African Zimbabwean educator is positive about the integration of IKS in the science curriculum. All the members of the group are showing interest in participating in the

seminars. The interest is generated by the want to probe the nature of IKS and its worthiness to the school science

Report back by members

Members were requested by me to write what they consider IKS to be.

The following are the responses from the group:

- IKS is the way an ethnic group living in the same environment interpret natural phenomena.
- IKS is a product of a people's worldview. It is a way of making sense of natural events and a means of sustaining life.
- IKS is a collection of how people understand the world around them. IKS cannot be separated from beliefs, customs and other cultural components.
- IKS is a primitive way of interpreting the world.

- IKS is ancient knowledge of the people. It is the knowledge that was developed through observation and interacting with the world.
- I do not understand anything about IKS.

- IKS is the knowledge of a group of people that reflects how they explain natural events and the world around them.

- IKS is another way of confusing science just like Black Economic Empowerment. Science education will soon be confused.

- IKS is the knowledge that people living as communities develop over a long time. IKS makes people meet their daily needs and enables them to survive.

At the previous meeting members of the group were asked to respond to the following questions at home:

1) Is there science in IKS?
2) What do you consider to be examples of 'science' in IKS?
3) Are your learners aware of IKS/

Is there science in IKS? (Mrs Pretorius)

IKS has science. The science in IKS is developed through the means of wanting to define and explain the phenomena. Indigenous people developed skills for survival. Those skilled are a testimony that there is scientific knowledge in IKS. Most of the science in IKS is mixed with some religious beliefs and other

customs. However we should not forget that IKS is still that primitive way of interpreting the natural phenomena.

Examples of science in IKS

- Indigenous people had a way of focusing the weather.
- The idea of genetics and inheritance is only explained through phenotypic expressions.
- Most of science in IKS is demonstrated by medicinal solutions to diseases.
- Diseases are caused by acts of witchcrafts (beliefs)
- Environmental conservations are through taboos eg. Some certain trees are not supposed to be cut down for fencing and firewood.
- Food preservation techniques eg adding salt to meet to dry.

Are your learners aware of the existence IKS?

My grade 10- 12 Life Sciences classes do not want to admit that they are in possession of IKS. When they were asked however when asked about how they interpret given natural phenomena there were elements of IKS in their explanations.

Most of my colleagues indicate that there is this thing IKS. I have since started to read about what it is. Yes there seems to be IKS. IKS is a body of knowledge that is developed by a group of people over a long time. Most of it is knowledge based over observations than facts. It is difficult to draw a line between knowledge in IKS and beliefs. The science of today consists of theories, facts, principles and so forth. We must be very careful how we handle the issues around IKS. Are there theories, facts and the likes in IKS? Let us go out and investigate the nature of IKS that surrounds us. It is then that we can come back and to talk about its integration in the school science.

Discussion

The discussions that followed the presentation by NC centered on the way the presenter has confidence on the existence of IKS. Afrikaans White educators felt that there should be an indication that IKS belonged to the Stone Age generation and that modern people have no IKS. This was disputed by a Ghanaian Black educator who argued that as long as people live as communities they continue to develop their knowledge system centered on how they continue. An Indian science educator suggested that they should be tolerance of various forms of knowledges from different ethnic groups. She described how the knowledge of the Indian people was looked down upon due to the effects of colonization but the Indian people have up to this day managed to blend modern science with their IK

Is there science in IKS? (Mr Kucherera)

In response to his question one would look back at what we consider to be science today.

The knowledge that led the users to develop some form of technology indicates the existence of science. Technology is through some form of science. It then follows that there is science in IKS. While we appreciate the existence of 'science' in IKS I am not sure whether there is an approach on how to include it in school science so that IKS will not be seen as changing the science that we teach.

Examples of science in IKS

- Amongst the African people death is an act of witchcraft.
- Lightning is an act of witchcraft.
- All forms of illnesses are caused by witchcraft.
- Rain is controlled by some special sangomas
- Being barren is a curse and its only women who are barren.
- Albinism is a curse.
- Inheritance from parents to offspring is through blood.
- Dominance and recessive ness is explained through strong and week blood of the parents.
- IKS science is built upon the macroscopic world.

Discussion

It was felt that what was given as examples of 'science' in IKS were various forms of misconceptions that might be a problem to undo in a science lesson. Other members of the group noted that if the examples that are given above are taken to be the 'science' nature of IKs then there is no science in IKS but a collection of myths and religious beliefs.

Are your learners aware of IKS?

My school is a typical multi- racial former model C school. The school' enrolment has a fair distribution of white and black learners. There is quite a good number of Indians, Portuguese and some other ethnic minority background learners. Amongst the blacks we have all tribes from South Africa, a few from Zimbabwe, DRC and Malawi. The whites are a mixture of the British, Afrikaans and Americans. All these ethnic backgrounds are emerging from different worldviews. Their IKS might be different. The black students in my science classrooms are the ones who assisted me to compile the list of the examples of science in IKS.

IKS is a way of knowing for indigenous people. We as African people have a way of knowing what takes place around us. Most of our knowledge relates to our need to sustain life. We have knowledge about the resources that are directly linked to our survival. This knowledge is passed on from generation to generation orally. Our IKS

can not be separated from religion and culture. When you talk of IKS in the African context you must not separate knowledge from other cultural components that include religion. Part of the knowledge that has a scientific background is passed on though ancestry powers. Ancestors occupy a big portion of African religion. In our African systems certain things have some importance such as:

1. Water- water has some cleansing effects. When one feels like a bad spell has been cast against his name he is referred to go for cleansing using sea water.
2. Water has some healing powers.
3. Water is associated with ancestors. When one is possessed by some ancestry spirits he/ she have to go to a river where he/she will meet the water snake. The person has to wrestle the snake till it is dead. The skin of the dead snake is part of the regalia that the new sangoma/ nyanga will wear.
4. Water is mixed up with most of the herbs in medicine preparation

Animals/ Reptiles/ Birds

1) Animals are a source of livelihood in that there are used as sources of food.
2) Some animal parts are used for medicinal purposes.
3) Some animals have a linkage with the ancestors eg the wildebeest, snakes and pangolin.
4) There are birds which are associated with rain making ceremonies, such as the fish eagle.

The sun/ moon and the stars

The stars, moon and the sun are considered to be central in controlling the climatic conditions of a place. The appearance and position of the moon determines the type of the weather that a particular place will experience. If the moon is surrounded by gold like band (umkhumbi) it is a signal of plenty of rains. The quarter moon is seemingly tilted many diseases and epidemics are likely to be experienced.

Discussion

The general feeling was that what has been reported on needed further clarification as it represents a culture of a people. The group felt that the presenter has given them a platform to investigate the nature of IKS from which they will pull out the existing 'science' in IKS. Generally this presentation brought about a turning point as the White Afrikaans educator made this comment:

> "It is surprising to note that there is someone like you who still posses such type of knowledge. May this is an awakening call for all of us to begin to want to know what our colleagues have to offer. I am beginning to have interest in this monster-IKS. Where can we gather more knowledge? May be our Black colleagues must take the lead.

Laughter. The members of the groups reminded the speaker that IKS was not only a black issue as every ethnic group has some form of IKS

Is there science in IKS?

In order for to appreciate the existence of science in IKS we have to understand what science is. Science's definition has been limited to what can be tested in laboratories. We have to appreciate that there is science that exist outside laboratories. Indigenous people have a way of meeting their daily requirements through their own forms of science. This is science that was developed through observing repeated occurrences. The IKS science does not exist outside the broad IKS. It cannot be separated from the other forms of IKS. This is a case where components of IKS can not exist in isolation. When you intend to consider the science in IKS then you have to view it in combination with the other aspects like religion, customs and culture. The bringing in of science in IKS can change the curriculum and if this is brought about without care it might yield negative results. Uncalculated introduction of IKS can result in confusion as the science that we teach is an examinable subject. One other danger that can be experienced through the introduction of IKS is that its religious relationship can create lots of misconception amongst our science learners. How can we examine the IKS related issues of science? May be the IKS does not affect the subject content but the methodology part

Examples of science in IKS

Most of the examples of IKS are drawn from traditional medicines and the diseases that they remedy. Indigenous people claim that diabetes is a sugar disease. Somehow there is relationship with the scientific definition. Asthma is described as a chest disease. To them asthma is referred to as ufuba. This is the same as TB. So TB and asthma are almost one and the same thing the difference being that they appreciate that asthma in incurable while TB can be cured through some herbs.

Are your learners aware of IKS?

We are living in an urban situation where culture is falling into pieces. Learners do not want to be associated with issues that they think are primitive. To most of our learners modernization means a complete departure to the past. Our learners might be in denial that they are in possession of IKS. In order for you to uncover the IKS that learners have you have to listen to their talk in the science classroom, their general talk and when they interact with friends. This goes further to mean that if you ask a community of people about their IKS they might not be willing and open to disclose it. When you observe their

behavior and their doings is when you will start to appreciate that they are in possession of IKS.

Is there science in IKS?

First we spoke about the IKS in our science lessons now we speak of IKS having science. Next we will call for the change of the science that we teach. May be the route that we are already following is taking us to change the face of the science that we teach. Well this will be very interesting. It will be a change that has involved us as science educators. This will make me participate more in these activities. I can now see the direction. All that which we are engaged in is trying to localize the science that we teach. So we are sort of leading to indigenization of the classroom science. As long as the move to indigenous the science that we teach will not jeopardize the quality of the learners that we produce, this will be an interesting move.

Examples of science in IKS

This is where I have a problem. I am an Afrikaans speaking science educator. I teach at a former model C school. The school's enrolment has a fair representation of Blacks, Coloureds and a few Indians. At such a situation the Black learners tend to adopt the culture of the other ethnic groups especially that of the whites. It is difficult in such a situation to pick up the IKS that the learners have. May be if we could devise means of siphoning the IKS from learners without them being aware the better.

Are your learners aware of IKS?

At my school there is no specific 'indigenous' as we are just a mixture of everything. If by IKS we mean African Indigenous Knowledge Systems then let there be specificity. Otherwise we ask- whose IKS that we talk about. Do you believe guys that every ethnic group has its form of IKS? No matter how modernized the ethnic group might seem to be it has its own form of IKS. In my school I would say no learner has explicitly come out to show case his/ her IKS.

Is there science in IKS?

Working at a former model C school affects one's access to the available IKS. Learners tend to easily adopt some other people's way of living. You will find that learners of these days easily develop their own way of interpreting natural phenomena. Their interpretation of natural phenomena is influenced by many factors one of which is globalization. While this is like so, according to our discussions there ought to be science in IKS. The problem is if the holders of the IKS are not so open on what they have how then can we extract the science in their IKS. It would only be logic for us to investigate

beyond questioning our learners about the IKS that they have. From the IKS that they have we can then try to extract the science that is in IKS. The other problem might be that indigenous issues are crumbled up together like that. You can not separate knowledge from myths, beliefs and the so called science in IKS.

Examples of science in IKS

I can not give out the examples of science in IKS from my school. All what I can say is that issues of herbal medicines and diseases are the only examples that I read from one of the Life sciences textbooks. Even if our learners are not admitting that they have a form of IKS they believe in witchcraft, existence of ancestry spirits and that there is witchcraft related cause to death. I will like to believe that our learners are making efforts to move away from the African epistemology. This move is being speeded up by the exposure to the scientific explanation of the natural phenomena. It is also being facilitated by the various forms of mass media. In other words the learners' IKS is being displaced by the globalization trends.

Are your learners aware of IKS?

My learners do not want to admit that they possess IKS. I think that they view anything related to IKS as primitive. The problem with IKS is that it is associated with primitive Stone Age ways of knowing. Even us as educators did not consider IKS as alternative ways of knowing. At our firs meeting we thought of IKS as knowledge that the ancient people survived on. It is now after our formal and informal meetings that we accept that IKS exist even today, that it is an alternative means of explaining natural phenomena.

Is there science in IKS?

There is a lot of science in IKS. It is difficult to appreciate the existence of science in IKS because our way of knowing is not separated from such aspects as religion, customs and some cultural practices. What I am trying to put across is that the science in IKS can not stand independent of the other aspects of IKS like culture and religion. The science in IKS at times is not expressed through words but in acted out by the owners as they strive to eek a living. I will give you an example of how people focus the weather. They observe the atmosphere. Within the atmosphere there exist some indicators of what the weather is mostly likely to be like. Indigenous people through observation have come to understand those indicators. I want to move away from giving out examples of traditional medicines as science in IKS. I am a Zimbabwean national and in Zimbabwe we largely rely on our indigenous science (allow me to use the term indigenous science, for this is what I think science in IKS should be called). We should be prepared for the changes in school science due to the inclusion of IKS. I personally support those changes. After all, whose science should be allowed to dominate our classrooms? We are in Africa, let us not forget.

Examples of science in IKS

I have given you one example, that of weather interpretation. In Zimbabwe (the Ndebele tribe with is part of the Nguni which is dominant in SA) we do a lot of crop and cattle breeding. This is done through the process of selection. Selection is through observation. Observation is an important skill ion selection. Seeds for the next cropping season are selected from the harvest. It is a scientific skill that the indigenous people use to select the favourable seed. This also happens with animal breeding.

The other very interesting example of science in IKS involved the sperm donation to a family male member who is in need of children. The sperm banks do not exist as they do in the modern world but each male member of the family is considered as a prospective sperm bank. If your brother's wife could not conceive the family elders could request you as the younger brother to assist by having once off sexual relations with your brother's wife. The resulting child will resemble the family members and the brother who might be barren will be convinced that it is his child. These are examples that testify the existence of science in IKS but are imbedded in other components of IKS

Are your learners aware of IKS?

I always argue that science teaching and learning should have connections to learners' everyday life experiences. I call this teaching science with connections. I always encourage my learners to bring in examples of what we are dealing with. The year has come to an end, how I wish I could invite you to my science lessons. You will be surprised to discover the atmosphere that prevails in my lessons. I do not claim to be the best science educator, but I intend to share with you my experiences. There is a lot of relevant science from the IKS that learners bring to class. Interestingly some of us believe that IKS will create misconceptions. I did not know that it is called IKS. I used IKS as knowledge that learners bring to class. We used this knowledge together with my learners and discovered that it made our lessons much more interesting and relevant.

Is there science in IKS? (Mrs. Pillay)

While I accept that there is IKS in communities I have not thought that there is 'science' in IKS. If it is there it is not the science that we can pull along and include it in the science that we teach. The 'science' in IKS will bring along lots of misconceptions amongst our learners. I don't think IKS is in a state that can be allowed to science education. Really most of us teach that the learners pass. How can IKS improve the pass rate? I don't see how. If we hurriedly pull IKS to science education there is bound to be confusion in the science classrooms.

What do you consider to be examples of 'science' in IKS?

I don't see any science about IKS. All what I see are pockets of traditional beliefs which are more skewed to religion than science. We need to deliberate more on these issues not to unfold the 'science' in IKS but rather to investigate whether there are any meaningful issues of IKS that can be brought to science education. It is wrong also to categorically deny the existence of science in IKS but rather let us find out.

Are your learners aware of IKS?

I have not investigated my learners to find out whether they are in possession of IKS. How do I do this? Do I ask them what they know about IKS? I mean there has to be an approach that we can devise to find out about their IKS.

Discussions Notes

- In the discussions that followed members of the group agreed that IKS is another way of knowing.
- Members of the former model C schools are gaining interest in knowing how other communities explain natural phenomena but are sceptical about the inclusion of IKS in school science.
- One member of the group (RT) invited the group to observe his trials in integrating IKS to school science.
- While the entire group now appreciates the call for the inclusion of IKS in school science- the how part of it remains a mystery.
- The group agreed to work out the methods of integrating IKS in school science.
- The group now seeks to identify the "science" component of IKS- while some members hope that the "science" part of IKS would be a suitable component to be included in school science, the other sections feels that this will affect the subject content and might lead to misconceptions.
- The group suggested that they should proceed with their efforts in compiling a working document of IKS.
- Dumi to step down as the chairperson as the group wishes to continue beyond his research.

Next meeting: Members to be informed by Mrs Pretorius as she will host it during the December Holidays.

NB: Mr Ndlovu to host the group in his science class to observe his efforts in integrating IKS in school science.

IKS Seminar 3

Venue: Vryburger High

Date 17 December 2009

Time 1030hrs- 1230hrs

Present: Present: Mrs S. Tsatsi, Mrs Wassermans, Mrs Pretorius, Mr D Moyo, Mr R. Ndlovu, Mrs S Pillay, Mrs Mboxela, Mr F Tuckkos, Mr S Mammata, Mrs O Naidoo and Mr G. Kucherera.

Agenda

1) Unpacking 'science' in IKS
2) Matching 'science in IKS with Western Science
3) Working out relevance of 'science' in IKS with school science

* Inserts in italics are the quotes from the participants

Unpacking 'science' in IKS

The Ghanaian science educator (Mr. S Mammata) who presented to the forum dominated this section that in Ghana there is a practice that they would referred to it as the selection of the seeds from the crops that are harvested. He told the forum that in Ghana seeds are collected from desirable appearing individuals in a population, and the next generation is sown from the stock of mixed seed. This procedure, sometimes referred to as phenotypic selection, is based on how each individual looks.

> *In Ghana communal farmers select seeds for the next cropping season from the harvested crops. This is mostly done by women. They select the seeds guided by the desired traits. Usually they look at how the seed looks like and will select those seeds that look healthy and have no wrinkles. (Mammata)*

The other black Southern African science educators (Mrs Mboxela and Mrs S. Tsatsi) who take part in these seminars claimed that the same processes of selecting the seeds for the next cropping take the same procedure. In terms of crop protection the Ghanaian science educator claimed that cow urine is used to deter pets from attacking seeds before they are planted. According to the claim Maize seeds are soaked in cow urine for 10-12 hours before sowing. According to the science educator this treatment increase resistant against insects and improves the viability of the cereal seeds.

> *Even in South Africa we use the same technique. It is unfortunate though that nowadays if you select the seeds from the harvest the next crop won't do well. May be this is due to Biotechnology. Otherwise in the past women knew what seeds they desired to use for the next cropping season. There is a practice to soak the seed in water overnight to improve their germination rate. Those seed which will be found floating in water would be eradicated. They were declared not to be viable. (Tsatsi)*

> *The same procedure is also practiced in Ghana and more over certain seeds are soaked in cow urine over night. This allows the seed cover to soften and reduces the period of germination (Mammata)*

> *Interesting, because the use of water allows the seed to imbibe water and the embryo breaks off from dormancy. Indeed this is some form of science even though the holders of the knowledge and skill are not aware that this is science. In terms of the cow urine, we know that it is acidic in nature. Dilute acids are used in scarification of seeds. This allows the seeds to break off from dormancy fast and prepare fro germination. (Tuckos)*

The Ghanaian educator (Mr S Mammata) also claimed that the communities in Ghana and neighboring countries practiced what they now refer to as traditional veterinary practices. According to the educator this involves the use of using traditionally prepared concoctions such as the herbs that are used to control ticks. According to the Ghanaian science educator the most common plant used is the Tithonia diversifolia (umbabane in Zulu) as it is considered to be a tick repellent.

> *There are other practices in Ghana that involve the use of herbs to control pests. Certain herbs are mixed with water and sprayed unto cattle. This practice controls ticks in cattle and other domestic animals. I am sure such practices are common in most developing countries especially in Southern Africa. The herb that is commonly used* is *Tithonia diversifolia. I whether the herb is found in this region. (Mammata)*

> *The herb is found in KwaZulu Natal and we call it umbabane. It is a problem in cropping lands as it is considered as a weed. This weed has a strong smell and we use it as a mosquito repellant*

> *The same herb is now commonly used as green manure b Helderburg farmers. They claim that the herb is rich in Nitrogen. (Pretorius)*

Mrs Pretorius claimed that while the mentioned herb is considered as invasive its use as organic fertilizers by small scale maize producers at Helderburg farms in Gauteng has proved to be worthwhile. The Indian science educator made a remarkable comment that the use of the herb by white farmers indicates that they too had some form of IKS. In laughter the White educators retaliated this by claiming that the use of organic fertilizers is scientific and is not part of the IKS. The Mrs. Naidoo responded by observing that the white community generally considered their form of IKS as being the nature of science and not IKS. The White educators claimed that their form of IKS is the foundation of what is considered as science today.

> *It is interesting to note that Whites also have some form of IKS. The use of the herb as green manure is some form of IKS. Lots of IKS forms will eventually come out as we discuss more and more.*

Members of the group discussed about what they knew about the contents of the urine, more specifically that of the bovine animal. According to Mr Tuckkos urine is generally acidic. She went further to argue that acids are used in scarification (a process that promotes germination of seeds). Once this has been qualified members of the group agreed that this is an example of 'science in IKS.

The Zimbabwean science educator (Mr. Ndlovu) who went further to claim that in Zimbabwe, sun-dried food is prepared mainly under two methods reported similar practices. Older women immerse fresh vegetables in salted boiling water for a few minutes and then dry them in the sun for about 3 days. These are then stored in a safe, dry place. This method is also used to dry edible insects such as white ants, termites, and caterpillars. Meat is sliced into long strips, which are then sprinkled with salt after which it is dried in sun for as long as it can be used.

> *There is a lot of science in IKS and the various procedures of preserving food is testimony to this. Various types of foods were preserved for later use. Take for instance the drying of meat into biltong. Meat was made into long strips, sprinkled with salt and left to dry in the sun. Sun drying of food was also applied to vegetables, ants and caterpillars. (Ndlovu)*

One white Afrikaans science educator (Mrs. Wassermans) noted that the use of salt to dry food is equivalent to the modern techniques whose principle is founded under osmosis/ plasmolysis. All the science educators agreed that it might be possible that the control of dangerous pests to man and animals might be done using extracts of smelling plants that repel the pests.

> *It is interesting that you guys know quite a lot and if these are examples of 'science' in IKS then there is reason behind the call of including IKS in school science. What I can see however is that the 'science' in IKS has limitations in how in can be integrated to school science. See IKS circles around food and medicine as being demonstrated by the examples given. (Wassermans)*
>
> *There are various Learning theories that we are being encouraged to refer to as we teach science. Take fro instance Constructivism, will IKS be accommodated in Constructivism. I doubt very much. (Naidoo)*
>
> *When you consider the Social Constructivist approach IKS can be accommodated so well. IKS is from of communal knowledge; it reflects how communities constructed knowledge. Various forms of scientific knowledge could be exploited in such a manner to the joy of the participants. May be Mrs Naidoo could explain what she understands by Constructivists Approach to teaching and learning of science. (Tuckos)*
>
> *Not here and now (Naidoo)*

But if you can explain this will help us. (Pillay)

On this note the Indian science educator (Naidoo) noted that the leaning theories such as constructivism can not accommodate the incoming IKS to school science. She claimed that in most cases IKS contradicts a recommended teaching strategy, such as constructivism. Mrs. Naidoo was requested to explain to the group what constructivism is. Naidoo described constructivism as the theory that guides learners to construct knowledge by being active participants in the learning process. Mr. Tuckos responded by observing that if IKS is included in science lessons then learners will find meaning to science. They will identify themselves with the content and participant in constructing knowledge.

Mrs Pretorius suggested that while they is evidence that there is 'science' in IKS there were however limitations in its use in the science classroom. She noted that the group was struggling to come up with more examples of 'science' in IKS. According to her observation such a struggle depicts what might take place in science classrooms where IKS in integrated to school science. Mrs Wassermans noted that she had such an attitude at the beginning but has since realized that there is an element of sanity in wanting to include IKS in science. She noted that the struggle that we are experiencing as a group is due to our lack of exposure to the sources of IKS. If our group was increased there was going to be a lot of ideas from different people. Wassermans suggested that may be in future other people who are not educators should be included to increase the base source of our IKS. In this regard she said'

> *"Coming up with few examples of 'science' in IKS has been a struggle for this group. I'm imagining a science teacher faced with the same task and having no one to rely upon. This is a serious task that could not be overcome over night by individuals without a sound IKS background like some of us. May be if educators could be encouraged to from groups like ours life would be better. I started up completely against this IKS busyness but look at where I am. Though I still have problems at least I can see the direction where we are getting to".*

Once everyone was convinced that there is existence of 'science' in IKS members engaged filling up the table below. This was done through each member writing on strips of paper areas of IKS where science could be extracted from. The strips were then copied into the table while members discussed how each identified item related to the Nature of science and school science in particular.

Document Compiled for 'science' in IKS

'Science' in IKS	Its relation to Science		Relevance to school science
	Examples	Relation to modern science	
Medicine	Mosquito Fern – (*Azolla*	The smell of the plant resembles that of	Gaseous Exchange-Respiratory

	caroliniana) Use of plant parts (roots, barks and leaves) to prepare medicines	eucalyptus which is used to manufacture eucalyptus oil.	Infections NCS Grade 10
Textile	Weaving and use of tree extracts to make dies	Mixing of chemicals as in chemistry	Matter and Materials,& Chemical Change NCS- Physical Science FET Band
Pottery	Use of finances in burning posts	Thermal control	NCS- Physical Sciences-: Effects of temperature on chemical change and reaction
Construction			
Mineral extraction and processing	Iron smelting in making weapons	Metallurgy	Chemical Reactions NCS Physical Science FET Band
Food production and preservation	Selection of seeds for the next harvest, selection of bull from calves,	Genetics- phenotype. Anatomy of Reproduction on castration	NCS life Sciences- Tissues, Cells and Molecular Studies
Agriculture and environmental conservation	-Crop rotation Mixed farming eg maize crop with legumes--indigenous indicators to determine cropping season pr - Indigenous ways to propagate plants; seed storage and processing (drying, threshing, cleaning, and	Nitrogen Cycle- Nitrogen fixing bacteria.	NCS Life Sciences: Environmental studies

	grading); preparation and care; farming and cropping systems crop harvesting and storage and food processing. and marketing; and pest-management systems and plant-protection methods;		
Water sources and purification	Uses of sunlight purify water.	Effects of heat energy from the sun on pathogens	NCS Natural Sciences: Light energy
Reproduction and fertility	Indigenous methods of pregnancy prevention using menstrual cycle. Enhancing sexuality using herbs		Reproduction- NCS Life Sciences Grade 12
Origin of humans	This was considered to be on religion side		
Fire	The discovery of fire is claimed to be related to force to friction	Law of conservation of energy. Energy converted due to friction	NCS GET Natural sciences- Energy

Discussion by the group members

Group members felt that extracting ‘science’ from IKS is very difficult. Mr Ndlovu suggested that ‘science’ in IKS should not be isolated from the IKS as this will tend to change the nature of IKS. He observed that IKS should be treated in its holistic nature and not as fragments. Mrs Wassermans suggested that the IKS to be included in school science should not be identified by educators as most of science educators are not aware of the IKS of the learners. She suggested that the issue of IKS was rather a community issue and not an educators’ task. This was disputed by Mr Kucherera who claimed that the struggle that they experienced in identifying the ‘science’ in IKS is that the group embarked on this task out of the communities that they operate within. Mrs Pilay observed that schools should not be isolated from the communities. She suggested that the elders of the community are the custodians of IKS and that may be in future we should invite such people to our meetings.

Appendix 4

Interviews 1, 2 and 3

Date: 12 January 2010
Time: 1000hrs- 1025hrs
Venue: Holy Rosary College (Edenvale)
Interviewee 3 SM
The interviewee is a Black Ghanaian who has worked in many African countries and is currently a science educator in a catholic school

The problem of the interviewee: The interviewee has a strong feeling towards the inclusion of IKS but seems not to be clear over what he considers to be IKS and the 'science' in IKS

What is your understanding of IKS?
My understanding of IKS is vague. Vague in the sense that while I strongly feel that IKS should be included in school science I am not clear what to consider as relevant to school science.

Perhaps we should start by addressing what you consider to be IKS
Ha IKS is the knowledge of a people. People by living as communities come to understand the world around them. This understanding of the world around them makes them build a body of knowledge.

Very interesting. Is this body of knowledge including science?
Our problem with science is that when we think of science we are restricted to Newtons and Mendels. There is science beyond the documented knowledge**.** Part of that science is in IKS. Unfortunately some ethnic groups did not document their knowledge. Many Indigenous Knowledge forms got easily brushed aside yet they were authentic forms of knowledge.

Can you think of an example?
Even though within a short space of time I can not draw an example it is known that people have been surviving without this modern science. Their survival was not by chance. They survived because they operated within a body of knowledge which made them to sustain their livelihood

You have lived in various communities. What forms of IKS did you encounter?
While I was in Cuba I was interested in how the Islanders used herbs to cure some diseases. The growing of sugarcane using indigenous processes was also fascinating.

How did they grow their sugarcane?
They used stems to produce the next crop. The stem was nicely cut at an angle and smeared with some dry ashes. This they claimed avoided the stems to be attacked by some fungi and dried by the light before produces shoots. Is this not science?

Sounds interesting. Now tell me what is your attitude with regards to the inclusion of IKS in school science?
To a large extent we have talked about librating communities from the European influence. What we consider to be science today is European knowledge. Schools as communities should also be liberated from this influence. This is not as easy as waging a guerrilla warfare against imperialism. May be if we say here is what our communities offer as knowledge then we blend it with school science. We will feel owning the knowledge. We think that white students perform better than Blacks in sciences. That is not the case. White students are at an advantage they own what today is called school science. Let Blacks also own the science. They can only own it if they can identify with the knowledge. IKS will achieve this.

Can all forms of IKS be used in the classroom?
From my understanding of IKS it is a broad system of knowledge. All the subjects of the curriculum can tape sectors of knowledge from IKS. Understand that IKS is a Holistic body of knowledge that sustained people's lives. There is what is relevant to science in IKS.

Is there 'science' in IKS?
Definitely yes. There is a lot of science. Remember I have just said science is not what is documented only. Isaac Newton saw an apple fall down. He built his theories from observing. Darwin saw the resemblance of species and hence formulated his theory of evolution. In the same manner Indigenous people see things happening and build up their scientific knowledge. This is indigenous science.

What are the sources of IKS?
What have I said? This is undocumented knowledge systems. So the sources are the people. You can not go around asking them what and where their IKS is. Live with them see how they interact with the world around them. Be part of them they their IKS will be at your disposal

Is there a reliable source of IKS where educators can tape from?
IKS is part of people's lives. As people are reliable so is their IKS>

What do mean by saying people are reliable?
You can not fail to find people in communities. Then that means you can not fail to find their IKS.

Does this imply the urban people as well?
Is that not a community as well? The notion that I get from your question is that IKS is not found in urban people. This is the idea that relegates IKS to old fashioned way of

knowing. That is not the case IKS is as modern as any recent piece of knowledge. Urban communities have IKS as well.

This is interesting. I enjoy your positive attitude to IKS
Thank you lets see how we can work together to change other people's attitudes

Thank you so much indeed we will

Interview 2

Interviewee: Mrs Naidoo
Venue: Bedfordview High
Date: 14 January 2010
Time: 1530- 1600hrs

Problem of the Interviewee: Mrs Naidoo is an Indian science educator who hardly contributes in organised seminars. She has neither brought a home work write up that members task each other to do.

Mrs Naidoo you are always quite in our seminars. It's very hard to tell what your views about IKS are.
You have realised that I hardly contribute. I am an Indian right. I hardly know anything about IKS may be that is why I prefer to be quite.

We have deliberated much about what IKS is. What is your position?
My position? Initially I thought IKS was about Blacks' culture and now its slowly unfolding in me that this is a body of knowledge.

What brought about the unfolding in you?
Our meetings. When people argue and come to a compromise on what IKS is I benefit a lot from such.

I see. Now do you think IKS can be integrated to school science?
It's a policy. A policy then it should be implemented.

Besides it being a policy. What do you think about the inclusion of IKS in school science?
There are a lot of curriculum changes. The department of Education does not make any effort to help us educators understand how to cope with changes.

So you consider the inclusion of IKS as some form of curriculum change?
Sort of. Is it not?

What changes are brought about by the inclusion of IKS in school science?
The content of school science will change. Is that not so?

So you consider IKS as bringing about content change to school science?
That is what I think.

Can you elaborate? What content changes are you foreseeing?
IKS is different from school science. This means that if we bring in IKS to school science the content of school science changes.

Do you believe that there is science in IKS?
Definitely yes. This has been deliberated enough to convince me. Our seminars are really an eye opener.

As a science educator won't think that the 'science' in IKS is relevant to your subject?
Oh let me see. Dumi this is very hard. I don't just want to follow bindly. I will have to work out the effects of bringing in the 'science' in IKS to my science lessons.

Then
If it benefits my learners then it will be cool.

As of now what is your position of the 'science' in IKS
Well that is another body of knowledge that I have recently been made to be aware of. I want to believe that people can't just make noise about something that is not authentic. My worry is the changing face of the science that we teach.

You still consider IKS as coming to change school science. I am sure you were there when at one of our seminars we agreed that IKS is anther way of knowing?
Now you see why I prefer to be quite?

Why?
How many ways of knowing are there?

You tell me?
Don't put me in a corner Mr Moyo.

How I wish you could tell me
Normally we consider the science we teach to be the genuine way of knowing
.
Now I understand. To you IKS is not a genuine way of knowing.
I don't want to be completely negative about IKS. Give me time that I develop to appreciate its authenticity. I am not the kind of a person who accepts what the majority takes.

That is a good attitude. When you call for more time you mean you want more of our seminars?

What is your intention? Collect information from us when you have had enough of it you write your thesis and leave us. That will be quite unfair to us.

That is not the issue. Remember the group has agreed to continue. I am a member of the group.
That being the case now let me have more time to understand the issues that surround IKS. May be my being quite at most times is my nature. I am generally quite at most of the times.

You seem to appreciate our seminars. Why?
Initially I knew nothing about IKS. Textbooks made me to believe that IKS was implemented through Learning Outcome 3. Now I undesrstand what IKS is and appreciate that there is 'science' in IKS. All this was because of our seminars. Seminars are may be the best way of understanding policies- especially new policies. I enjoyed when some members of the group were rejecting IKS initially. Now they are taking the lead. This is team work.

What else do you want us to deliberate on with regards to IKS issues?
May be we can write a working document that will assist us to integrate IKS.

Mrs Naidoo it was good talking to you. At least I have had your silent voice

Thank you

Interview 3

Date: 3 setember 2009
Venue: Primrose High
Time: 1400Hrs- 1430Hrs
Interviewer: Moyo Dumi
Interviewee: Mrs Wassermans

Background: Wasserman is a science educator who considers IKS as body of knowledge that is consists of African myths and religious beliefs. She is against the inclusion f IKS in school science.

The NCS calls for the inclusion of IKS in the science curriculum. What is your understanding of IKS?
There is the universe. It is as abstract as it is. People will always want to interpret the abstract universe. In the process they formulate a body of knowledge. The body of knowledge formed in the IKS. Yes that is what I will think. Am I right? (Laughter and the interview continues)

This is very interesting. How is IKS different from the societal religious beliefs?

It's like you are asking me how religion differs from any other body of knowledge. For instance how does religion differ from science? The difference is very clear.

What is the difference?
Dumi, religion is a body of beliefs while science is a body of knowledge.

In any case what is your opinion about the influence of religion in science education?
Well even if religion can influence one's scientific orientation I think it brings along what we classify as misconceptions.
Are there some elements of religion in IKS?
Even in science there is religion. You need to believe in some theories without searching for proof. That is why science is not rigid. There is religion in IKS just as it is with other bodies of knowledge. I am confused may be ha what do I want to say. Ha part of IKS seems to be religiously inclined.

Can you think of an example?
Do you want me to use knowledge we gathered from our seminars? Yes think of the healing process in the IKS way. One has to be possessed with some spirits in order to heal.

Is that so?
Sort of **(laughter)**

Can all forms of IKS be used in the classroom?
We need to be very careful with what to integrate to school science. May be I could have said we should be careful with how we intend to integrate IKS in science. This might change the content of the science that we teach.

In the first place what is your opinion about the inclusion of IKS in the science curriculum?
It is a policy. What else can I say?

Suppose you had a choice?
I don't think I would do such a thing

As what?
As integrating your IKS?

Why do you refer it as my IKS?
Dumi you are surprising me do you think when they say include IKS they mean everyone's IKS? No. They actually mean the black people's IKS**.** This is unfair The policy makers ought to have moved out of the shadow of apartheid and consider everyone as equal**.**

How does this relate to the issues of IKS?
Answer me first. Who's IKS? It's not about Blacks Blacks only we are people as well we are indigenous to Africa. I know no other home but South Africa? I am indigenous too.

Then it is your IKS as well?
No no may be the IKS differs from the one that you guys talk of.

Anyhow the policy say integrate IKS in the curriculum. **Do you have some suggestions on how integration of IKS should be done?**
Well I have no idea. May be this is another way of saying Whites out of the system. They did it with the economy. What is the difference between BEE and IKS? How I wish the IKS issue is so academic without the mingling of the politics. If the IKS thing is coming in to solve the problems we have in teaching science- may be then I can understand. But what is it that the indigenous people have to offer in science. Are we not going to teach about witchcraft and the many myths that the African culture has? May be, one has to think deep about how to go about this IKS issue.

Can you explain further what you are suggesting?
I cannot suggest as of now as I still struggle to identify the IKS.

Do you think there 'science' in IKS?
Let me see. You are taking me far. There might be well may be. How can they say we include what is not science in science. Ya one needs to think carefully when dealing with such issues. There might be some authentic reasons behind the inclusion of IKS, and at the same thing this might be the…… issue (a mention of a politician's name). People can kill for stupid reasons, why can they not do it for what ever they want. I reckon they cannot kill for the want to indigenous science.

You seem not to be sure where you stand with regards to IKS
I am not sure. At least you can see that. My problem is that the IKS saga is a policy. What are we going to do? Nothing, but to implement the policy. I am still searching for this IKS.

Where are you searching for it?
I mean I am searching my mind on how to deal with it. May be as we meet occasionally I will come to understand it. Let us continue. I am very much interested in discovering what they call IKS more so that there is a claim that there is science in it.

Do you think a policy can be formulated on something that does not exist?
That will be ridiculous**.**

Then IKS is in existence don't you think so?
May be

You are still in doubt?

I am not in doubt but I am against the confusion with that IKS will bring to school science.

Whose science is school science?
It is everybody's science. Worldwide the science is the same. If we teach IKS then we are limiting our learners to a confined knowledge. They won't function at a global world.

This is interesting. How do you claim that school science is everybody's knowledge when it alienates the knowledge forms of other people?
Which knowledge of other people?

IKS of various people- say Blacks for instance.
See now you are coming up clear. This is about indigenisation of the curriculum. I sensed it from the beginning that the policy makers want everything to be Black Black. This is not good.

I am not saying Black people are the only ones with IKS. You have your own IKS too. Don't you think so?
Now what are you saying?

I mean every ethnic group has some form of IKS. IKS should not be taken to be of Blacks only.
If that is the case which IKS should be integrated to science then?
I and you are as yet to figure out. Are we not going to meet to deliberate of IKS issues?
Now everything seems to be clear. All along I thought it's a Blacks issue.

How could that be when the policy does not specify that Blacks' IKS should be the only IKS that should be included in school science?
Well may be the politics of the day is the one that made me to be scared of every mention of IKS

Now what is your position?
Dumi you are too pushy

Not as such about I need to know your position with regard to IKS and its integration to school science.
Ok suppose I was not informed so well about all this IKS noise. Let's continue deliberating on it. I hope to learn more. Are you going to educate us on it?

Me. No together we seek to understand IKS and search for its relevance to school science. Otherwise thank you so much. Let us meet as we have scheduled.

References

Abd-El-Khalick, F.; Bell, R.L., and Lederman, N.G., (1998). The nature of science and instructional practice: Making the unnatural natural. *Science Education,* 82, 417-437.

Abimbola, I. O., (1997). The problem of terminology in the study of student's conceptions in science. *Science Education*, 72, 175- 184.

Aladejana, F., and Odejobi, C., (2005). Actualizing the Effective Learning of Science in a Globalized World: The Place of the Nigerian Indigenous Knowledge. Nigeria: Obafemi Awolowo University.

Alebiosu, K. A., (2001). Cooperative learning and students' affective learning outcome in Nigerian chemistry classrooms. *IFE Psychologia: An International Journal, 9*(2), 135–142.

Alebiosu. K. A., (2006). Indigenous science practices among Nigerian women: Implications for science education. Retrieved January 23, 2009, from http://www.newhorizons.org/trans/international/ alebiosu.htm.

Agrawal A., (1993). Indigenous and Scientific Knowledge: Some Critical Comments. *Indigenous Knowledge and Development Monitor 3.*

Aikenhead, G. S., (1996). Science education - Border crossing into the subculture of science. *Studies in Science Education,* **27**, 1-52.

Aikenhead, G. S., (1997). Integrating the scientific disciplines in science education. A keynote presentation made to the Gesellschaft Chemie and Physit, Universitat Posdam, September 21, 1997.

Alebiosu, K. A., (2006). Cooperative learning and students' affective learning outcome in Nigerian chemistry classrooms. IfePsychologia: *An International Journal*. 9(2), 135-142.

Alexander, A., (1997). Children's Television Workshop. In *Museum of Broadcast Communication Encyclopedia of Television* (Vol. 1, pp. 358-359). Chicago: Fitzroy Dearborn Publishers.

American Association for the Advancement of Science., (1990). Benchmarks for Scientific Literacy. Oxford: Oxford University Press.

Balasubramanian, N., (2004). Response from Nathan Balasubramanian on 12/26/2004 in response to U. S. Math and Science Skills: Improving or Education Week website http://www.edweek.org/tb/ (2009/12/14).

Bassey, M., (1999). Case Study Research in Educational Settings. London: Open

University Press.

Brown, A. L., (2004). Learning, remembering, and understanding. In J. H. Flavell and E. M. Markman (Eds.), Handbook of child psychology*:* Vol. 3. Cognitive development. New York: Wiley.

Cameron, A. K.; Rollinick, M. and Doidge, M., (2005). The influence of prior knowledge, culture and religion on first year and foundation students' understanding of basic astronomy. Proceedings of 13th Annual Conference of South Africa Association in Research in Mathematics, Science and Technology Education, Windhoek.

Casley, D. J and Lury D. A., 1987. Data Collection in Developing Countries. Oxford: Clarendon Press.

Cobern, C. C., (1998). Worldview theory and conceptual change in science education. *Science Education ,* **80**(5), 579-610.

Cohen, L.; Manion, L., and Morrison, K., {2000). Research methods in education (5th ed.). London: Routledge/Falmer.

Davenport, T. H. and Prusak, L., (2000). Working knowledge. How organizations manage what they know, 2nd Edition. Cambridge, MA: Harvard Business School Press.

Department of Education. (2003). National Curriculum Statement Grades 10-12 (General) Policy: Physical Sciences. Pretoria: Government Printer.

Department of Education. (2006). National Curriculum Statement Grades 10-12 (General): Physical Sciences Content. Pretoria: Government Printer.

Department of Education. (2006). National Curriculum Statement Grades 10-12 (General): Life Sciences. Pretoria: Government Printer.

Department of Education. (1997). White Paper on Education and Training Government gazette (No. 16312).

Dzama, E. N. N., and Osborne, J. F., (1999). Poor performance in science among African students: An alternative explanation to the African worldview thesis. *Journal of Research in Science Teaching*, 36(3), 387–405.

Geertz, C., (1993). Religion as a cultural system. Pp. 87-125 in Clifford Geertz, The Interpretation of Cultures: Selected Essays. London: Fontana Press.

Erickson, F., (1998). Qualitative research methods for science education. In B.J.Fraser and K. Tobin (Eds.), The International handbook of science education (pp. 1155- 1173). Dordrecht, Netherlands: Kluwer Press.

Fakudze, C. G., (2004). Learning of science concepts within a traditional socio-cultural environment. *South African Journal of Education*, 24(4), 270-277.

Freeman, D., (1998). Doing Teacher Research: from inquiry to understanding. Toronto: Heinle & Heinle Publishers.

Glaser, B. G., 1992. Basics of Grounded Theory Analysis: emergence versus forcing. Mill Valley, CA: Sociology Press.

Golafshani, N., (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report,* 8 (4), 597-607.

Grange, L. L., (2007). Integrating Western and Indigenous Knowledge: The Basis for Effective Science Education in South Africa? *International Review of Education* (2007) 53, 577- 591.

Grogan, J. and Suiter, R., (2007). Life Sciences. Textbook and Workbook. (Mind Action Series). Captown, Allcopy Publishers.

Gunstone, R. and White, R., (2000). Goals, methods and achievements of research in science education. In R. Millar, J. Leach and J. Osborne, Improving science education: The contribution of research (pp. 293-307). Buckingham: Open University Press.

Hannan, A., (2007). Interviews in education Research: London, University of Plymouth.

Hatch, J., (2002). Doing Qualitative research in educational setting. SUNY. New York. Chapter 4. 147- 210. Indigenous Knowledge and Development Monitor 3.

Isaac T., Chetty S.; Naidoo S.; Manganyo H.. T., Mdluli B. N. Mpondwana N. L. and, White L., (2007). Understanding Life Sciences Grade Twelve. Cape Town: Pulse Education Services cc.

Howes, E.; Jones, K. M. and Josenthal, B., (2004). Cultivating environmental connections in science teacher education: Learning through conversation. *Teachers and Teaching: Theory & Practice*. 10(5), 553-573.

Jansen, J., and Christie, P., (1997). Changing the curriculum: studies based on outcomes-based education in South Africa. Kenwyn: Juta & Co Ltd.

Jegede, O., (1995). Collateral learning and the eco-cultural paradigm in science and mathematics education in Africa. *Studies in Science Education*, 25: 97-137.

Jegede, O., (2002). Effective Science teachers in Nigeria. Lagos: Totan Publishers.

Jegede, O. J., and Okebukola, P. A., (1991). The effect of instruction on socio-cultural Beliefs hindering the learning of science. *Journal of Research in Science Teaching*, 28(3), 275-285.

Jegede, O.J., and Aikenhead, G.S., (1999). Transcending cultural borders: Implications for science teaching. *Journal for Science & Technology Education*, 17, 45-66.

Keane, M (2006), 'Understanding science curriculum and research in rural Kwa-Zulu Natal.' Unpublished PhD Thesis. University of the Witwatersrand, Johannesburg, South Africa.

Kinginger, C., (2002). Defining the Zone of Proximal Development in US Foreign Language *Education. Applied Linguistics* 23(2): 240-261.

Kyle, W. C., (1997). Editorial: Assessing students' understanding of science. *Journal of Research in Science Teaching*, 34, 851-852.

Lave, J., and Wenger, E., (1991). Situated learning: Legitimate peripheral participation. Cambridge: Cambridge University Press.

Lee, O. and Fradd, S. H., (1998). Science for all, including students from non-English language backgrounds. *Educational Researcher*, 27(3), 12-21.

Lemke, J. L., (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching*, 38(3), 296-316.

Manzini, S., (2000). Learners' attitudes towards the learning of indigenous African science as part of the school science curriculum. *Journal of the Southern African Association for Research in Mathematics, Science and Technology Education*, 4(1), 19–32.

Maundu, P., (1995). Methodology for collecting and sharing IK: a case study. *Indigenous Knowledge and Development Monitor*, Vol. 3 No. 2.

Matthews, M.R., (1998). In defence of modest goals when teaching about the nature of science. Journal of Research in Science Teaching, 35(2), 161-174.

Mbiti, J. S., (1990). African Religions and Philosophy. Second Edition. Cape Town: Heinemann.

Miles, M. B. and Huberman, M., 1994. Qualitative data analysis: an expanded sourcebook. (2nd ed.) Thousand Oaks, California: Sage Publications Inc.

Mito Meeting., (1996). Effects of Traditional Cosmology on Science Education: Japan, September 23- 27 1996.

Mosimege, M., (2005). Development of Indigenous Knowledge Policy and Legislation in South Africa: Intellectual Property Implications for Knowledge Holders and Practitioners. In I. N. Mazonde and P. Thomas (Eds), Indigenous Knowledge Systems and Intellectual Property in the 21st century: Perspectives from southern Africa.

Mutandwa E and Gadzirayi. T. C., (2007). Comparative Assessment of Indigenous Methods of Sweet Potato Preservation among smallholder Farmers: Case of Grass, Ash and Soil based Approaches in Zimbabwe**,** *African Studies Quarterly*, Vol. 9, No 3, 2007.

Noddings, N., (1990). Constructivism in mathematics education. In R. Davis, C. Maher, and N. Noddings (Eds.), Constructivist views on the teaching and learning of mathematics (pp.7-18). Reston, Va*: National Council of Teachers of Mathematics.*

Odora Hoppers, C., (2000). Interview – Renaissance or 'menaissance'? *Agenda* 44.

Odora-Hoppers, C.A., (Ed.) 2002. Indigenous knowledge and the integration of knowledge systems: Towards a philosophy of articulation. Cape Town, SA: New Africa Books (Pty) Ltd.

Odora- Hoppers, C., (2003). Indigenous Knowledge and Public Authority. Paper Presented at the Science and Authority Annual Symposium of the Academy of Science of South Africa (ASSAF), Pretoria.

Odora Hoppers, C. A., (2008). Culture, language, indigenous knowledge and the role of universities in sustainable rural development. Proceedings of Universities in Southern Africa as catalysts for sustainable rural development, Johannesburg: Centre for Education Policy Development, 29-35.

Ogawa, M., (1995). Science education in a multi-science perspective. *Science Education*, **79**, 583–593.

Ogunniyi, M. B., (1986). Cognitive consequences of traditional cosmology among Nigerian university students. *Educational Perspectives* , 1 (2), 66-76.

Ogunniyi, M. B., (2007a). Teachers' stances and practical arguments regarding a science-indigenous knowledge curriculum: Part 1. *International Journal of Science Education*. Vol. 4, No. 3, July 2009, 201-213.

Ogunniyi, M. B., (2007b). Teachers' stances and practical arguments regarding a science-indigenous knowledge curriculum: Part 2. *International Journal of Science Education.* Vol. 3, No. 4, October 2008, 159-177.

Ogunniyi, M. B. and Hawson, M. G., (2008). Effects of an Argumentation- Based Course on Course on Teachers' Disposition towards a Science- Indigenous Knowledge

Curriculum. *International Journal of Environmental & Science Education* Vol. 3, No. 3, July 2008.

Okebukola, P.A.O., (1986). Mechanism of cultural influence on science learning. Paper presented at the Seminar on Science Education, Lagos State University, Lagos, Nigeria.

Okebukola, P.A.O., (1991). Concept mapping in biology with a cooperative learning flavor. *American Biology Teacher*. 23(2), 12-19.

Onwu, G. O. and Mosimege, M., (2004). "Indigenous Knowledge Systems and Science and Technology Education: A Dialogue." *African Journal of Research in Mathematics, Science and Technology Education* **8**(1).

Opie, C., (2004). Doing educational research: a guide to first-time researchers, London:SAGE.

Patton, M. Q., (1990). Qualitative Evaluation and Research methods (2nd ed.). Newbury Park, C.A. Sage Publications.

Puchta, C. and Potter, J., (2004). Focus Group Practice. Sage Publications.

Roth, W. A. and Alexander, T., (1997). The interaction of students' scientific and religious discourses: two case studies. *International Journal of Science Education* 19 (2) pp 123- 140.

Samuel, T., (1996). Towards a result-oriented science and technology policy for Nigeria: A new agenda. *Studies in Education*. 2(1), 26-30.

Schneider, R.M., (2006). Supporting science teacher thinking through curriculum materials. In Barab, S.; Hickey, D., & Hay, K. (Eds.), *Making a Difference: Proceedings of International Conference of the Learning Science (ICLS)*. (pp. 674-680). Mahwah, NJ: Erlbaum.

Snively, R., and Corsiglia, J., (2001). Discovering Indigenous Science: Implications for Science Education. *Science Education,* 85, 6-34.

Soudien, C.A. and Nekwheva, F., (2004). Indigenous culture and resistance: African-centred responses to education in *South Africa. Journal of Postcolonial Education,* 3(1): 25-45.

Stake, R., (1995). The art of case study research. Thousand Oaks, CA: Sage Publications.

Thomas, J.C., Kellogg, W.A.and Erickson, T., (2001). The knowledge management puzzle: Human and social factors in knowledge management. *IBM Systems Journal*, 40/4: 863-884.

Van der Flier, H.; Thijs, G.D. and Zaaiman, H., (2003). Selecting Students for a South African Mathematics and Science Foundation Programme: Effectiveness and Fairness of School- Leaving Examination Aptitude Tests. *International Journal of Educational Development*, 23(4), 399- 409.

Von Glaserfeld, E., (1993). Questions and answers about radical constructivism. In K. Tobin (Ed.), The practice of constructivism in science education. Hillsdale, NJ: Lawrence Erlbaum

Vygotsky, L. S., (1978). Mind in Society. Cambridge, MA: Harvard University Press.

Wasko, M.and Faraj, S., (2000). It is what one does: why people participate and help others in electronic communities of practice". *Journal of Strategic Information Systems* **9**: pp. 155–173

Wenger, E., (1998). Communities of Practice: Learning, Meaning, and Identity. Cambridge: Cambridge University Press.

White L.; Grogan J. and Suiter R., (2007). Understanding Life Grade 12. South Africa, Pulse Educational Services.