

Turkana Children's Sociocultural Practices of Pastoralist Lifestyles  
and Science Curriculum and Instruction in Kenyan Early Childhood Education

by

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## ABSTRACT

This dissertation discusses the findings of an ethnographic exploratory study of Turkana nomadic pastoralist children's sociocultural practices of their everyday lifestyles and science curriculum and instruction in Kenyan early childhood curriculum. The study uses the findings from Turkana elders to challenge the dominant society in Kenya that draws from Western education ideology to unfairly criticize Turkana traditional nomadic cultural practices as resistant to modern education. Yet Turkana people have to rely on the cultural knowledge of their environment for survival. In addition, the community lives in abject poverty caused by the harsh desert environment which has contributed to parents' struggle to support their children's education. Cultural knowledge of Turkana people has received support in research demonstrating the role cultural lifestyles such as nomadic pastoralism play as important survival strategy that enable people to adapt to the harsh desert environment to ensure the survival of their livestock critical for their food security.

The study documented ways in which the Kenya national education curriculum, reflecting Western assumptions about education, often alienates and marginalises nomadic children, in its failure to capture their cultural Indigenous knowledge epistemologies. The research investigated the relationships between Turkana children's sociocultural practices of pastoralist lifestyles and the national science curriculum taught in local preschools and first grade science classrooms in Kenya and the extent to which Turkana children's everyday life cultural practices inform science instruction in early childhood grades.

Multiple ethnographic methods such as participant and naturalistic observation, focus group interviews, analysis of documents, archival materials, and cultural artifacts were used to explore classrooms instruction and Indigenous sociocultural practices of the Turkana nomads. The findings from the elders' narratives indicated that there was a general congruence in thematic content of science between Turkana Indigenous knowledge and the national science curriculum. However, Turkana children traditionally learned independently by observation and hands-on with continuous scaffolding from parents and peers. The study recommends a science curriculum that is compatible with the Indigenous knowledge epistemologies and instructional strategies that are sensitive to the worldview of nomadic children.

## DEDICATION

This dissertation is dedicated to my mother, Ann Lolidia whose wisdom and judgment to take me away to escape hunger in Turkana led to the start of my schooling opportunity at the European Settlement in *Kitale*, Kenya.

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## Chapter 1

### INTRODUCTION

#### **Introduction**

The attitude of the dominant society in Kenya, that views Turkana nomadic pastoralist people as antagonistic to modern development, has in one way contributed to the marginalization of Turkana children in education (Dyer, 2006; Kratli, 2001). Turkana nomadic pastoralist culture has incorrectly been attributed by the political ruling elites in Kenya as the cause of children's poor performance and low participation in education, even as schools in this community continue to operate in abject poverty. However, the negative perception of the mainstream society to the cultural values of Turkana people appear to have been challenged by the national examination results recorded in Kenya Certificate of Primary Education (KCPE) examination that indicated children in pastoralist areas performing better in science and mathematics in general compared with students studying in urban and in the economically endowed areas of Kenya (Ministry of Education [MoE], 2010).

The positive examination results reported in science and mathematics demonstrated that even with poverty and lack of instructional materials in most schools in Turkana the potential for success in academic tasks can still be realized by children in pastoral communities. Rogoff (2003), argues that there is a mutual relationship between individual development and culture. Rogoff's views challenge the mainstream popularized argument in Kenya that treat culture of nomadic people as separate from education of their children.

In addition, Rogoff's theory gets supports from the local education officials in Turkana who attributed success of children in science and mathematics to their resilient attitude inculcated to them through family social cultural practices of pastoralist nomadic lifestyles. For example, the area District Education Officer (DEO) in charge of Turkana South District explained his observation of nomadic children that; "Turkana children are hands-on survivors and problem solvers as their nomadic economic mainstay embraces counting, differentiating and figuring out the health of livestock". Further, the principal of one of the schools concur with the area education officer and again I quote his words; "Turkana children are talented; they are not forgetful and are practical by their style of learning. This is the nature of their culture" The observations of the education officials in Turkana appear to agree with research findings from case studies analyzing cultural practices and children's cognition in science of poor and minority Haitian and Latino elementary students that showed that children's ability in scientific inquiry was enhanced by the intellectual resources of their everyday cultural knowledge (Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). In addition, evidence from Vygotsky's research demonstrated that cognitive skills are dependant on cultural tools that include; literacy, mathematics, mnemonics, problem solving and reasoning (Rogoff, 2003; Vygotsky, 1978).

This dissertation was an exploratory ethnographic study of the relationship between the everyday pastoral sociocultural lifestyles of the children and science curriculum and instruction in early childhood education in Turkana in Kenya. The



main findings of the study was that key concepts of science content in the national science curriculum in Kenya have the potential for congruency with the indigenous knowledge of Turkana children that they engaged with in their everyday socioeconomic survival activities. However, the teachers' science instructional strategies encouraged didactic transmission of science content to children in ways that these concepts appear separate from children's every day life experiences of their culture.

Multiple ethnographic methods were used during this study to lead to data that was used to compare the national school science curriculum in Kenya and Indigenous science knowledge curriculum of Turkana nomadic pastoralist community. The objectives of this study were to: (1) explore everyday life sociocultural practices of Turkana children with a view to determining the areas of congruency with the national science curriculum taught in early childhood classrooms; (2) to establish the extent to which every day life cultural practices of Turkana children inform science instruction in early childhood

Specific ethnographic methods used in this study were participant and naturalistic observations, individual as well as focus group interviews with teachers teaching in preschools and lower primary classrooms in two selected schools operating in nomadic pastoral rural communities in Turkana district of Kenya. The researcher observed children's out of school activities after school and documented the activities of parents and families as they engaged in day to day socioeconomic nomadic lifestyles including records of cultural artifacts used

at home or preserved in community museums etc. The elders and other community members were interviewed.

## **Background and Study Context**

### **Sociocultural Practices and Science Instruction**

This study was triggered by my experiences with students as a secondary school science teacher and as an early childhood educator in my ethnic home district of Turkana, Kenya. Having been trained in Western science teaching approaches, I was not prepared for challenges in science instruction that require me to guide my students to experiences of science that relates to use of cultural knowledge in the classrooms. For example, during one of my science lessons to demonstrate the relationships between pressure and surface area ( using sharp and flat objects), I asked the students to give related examples of surfaces that exert the largest or least amounts of pressure on a surface area.

In response the students spontaneously named hooves of donkeys, goats, cows and camels. They did the ordering of hooves of their livestock herds in terms of those that exert greater pressure and those that exert less pressure. They said a camel's hoof exerts less pressure because of its flatness and a goat's and donkey's exerted the greatest pressure due to their sharp surfaces.

These cultural experiences of pressure added a new dimension to the ways that I was formally trained in science education. These cultural ideas are alien in science textbooks. Discussing science from students' own cultural perspectives was exciting and interesting to students. The challenge I faced in this class was that the national examinations in Kenya do not test this kind of knowledge as it is

considered unscientific, although the cultural experiences provided valuable examples in the understanding of science concepts during this particular lesson. In a typical nomadic village one would observe a repertoire of sociocultural practices that children engage with at home which included traditional survival skills of herding, hunting, fruit gathering, milking, watering animals, birds nesting, boat making, sailing, wood-curving, smithing, smelting, bee-keeping, healing, drumming and others. Young children will be eager to relate science concepts with these cultural practices in early childhood classrooms.

Brock-Urtne (2007), comparing the teaching of science in Kiswahili and English in secondary schools in Tanzania, found that when students are learning science in Kiswahili (Tanzanian national language) they draw a lot of science examples from their cultural experiences. These students formed a community of learners and by sharing their cultural knowledge in the science classroom they enriched and strengthened their understanding of science. The teacher also learns from the experiences of the students. In English classrooms examples of science were limited to the textbooks and children's poor English skills limited their ability to draw from their cultural knowledge and experiences.

I remember as a student, answering a question in one of the examinations in ninth grade science that asked me to draw and label a cotton plant. I knew I had read about cotton growing in the textbooks but I had not seen the physical appearance of the cotton plant. As a pastoralist of Turkana ethnic origin, I grew up in a semi-desert environment where only limited agriculture is practiced usually along the rivers through irrigation. Knowledge of plants like cotton, which

had no cultural significance as a crop in my community, was going to be based on my imagination and guess work. The consequence of this was that I was not successful in drawing a cotton plant. This meant that I scored nothing in this particular examination question. Many years later after I had finished school and was traveling to Nairobi to start my teacher training, I was shown a cotton plant on the way. In practice, if children in nomadic communities do not get the opportunity for field visits to some of the agricultural areas to have hands-on experiences with the content knowledge of science described in school textbooks, most of the school knowledge learned would be rote and mythical as textbook knowledge is never applicable anywhere in the children's cultural everyday life experiences.

This example of my school experience is not meant to suggest complete lack of success in school by nomadic children. It suggests the limitation that culture can contribute to the fullest exploitation of ones potential in national examinations. It points out that if textbooks and curriculum were inclusive in ways that diversity is respected, equity can be achieved in national examinations by all children including nomadic students. Indeed it is the finding of this study that children learn more science skills from their culture than what they read in the textbooks. Professor Sifuna, of Kenyatta University supported this finding as he observed that "science textbook writers do not understand Kenya as a country. They focus their understanding of science to their own cultures." The statement of the professor confirmed my document analysis data of the textbooks of science used in early childhood centers in Turkana, which pointed out the biasness of the

writers of science textbooks. In all the science textbooks I reviewed while in Turkana, for example, not one has acknowledged the existence of arid land pastoral environment. Explaining scientific concepts on the basis of a homogenous culture while marginalizing other cultures presents a narrow view of science. Research shows that textbooks treat culture as something static, normative and exclusive (Gonzalez, Moll & Amanti, 2005).

### **Funds of Knowledge and School Science in Cross-Cultural Context**

When I arrived in the United States I was exposed to qualitative studies that framed science curriculum and instruction on the theoretical framework of Funds of Knowledge and Indigenous knowledge (Barton & Basu, 2007; Cajete, 1999, 1994; Gitau 2006; Gonzalez, Moll & Amanti, 2005; Jegede, 1997; Kawagley, Delena Norris-Tull and Roger A. Norris – Tull, 1998; Moll, 2000; Ogunniyi, 1988; Teddla, 1996). These studies are all united on the importance of Indigenous and cultural knowledge of families in engaging children in learning academic concepts.

This study found that after school children in Turkana continue learning and exploring nature at the dry seasonal river bed that flows across the community. At the river bed I watched children engaged in various types of experimentation and exploration activities with sand constructions, swimming, tree climbing, birds hunting, fruits gathering, goats herding and watering etc. The children enter the river bed to engage in playful exploration of Mother Nature while at the same time taking a break from long hours of learning apathy of

school life. John Dewey's words, quoted below, confirm my observation of science instruction in early childhood classrooms;

From the standpoint of the child, the great waste in school comes from his inability to utilize the experience he gets outside ....while on the other hand, he is unable to apply in daily life what he is learning in school. That is the isolation of the school its isolation from life (Bransford, Brown & Cocking, 2000:147).

This study established that the conditions in early childhood environment in Turkana did not favor science instruction. For example, barren classrooms, large enrolments and lack of teachers exposed children in early childhood to idleness and boredom at schools. In lower primary science instruction was by means of textbooks and lack of hands on interactions with materials was the norm in all the schools. In both early childhood centers and lower primary classes children sit on the floor and with large numbers children occupy the whole class confining teachers to the blackboard area of the classroom. The blackboard was the only other resource in the classroom besides the textbooks.

The findings of this study support reform in science education in countries that encourage educators to explore ways of connecting the school environment and the broader community as a strategy for hands on teaching of science. These education reforms have been engineered in the United States, Canada, Africa and other parts of the world, especially in relation to reforms that address issues of science education in Non-English speaking cultures (Aikenhead, 1994; Bransford, Brown & Cocking, 2000; Yager, 1996). The concepts of funds of knowledge demonstrate that "people are competent, they have knowledge, and their life

experiences have given them that knowledge” (Gonzalez, Moll & Amanti, 2005: ix).

Participant and natural observation of children’s every day social cultural lifestyles out of school in Turkana matches the findings of a study in the U.S which compared time spent by children at home, school and community. This study found that children spent 33% of their time in sleep, 14% doing school work and 53% of their time is spent in home and community activities (Bransford, Brown & Cocking, 2000).

Indeed my observation of children’s play activities at the river bed and participant observation of Turkana families’ daily survival activities, including selling small groceries, showed that children learn more hands on experiences of science from their informal play activities and by participation in family survival socioeconomic activities. According to this study children appear to sustain their science skills and make up for the inadequate instruction of science in school due to lack of instructional materials through the activities they engage with at play after school. This study unearthed answers to the following questions: What cultural practices relate to science skills learned in science curriculum in early childhood institutions operating in Turkana community? How will teachers bring these cultural practices of children to science classrooms? This dissertation encountered apathy in science instruction created by teachers believing that the quality of science instruction was dependent on the resources purchased from science suppliers from Nairobi such as science Kits. During my interview with teachers, lack of science kits (and other learning materials) was attributed by

teachers as the cause of lack of hands on experiences in science instruction.

However, when I interviewed the Ministry of Education officials they argued that science Kits was a proposal that is in the progress of consideration and according to them, teachers were expected to improvise science materials from the local environment of the children.

### **Science Instruction in Early Childhood in U.S and Kenya**

While conceptualizing this study, I did a small ethnographic interview with teachers at the Mary Lou Fulton College (MLFC) and Child Development Lab (CDL) preschools at Arizona State University. The focus of the interview was on teaching methods and philosophy of science in early childhood. In the interview, phrases such as “messing about,” “wondering about,” “learning science through play,” and related themes emerged from the teachers to emphasize the fact that learning in the early childhood environment is child centered and evolves naturally as children engage with materials in the environment. The teachers pointed out that they followed the National Association for Education of Young Children (NAYEC) guidelines on Developmentally Appropriate Practices (DAP) in science teaching in early childhood. NAYEC advocates for an integrated science teaching through play that facilitate learning by exploration of the natural environment through experiments, creativity, problems solving (Chaille & Britain, 2003). Bass, Contant & Carin (2009) indicated that the strategies for scientific inquiry included messing about and wonder.



Science instruction in early childhood emphasizes learner centered environments defined as the ability of the teacher to pay careful attention to the knowledge, skills, attitudes and beliefs that learners bring to the classroom and use these experiences to structure and organize the learning experiences of children (Bransford, Brown & Cocking, 2000). This strategy of teaching is also called diagnostic teaching in which the teachers are able to figure out what the child is thinking and the child's misconceptions and readjust the learning environment to enable the child figure out the solution to the problem at hand as they pursue a science activity. A learner centered environment includes teaching approaches referred to as "culturally responsive", "culturally appropriate," "culturally compatible," and "culturally relevant" learning classrooms (Bransford, Brown & Cocking, 2000). Strategies of teaching science that emphasize observation, listening to children, questioning, helping children make connections and learning by making mistakes supports the concept of diagnostic teaching or learner centered teaching.

The interview with preschool teachers at MLFC and CDL preschools emphasized that materials for teaching science should originate from the natural environment of the children and the families. The "messing about" teaching philosophy emphasized the use of "junk" materials collected from the community in teaching science to children. The use of local materials echoes the understanding that learning of science in the early childhood reflects what goes on in the society. For example, children do science activities related to sustainability, recycling, conservation, and Halloween celebrations, which are relevant to the

family's culture in the United States. Targeting the teaching of science to match with the cultural experiences of children ensures that knowledge and skills of science are meaningful and relevant to the life of the learners.

In Kenya, Western theories and ideologies of child development continue to influence early childhood education, especially in the private enterprise. In pastoralist arid nomadic areas, however, preschools are typically run by churches and operate in church compounds. These categories of preschools are most likely to be under a teacher who is untrained. In addition, they are not likely to use any form of early childhood syllabus or guidelines for instructional purposes. I focused this study on preschools that operate in the compounds of primary school, which are guided by the principals. My understanding was that preschools guided by primary school management are most likely to adhere to the ministry of education guidelines. However, when I visited the schools in Turkana I found that majority of the preschools lacked key instructional materials like syllabi, guidelines and children's literacy materials. For example, classrooms are bare empty walls; floors without desks and walls without places to hang instructional materials. Preschool classrooms were overcrowded as students sit on the floor receiving direct instruction from the only teacher present. The blackboard was the only common learning resource observed in most preschools.

### **Science Instruction Reforms in the United States**

In the United States many reforms in science teaching were initiated by American Association for the Advancement of Science (AAAS) through the establishment of Project 2061, which led to the publication of the National

Science Education Standards (NSES) in 1996. The primary emphasis of NSES is on teaching science as inquiry and here I quote from this document;

From the earliest grades, students should experience science in a form that engages them in the active construction of ideas and explanations and enhances their opportunities to develop the abilities of doing science. Teaching science as inquiry provides teachers with the opportunity to develop student abilities and to enrich student understanding of science. (1996, p. 105)

According to Bass, et al (2009) teaching science as inquiry depends on questions children generate from planned classroom activities. NSES stresses that it is inquiry into authentic questions generated from student's experiences that is the central strategy for teaching science. Scientific inquiry involves asking questions, carrying out investigations, answering the questions, and presenting the results to others. Younger children may experience difficulty in carrying out experiments and testing of ideas and the logic of using evidence to formulate explanations. However, with appropriate materials and scaffolding by the teachers children will be carefully assisted to develop scientific attitude of experimentation and collecting data to develop explanations.

Bass, et al (2009) argued that, whereas children are the ones who construct knowledge when involved in inquiry science activities, teachers play an active role of providing new experiences of the natural world, encouraging children to wonder, support children to formulate questions they will investigate, help children plan investigation strategies, provide materials, observe, interact and listen to children, help children organize their investigations into data and guide

children to construct scientific explanations of concepts, principles and theories of science.

In practice, science as inquiry does not mean a scientific method carried out through a step by step sequence. Learning science as inquiry in most of children's investigations may involve trial and error or problem solving approaches. Bass, et al (2009) indicate that inquiry is a method of science instruction that parallels what scientists do when they study science. Scientific inquiry is broadly characterized by asking questions, doing observations and experiments, collecting and organizing data and constructing theories and explanations using evidence of existing knowledge and clear argument.

Scientific inquiry as a methodology of science instruction was rarely mentioned by curriculum experts and teachers in Kenya during my interview with them and observations of science instruction. I asked the teachers to define science and they enumerated the process skills of science (observation, classification, predicting, hypothesizing etc). Even though teachers are aware that science instruction require materials familiar to the children and that science require practical hands on experiences, teaching science as inquiry remain a major challenge to teachers in Kenya.

### **Science Technology and Society (STS) Instructional Reforms in Africa**

In Africa, STS is argued as embracing sociocultural factors that seem to create a conflict between traditional African Indigenous sciences and Western science. Consequently STS curriculum has been argued to be critical in providing

the bridging gap between traditional anthropomorphic world view of African values and the mechanistic world view of Western scientific values (Jegede, 1994). Since African children's understanding of the natural world may be related to a complex system of sociocultural factors originating from their traditional environment, it is important not to assume that African children can learn school science skills without experiencing cognitive challenges (Aikenhead & Jegede, 1999), especially during the early childhood years. This is important, especially when the teaching of science in African schools does not originate or relate to the sociocultural environment of the children. Jegede (1994) argued that understanding the sociocultural framework of a learner's mind is compatible with the emerging paradigm of alternative conceptions and constructivism in science instruction. In teaching science to African children, Jegede proposed a conceptual eco-cultural paradigm defined as a "state in which the growth and development of an individual's perception of knowledge is drawn from the sociocultural environment in which the learner lives and operates" (p. 130). Further, Jegede proposed ways of teaching science in Africa and here I quote:

One way to help eradicate the fear or apprehension African children have towards science is to identify the elements of a number of fundamental scientific principles in some of African's so called fetish, primitive, or crude practices, and to link these practices to some western science principles (p.128).

Analyzing the literature of Turkana cultural practices of their everyday life of livestock herding and their socio-cultural activities in conjunction with Alaskan Indigenous science curriculum, I provide a few examples below to illustrate the relationship between the national science

curriculum of Kenya and traditional science practices in indigenous cultures.

**Table 1**  
**Local Knowledge Practices and National Curriculum in Kenya**

Local Science Practices	Early Childhood Science Curriculum
Preserving food stuffs	Human body
Fruits gathering	Health education
Animal skinning & slaughtering	Plants
Making cheese	Weather
Drying Milk, meat, fish	Water
Animals' sounds	Animals
Animal hooves	Soil
Interpreting the clouds	Food
Rain making	Light
Classifying plants	Energy
Livestock treatment	Sound
Hunting	Air
Tracking animals	Making work easier
Rabbit snares	
Fire making	
Sharpening with stones or hard steel	
Myths	
Songs	
Stories	

Source: (Dick, 1997; Tedla, 1996; MoEST, 2004)

A glance at Table 1 shows glaring similarities between community cultural practices and science skills/concepts taught in traditional school science curriculum in grades one to three in Kenya primary schools and early childhood centers.

Aikenhead (1994) while emphasizing for reform in science curriculum based on STS approach argued for a curriculum of science that is connected and integrated with children's everyday world. This curriculum should emphasize the

learning of science based on the natural ability of children to make sense out of the worlds surrounding them. According to Aikehead “STS science teaching conveys the image of socially constructed knowledge. STS which is student oriented approach, emphasizes teaching of basic facts, skills and concepts of traditional science, while integrating social and technological contexts meaningful to students. The focus of STS is the community as the laboratory (Yager, 1996). A key feature of STS is constructivism in which the learners are actively required to take responsibility of planning and directing their learning activities. Yager (1996) listed instructional advantages of STS as; students see science concepts as personally useful; concepts are seen as needed commodity of dealing with problems; concepts learning occur because of activity; and when students learn by experience they retain concepts and can relate them to new situations.

### **Education Policy and Curriculum Challenges in Kenya**

In postcolonial era, Kenya has reviewed its education to meet the demands of her development goals while at the same time ensuring that education policies match with the international pressure on respect for human rights. For example, to ensure every child in Kenya has access to education, Parliament passed the Children Act in 2001 (The Children Act 2000). The passing of this Act has since led to the implementation of Universal Primary Education (UPE) through the initiation of Free Primary Education (FPE) in 2003 and Free Secondary Education (FSE) in 2008.

The implementation of FPE led to an overhaul of education system through a national conference on education and training held in 2003. This

conference mandated the ministry of education to develop a robust policy framework which the government responded by formulating the Sessional Paper No.1 of 2005 on a policy framework for education, training and research. Since then the ministry of education has developed the education sector strategic plan (ESSP) which is implementing the new policy through Education Sector Support Program (KESSP). This program lays emphasis on collaboration of stakeholders with the Government and community support in the provision of education services to children from early childhood to public tertiary institutions.

KESSP emphasis is on quality and relevant education and training to inspire economic development through technological advancement and industrialization (MoE, 2005). Science is instrumental in accelerating growth in technological advancement. The emphasis on science in education in Kenya is a response by the Government to bridge the gap created by the colonial administration, which discriminated against African children in learning science. During colonial rule in Kenya schools were divided into three categories (Whites, Asians and African schools). Children in African schools were taught arithmetic, reading, writing and vocational training to prepare them to become clerks, read the bible and work as artisans.

Consequently at independence, Kenya experienced a shortage of African science teachers and trained technical personal to inspire economic development through science and technology. The mandate of education policies in Kenya, implemented through the 8-4-4 system (eight years in elementary, four years in



high school and four years in university) is to ensure that science subjects receive emphasis in the curriculum. Currently, science instruction in both primary and secondary schools is being addressed through a program named strengthening mathematics and science in elementary and secondary education (SMASE). The objective of this program is to improve the teaching of mathematics and science in African schools and was launched in Kenya in 2003.

However, these reforms in science instruction do not target early childhood directly, although there exist a science curriculum at this level which covers ages 3 – 5 years (MoE, 2008). The syllabus of science in early childhood identifies objectives of science that are geared to developing student's observation skills, making simple hypothesis, carry out experiments, make predictions, develop problem solving skills, report findings and make simple recordings, acquire concepts such as measurements, weighing, speed, floating, sinking, force, solubility, machines, acquire knowledge of living and nonliving things and properties of matter and develop curiosity and interest (MoE, 2008). To ensure the quality of science instructions in early childhood a national policy framework and early childhood service standard guidelines have been developed to ensure children are provided the enabling environment for learning and safety. For example the guidelines stipulate the classroom sizes (8m by 6m) and class ratios (1:25) in early childhood centers. In addition the policy mandated the Teachers Service Commission (TSC) to recruit and employ early childhood

teachers (RoK, 2006). This will effectively result in the full integration of early childhood with primary education (MoE, 2005).

Reforms in science education do not necessarily cover the needs of children across all socioeconomic groups in Kenya. For example, education system in Kenya appears to marginalize children learning in rural nomadic schools as it perceives their culture as barbaric, archaic, primitive and the cause of cognitive deficiency in school children (Dyer, 2006, Ntaragwi, 2004). When nomadic children enter the schools, the aim of the school is to clean them mentally from their unhygienic backward cultures and usher them into modern hygienic culture of schooling (Krätli, 2002). The replacement order of primitive culture is hierarchical, from nomadic to agriculture and then to modern Industrial economy (Dyer, 2006; Ntaragwi, 2004). This manner of thinking suggests that all children in Kenya must receive universal education with the goal of achieving modern ways of life. However, this is problematic as most children in cultural traditional communities usually drop out of school before attaining the skills required for modern industrial urban life.

### **Statement of the Problem**

The extent to which cultural practices of Turkana children are used in Kenyan early childhood science curriculum appears to be an important issue of research and the concern for this study. Critical for children in pastoral nomadic areas is the degree to which the curriculum content of school science is congruent or compatible with their cultural values, beliefs and socio-cultural knowledge that

include survival skills of livestock herding and keeping. The purpose of this research is to establish the degree to which Turkana children's cultural practices, beliefs and values are compatible with the curriculum content of formal science and the extent to which these cultural practices are integrated in science instruction in early childhood grades in schools operating in Turkana community in Kenya.

### **Theoretical Framework**

This study draws from Vygotsky's theoretical framework that lays the argument explaining the integration of individual development in social, cultural and historical contexts (Gonzalez, Andrade, Civil & Moll, 2005; Moll, 1990; Rogoff, 2003; Vygotsky, 1978). Vygotsky argued that individual development cannot be separated from its social, cultural and historical context and that individuals are influenced by the kind of activities they are engaged in and the kinds of institutions they belong. Bruner (1962), agreed with Vygotsky's theory by pointing out the role of culture in shaping individuals' minds and argued that culture provides individuals with the toolkit for constructing their worlds and conceptions of themselves. By equating education to culture, Bruner helped to advance Vygotsky's theory and the view that the development of human intellectual capacities is a result of mediation of actions through artifacts and practices of the everyday cultural life of people (Moll, 1990, Rogoff, 2003; Smith, 2002). Vygotsky's theory has drawn further support from research on theories exploring the cultural nature of human development which pursue the argument

that humans are biologically cultural (Rogoff, 2003). This research is founded on the basis that cultural and biological characteristics are mutually dependent.

Key to Vygotsky's theory is the argument that meaning is mediated through social relations (Gonzalez, Andrade, Civil & Moll, 2005; Vygotsky, 1978). The emphasis is how human beings use social processes and cultural resources of all kinds in helping children construct meaning of their worlds. Vygotsky proposed the concept of Zone of Proximal Development (ZOPD) to explain that children's capability to learn independently is limited to the extent that the mediation of adults, peers and significant others becomes necessary in moving the child to higher levels of understanding. The social support from adults and peers help the child to reach the ZOPD.

At the heart of Vygotsky's theory are the resources available at household level within the everyday cultural experiences of the families and children that can be harnessed for mediating learning to young children. Vygotsky's theory has found its educational application in the studies of funds of knowledge that refer to "historical accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and wellbeing" (Moll, Amanti, Neff & Gonzalez 2005: 72). The use of funds of knowledge emphasizes the integration of household and community resources in creating instructional materials for teaching children in schools operating in communities perceived as poor economically. In schools in the U.S that have embraced the use of funds of knowledge, the instructional materials have transformed the quality of instruction

in classrooms of the minority working class children and has helped to remove learning from dependency on rote memorization of academic concepts.

Funds of knowledge place emphasis on instructional approaches that nurture students' strengths and resources by linking classrooms instruction to students' lives, local history and the context of their communities. Children's cultural experiences and their everyday life survival activities should provide the foundation for interpreting and learning new information presented in formal school settings. Treating children as blank slates in order to force them learn academic content using the culture of the mainstream upper class may lead to the perpetuation of inequalities in education. Educators must move away from the thinking that low income children are not likely to succeed in education because of the believe that their home environment do not provide them the prerequisites skills for success in school. The tendency to treat low income and indigenous children as requiring compensatory education needs to be challenged with appropriate curriculum alternatives.

Emphasis in sociocultural education has lead to science educators reexamining the extent to which science instructional approaches are based on humanistic pedagogy or Western modes of instruction. Humanistic approaches emphasize the link between science concepts learned in schools with cultural ways of life of the children (Aikenhead, 2006). Aikenhead observing teachers' instructional approaches was able to classify their teaching strategies as 'humanistic', 'pipeline enthusiast' or 'middle of the road teachers'. In my study in Turkana, early childhood teachers demonstrated teaching approaches that most

likely linked them to humanistic teaching and lower primary teachers would be in the category of ‘pipe line enthusiasts’ as their instructional approaches were geared to success in national examinations. These teachers were inflexible and were unable to accommodate the views of the children in science instruction. However, majority of preschool teachers due to academic pressure have moved to adapt “middle of the road” teaching to accommodate the dominance of the primary school teachers who require preschool children to sit for examination to quality for standard one places at the end of the year. But overall whether teachers in Turkana were humanistic or not instructional materials remained to be text book driven. The textbooks together with the curriculum are developed by the central government and consequently are conceptually and spatially removed from nomadic children.

Based on the humanistic model, cross cultural approaches to science education also argue for harmony between school science and everyday cultural practices of the children. Cross cultural theories differentiate between home science, school science and Western science. They argue that children need bridges to facilitate crossing over from one culture of science to another culture. The smoother for an Indigenous child to cross over from his cultural knowledge to modern science knowledge or to cross over to school science, the more easily is the understanding of science. These theories argue for smooth border crossing between the cultures of science in science instruction.

Collateral learning theories have also been developed to explain instructional approaches of science that help children learn science better despite

their socioeconomic and cultural challenges (Aikenhead & Jegede, 1999 and Aikenhead, 2001). These theories argue that science instruction should provide opportunities in which children share knowledge of different cultures and compare and contrast them to develop consensus. For example Turkana calendar begins in March, while Western calendar begins in January. The Yupiaq people have 13 moons and the Western calendar has 12 moons. Turkana month has 28 days while the Western months vary between 30, 31, 29, and 28 depending on whether it is a leap year or not. Collateral learning theory argues that all these information should be presented to children so that children develop their own rationale regarding how they will use these different types of valid ideas for learning. Children require exposure to all kinds of cultural understanding for holistic development that prepares them for national examination while they are able to use other skills for survival at home and the world.

Collateral learning theories may be a bridge to negotiating the barriers created when cultural norms and beliefs are incompatible with the scientific thinking. For example, evidence from research in science instruction in schools in diverse cultures (Lee, 2002) indicates that these cultures may not encourage children to question, explore or to seek alternative solutions to issues. These cultural practices may be incongruent with Western scientists habits of mind that favor curiosity, wonder, interest, diligence, persistence, imagination, critical thinking, questioning etc. Children from diverse cultures are most likely to develop in an environment that adhere to norms that favor cooperation, consensus building, social and emotional support, acceptance of authority of teachers and

elders (Lee, 2002). Compatibility perspective of the Western science culture with the cultural ways of thinking of diverse learners has also been documented in research done at the Chèche Konnen project in Haiti. This research has shown that there are various ways in which poor and minority children's ideas and ways of knowing and talking are related to the characteristic of thinking of scientific communities.

The compatibility or incompatibility perspective has instructional implications in science education. When cultures are compatible or congruent science instruction emphasize the everyday cultural resources that children bring to class and the intersections of the two cultures. When they are incompatible respect for children's cultural knowledge is critical as science instruction engage the minds of learners to the thinking, practices and habits of scientists.

### **Purpose of the Study**

The purpose of this study is to establish relationships between Turkana children's cultural practices of their everyday sociocultural practices of their nomadic pastoralist life styles and the national science curriculum and instruction and document whether, and how, these cultural practices inform science instructions in early childhood learning environments.

### **Objectives of the study**

- 1) To explore everyday life cultural practices of nomadic pastoralist life styles of Turkana children with a view to determining the relationship with the national science curriculum taught in local early childhood settings and lower primary classrooms.



- 2) To investigate the extent to which every day life cultural practices of Turkana children inform science instruction in local preschools and lower primary classrooms

### **Research questions**

1. What are the relationships between Turkana children's everyday socio-cultural practices of pastoralist lifestyles and the national science curriculum taught in local preschools and lower primary classrooms?
2. How do Turkana children's everyday life sociocultural practices inform science instruction in preschools and lower primary classrooms?

### **Significance of the Study**

Decisions about what sort of science content and instructional materials are developmentally appropriate in early childhood may prove challenging to teachers of young children. More important is the challenge of teaching science as inquiry in early childhood (Bass, et al, 2009, Bruner, 1960; Eshach & Fried, 2005). Bruner, (1960) in his book "the process of education" acknowledged that the decision of what science concepts should be taught in preschool is hard for teachers as they are not usually adequately prepared to teach young children. In Kenya, science curriculum content at every level lists identical topics from early childhood through grades one to eight (RoK/MoE, 2002). This arrangement of science topics appears to suggest a curriculum design that follows a spiral content delivery of subject matter (Bruner, 1960). For example the concept of machines is in both preschool syllabuses through first grade to eight. The challenge is how to teach a topic such as machines to young children in a developmentally

appropriate way without falling in the trap of using the same materials and examples used in upper grades, bearing in mind that the concepts of science such as machines remain the same whether it is being learned in early childhood or in first grades. In addition, scientific concepts, whether taught to preschoolers or to university students do not necessarily change. In Kenya, because of examination pressure, majority of preschool teachers teach the diluted version of first grade science to early childhood students.

This study is significant in that it argues for use of everyday sociocultural practices and Indigenous knowledge of the children in science instruction in early childhood as a strategy for enhancing the learning of science concepts in contexts that are culturally traditional. If children in early childhood learn science using familiar everyday resources of their culture, for example funs of knowledge and other traditional ways of life including children's everyday play activities like those encountered during sand play, science will be fun as children use the natural knowledge familiar to them to be able to make hypothesis and explanations of the natural world.

When science instruction takes place in the most authentic way, children are capable of engaging in learning that places them at the zone of proximal development (Vygotsky, 1978). For example learning will occur in familiar mental environment but remains challenging to lead to higher mental function. Bruner, (1960) argued and I quote; "the task of teaching a subject to a child at any particular age is one of representing the structure of that subject in terms of the child's way of viewing things. The task can be thought of as one of translation"

(p.33). Familiarity of instructional materials is critical for science instruction to proceed at the zone of proximal development. This instructional strategy ensures that learning is developmentally appropriate while remaining to be mentally challenging.

### **Organization of the Dissertation**

In chapter one I have outlined the contextual background to this dissertation culminating in the theoretical framework and the problem statement. Research questions and the rationale for this dissertation have also been addressed in chapter one. Chapter two will explore the relevant literature related to critical issues of science curriculum and instruction in Indigenous cultures. The literature will focus on themes such as cross cultural science education, humanistic science curriculum and instruction. Issues related to approaches of learning and instruction relevant to Indigenous children and justification for ethnography methodology. Research related to issues of language, learning materials and textbooks will be discussed in relation to how they hinder culturally relevant pedagogies.

Chapter Three describes the methodology and data collection methods and their rationales including methods of data analysis and issues related to the trustworthiness of the ethnographic field work process. Chapter Four will present the research finding answering the first research question related to the relationship between Indigenous science knowledge of Turkana people and the national science curriculum in early childhood grades. Chapter Five will continue with the findings that answer the second research question related to science

instruction. Finally, Chapter Six will present the conclusion, discussions and implications of the study. This chapter will conclude with the reflection of the researcher's experiences in the field and future research agenda.

## Chapter 2

### LITERATURE REVIEW

#### **Indigenous Science Knowledge**

Indigenous educators and scientists argue that science is a cultural construction of the natural world (Ogawa, 1995). For example Sertima (1990) points out that all cultures share the ability to conceptualize, to think abstractly, to generalize and to discover new laws of science. However, the ways in which different communities of the world perceive, define, classify and think about the environment vary across cultures (Reyhner, 1992). In American Indian culture indigenous science knowledge has been referred to as Ethnoscience (Cajete, 1999; Reyhner, 1992). According to Cajete and Reyher Ethnosceince is defined as methods, thought processes, mind sets, values, concepts and experiences by which Native American groups understand, reflect, and obtain empirical knowledge about the natural world (p. 224). In this perspective, Ethnosceince represents the shared understanding of indigenous science knowledge by all Native cultural groups in the world. Ethnoscience is a cultural phenomenon reflected in cultural practices as intellectual processes of manipulating the environment for survival. These scientific processes are demonstrated in people's activities, for example, in agriculture, astronomy, navigation, mathematics, medicinal practices, engineering, military science, architecture ecology and others (Sertima, 1990).

The way native cultures use their science to obtain empirical knowledge of the natural world may differ from the way Western cultures structure, interpret and manipulate the environment. For example, a frog used in an experiment in an

Indigenous science class will likely elicit spiritual emotional reaction from the children than it would from a non-Indigenous child. Indigenous child may view the frog as spiritual and a sacred creature that requires consultation from the community beliefs before it can be used for experiment in the laboratory. Non Indigenous children on one hand may just be thinking about conservation of animals, love of animals or animal rights (Cajete, 1999; Reyhner, 1992). Doing experiment with Indigenous children in a laboratory can be problematic as the teacher must have knowledge of the culture of children to be able to link science to their beliefs and cultural Worldviews. For example, experiment with seed germination might have to consider factors such as time of the day associated with planting and knowledge of the cosmology of the universe. Science teachers should know how Indigenous children view the natural world and establish teaching strategies that harmonizes their worldview of children with how they should learn school science. How teachers incorporate the world view of children in nomadic communities in teaching science are issues that need to be explored in school science curriculum operating in traditional cultural environments.

### **Cross Cultural Science Education**

Studying Indigenous science in Yupiaq culture in Alaska in U.S, Kawagley, Norris-Tull and Norris – Tull (1998) found that Yupiaq culture is highly technological and their cultural inventions are highly scientific and include river fish traps and different types of hunting and fishing gear. The Yupiaq people developed this technology as a result of highly extensive culturally scientific knowledge of the flow of rivers, a study of the flow of tides and feeding,

resting and migratory habits of fish, mammals and birds. A curriculum for teaching Yupiaq children in Alaska was developed by Kawagley (2006) which incorporate all the Yupiaq cultural knowledge for example, fishing and processing, weather, mental healing, Native diet and others. Turkana nomads of Kenya have cultural characteristics similar to those of Yupiaq culture. For example Turkana knowledge accumulated as a result of livestock herding and keeping is highly complex and scientific. Turkana study their animal's anatomy and can identify their livestock by reference to the bone structure. They have the capability of developing a repertoire of voices of their livestock to be able to identify them by their sounds. They know their livestock by hoof marks. They don't count their livestock but they can identify almost instinctively a lost livestock. Tedla (1999), reported that African children's ways of learning include, dramatizing, observation, repeating, imitating, memorizing and participating. Among the Kikuyu of Kenya herd – boys are trained to be good observers and to keep record of livestock by observation without counting (Kenyatta, 1953; Tedla, 1999). Counting in Kikuyu of livestock like sheep, goats, cattle or people just as in the case for Turkana is a taboo. To observe these taboo herdsmen will have to learn to recognize their livestock by color configuration, shape of horns, by sound etc.

Research in cross-cultural science education (Aikenhead, 2000; Aikenhead & Jegede, 1999) argues that there is a difference between a student's cultural identity and the culture of science or school science. Effective instructional strategies of science should enable students to cross the cultural border between

the culture of Western science or school science. The quote below illustrates the role of border crossing;

A person's engagement with scientific knowledge must fit with his or her self – image and lifestyle, to enable them to act with confidence and self – direction. Where these features of learning are weak then engagement with ideas and concepts is likely to be insecure ... (Aikenhead, 2000:185)

To facilitate smooth crossing between cultures, a theory of collateral learning was proposed in which students learning science in a non Western classroom constructs side by side with minimal interference and interaction Western and traditional meanings of simple concepts of science (Aikenhead, 2000; Aikenhead & Jegede, 1999 ; Jegede, 1997). Collateral learning recognizes multiplicity of cultures and allows students to learn not only the ideas of science but also the context in which these ideas are valid.

Using a curriculum described as rekindling traditions, Aikenhead (2001), taught Aboriginal students in Canada Western science along side Aboriginal cultural practices which included: Snowshoes, Natures hidden gifts, the night sky, Survival in our land, Wild rice, Trapping etc. Aboriginal content is used to introduce the science lesson for example going on a snowshoe hike, finding Indigenous plants that heal, listening to an Elder, interviewing people in the community, or assisting in a local wild rice harvest. The students use their knowledge to help discover similarities with the Western science or use the local science knowledge to critique school science knowledge. For example Aboriginal culture has 13 moons and Western science has 12 moons. Each culture maintains



the number of the moons without forcing the other to change or assimilate to the other.

Rekindling traditions enables the students learning science in traditional cultural environment to use local science knowledge to frame the science lesson in a way that the instructional strategy is community based, enriches the students' science knowledge and not replace it and ultimately leading to autonomous acculturation (Aikenhead, 2001). Teaching science using local knowledge and culture of students is demonstrated in studies done in Nigeria (Jegege, 1997), South Africa (Kyle 2006; Ogunniyi,1988), in Native American education (Cajete, 1999;1994 and others), in rural schools in India (Rampal,1994) and in research using funds of knowledge in schools in Tucson in Arizona (Moll, Amanti, Neff & Gonzalez, 2005).

This strategy of teaching can be researched and used in Turkana schools with the goal of incorporating the knowledge in science instruction and other areas of the school curriculum. The use of Indigenous science knowledge has not been researched and proposed in Kenyan education system (Ntaragwi, 2004). Education for Turkana children should be defined in terms of processes that inculcate in learners values, aesthetics, spiritual beliefs, and all unique aspects of people's culture (Ntaragwi, 2004). Researchers in science education in Indigenous communities view education as encompassing what children learn at school and at the community (Kawagley, 2006: Okaka, 2008). This view define education as a life long process that is the sum of learning acquired through interaction with ones environment, family, community members, schools and other institutions and

agencies. Okakok (2008), points out that schooling occur in schools and education is the sum totals of all that makes a person a better responsible human being.

Families and children in nomadic communities express the wish that education curriculum offers opportunities that help the community survive for prosperity (Dyer, 2006). Further in contemporary Turkana families' ways of life, the focus is on fighting poverty and time to socialize children in traditional cultural values in no longer available at home. This means that families are turning to formal education to provide children the skills they needed to complement the survival skills of parents (Krätli, 2002). However, poverty continues to bite the families as children keep dropping out of school without adequate skills to support the families and worse these school dropouts become an added burden of dependency to the families (Dyer, 2006; Krätli, 2001). African educationists and researchers believe that most Ministries of education in most African states are schooling ministries (Ntaragwi, 2004). Science teaching in communities such as the nomadic of Kenya should embrace approaches that integrate the concept of STS proposed in U.S, Canada and Africa. In this approach science will be meaningful to the lives of the children and families.

### **South Turkana Ecosystem Project (STEP)**

The findings of Turkana Indigenous knowledge and cultural practices narrated by the elders in chapter four of this dissertation confirmed research findings of a study known as South Turkana Ecosystem Project (STEP) carried out by a group of scientists and Anthropologists from United States (McCabe, 200). The STEP research took place in the same area of Turkana I did my

research. Coughenour (2004), in an article “the Ellis Paradigms – humans, herbivores and rangeland systems” discusses the studies of Jim Ellis, a research ecologist with Grassland Biome Study of the International Biological Program (IBP) at the University of Colorado. With the funding from the National Science Foundation, Jim with other scientists at the university initiated STEP as a pilot study in 1978 and led to a major research project in 1985. In the STEP research, human ecological studies were fully integrated with traditional soil, plant and animal ecology studies in an undisturbed traditional pastoralist ecosystem. The research demonstrated an emerging new paradigm of science that is based on a basic comprehensive understanding of the ecologically adaptive features of pastoralist resources utilization strategies and the ecological processes that determine energy flow from plants to livestock and humans in spatially and temporally variable harsh terrain environment. The STEP research showed that it is possible for scientists to appreciate the importance of human mobility of nomadic people as a strategy of harnessing resources for survival in an extremely dispersed and unpredictable arid lands ecosystem.

The STEP research provides critical data that adds to the credibility of this dissertation in arguing for possibilities for identifying the concepts of science that need to be captured in the national curriculum of science taught in schools in nomadic communities. For example, a question addressed in the STEP study was how the Turkana people can withstand long drought periods and continue to coexist with their livestock and wildlife without degrading the environment. The STEP argued against the conventional believe that pastoralists because of socio-

political reasons accumulate large herds of livestock, which are the cause of overgrazing and degradation of the environment. On the contrary, Jim's STEP study showed that there is no evidence linking subsistence pastoralism with overgrazing or with human malnutrition (Coughenour, 2004; McCabe, 2004). STEP research findings show that pastoralist resource exploitation strategies are adaptive and rational. For example, the Turkana pastoralist are capable of recovering rapidly even when they are adversely affected with serious drought as compared to other African communities that depend on subsistence sedentary economy for survival. There is a lesson science educators can learn from STEP research. For example, science curriculum and instruction can incorporate sociocultural scientific practices that pastoralists use to perceive the Mother Nature by making predictions that are critical in relating with their natural environment. STEP research identified critical areas of science that can form part of the science curriculum and instruction in early childhood and lower primary which include; conceptual understanding of scientific explanations that involve studies of soil water and soil nutrients, study of herbivorous and woody plant productivities and spatial distributions and studies of five species of livestock (sheep, goats, camels, cattle and donkeys), including their seasonal diets, forage intake rates, movements, habitat utilization, and nutritional balances. Other possible science areas in a pastoralist school may include; human biological adaptations to the physical environment, growth, morphology, and body composition, dietary intake and nutritional status, health status and disease prevalence, physical activity levels and physiological work capacity,

demographics structure and population dynamics, decision making, herd management, grazing orbits, mental maps, and human labor. Science instructions should connect science concepts in the classrooms Turkana cultural Indigenous knowledge. In this way students will see how science learned in the school relates to their everyday life activities of their pastoralist families. Whether science is taught as inquiry or as the nature of science or as STS or from the perspective of Indigenous science, linking science to creative use of the environment as demonstrated by pastoralist strategies of survival in harsh dry unpredictable ecosystem is critical.

### **Similarities of Indigenous and Western Science Perspectives**

All cultures irrespective of their levels of sophistication possess similar characteristics in terms of the way they structure, perceive and classify natural phenomena. Fundamentally the goal of science is the same in all cultures. For example, the basic process skills of learning science in all cultures include; investigating, discovering, experimenting, observing, defining, comparing, relating, inferring, classifying, communicating, problem solving, predicting and hypothesizing (Reyhner, 1992; Sertima, 1983; Snively & Corsiglia, 2001; Tedla, 1992).

In the case of native children, science skills are transmitted orally in the form of names, stories, myths, metaphors, riddles, proverbs and spiritual activities. Ogunniyi (1988) reported a compatibility of Indigenous science with nature of science and the need for integration of the two in school science curriculum in African schools. The commonness in science approaches reinforces the need for

school science to recognize the use of culturally relevant approaches of teaching science to children in communities that continue to value their cultural values for socio-economic survival. Research in native cultures (Kawagley, Norris-Tall and Rodger, 1998) of Alaska confirms that cultural knowledge can provide a relevant frame of reference for teaching science concepts to Yupiaq children. Reyhner (1992) argued that the use of Indigenous science knowledge will allow children to use learning strategies that have served their hunting ancestors for centuries and at the same time help the children acquire skills of using western problem solving techniques that they can apply in solving local problems at home. Ogunniyi (1988) sums up the similarities of the two perspectives in learning science using a quote from below:

It must be emphasized that Indigenous people use methods similar to those of the scientific world. For example the Indigenous peoples classify soils using color, texture and structure. They use indicator plants for deciding the suitability of soils for a given cropping system. They classify plants using morphological characteristics...The scientific world did not bother to study local people's science and technology but instead went about, in many instances, reinventing the wheel (p.39).

The question that requires science teachers to explore is whether the teaching of science should continue to insist in the use of modern equipments, laboratories and materials, even in communities that have continued to live in their cultural traditions or lack the access to contemporary methods of teaching science? Schools in many Indigenous communities are under makeshift shelters. In Africa, preschools and elementary school children learn under tree shelters. Rampal researching in the Hoshangabad science teaching program in India

confirms the poor state of school's infrastructure as consisting of dilapidated, leaky, ill – equipped classrooms in addition to lack of science equipments.

Rampal in Solomon & Aikenhead (1994) and Ogeno (2005) both report that ill equipped classrooms and lack of science equipment encourage teachers to resort to rote memorization of teaching facts of science using blackboards, chalk, pencil and paper or simply abandon teaching science.

### **Pedagogic Advantage of Indigenous Knowledge Epistemologies**

Ogawa (1995) recognizes the value of Indigenous science knowledge as a useful pedagogical stepping stone for learning mainstream school science.

Children's conceptual understanding of science is enhanced in more meaningful ways if local science knowledge is reflected in the process skills of science. The pedagogical advantage is that concrete experiences of science from the local Indigenous environment are used as resources for learning science concepts.

Jegade (as cited in Solomon and Aikenhead, 1994) supports Ogawa and argues that the teaching of science in African schools should take a paradigm shift in the learning of science draws from the sociocultural environment in which the learner lives and operates. Harnessing cultural knowledge in teaching science has advantages to indigenous children and families. For example integrating school science with indigenous knowledge will ensure that:

- Local resources are used for the benefit of children's learning in addition to lowering the cost of science equipments (Jegade & Rampal as cited in Solomon and Aikenhead,1994)

- Skills of science are practical and are immediately applicable to solving local problems of the community for survival of the families (Gitau, 2006; Young, 1986)
- The Community identifies with their children's education and can contribute to its sustainability. (Gitau,2006; Jegede,1994 and Kawagely, 2006; Kawagley et al, 1998)
- Equal access of children to science education disregarding their gender, social, economic and cultural diversity (Rampal,1994)
- Social equity and social justice in science education is pursued in achieving the goal for science for all (Cajete, 1994; Lee, 2002; Rampal, 1994).

### **Negotiating Indigenous Children's Beliefs in Science Instruction**

School science should include beliefs and world views of Indigenous children in science activities to help negotiate their misconceptions about science. For example, Indigenous children may believe that all natural objects, including lakes, trees, the Universe, stars, sun etc. are spiritual and are God's creation. Children have a repertoire of all the knowledge present in their cultures and are the basis to which they relate to school science activities. These beliefs represent the mental misconceptions of children that can sometimes hinder them from understanding scientific concepts. Kawagley et al's (1998) research in Yupiag culture reported that there is a wide gap between the culture of the child at home and culture of the child at school. This gap results in cognitive misconceptions of science concepts in school. Barton and Basu's (2007) research on Funds of



Knowledge addressed the relationship between Funds of Knowledge children bring to school science and the development of sustained interest in school science learning.

African children's naïve understandings of the concept of decomposition, found that children's culture, its beliefs and myths about science expressed in African language, in addition to the ecological environment of the children, can exert influence to the way children think and learn science (Khatete, 1995). For example, African children like those of other cultures may reason that a decomposing organism spontaneously produces maggots. Rampal as cited in Solomon and Aikenhead (1994), observed that Indian children also held beliefs that flies spontaneously emerge from cow dung and frogs spontaneously emerge from rain.

Teachers can help children move out of their beliefs if they help them learn with concrete experiments and if they themselves have understanding about children's mental beliefs they bring to school from their social cultural environment (Khatete, 1995). For example nomadic pastoralist children learn from their parents that both the Sun and the Moon move round the Earth. They learn that the Earth is flat and stationery and that the moon and the Sun die during eclipse. Teachers who do not know these beliefs will fail to address them in school science. Consequently children will remain with these beliefs throughout their life in school and after school. However, Kawanglely et al. (1998) research found that Yupiaq native teachers understood the beliefs children bring to school

and are able to provide culturally rich science lessons based on local myths, stories, and resources.

Rampal (1994) showed that Indian children were able to test and dispel their cultural misconceptions of science in schools by actually observing the “birth” of frogs from larvae in a water pond. Children went further to collect eggs of lizards, lice, cockroaches and other animals to observe and learn their reproductive lifecycles. In this way children used the knowledge discovered from their discoveries to disapprove or confirm their own cultural beliefs held by their parents. According to Rampal’s study children used their own Indigenous knowledge to challenge the beliefs of their parents. In this way teachers are able to change the cultural beliefs of children by adapting and integrating them in the formal school learning process of science

### **Science Instruction and Indigenous Children’s World Views**

Bass et al (2009) argued that understanding science as knowledge of the natural world and the processes that establish this knowledge is critical in science teaching. Indigenous science researchers (Kawagley, 2006; Aikenhead, 1994, Jegede, 1994) are concerned not only with the curriculum of science but also the world views of the children. STS goals of science seem to match the goals of science curriculum and teaching advocated by Indigenous science educators. For example, Kawagley proposed a curriculum of science based on the Technological cultural knowledge of fishing, hunting and navigation of Yupiaq people in Alaska (Kawagley, 2006). Similarly Aikehead (2001,2000,1996) developed science and technology teaching approaches, referred to as “rekindling traditions” in which

he developed teaching approaches of science that integrate formal science skills with traditional Indigenous cultural every day life practices of the people. In Nigeria, Jegede explained how knowledge of the local people on green vegetables eaten at home was used in schools science to teach the process of photosynthesis (Jegede, 1994).

These examples appear to suggest that STS and Indigenous science approaches are congruent. However, Indigenous science teaching emphasizes the incorporation of the anthropomorphic view of thinking of the Indigenous children in science instruction. To illustrate this anthropomorphic world view, I draw from a study of Brayboy and Maughan (2009) describing the story of the bean, where an Indian teacher was explaining in a workshop of Indian pre-service teachers how she would teach seed germination experiment to Indian children. The statements quoted below are words of the Indian teacher as reported by Brayboy and Maughan:

I will do it this way,” “I would start it at the beginning” “they are going to plant it right, so you don’t just plant any seed at any time” ...I would then ask the students to come in one night to school. We would probably do this a few times a year. Then we would look at the sky and the pattern of the stars. The constellations tell us when to plant certain things... (p.10)

According to this Indian teacher there is a particular way of planting seeds that is traditionally consistent with Indian culture. If Indian children will be taught about seed germination in the usual laboratory methods of growing seeds, observing and measuring their growth, the children might find the science experiment contradicting what they know about planting seeds based on their cultural

knowledge. To avoid the contradiction of cultural knowledge, an Indian teacher “would do it right including starting at the beginning” (p.11). Therefore, for an Indian children’s class, a science experiment must be based on the reality of planting as practiced by the community, which includes knowledge about the cosmology of universe, respect for religious beliefs, and sacred cultural activities. Experimenting for the sake of learning science confuses children because in their natural cultural life, people plant for survival or for the purpose of growing crops for food. In traditional indigenous cultures seeds are not just grown any time of the day or on any soil. Culture is spiritual about planting and therefore it has to be done right. An experiment that appears familiar to Western children may turn out to be confusing to children from minority cultures in non-western contexts. For non-western children doing experiments is unreal knowledge. These children need to learn in situations that are ‘real,’ that conform to the reality of the people’s ways of life.

Teaching science with cultural knowledge may help in challenging children’s beliefs and misconceptions of the natural world. For example, a situation similar to the Turkana school environment is presented in a science teaching program in an Indian rural community by Rampal (In Solomon & Aikenhead, 1994). To address the needs of children learning science in poor rural schools infrastructure in India generally described as consisting of dilapidated, leaky, ill equipped classrooms; Rampal designed a program of teaching science lessons using low-cost equipments, Indigenous designed apparatus, and use of locally made materials. When using the local technology in teaching science in

these rural schools, children are able to relate the skills of science to their cultural ways of life and how they can use these skills to participate in the socioeconomic survival of the community. Rampal also addressed issues of harmonizing the teaching of science with children's culture by working with children to draw hypothesis based on their local knowledge and together develop experiments to test their beliefs. For example, in this Indian community both children and parents hold the beliefs that flies spontaneously emerge from cow-dung and frogs spontaneously emerge from rain. However, Rampal tested these beliefs with children in school and children were able to question their own beliefs and those of their parents. This teaching approach used in Indian rural communities demonstrate a critical idea that Indigenous children have beliefs about the natural world which need to be acknowledged and developed or disapproved through systematic experimentation and knowledge of their culture.

Barone (1988) narrates the story of a boy, named Billy Charles, who learned apprenticeship and survival skills, such as hunting, fishing and cooking from his father. Billy and his father used to go hunting, fishing and trapping together many hours of their life come sunshine or rain. The apprenticeship continues between the teacher (father) and the student (Billy, the son) for many hours throughout their family life. However, when Billy joined school, he found that his own talents acquired from the tutelage of his father were not going to be part of the skills that will be recognized in school or continue to be developed. Instead teachers found that Billy is a child at risk to be placed in a special needs education program.

His ability was regarded as insufficient and cannot enable him to lead a better life in the society. According to the school principal, Billy will at best become a common laborer like his father and probably do night duties operating a forklift and will never have a chance to read a news paper, a novel, or a book of poetry. Certainly the vision of the school did not relate to the goals of Billy Charles. This was frustration that Billy had to confront, and it eventually forced him to get into drugs. Billy Charles example, demonstrate how schools destroy the skills and experiences of children learned from home, which can provide a stepping stone to the learning of formal science skills if recognized and appreciated by teachers.

Cajete (1999) enumerates examples of apprenticeship experiences of Native American children, which may have scientific implications. For example, a girl accompanying her grandmother on a herb gathering trip, a boy watching his father hunt deer, a girl watching her mother dye wool, a boy watching his grandfather observe the sun and moon to determine when to plant or harvest corn, or children watching their parents involved in a particular art work. These experiences are acquired by children from early childhood as a cultural way of thinking and problem solving. This dissertation findings show that in Turkana boys and girls learn the same skills in general. The responsibility of educating children lies in the whole community and children are trained by both women and men irrespective of gender.

## **Science Instruction in Early Childhood Classrooms**

Literature related to the role of the teacher in science teaching emphasizes teaching approaches that are child centered and situate the teacher to be co-experimenter or a learning partner. Preschool teachers interviewed emphasized the type of teaching approach called “reciprocal teaching” (Chaille & Britain, 2003). Reciprocal teaching is used to describe the relationships between concepts in different learning centers. It means concepts are integrated, such that as children explore and experiment with objects and organisms they find that there is a reciprocal relationship between activity areas in various centers that reinforce and support the concepts of science initiated in another activity area. Theories of learning emphasize the fact that the teacher has a very critical role in learning and should be more involved than just being a co-partner of learning. This may be related to the fact that the teacher is knowledgeable and should be more instrumental in organizing meaningful learning environments of the children.

Chaille & Britain (2003), enumerates eight roles of the teacher in a science activity in early childhood and includes teachers as the presenter, an observer, question asker or problem poser, an environment organizer, a public relations manager, documenter, contributor of the classroom culture and a theory builder. These studies emphasize the teacher as the architect to children science activities and it is through thoughtful skills of the teacher that children are able to engage effectively in science inquiry process. The critical role of the teacher is also emphasized by Dewey (1938), when he describes the teacher’s role as that of providing leadership of children’s learning experiences. According to Chaille &

Britain (2003) “The teacher is described as the core, the orchestrator, the creator of an environment in which learning thrives. This is no easy task” (P. 47).

An important teaching strategy of science which teachers in preschools I interviewed at MFC and CDL preschools alluded to relates to the extent at which learning environment is community centered. Community centered learning refers to the degree to which children and teachers feel connected in school and to the larger community. Community centered is a strategy of teaching in which the classrooms and schools promote a learning environment that is enhanced by social norms that value the search for understanding and allow students the freedom to make mistakes in order to learn (Bransford, Brown & Cocking, 2000). The community can be regarded as a laboratory of children’s science activities (Yanger, 1996; Kawagley (2006). Another critical teaching strategy of science emphasized by the preschool teachers is the link between literacy skills and acquisition of science concepts. The teachers explained that children extend the learning of science concepts by reading about the stories about the animals they observe like fish, whales, frogs, insects, snails and Insects etc. From the literature they learn the names of the concepts and other facts about animals which they return to check by continuing with the observation of the animals or plants. They learn details such as feeding habits, food chains, types of mammals, reproduction process etc.

### **Skills and Processes in Science Instruction**

Skills or processes of science are skills that children need to be able to figure out scientific understanding. For example, based on questions children ask,



investigations are initiated that begin with collection, recording, reporting, and interpretation of data. This process will result in explanations or generation of theories leading to scientific explanation of the natural world. Children understanding of science involve investigating the natural world using a combination of simple tools such as thermometers, rulers, hand lenses, weighing scales etc together with skills like observation, measuring, recording data, graphing, inferring, prediction etc. Bass et al (2009) and Millar (1989), identify skills and processes in science teaching as observation, classifying, inferring, measuring, communicating, predicting, hypothesizing, and experimenting (controlled investigating). However, Bass et al and Millar argued that teachers have mixed understanding of process skills to the extent that they are taught as science content. This is evident in Kenyan ECD science syllabus which implies that experimentation, classification, fieldwork etc are separate skills of science that need to be listed as content to be taught separately (RoK/MoE, 2008).

According to ECD syllabus in Kenya, emphasis should be on the children's acquisition of process skills and not in the understanding of science using these skills. In Kenyan elementary syllabus, process skills are not even mentioned in lower classes (RoK/MoE, 2002). Whether, these skills are used as means of achieving science understanding in elementary grades or not, the Kenyan syllabus is not explicit. The way in which process skills are portrayed in Kenyan science syllabus in ECD seem to confirm the views of Bass et al and Millar that science teachers teach these skills either as content or they never incorporate them in science instruction.

Perhaps one argument that will prove problematic to science teachers is the controversy surrounding the method(s) of science. Even though science educators portray process skills as the activities critical in the understanding of science, scientists warn that this should not imply that science is something that can be construed as having a rigid or a definite method of doing (Millar, 1989). This is reflected in inquiry as a way of doing science demonstrated in the practices and activities of which scientists figure out the natural world which also argue that science as inquiry is not a linear sequence of stages to be followed hierarchically to develop scientific understanding (Bass et al, 2009, NSES, 1996; Rachelson, 1977). Millar argued and I quote;

I want now to argue that these “processes” have no special link with science but are simply convenient labels for the general approaches which we all use all the time in making sense of the world. It is not just that the method of science is more than the sum of these parts, but rather that the essence of what it means to do science lies elsewhere (1989:51)

Scientists argue that activities such as process skills are means of engaging student’s attention and interest in science instruction but should not be misunderstood by teachers to be means to ends or goals of science instruction (Millar, 1989). Doing science should a way of engaging a repertoire of “craft skills” in figuring out a natural phenomenon than simply as a way of following a sequence of rules. It is not clear whether traditional cultural approaches children and adults use in figuring out their environment involves scientific understanding. This dissertation established that Turkana people, for example, have a repertoire of skills that involve a complex understanding of aspects such as reading hoof’s

prints of livestock, studying rocks for water exploration, memory of livestock color configuration, mastery of animal cohorts and their reproductive patterns, understanding of weather changes and use of the universe to figure out directions etc. Culture does not prescribe a set of methods for children to follow to learn these complex skills. But learning is by observation and scaffolding by adults and peers. These cultural practices seem to be potentially related to science understanding.

### **Learning by Observing Adults Tasks in Everyday Life**

Children learning through observation or learning by intent participation has been researched and documented in cultures that provide environments that maximize opportunities that embrace this kind of learning as a tool for cultural transmission (Gaskins & Paradise, 2009; Rogoff, Paradise, Arauz, Correa-Chàvez & Angelillo 2003). Observation learning although arguably universal, has been reported widely as influencing children learning in Indigenous cultures including Native Americans, Latino, Inuit and cultures in Africa. For example in Mexican cultures children without any verbal evidence or any form of encouragement learned complicated skills such as weaving, tortilla making, paddling canoes etc by simply watching and observing adults activities. In Native American cultures learning by observation is available to children of all ages in which the centrality of the visual aspect of learning is critical as children are expected to use their eyes even though the full use of all the senses is still essential.

Theories by Mead, (1962), Bandura, (1986, 1977) and Lave & Wenger (1991) argued that individuals are motivated to learn through observation by the

need to be a member of a social group in addition to learning within the group. Children therefore strive to learn the activities of a social group such as values, cultural norms and knowledge, attitudes, practices etc so that they can be like members of the group. Bandura (1977) describes this learning as motivated by the need to be identified with a model. Lave & Wenger (1991), see knowledge as embedded within a community of practice and leaning is intrinsically an integral and inseparable aspect of a social practice. They argue that learning and a sense of identity are inseparable.

Like the case for Turkana children who learn as an integral part of the adult world and in which the curriculum often is hard to separate childhood activities from older children or adult activities, Gaskins & Paradise (2009), have provided similar research that demonstrated that children feel proud to as they learn adult tasks little by little. For example, as they sing songs and dance dances as adults do. As in the case of Turkana children they accompany adults as they herd stocks, watch as they milk goats, cattle, camels or are present as adults interpret intestines.

These studies also confirm the finding that, Turkana children learn for survival and as a contribution to the family household socioeconomic support as useful members of the wider community. In observation learning the “chore curriculum” is available from the everyday life activities of the children as well as the “social interaction curriculum”. Lave and Wager describe this strategy as learning through legitimate peripheral participation in which the learners are learning to participate in a community of practitioners as well as in a productive activity.

## Language of Science Instruction in Early Childhood

English as the language of instruction appears to be a hindrance in science instruction in early childhood, especially in children in nomadic pastoralist communities who are most likely speak English as a third language. Brock-Utne (2000; 2007) discusses African linguistic studies done in Nigeria, Cameroon, Tanzania, Swaziland and South Africa and used these researches to demonstrate the effectiveness of mother tongue in teaching academic subjects. These studies are unanimous that the best way to learn a foreign language is through the best possible command of your own language achieved by using it as the language of instruction up to the highest level of schooling one is capable of reaching.

In Tanzania Brock-Utne (2007) observed teachers teaching science in secondary schools in English and in Kiswahili (the national language of Tanzania). The study documented characteristics of learners in the two classrooms of science and the results are presented as shown below;

**Table 2**  
**Comparison of English and Kiswahili Classrooms in Tanzania Schools**

Kiswahili Classrooms	English classrooms
No chorus Answers. Children were confident when answering questions in their native language.	Chorus teaching or “safe talk” was common in English classrooms.
Concepts of science were explained Clearly using Kiswahili words	Students did not understand English vocabularies
Teachers learned from student’s examples from their culture	Students were passive and handily asked questions.
Students brought their own experiences	Students felt humiliated saying

in learning. They challenged their answers, were critical and lively and asked many questions. They build on each others answers.

words they do not understand. They read the answers secretly from the textbooks.

Creativity was heightened. Students gave original answers not necessarily from the textbooks.

Students learned to memorize or to refer answers in the textbooks.

Students were very active, asked questions, and were eager to answer the Teacher's questions.

Students were afraid to speak in class. students were punished when they made mistakes. They learned through punishment

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Source: Brock-Utne (2007)

The pedagogical value of mother tongue as a medium of instruction draws support from Indian education in Navajo and Hawaii in the United States. An example is a study by McCarty (2009) reporting a longitudinal data of Navajo students' academic achievement showing unequivocally that children who learned to read first in Navajo did not only outperformed students in English programs, but also surpassed their previous annual academic growth rates. In addition students who have the advantage of becoming literate in Navajo exhibited more self confidence and pride in school.

Science education research in diverse cultures in the United States argues that the language of instruction in science classrooms marginalizes children who are non English speakers (Lee & Fradd, 1999). These studies are concerned that, although high education standards are critical in enhancing the quality of science and high academic achievement students learning science in diverse cultures may not realistically benefit from these standards. As long as science instruction continue to be taught in English, which generally represent a western culture,

equity in science education will remain a challenging issue for non English speakers. There is a growing need to take into consideration the culture and the language of the children in learning science. Studies in teaching science using the Haitian Creole by Rosebery, Warren & Conant (1999) argue in support of science that bridges the language of home and the language of science.

Further, Research in Haitian and Hispanic children (Fradd & Lee, 1999) indicate that children of diverse cultures may have difficulties in using inquiry in learning science if they are learning English and science at the same time.

However, teaching science with Indigenous cultural examples will address the link between the nature of science and children's experiences and will also provide an enabling learning environment that promotes scientific inquiry.

Children ask questions as they wonder as they observe natural phenomena, for example bees, antelopes, butterflies, flowers, snow, rain, wind, rocks etc. Inquiry should be in the context of the children's cultural experiences and should involve ability of the teachers to mediate science content with the cultural experiences of children. Most critical is the ability of the teacher to allow the children to continue to engage with the natural world and ask questions in their native language. This will ensure learning of science continues as children continue to develop the academic language and reduce the science learning gap between rural nomadic schools and urban schools. This study presents observations of science instructions in early childhood classrooms and the findings show that majority of students in early childhood grades in Turkana do not speak English resulting in

miscommunication between students and the teacher which interferes with students' understanding of science.

### **Science Textbooks in African Schools**

Review of literature in nomadic communities indicates that science teaching is basically from the textbooks (Brock-Utne, 2000; Dyer, 2006). The greatest threat to integration of locally adapted curriculum based on indigenous knowledge systems is testing children using a national examination based on culture of the middle class or upper social economic class of children living in urban and cities in Kenya. National assessment denies teachers the creativity to incorporate local knowledge in the curriculum even as they use imported textbooks for teaching. For example in Namibia, a review of Art examination paper showed that only 16% of the marks could be earned on anything to do with Namibia and 84% were devoted to European art history ( Brock-Utne,2000). In the nomadic community of Turkana, environment surrounding the schools may have an economic activity like fishing with related traditional methods of fishing such as drying, salting, boat building, rafts and the lake with all its aquatic life. Besides fishing children engaged in hunting, herding, swimming, milking and surprisingly textbooks do not captured in any of these nomadic children's social cultural activities. Most textbooks I analyzed while conducting my field work were illustrated with environment activities generally reflecting the author's culture or were written on the basis of Western culture.

Sertima (1983) found that science textbooks used in schools in the United States exclude African scientists and thus effectively denying African students the



opportunity to learn science from their own scientists as role models. Further, Jegede (1997) indicated that school text books promoted a mythic view of science rather than present the true image of science that reflect the real nature and outcome of scientific enterprise. Goodman ( 1992) and Callahan (1962) arguing against Bobbitt's scientific approach to curriculum indicated that a linear curriculum encourages teachers to teach to the test, adhere to textbooks sequence, follow teaching procedures established by their superiors and disempowered teachers from making decisions about what they teach. The weakness of linear curriculum is embedded in the argument that it does not offer teachers opportunities to make informed judgment, engage in thoughtful discourse and participate in reflective decision making regarding curriculum matters (Callaghan, 1962; Goodman,1992).

### **Choice of Ethnography**

Ethnography is the means of representing a culture or a cultural practice of people, usually in a written narrative form (Maanen, 1988). It is not merely a matter of accessibility to culture, intimacy, sharp ears and eyes and good habits of recording culture etc. Ethnography is the result of fieldwork as a display of culture in a narrative written report demonstrating the fieldwork experience in self consciously selected words. Maanen (1988) argues that ethnography is a written product that has a degree of independence from the fieldwork on which it is based.

When tracing the history of ethnography, Maanen (1988) points out that the methodology as practiced by anthropologists was not initially dependent on their personal experience and cultural background. There were for example so

called “verandah or border” anthropologists who were accused as doing ethnography while seated in their writing workshops or sometimes adapting stiff interviewing in obtaining their data. This resulted in most times imposing cultural concepts and categories that anthropologists created on people’s behavior and cultural practices. Those limited interpretations on other cultures had little relationships with people’s everyday life. However, there was a compelling need for anthropologists to salvage their shady operations by changing their methods of study with a view to entering into the native villages where “real” life was surely to be found (Maanen, 1988).

Malinowski, a Polish anthropologist is credited for the turn to personal or open ethnography (Maanen, 1988). The need for field work was also considered by researchers in America and Franz Boas was credited for initiating the importance of anthropologists moving out of the universities into life worlds of those they studied and wrote about. Both Malinowski and Boas urged researchers to stop relying on second hand reports for the analysis of culture and instead go to the field themselves and collect their own data. In 1920s fieldwork became the cornerstone of anthropology in Europe and America. In short the method of Ethnography demands the ethnographer’s presence in the culture of studied.

### **Critical Ethnography**

Early Anthropologists, like Sociologists were of the view that ethnography is a newspaper type of reporting of what you see and hear from the culture. The goal was to dig the data and to get the real story to tell. As long as all the recorded details are in order and represent the reality of the cultural life of the natives in

such a way that technically nothing should be seen to be problematic since the facts presented will speak for themselves. However, this faith in facts of ethnography has been criticized as a parochial, romantic, and naïve idea that has a limited understanding about other cultures. While appreciating the unique strength of fieldwork, critical ethnography is of the view that there is more than just reporting reality. Ethnography should go beyond reporting and reveal larger issues represented by the studied, especially as relates to politics and capitalism practiced in different societies.

Maanen(1988:130) argued and I quote;

The criticism, often justified, is nonetheless akin to the complaints of missionaries and colonialists who viewed the early anthropologist as godless, unpatriotic folk who cared not a whit for the souls of those they studied and were content to leave the groups of their interest unchanged and no better off ( perhaps worse) their presence.

Critical ethnography is inspired in a greater extent by Marxist's thinking and a concern for representing social structure as seen through the eyes of disadvantaged groups in advanced or less advanced capitalist countries. Consequently ethnographic materials comprise only part or a half of the real issues of the society, implying that the remaining half, which is hidden in the facts, needs to be revealed. Kaomea (2004) describes the process of uncovering the hidden as "unpeeling the onion to uncover the truth underneath". Critical Ethnographers ask questions such as "Knowledge for what? Whose side are we on? Why can't social scientists be partisan? Why should we be content to understand the world instead of trying to change it?" (Thomas, 1993: 2)

Critical ethnography is a type of reflection that examines culture, knowledge and action with a view to widening our capacity to see, hear, and feel. It requires us to be political and be able to describe, analyze and open to scrutiny hidden agendas, power centers, and assumptions that inhibit, repress, and constraints (Thomas, 1993). For example, Turkana pastoralist nomadic people being rated among the poorest people of Kenya with high dropout rates of school children in formal education requires intervention in education that will empower children to succeed in school like children in the rest of the potential areas of Kenya. For example, education in Turkana should address questions such as; whose education? Education in whose language? etc (Brock, 2000). Education policies inherited from Europe has continued to maintain the status quo creating disparities in different regions of the Kenya. This dissertation exposes critical issues of science instructions that require teachers to reflect upon and rethink their instructional strategies.

### **Indigenous Science Ethnography**

As an educator growing up in my own community, I am inspired by Turkana people's ability to perceive and conceptualize the natural world in a highly abstract and creative ways. The strategy they use to make adjustments in responding to their ecological changes is nomadism (Dyer, 2006; Krätli, 2002; McCabe, 2004). For example, while growing up as a nomadic child and teaching Turkana children, I learned that the way in which the Turkana relate with their livestock is highly complex. Their knowledge of tracking animals and ability to recognize their livestock using the hoof prints, ability to take records of the colors

of animals, having a repertoire of livestock sounds to use to recognize the animals and knowledge of the anatomy of an animal and interpreting nature (rain, natural disaster, enemy etc) using the intestines of goats, demonstrated a sophisticated mental abstract ability. This dissertation is an education ethnographic account of how Traditional knowledge of dealing with nature is used in school science instruction and in textbooks to inspire creativity and abstract thinking in children.

The research draws from an ethnography study by Kawagley (2006) who studied the life of Yupiaq Eskimo community and fish camp to determine how the people incorporate their traditional epistemologies as well as modern knowledge in manipulating nature for survival and how this relate to school science. For Yupiaq people, fish camp season is a period of concentrated community activities involving the use of many sophisticated scientific principles in activities such a preparing food, catching and preserving fish, reading river energy, adapting to seasonal transformations, and classifying plants, fishes, and animals. According to Kawagley (2006), the fish camp environment represented a community laboratory in which the learning of children is drawn from the experiences of the community. Kawagley observed and documented the behaviors of the Yupiaq people in relation to their day to day thinking and their subsistence activities in the summer fish camp and compared to instructional methods of science in formal local schools to establish differences and similarities. A similar perspective occurs in a nomadic Turkana village, where the school can draw from the cultural knowledge of livestock manipulation and develop instructional methods of science in formal schools.

## **Literature Review Summary**

The focus of the literature that frames this dissertation has been on three themes; namely, Indigenous knowledge epistemologies, cross cultural science education, and science as Inquiry in diverse cultures. The aim of the literature review was to pursue evidence that will be critical in arguing out instructional strategies of science that are inquiry based within the framework of sociocultural practices of children. The literature pursued the argument that science is culturally universal. The argument is that Western science reflects the thinking of the scientists which is modeled through inquiry instruction that is based on constructivism. But there seem to be a universal agreement that science is a cognitive activity which is dependant on the cultural environment of the children (Lee, 2002). This argument appears to suggest that Western science and Indigenous science practices are complementary. This has the implication that children who are learning science in Indigenous cultures are capable of acquiring traditional science knowledge as long as their inquiry instruction is based on social cultural practices of their everyday activities. These instructional approaches should be based on humanistic teaching or STS approaches. This approach to teaching is rooted in social cultural historical theoretical model of Vygotsky which support from Bruner's research in science curriculum.

## Chapter 3

### **RESEARCH DESIGN AND METHODOLOGY**

#### **Methodological Framework**

To decide the methodological framework for this study, I reviewed various ethnographic studies in the United States that addressed the link between homes and communities with classrooms and drew upon funds of knowledge frameworks (Moll, Amanti, Neff & Gonzalez, 2005). In addition, to guide the process of my fieldwork, I reviewed other related ethnographic works, especially studies that focus on the researcher's conduct and relationship with participants during fieldwork (Maanen, 1988; Thomas, 1993; McCabe, 2004; Barone, 1988; Kouritzin, 1999; Li, 2002; McCarty, 2002; Mendoza- Denton; 2008; Malinowski, 1922; Wolcott, 1988). I also reviewed ethnographic studies that addressed research issues related to Indigenous science epistemologies in Native American education in the United States and Canada (Aikenhead, 2006, Kawagley, 2006). This study also drew its methodological framework from decolonizing and defamiliarizing research methodologies (Kaomea, 2003; Mutua & Swadener, 2007, 2004; Smith, 1999)

Equipped with these methodological tools, I was ready to carry out a study to establish the relationship between Turkana children's sociocultural practices in their everyday experiences of nomadic pastoralist lifestyles and the national science curriculum and instruction in early childhood grades (preschools to first grades) in Turkana, Kenya and find out whether, and how, these cultural practices inform science instructions in early childhood learning environments. The

research questions guiding this study were: 1) What are the relationships between Turkana children's sociocultural practices of nomadic lifestyles and the national science curriculum taught in local preschools and first grade science classrooms? 2) How do Turkana children's everyday life cultural practices inform science instruction in preschools and first grade science classrooms?

## **Study Design and Location**

### **Study Location and Context**

This study was carried out in two communities and schools in Turkana South district, inhabited by Turkana pastoralist nomadic ethnic community. Turkana South is part of the greater Turkana pastoralist district that covers an area of 77,000 square Kilometers. The greater Turkana occupies North Western area of Kenya bordering Uganda on west side, Sudan and Ethiopia on the Northern side. In the recent districts boundary review in Kenya, the greater Turkana was subdivided into six smaller districts (North, West, Central, South, East and Lokiriana districts). Turkana people are nomadic pastoralists who live in arid and semiarid region of North Western Kenya. The census report of 1999 estimated the population of Turkana to be approximately 500, 000 people (Kenya Food Security Steering Group [KFSSG] (2008). However, a new census report carried out in 2009 is expected to release new population estimates. The location of the greater Turkana is shown in Figure 1 of the Map of Kenya showing the major districts of Kenya after independence. The number of districts has since been reviewed.



**Figure 1**  
**Map of Kenya Showing the Location of Turkana District**



Source: [http://www.bushdrums.com/news/districts\\_of\\_kenya.php](http://www.bushdrums.com/news/districts_of_kenya.php)

The Turkana are among the most marginalized communities culturally and economically in Kenya. The Turkana continue to be deprived of education, health and lead a poor standards of living compared to other tribes in Kenya. A recent

UN study on poverty in Africa released in London by United Nations Development Program (UNDP) Human Development Report indicated that 96% of Turkana pastoralist people live in poverty (Gisesa, 2010). Consequently Majority of families in Turkana depend entirely on relief food provided by the Government and humanitarian organizations (United Nations Girl Child Education Initiative [UNGEI], 2009; Oxfam, 2008).

School statistics indicated that 60 % of the total population of school age children in Turkana district attended primary school. This is a marked increase in the number of children attending elementary education as a result of the introduction of Free Primary Education (FPE) policy in 2003 (GoK, 2008). However, the dropout rates in schools in Turkana remain high due to factors such as lack of teachers, nomadic lifestyles of the families, insecurity due to ethnic conflicts, early marriages, long distances between schools, and sanitary towels for girls (Sifuna, 2005). Curriculum relevance is not usually taken as a problem issue in education reforms in the district despite the fact that Turkana people are very much close to their cultural traditions and schools are usually found in the most remote places without roads, classrooms, water and health services that are critical for children retention in schools (Dyer, 2006).

The subdivision of the greater Turkana district to the smaller six new districts is most likely to lead to improved education services. However, during the time I was in the field in one of the new district (Turkana South), the new area education offices were not very well established as they had only a skeleton of staff. The new officials were still picking up in terms of planning and finalizing

their strategic plans while the schools continued to lack basic learning and boarding facilities. Shortage of teachers was an acute problem in the new district.

During the colonial administration, Turkana was regarded as a closed district (McCabe, 2004). To travel to Turkana one needed a permit from the colonial Government. The district was only accessible to a few Government officials and missionaries. This inaccessibility has continued even in the present independent Kenya and has led to the marginalization of districts generally inhabited by nomadic Indigenous pastoralist tribes.

At the time I carried my study in Turkana, travelling to the district was nearly impossible. A journey from Nairobi, the capital city of Kenya, to Turkana, a distance of close to six hundred, miles was a nightmare. There were heavy rains in Kenya and roads to Turkana were impassable in some sections. A journey to Turkana by bus was slow and tiring. During my journey to Turkana from Nairobi, I stayed two nights on the way before I reached the research area. I set out by bus from Kitale (a town in Kenya about 150 miles from Turkana) and on the way the bus developed mechanical problems. This forced us to spend a night in the bus as mechanics were brought from Kitale to repair it.

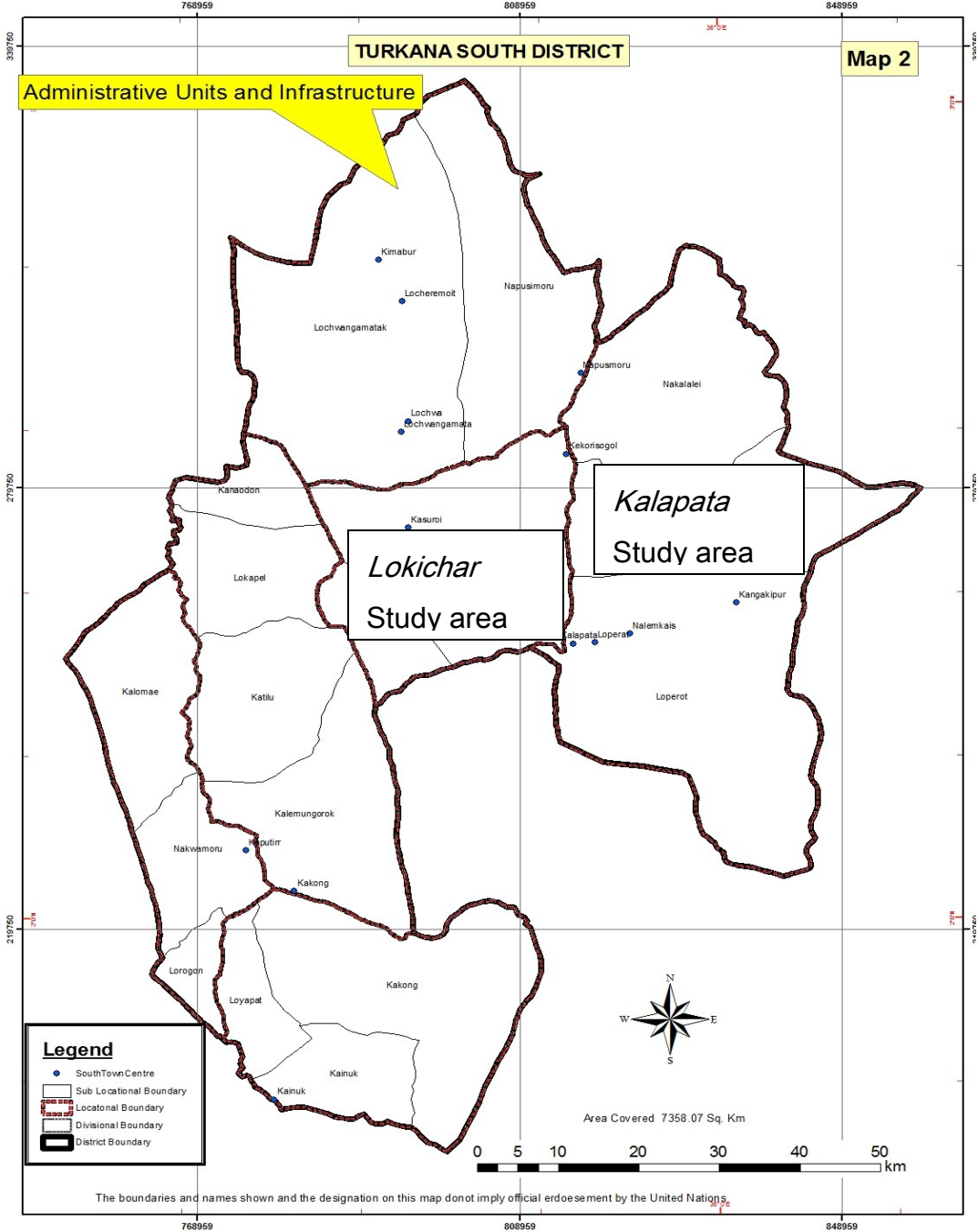
The following day the mechanics arrived, repaired the bus and the journey started. However, rain had just started to fall and when the bus arrived at the next river a few miles ahead we found that the bridge had just been washed away by the strong flowing water currents. I stayed here again for another night until the river subsided. The journey started again after the flowing river water had subsided. This would be after all the passengers disembarked from the bus to

assist in pushing the bus across the river. After a short drive from the river, the bus got stuck again on the muddy road. The passengers disembark again to push the bus out of the sticky mud. By the time I arrived in Turkana (my study area) I had spent four days on the road. I was lucky to have carried some food and water to use on the way. The lack of proper roads infrastructure is rampant in marginal districts of Kenya. Majority of business people, government officials and humanitarian aid workers travel by Air. One way Air ticket to Turkana costs about 200 dollars. The government of Kenya has been accused for neglecting nomadic districts. This situation of neglect continues to persist in all areas development including education.

Figure 2 shows the administrative boundaries of Turkana South District and the neighboring Turkana East District. The boundaries show the location of *Lokichar* and *Kalapata* villages which I visited during my field research.

# Turkana South District Administrative Units

**Figure 2**  
**Research Site (Turkana South District)**



Source: Litunya (2010).

The research permit I got from Nairobi at the Ministry of Education Science and Technology (MoES&T) required that I report to the district commissioner (the head of the district) and the district education officer (Official in charge of education administration in the district). This protocol in Kenya was important in order to enable me get access to elders through the chiefs and the teachers through the district education office. At the district education office, I was briefed on the education status of the district. Education statistics showed that the new Turkana South district had 84 early childhood development (ECD) centers with 11,734 students, 56 primary schools with an enrolment of 17,285 students and 4 secondary schools with a total of enrolment of 1464 students. The education officials estimated that 52 -64% of children in the district are enrolled in elementary school in the district, although transition rates are estimated to be 32% annually. Equity and access to education for children in nomadic communities is threatened by the high dropouts of children from schools as they progress to the upper grades.

When I walked in the villages I found many children hanging around the homes and at the river beds who should have been at school. Studies in pastoralist areas in Turkana and Karimojong in Uganda indicated that families in these communities do not take all their children to school (Dyer, 2006; Krätli, 2001). Some children in a family have to remain home to help herd the livestock. The families argue that they have to “stand with two legs” [one leg in school and one in the livestock] (Krätli, 2001). When dropouts of children are high and jobs are

not guaranteed to school leavers, the families are most likely to retain children at home to help in livestock herding. The figure for ECD children was even more problematic as most preschools lacked teachers. However, preschool children hang around the schools to feed and return home. Schools are the sure places for children to get food for the day. In arid areas food is used to attract children to school. To take care of preschool children, elementary teachers teach them with children in first grade.

### **Research Settings**

I completed my fieldwork in two schools in Turkana South district. The schools were located in two communities with relatively varying socioeconomic settings representing an extremely rural nomadic lifestyle (*Kalapat* community) and a semi-urban environment (*Lokichar* Community) [this place would be regarded as extreme rural if compared with high potential areas of Kenya]. I selected a school from each of the community (*Kalapata* and *Lokichar* respectively). Both schools operated preschool classes and were the focal points of education of each of the community. My intention was to compare the instructional styles of teachers in different socioeconomic settings in Turkana and analyze out of school activities of the children in the two areas.

### ***Lokichar* Primary School**

*Lokichar* primary school is Located at the district headquarters of Turkana South District. The school compound occupied an open flat sandy area that operated as part of the Reformed Church of East Africa premises. One would see the school neighborhood while standing outside the principal's office. Each time I

visited the school I would enter it from any side as it had no fence or gates. On the eastern side of the school you would see the area education offices just a little more than 200 meters away and a few meters beyond the education offices ran the main seasonal river that students used for drawing drinking and bathing water during the rainy season. On the western side a small Air strip ran parallel to the school compound and a section of the village would be seen further away. The classrooms were built to stand in two rows with doors facing each other. The middle space between the classrooms was used for the assembly parade. The rest of the space between the buildings was used by teachers and the students to plant tree seedlings. Early childhood section was located on one end of both buildings.

As I stood outside the classes I would see the church, a children's home close by, a soccer field and a health center. On the north side there were workshops and houses for the mission staff and teachers. This elementary school was begun in 1971 by Reformed church mission. During the time of my research in the school, the enrolment was estimated at 844 students. This figure did not include preschool students. In total the school had seventeen classes handled by seventeen teachers. At least there was a teacher in each of the seventeen classrooms, although the school principal indicated to me that the school was grossly understaffed. He argued that seventeen teachers cannot handle 844 students, especially when they had to support the preschool teacher who was handling a class size of 130 students. He said that the average class size in the school was sixty students. However, in early childhood grades (grades one to three) the average enrolment was eighty students and above. When other factors



such as maternity leave for female teachers, sick leave etc. were taken into consideration; children in some classes, especially lower grades would have no teachers at some point of the school term.

With an enrolment of over eight hundred students, only eight pit latrines with broken doors served the all population of children including preschool children. There were two water taps for all the students, which sometimes will run dry due to shortage of water from the solar pump. The community shared water with the school and this added to the challenges of water in the school as the solar power was weak to serve the large community including school children. Despite the shortage of water, the broken taps wasted a lot of water to the ground.

The physical infrastructure of the school was excellent. All the classrooms were permanent and well painted, especially the upper elementary classes. I noted that the situation in early childhood classes was a little different. The classes were not painted and the inside floors and walls were dusty and lacked desks and learning facilities and materials. Literally most classrooms in early childhood grades were bare halls and when students were not in the classrooms, one would mistake for empty deserted rooms. In these classes the walls were open allowing the strong desert winds and dust into the classrooms. The teachers would not hang learning materials on the board or on the walls as the winds would blow them away. When I was observing one of the classrooms the wind blew away the teachers materials that hanged on the blackboard for the children. In addition the classrooms doors were not lockable and no cupboards to lock children's materials. Even though the early childhood guidelines recommended a class size of 25

students in preschools, these classes in Turkana were the most over populated with enrolment in excess of 130 students handled by one teacher. At *Lokichar* Primary school the preschool teacher has been teaching for the last 24 years without a salary.

### ***Lokichar* Community**

*Lokichar* community would be described as semi-urban, although by Kenyan standard it is still very rural. Its higher status was attributed to the fact that it had the district administrative headquarters. The main highway linking Sudan and Kenya passed through *Lokichar* town and this added a boost to increased socioeconomic activities in the area. *Lokichar* community was relatively an old settlement that attracted Reformed Church of East Africa Missionaries to settle in the area. The community would be regarded as more developed as compared to the rest of the pastoralist areas in Turkana district. The settlers of *Lokichar* were people whose socioeconomic activities vary depending on their degrees of businesses and employment opportunities. For example, some civil servants who worked in Government administrative service lived in the town and thus contributing to changing lifestyles of the people as most of the Government employees and business people were non Turkana. Teachers form the majority of Government workers and helped to support the families especially the local teachers.

There were a few well developed businesses by the local people while others operated in muddy and makeshift buildings. The population of the area number about twenty thousand people and the majority were permanently settled.

The pastoralists move in and out of *Lokichar* as they were in constant search for water and market for their livestock products. Socioeconomic activities were varied from established businesses to makeshift survival activities like, handcraft, small grocery kiosks, livestock trade etc. Majority of poor people live by relief food supplies from the Government. Women are key in sustaining the economy of Turkana especially in terms of sustaining small hand to mouth socioeconomic activities like operating small groceries and handcraft products for tourists and other visitors.

Lokichar community is surrounded by seven elementary schools and two secondary schools. Three major churches run schools in the area including Lokichar Primary school which I visited for this study. The Catholic Church runs a girls boarding primary school which also has a special education unit. While the African Gospel Church runs a mixed boarding secondary school. Poverty continued to be a challenge even in *Lokichar* and this has impacted children's progress in schools. Those especially hit by poverty were the pastoralists who had come to settle in the area after losing their livestock through drought and theft from Pokot raiders (neighboring community).

### ***Kalapata Primary School***

This School was located in a rural nomadic community. Like *Lokichar*, this school had no fence. You would enter and leave the school from any direction. The school stood on a rocky, sandy and hilly desert landscape. A few desert trees surrounded the school, but generally the school operated on an open area without any other physical infrastructure around. A dry seasonal river separated a section

of the community with the school. The school buildings were well painted with very little learning resources inside the classrooms or in the teachers' room. Students learning in the lower grades including early childhood continued to learn in poor unmaintained environment as their classrooms lacked desks and students sat on dusty floors. The school began operating in 1993 under the reformed church. This school had an enrolment of 252 students. The majority of the students were in lower grades. The preschool had 105 students enrolled and there were 86 first graders. The school had eight classes with an average of 32 students per class. Enrolment decreased at the upper classes and like *Lokichar* primary, the principal was concerned with the few number of teachers teaching in the school, although the school's enrollment in upper classes hardly reached twenty students. Ironically there were only four teachers in the school. Three were from the Turkana community and one teacher was nonnative. At the time of this study one teacher had gone for maternity leave leaving the school with only three teachers making teaching in the school a nightmare. According to the principal, there should be at least eight teachers in the school to ensure that each class had a teacher. The two senior teachers, who included the principal and her assistant, used multigrades teaching approach in order to give every student teacher attention especially at the upper primary section. The deputy principal defined multigrade as a teaching strategy in which many classes were taught in one room by one teacher but students did the tasks equivalent to the skills of their grade levels.

Although the school had the highest enrolment in preschool, their teacher was untrained. He was a former graduate of the school from this nomadic community. The school faced the challenge of keeping preschool teachers when they cannot earn a regular salary. For example, the preschool teacher in the school had left due to lack of funds to pay her salary.

Based on my observation, the young man who was volunteering to help was actually helping fill up the gap for the shortage of teachers in the school not necessarily to fill in for the missing preschool teacher. When I visited the school he was teaching grades one and two while the preschool children were teaching themselves with the help of the oldest student. The principals in both schools did not really pay attention to preschool children. These children were just there to feed and little learning took place among them due to persistent lack of preschool teachers.

*Kalapata* operated as a boarding school. There were two dormitories to cater for boys and girls. None of the dormitory had beds. However, the girls had mattresses while the boys slept on the floor with mats or anything they grabbed from home to put on the floor. There was no tap water in the school. Students shared water with the community operated with a hand pump. The hand pump was about a mile away from the school. Students carried water from the hand pump to the school for cooking and drinking. Girls lacked bathrooms but would bathe at night next to their dormitory. The principal and the rest of the teachers lived like the locals as there were no teacher's houses. The Principal's makeshift

round hat was located right in front of the girls' dormitory as she also doubles as the provider of security for the girls. The School had no electricity.

### ***Kalapata Community***

This was a very traditional pastoralist nomadic community. The principal described this community as having unconcerned attitude to education and she attributed this indifference to ignorance caused by illiteracy. The community would rather concentrate to livestock herding than getting involved in school business. In this community the children came to school to feed especially those in lower classes. During rainy season all the children were withdrawn from school to herd livestock and drink the milk from their stock. Pastoralists considered livestock products to be more nutritious than school meals which were usually made of corn or a mixture of corn and beans with inadequate ratios of fats. However, during drought seasons, the pastoralists including their children would persevere to feed on school meals and relief food from the Government. *Kalapata* community was semi mobile. A section of the population with a population of approximately two thousand people settled around the school area where they survive with handouts from the government as they sold livestock products such as milk, skins etc. to earn money to buy other food items like sugar and others or pay for school requirements. They occasionally sold their livestock especially goats for money when necessary. The community in addition carried out survival socioeconomic activities like gathering wild fruits, baskets and other handcraft products, wood carvings, firewood, charcoal, palm leaves for thatching etc. The typical nomadic community lived far from permanent settlements and would

entirely survive by livestock products and food relief from the Government and Nongovernmental organizations. In communities such as Kalapata, which survive by combining livestock with other social economic activities as described above, women played a key role in exploring alternative ways of survival. Men on the other hand were keen on livestock but were unable to venture into innovative ways of survival like women. Consequently the key to family survival in a mixed pastoralist socioeconomic lifestyle were the women.

Security was a major concern in *Kalapata* area. Cattle robbers terrorized students and looted school food and destroyed students' textbooks. Due to fear of Cattle rustlers (cattle robbers) children occasionally stayed home to herd or travelled to learn in other boarding schools operating in secure places of the district such as *Lokichar*. Majority of students studying at *Lokichar* came from this community. The teachers were challenged by the hardship caused by the dry terrain of the area compounded by lack of infrastructure such as roads, water, health services, housing and electricity. One teacher I interviewed said; "here we don't teach because of salary. We just sacrifice ourselves to be here. The salary we earn cannot pay the work we do here" Teachers did not like to teach in schools in this community especially if they were non natives. Consequently, shortage of teachers was a challenge in this area as the Government worked out ways of having local teachers teach in their own communities.

## Research Participants

**Table 3**  
**National Education Officials**

Categories	Males	Females	Total
Ministry of Education officials	01	0	01
Curriculum experts at KIE	01	01	02
Teachers trainers	02	02	04
Total	04	03	07

**Table 4**  
**Lokichar Community**

Categories	Males	Females	Total
Area Education Officers	03	01	04
Schools Principals	02	00	02
Teachers	00	04	04
Elders	06	03	09
Total Participants	11	08	19

**Table 5**  
**Kalapata Community**

Categories	Males	Females	Total
Schools Principals	01	01	02
Teachers	02	00	02
Elders	07	01	08
Total Participants	10	02	12

Table 3-5 show the categories of people I interviewed during my study. I interviewed thirty eight participants drawn from National education officials, District education officials, Teacher training institutions, Principals, Teachers and Elders in the two communities I visited during the field work. I targeted mainly early childhood grades teachers and the principals. However, I did an interview with a principal of one of the nearby a school to ensure I have a broad perspective



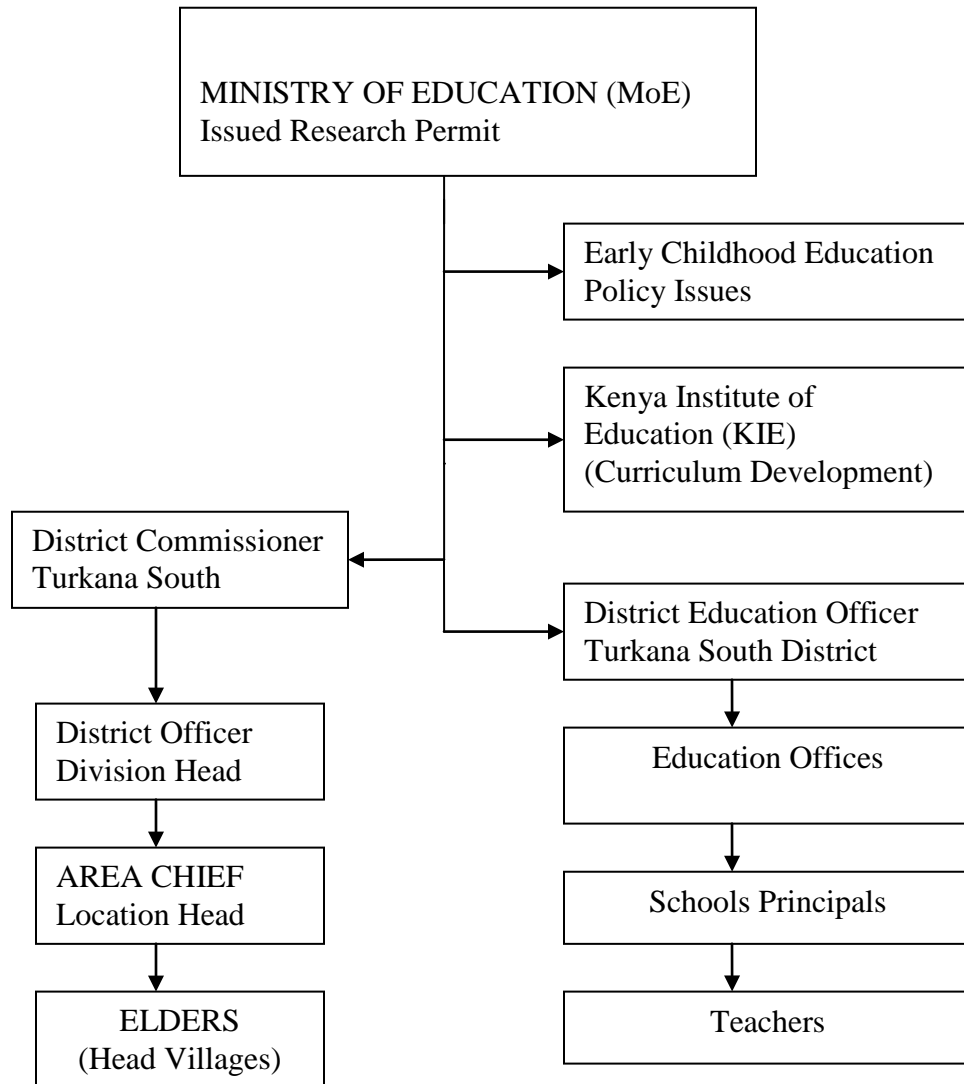
of education issues in the community. Majority of the teachers had at least four years of experience and above except for one untrained preschool teacher. I used purposeful sampling as well opportunistic (Mendoza- Denton; 2008) where necessary especially when sampling the elders. To reach the elders I contacted the chief of the area who knew them. He introduced me to them at their shade tree. The elders rested by the riverside under a huge acacia tree during the day to plan the day to day operations of the community. They would decide who among them would participate in my interview. When I started the interview with the first elder, he/she would then recommend to me the next elder that I would interview based on his/her expertise.

Similarly to identify the education officials, I had to first approach the head of education department who would recommend the education officials that I would interview. For example, the area education officer would identify his officers based on the duties and responsibilities they served at the district. The teachers and college trainers would be contacted through the principals.

During my interviews I talked to officials in charge of school feeding program, quality assurance and training of teachers. It was important for me to follow community entry protocol laid down by the Kenya Government. However, elders were particularly pleased with my work and were happy to talk to me. This community was my home place and most of the elders new me and respected me as one their educated son working in Nairobi. My journey to the community through various levels of research protocol beginning from the national office at

the Ministry of education to the village is shown in the low chart below;

**Figure 3**  
**Kenya Government Research Protocol**



**Source: Constructed by the Author (April, 2010)**

### **Field Work Methods Employed**

To address my research questions I used multiple ethnographic methods (Wolcott, 1988). In this study I interviewed the elders, teachers and education officials. I did observations of science instruction in early childhood grades (preschools and first grade classrooms) and observations of children everyday life activities at the community. I also did content analysis of syllabuses, textbooks, examination scripts, teachers, lesson plans and schemes of work and official education policy documents and Turkana cultural artifacts.

### **Observations**

During my fieldwork I collected data using observations. When interacting with teachers I acted as a participant observer, in that I shared with teachers my experiences as a professional teacher and as a student. The teachers also shared their experiences and challenges as teachers. This helped me to build strong interpersonal relationships with teachers. I became their colleague, a mentor and a resource person. They used me as a means to communicate their needs, challenges and frustrations. They believed that I can be their advocate. For example, when I was travelling to a school in the rural remote area of Turkana for preliminary fieldwork, a teacher approached the driver of the vehicle I was using to request for a ride to his school. This teacher had stayed on the road for 14 days waiting for vehicles to get a ride to his school which was 20 miles away. Teachers in Turkana spend days and days without reaching the schools due to lack of public service vehicles to take them to school. When I heard his story I asked the driver to take him to school and I paid for the extra fuel expenses. When I returned later

to do my field work at *Lokichar Primary* I found that this teacher had been transferred and he was one of the teachers I would meet again in my first chosen school for this research. He was very grateful and was instrumental in building relationships between me and the rest of the teachers. At *Lokichar Primary*, I new the principal who I worked with during the time I taught in Turkana. He was a principal of the school which my nephew studied in 1990. Further all the native teachers new me as their neighbor at the village and as one of the leaders in the community. By knowing the teachers and freely interacting with them as colleagues, I observed them closely and listened to what they were saying which sometimes reflected their inner selves and sometimes their naivety.

As a naturalistic observer, I observed science instruction in first grade classrooms. I walked to the class with the teacher, greeted the students, I introduced myself, talked to them about the importance of education and then explained to them what I had come to do in their class. Then I sat down to a place identified in the class by the teacher. I made sure I sat close to the students and continued my observation of the learning interactions in the science lesson. Sometimes quietly I would stand and peep into what the students were doing or walked to another location in the class and passively observe that section of the class and then sat or stood to write my notes. I made sure I don't interrupt the learning or draw attention of the students.

Outside the classes, I observed the school compound. I went round everywhere sometimes by myself and sometimes in the company of the deputy

principal. In this way I became familiar with the school both internally and externally. I learned from the teachers, the principal and the deputy principal.

My observation did not just end in school. I walked on foot, sometimes in company of the teachers or the education officials to the village. We cross the wet river bed, where there were many play activities of the children (those from school and those who stayed at home). I had a hands-on encounter with children's out of school activities. At the village, I visited the market and interacted with families as they engaged in various socioeconomic activities. I visited their grocery stalls, shops, butcheries etc. I and the teachers would also visit a tailor's shop to measure children's uniform or pay the tailor.

My observations both in the school and at the village were focused on the following areas:

- How often did the teacher use children's everyday knowledge in science instruction?
- How did the teacher make scientific concepts clear to the students?
- How did the teacher maintain a balance between direct instruction of scientific concepts and hands on experiences using authentic activities of everyday life experiences of home activities?
- How did the teacher encourage students to learn science as communities of learners?
- How did the teacher support children's cultural knowledge/experience?
- What concepts of science did children demonstrate in their play activities at home and at school?

- Who stimulated children most at home?
- What role did women and elders play in socializing children at home?
- What support were the teachers getting?

At the village I did my observations sometimes when in company of an elder. There was usually an elder, who accompanied me to the village to meet some of the elders I planned to interview. As I walked in the village I would come face to face with children's social cultural practices. I would meet a group of children playing with sand in the river bed or on the path, climbing trees and hunting birds by the river, helping the families with household chores in the grocery stalls or at the shops, herding goats, fetching water etc. Children participated in every aspect of their families' life, no matter how complex it may appear to be to a stranger. In remote typical rural nomadic areas, children joined families after school to do herding and fruits gathering. In Turkana, children played by themselves away from home. This applies to children of any age as long as older siblings gave support to the young ones whom they can carry on their backs or walk with them if they were at the age where they can walk. Children walked to school by themselves without adult's company. This includes preschool children. To walk to school some children would have to cross dry or wet river beds which are usually sandy. Children walked at least two miles or more to school depending on how far or close the school was from the village. In nomadic communities, children are exposed to the natural environment from birth. The community was responsible for their safety and security. Older children were responsible for the safety and security of the younger ones.

The play ground of nomadic children was the river bed. Children played at the river, whether they were from school or they were herding livestock. The river bed was the place they explored the natural laws of Mother Nature. The presence of the rains made the river bed the center of creativity of the children.

### **Interviews**

Wolcott (1988) and Seidman (2005) provided the theoretical framing of my interviewing techniques during my fieldwork. Although I adapted most of Wolcott suggestions related to human nature in field work practice, I modified Seidmans interviewing techniques. I opted to interview the participants for longer hours and repeat with a different participant to ensure I understand the complexity of the nature of Turkana cultural practices and education issues. In addition, I adapted a lot of flexible survival techniques in the field. The area was very remote with challenging terrains. The elders were highly mobile and the teachers had very busy schedules. During my interviews, I sat face to face with my interviewees. I started my interviews in Nairobi and then moved to the community to interview the grassroots education stakeholders. Ninety five percent of my interviews were audio taped.

Interview process was challenging. It was a struggle to secure an appointment with Government officials in Nairobi. But I kept my patience and after several postponements I was able to meet the curriculum experts and MoE official and did the interviews. At the community, I was generally received well and had no problem scheduling an appointment with participants I identified. The teachers and the education officials new me and gave me very warm welcome.

The elders were very interested to discuss with me issues of education related to their culture. They were interested to learn from me that their cultural knowledge can be part of the school curriculum. I audio taped interviews with elders and played the audio tape for them to listen. They listened and added more information to strengthen their own contributions. I had good time with the elders and they respected me as somebody educated and appreciative of the cultural traditions of the community. To build more trust with the elders, I participated in the traditional initiation ceremony to become an elder. The interviews with the elders followed the protocols of Turkana traditions. When talking to the elders, I would sit in a particular side to the elders and would not call them by name, but by his child's name or by his Bull's name or I used the word *Ekasukout* (*elder*) in Turkana language when calling the elder attention. I had to know who was senior among the elders to read the Arizona State University Institutional Review Board (IRB) protocol. I was a listener and I asked my question when the elder was ready. My role was to try to focus the discussion when need be but always listened.

My entry to the village required the approval of the chief. The chief is the head of the location and the villages where the Elders live. I was given the names of the Elders and was introduced to the Elder who would be my guide by chief. However, once I reached the village and explained to the elders my research, the elders took control of who I should interview next. The elders knew who among them was an expert in what type of knowledge I require and would always direct me to him/her. As I continued talking to them, the more the elders were helpful in identifying the right individuals to interview and how I would contact them. They



would assign me one of them to take me to the home of the elder. The elders were just amazing to work with. They completely gave me all the support I needed and they were extremely respectful.

The elders did not know the discourses of Western science, but they understood their natural world. Their knowledge of their environment and how nature works was very clear in their minds. My interview with them was open ended, but occasionally getting focused to areas related to their expertise like knowledge of hydrology, weather and climate, livestock, plants, tools etc.

The other groups of my interviewees were education officials and the teachers. At Lokichar Primary, I sat with the teachers for interviews at the principal's office. This was the decision of the principal to enable me work in a quiet place with fewer interruptions. At *Lokichar* Primary, the principal was out of the school attending workshops and sorting out examination registration issues. I therefore I sat in his office by myself as I wrote my field notes. I interviewed teachers individually and in focus groups. All interviews with teachers were audio taped. I requested the permission each time I was audio taping and played the audio recording after the end of every interview. After the interview, I would ask, did you hear something contradictory or something you feel you would want to add a little more information? If the teachers or the elders feel they have to add or strengthen an issue, we continue with the interview again, leading to another audio taping.

In case of the education officials, I conducted the interviews in their respective offices. Again I tried to make the interview focused to the theme of

science but at the beginning I started by asking broad questions like to describe their day today duties of the provision of public education. Then I would ask them to explain the structure of the curriculum and the role science play in education in Kenya and finally narrow down to issues of teaching science and the curriculum in relation to the local cultural knowledge. It was challenging to start straight with questions of culture and science as most education officials did not know how to explain culture.

### **Use of Records, Artifacts and Archival Materials**

While in the schools and at the curriculum development institute I looked at the syllabuses, the textbooks, education policy documents, teachers teaching lesson plans, schemes of work and learning materials, examination scripts and national science examination results records etc. At the village, I visited community handcraft centers and traditional artisan's workshops and examined household utensils used in traditional nomadic households. At the teacher training colleges, I visited the science laboratories, resource centers and looked at the students projects etc. I went through a sample of national examination papers for science for testing both college students and elementary students.

### **Data Analysis and Writing**

The analysis of the data began immediately after I interviewed and observed a participant (Wolcott, 1988; Creswell & Miller, 2000). Each time I conducted an interview or an observation I had to reflect on the data as soon possible when fresh in my mind. Through out the entire time of the study, I kept a diary of field work events in my Journal. It is in the Journal that I captured some

of the themes and the categories of my important coding information. At the end of the interview or observation I immediately wrote a thick description of what I considered to be a relevant theme of my finding. However, clear sense making of the data took place after studying carefully and finalizing the coding process after transcribing all the data. The transcripts helped in solidifying the thick descriptions of the themes initiated at the preliminary stages of data analysis at the field. Being aware that transcription would most likely to be lengthy as the interviews and observations were long, I made sure I wrote detailed observations for example in the classrooms and capturing some aspects of it with my audiotape. On the interviews with elders, I tried to transcribe little by little (Gibbs, 2007) and by the end of the study I had almost transcribed most of the interviews. I had my computer with me to ensure I did all the transcription by myself and complete most of them in time for analysis. I was also aware of the possible biasness that transcription can bring to the data and to minimize this I listened to the tape repeatedly whenever, I suspected some inconsistency (Gibbs, 2007). Finally the analysis of the data concluded with flexible coding system incorporating descriptive codes, categories and analytic codes. Classrooms observation was coded as descriptive as well as analytic theoretical explanations of instructional strategies. The data from the interviews of elders was mainly coded as themes or categories. Analyzing elders' interviews was mainly a matter of piecing down pieces of evidence together to develop thick narratives of the themes of the elders' cultural knowledge. Creswell and Miller (2000), describes this process as like piecing a puzzle together.

I made the necessary arrangement when needed to get back to check unclear data with the participants, especially with teachers and the education officials. With the elders, I interviewed different as many as possible to ensure facts were being clarified or were being challenged for accuracy. The elders were clear that sometimes their methods of predicting natural phenomena can be challenged by others. In the field I had a notebook, a pen and the audio recorder. I would sit down under a tree or on a tree log and write thick narratives as I observed children play on a river bed or under a tree shade. I wrote brief narratives in my diary of the interviews even though I had them audio taped. At the end of the day, I would listen to the audiotape to fill in the gaps.

All the audio tapes were transcribed in English and typed in my computer. Each transcription was analyzed by checking the key ideas emerging from the interviews. I would then place the ideas into categories to develop a written narrative of the themes that addressed my research questions.

### **Ensuring Validity and Trustworthiness**

To ensure validity of my research findings, I adapted the techniques proposed by Creswell and Miller (2000) in their article “Determining validity in qualitative inquiry” (p.124). One strategy I used was to revisit my data as soon as possible before leaving the field to ensure everything was fresh in my mind. I wrote the skeleton of my narrative while still in the field. I would go back immediately to my participants and asked for more details of the data or seek clarification. This was much easier when I was working with teachers and the education officials who were available in the schools and offices. It was not easy

to contact the elders, because of their mobility and the distances of the villages. To fill this gap, I tried to be in contact with many elders whom I can Interview when checking facts and seeking clarification and accuracy of their information. This ensured authenticity and trustworthiness of the data. An example was when I learned from one elder that an anteater's mark on the sand on a river bed was an indicator of the closeness of the water table to the surface. I interviewed several elders on this finding and found that the anteaters mark on the river bed is the surest indicator of water presence bellow the sand and this is how Turkana people tracing the evidence of water. I did try as much as possible to ensure the multiple methods I used for data collection triangulate each other (Creswell & Miller, 2000; Gibbs, 2007; Hatch, 2007). Triangulation ensured consistency and validity of the data. I followed different methods for example document analysis, studying artifacts etc. to ensure consistency and accuracy of the Elders cultural knowledge. Facts from observation were critical in helping strengthen the validity of teachers' interviews and education officials' narratives and interpretation of curriculum.

### **Potential Biases, Barriers and Opportunities**

The things I saw and the stories I heard from the teachers and education officials were familiar to my own life experiences as a child learning in these schools over forty years ago and as a former teacher in the district. I could not help showing my emotional feelings and empathy as one of them. I found myself being part of the story telling and would not help filling the gaps. I found my self

challenging the interviewee to speak the truth, when I discover that the respondent was not saying what I already knew to be true about the system of education.

From an insider perspective it was hard for me to be naïve, to ask question, to seek clarifications and to listen. I found myself being the participant of my own study. However, as an outsider from U.S and working in Nairobi, I learned a lot. I was highly regarded and given extraordinary support. Teachers, education officials and elders gave me their hearts and revealed everything they thought was needed to be addressed to make schools better for children. My participants saw me as their advocate and consequently bestowed their trust in me.

Traveling in Turkana was a nightmare during rainy season. The roads to rural schools were impassable. I postponed a visit to *Kalapata primary* until the rains were over and the road was passable by a motor cycle. In Turkana public transport was simply not in existence due to poor road system or lack of road infrastructure. But reaching the elders at the villages I had selected for fieldwork was still possible from my home village. Elders visit their friends and relatives and some of these relatives would be in my village. The elders who helped me in the village would know that an elder from one of the villages I had planned to visit was around. The elder would then be contacted for me to interview. In this way the village elders networked among themselves and really contributed to the success of my fieldwork.

I used three languages in interviewing and writing the dissertation; English, Turkana and Kiswahili. Translating Turkana language to English was challenging as it was not easy to find exact English words for Turkana words. For example, it

was not easy to find names in English for most Turkana trees, diseases etc. Thus I have included Turkana words with context for the reader in some sections of the findings.

Finally my methodological framework and fieldwork methods ensured I had the tools required to access the data that I analyzed to lead to the findings I will describe and discuss in the next three chapters of the dissertation. Chapter four will present the findings related to Indigenous knowledge and sociocultural practices of the Turkana nomads. Chapter five will describe instructional approaches observed in early childhood grades (preschools and first grade classrooms).

## Chapter 4

### TURKANA SOCIOCULTURAL PRACTICES AND SCIENCE

#### CURRICULUM AND INSTRUCTION

##### **Introduction**

In this chapter I explore the answer to my major research question regarding the relationship between Turkana children's everyday sociocultural practices of their pastoralist lifestyles and the national science curriculum taught in early childhood grades (preschool to first grade). I answered this question by exploring two kinds of data. First, I interviewed elders and made observations of their cultural practices and artifacts in homes and the community. In addition, I observed children in their naturalistic settings while performing family responsibilities at the homesteads and at their natural playgrounds. The second part of the question dealt with the national curriculum content in schools, which I will describe in the final sections of the chapter.

As indicated in the methodology chapter, my fieldwork was conducted in two communities of Turkana. One community is semi-urban and the other a traditional nomadic pastoralist community. However, the distinction is largely political, as realistically this research did not establish differences in their socioeconomic lifestyles that give one advantage over the other in terms of resources for educating children. People in semi-urban community tend to be more settled and live by operating small businesses in the form of shops, small kiosks, women selling small vegetables in makeshift groceries, selling of fire woods, charcoal, operating wood carvings and basketry in handcraft shops for



tourists, selling livestock products and other small socioeconomic activities. A large population in the town though remained to be inhabited by local pastoralist and reflected life in poverty that depends entirely on handouts from the Government. Majority of these families who live in poverty tend also to have the majority of children in the surrounding schools. Other inhabitants of the semi-urban community include local teachers, non-native people who are working in Government and business people from other communities of Kenya. The children of this class of people (“middle-class”) tend to live structured life which is basically from school to home and vice versa. Children from this category of families do not in most times engage in informal play activities outside school common with traditional children whose families lead traditional lifestyles.

In the traditional nomadic communities, settlements are both permanent and temporary. The mode of socioeconomic lifestyle is livestock husbandry, selling firewood, wild fruits, honey, charcoal, livestock skins, wood carving and basketry etc. During draught most people tend to move to a settled area that usually may have a business center with a school, a chief camp and a church. However, during the rainy seasons, people migrate from the permanent settlement to far places where livestock can get adequate pasture. This time of the year is not good for school, as children also migrate with their children. During draught periods schools usually have adequate children population as compared to rainy seasons. Children also do not find the feeding in school to be more nutritious as compared to the kind of meals available at home during the rainy seasons.

In traditional settings, elders gather under a huge sacred tree to rest, plan their activities, discuss issues of the community together, meet visitors etc. Other elders will be busy with their household chores in different areas of the community. The elders in semi-urban settlement conduct their activities in some similar ways, although their way of life is characterized by idling and apathy. Majority of these semi-urban elders were likely to have lost their livestock and were most likely to see themselves as living in misery. I did not enjoy interviewing the urban elders as they were seeing me in terms of a rich educated person coming with gifts from Nairobi. In fact the urban elders never had time to listen to me, compared to elders in traditional nomadic areas, who literally identified with my goals and were prepared to help me as much as possible.

In both communities, children play a lot after school at the river beds. Traditional Turkana children in both communities continue to stay away from home even at the end of the school day. Usually the day meal for the early childhood age children would be at school. Since the children have eaten in school, they would continue to play after school on their way home until evening as they are aware that the only other meal they will get from home was dinner. In this way the life of Turkana children in most cases was spent in the open in the natural world. However, children in nomadic traditional villages combined play with herding of livestock, especially the goats and their kids.

## **Turkana Cultural Practices and Indigenous Epistemologies**

This section presents the findings of my informal semi-structured interviews with Turkana elders. The questions were generally focused on areas related to their expertise and covered areas such as their knowledge of hydrology, weather and climate, livestock, plants, tools, traditional medicine and socialization of children etc. The elders were open to add to the list of my questions other areas of Indigenous knowledge that I missed in my line of questioning. While at the village I visited community handcraft centers and traditional artisan's workshops and examined household equipments and tools used in traditional nomadic households. The interviews included both men and women. Analyzing my conversation with the elders which I audio taped, I was able to develop themes of Turkana sociocultural practices and their Indigenous knowledge which I am describing in this section.

### **Turkana Calendar**

Turkana people believe that the moon "dies" on the 28<sup>th</sup> day (of each month) and rises two days after. This day is also the end of their lunar calendar. The Turkana are in complete darkness for one day, on the second day the moon is seen by blind people and everyone will see the moon on the third day. The Turkana calendar will start to operate on the third day when the moon is visible to everyone in the community. Turkana people do not count "the dark days." They claim that the White man's calendar includes the dark days when the moon is not in sight.

The Turkana believe that the modern year is equal to two years of their calendar. Each Turkana year had six months consisting of dry and wet seasons respectively. However, the Turkana had to modify their calendar and merged their six months seasons into one full year calendar of twelve month to match with the Western calendar, although their calendar year starts in March and ends in February. But the Turkana year continues to be determined by the two seasons (wet and dry seasons), each lasting for six months. The wet season starts in March through August followed by a dry season that begins in September and ends in February. In the Turkana language the wet season is called *Akiporo* and the dry seasons is referred to as *Akamu*. The names of the months in Turkana language describe the weather conditions as reflected by changes in the ecosystem. Some months' names signify the activities the people carry out during that particular weather condition. For example, there are months the community devotes for rituals and celebrations, while in other month's people engage in copying activities as the climate becomes drier and food becomes scarce. The section below provides Turkana elder's descriptions of each of each month of the year.

**Table 6**  
**Turkana Seasons and Annual Calendar**

	English Month	Turkana Month	Characteristics Turkana months
Wet Season	March	<i>Lomaruk</i>	This is the month of hunger, although the clouds are starting to form marking the start of rains. Livestock (camels) are slaughtered for food. The community is hopeful as the long rains are expected.
	<i>Akiporo</i>		

April	<i>Titima</i>	The rains start to fall. The land turns green with plenty of grazing pasture for livestock. Milk is plentiful in the community. People are happy as food is available even from plants.
May	<i>El-el</i>	This is the flowering month. The land is beautiful. Livestock are reproducing. Environment is rich in fauna and flora.
June	<i>Lochoto</i>	Lochoto means muddy, because the livestock resting grounds are muddy. Women and children wade in the mud as they milk the livestock. The community continues to experience rain storms. Kids and calves keep young children very busy.
July	<i>Losuban</i>	Sacrifices are given to god to thank him for the rain and plentiful food. This is the month of celebrations (weddings and spiritual ceremonies). Traditional dances cut across the community. Unpaid dowries are paid to families.
August	<i>Lotiak</i>	<i>Lotiak</i> means to separate rainy months from dry months. The season of plenty and happiness ends and food becomes scarce. Blood is extracted from goats, camels and cows to supplement the little milk available. The end to friendship and men leave their homes to look for pastures and food.

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Dry Season <i>Akamu</i>	September	<i>Lolong'u</i>	<i>Lolong'u</i> means the middle of wet season and dry season. Hunger is approaching as the food is limited. Animals are no longer capable of providing milk or blood extracts.
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October	<i>Lopo</i>	<i>Lopo</i> means cook or boil for longer hours. It is associated with cooking hard foods like wild fruits. People resort to hunting wild animals and gathering of wild fruits. Cooking wild fruits can be a hard task. Cooking is done by the water source as plenty of water might be necessary.
November	<i>Lorara</i>	<i>Lorara</i> is falling fruits, seeds, leaves etc. Livestock (goats and sheep) depend on dry ripen fruits of acacia trees. People dry plant seeds for livestock and for human consumption. People resort to dried foods such as milk.
December	<i>Lomuk</i>	<i>Lomuk</i> means cover. All the fruits and disappear and trees start to blossom to form canopies. This is the time for adaptation of plants and livestock to survive dry weather.
January	<i>Lokwang</i>	<i>Lokwang</i> means white to signify dryness associated with the month. There is severe hunger in the community. Children are malnourished. Livestock slaughtered to sustain the families against the drought.
February	<i>Lodunge</i>	<i>Lodung'e</i> is putting off the dry season. The dry season comes to an end ushering in the start of a wet season.

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Source: Turkana Elders: March/April:2010

Nomadic people predict rain by analyzing patterns of the environment and the universe. They believe in the predictability of nature. Their calendar is a predictor of rainfall and drought conditions. If the pattern of climate conditions change, the monthly calendar will be interrupted and the need to start strategizing to prepare for good or hard times becomes necessary. Besides the Calendar,

Turkana use the planets and the changing positions of the constellations' on the sky to predict annual weather changes. Elders predict drought or a calamity (death of a community leader) when the sun or the moon is setting or rising with a reddish color. Whereas, a yellow color of the sun and moon indicate a good harvest or a rainy period. The Turkana observe the position of the moon when it appears for the first time and if the moon's crescent appears to be upside down, the people believe that it is an indication of bad times ahead.

Turkana people share stories, beliefs, myths, etc. about the universe. The Elders believe that rain came from God. The Rainbow on the other hand is associated with the devil because its appearance on the sky is an indication of the end of the rain. Traditionally elders pray and gave sacrifices to God to request for rain, especially when drought persists. The universe is a sacred system and heavenly bodies like stars, moon and the sun all carry supernatural and spiritual significance. For example, whenever the moon is sighted, spiritual messages have to be said by the elders, which included prayers to thank God for allowing the moon to return (elders spit on the sky, on to the chest and on the faces of children). Eclipses are regarded as the death of moon or of the sun. When eclipses of the moon and the sun are sighted each household in the entire community plays the drum (played by women assisted by children in all the villages). The sounds of drums travel across the entire community and the different villages respond in unison to the drum beats. The purpose of drumming is to resurrect the moon or the sun from death. When the eclipse clears releasing the heavenly body, the drum beating stops and people return to their normal socioeconomic activities.

Another way of predicting natural phenomena is to use traditional shoes made from camel or cow skin. The pair of shoes is flipped in the air and when they land on the ground and rest a certain way, the reader can tell the message conveyed by the arrangement of the shoes. For example, they will read from the shoes that they are likely to experience an epidemic, lack of rain or plenty of rain. Turkana Elders have general ideas about their natural environment and are not surprised by lack of rain or by flooding when heavy rains strike. They are aware and expect certain calamities (natural or manmade), conflicts, human as well as livestock diseases, raiding or tribal conflicts over livestock, etc. as they have already predicted them from studying the intestines or by playing their shoes and by studying the universe.

The elders emphasized to me that, this calendar does not apply today, as they are no longer able to relate weather patterns with the monthly changes. One elder commented; "Today the world is upside down." The elders indicated in their narratives that in this modern era they are surviving by mere luck and depend to a large extent on assistance from the Government. They are unable to survive on their own as they are no longer able to predict and monitor their own weather patterns using their traditional methods.

### **Figuring out Directions**

The moon and the sun give life to the community. Rituals are performed as long the moon continues to be sighted on the sky even though they are held in the morning. In a cleansing or initiation ceremony, for example, the individuals involved face to the east (face the sun) when the blessing or the initiation rituals



are in progress. The sun is the reference point of directions in Turkana during the day. For example, East is referred in Turkana as *Kide*, North is *Kwap*, South is *Kuju* and west is *Atoo*. Despite the vastness of their land, consisting of harsh desert terrains without roads, Turkana people are able to figure out directions to their destinations day and night without difficulty. They are guided at day time by the sun and at night by the moon.

Besides the sun and the moon, Turkana use the stars and the planets to locate the directions of their destinations when travelling at night. The stars at night are also used to identify the times of the night. Turkana people are travelers and therefore knowing the times of the night and the direction of their destination is very critical. The sun and the moon are used to predict climatic conditions and traditional beliefs. Elders study the stars' arrangement, the trend in the setting and rising of the moon and observe the colors of the sun and the moon as they rise and set. The elders interpret stars' constellations, for example, one constellation in the universe has a shape of a male Camel sitting on its sleeping ground. Other constellations are said to represent a group of hunters with their hunting dog. Herdsmen use the planets that appear in the morning for figuring out directions and for telling the time of the night when they would start a journey in the early hours of the morning.

### **Predicting Natural Phenomena Using Animal Intestines**

Experts read the intestines of both domestic and wild animals to confirm the predictions of weather changes predicted by observing the sun or the moon. By rechecking the predictions of the heavenly bodies with the intestines of

animals, Turkana people are able to manage the grazing patterns of their livestock (e.g. move the herds to a different location) and in some circumstances may offer sacrifices to keep the community shielded from the predicted calamities.

Turkana people predict natural phenomenon such as rain, weather conditions, calamities, visitors, draught, enemies, killer diseases etc by reading the intestines of goats, sheep, cows including those of wild animals, for example intestines of rabbits, gazelles and others. Camels and donkeys intestines are not used for predicting. The elders describe the intestines as an animal organ that houses their world view. It is like reading a map or a city plan. The difference is that the intestines represent a dynamic world view of the people and show events in the community as they unfold continuously. In the intestines they can read the plan of the community, the villages and homesteads. A goat slaughtered by a family will have its intestines showing every aspect of the homestead, such as the settings of the compound, number of co-wives and arrangement of their houses, number of children and relatives. The intestines will tell everything about the family including expected visitors, fortunes and misfortunes. If visitors are expected, it is possible to tell where they are coming from and the direction from which they will enter the village or homestead. This is the same for enemies when they are planning an attack to the community.

The Turkana study the intestines carefully, examining the blood vessels and the manner the blood flows. They will look at the flow of the digested materials in the intestine and study how it is arranged. Scarcity of digested food materials and constrictions in the intestines give predictions of drought or

misfortunes in the community. They will tell the death of a close relative or of prominent person, including the signs of good weather or draught. Although, ordinary traditional Turkana people have general knowledge of how intestines work, there are experts readers of the animal intestines. The clan of the experts is referred to as *Ng'isiger*. All *Ng'isiger* people, men and women are intestine readers. Most of the time, it is the men who read the intestines, even though women are capable of doing the same with accuracy. In homesteads where women are in charge or have been given permission by their husbands, they will read the intestines and give guidance to the community.

Predicting events through intestines can be problematic and sometimes can lead to a contested argument between experts. Usually the opinion of one person is not enough to give a full report of what the intestines are predicting. Several elders have to read in turn or they will read as a group to reach a consensus of the interpretation of the predicted event. This consensus building helps them to achieve some sort of “triangulation.” However, the problem starts when some ambitious elders try to hijack and monopolize the prediction process for the sake of recognition. This may lead to an argument between elders and might cause disagreement, especially if the prediction enforced by the expert appears problematic. Disagreement in the intestines reading is not good for the community as it signifies lack of clear leadership. The community trusts the information the elders release as a result of reading the intestines as it is critical in providing leadership in how the people will face the future.

It should be noted that in the present contemporary lifestyle where modernity is the way of life, Elders have lost the ability to practice their cultural practices to the extent that the use of intestines as a way of predicting natural phenomena has become a rare cultural practice. In addition, due to unpredictability of the climate in Turkana in the recent times, the Turkana people experience droughts almost yearly. Elders have continually been experiencing discouraging predictions of their environment from the intestines and as a result they have resorted to abandoning reading these animal organs since the messages are consistently showing harsh climatic conditions. Turkana people are almost sure that they will continue to experience long periods of rains even without reference to the intestines. The predictions are always related to hard times and the frequency at which the intestines predict misfortunes such as draught, inter tribal conflicts, hunger, poor school success of children are continuously discouraging the people. As one elder stated, “We no longer see the intestines because they are not good to read. The picture they give is discouraging” The elders explained that modern life has interfered with the way they strategize traditionally to respond to issues they predict. For example, even if they were to apply their predictions to organize themselves, they will no longer depend on their own experts. They have to report everything to the chief or to other local leaders who usually do not trust traditional ways of predicting Mother Nature. In addition, modern ways of leadership contradict traditional modes of administration.

Like the training for all skills, the children learn how to read the intestines and make prediction as soon as they start herding livestock, which is usually

during the preschool age. For example, by toddlerhood the child is watching and holding a stock such as a goat. The mother or the father will encourage a child very early to touch a goat, a sheep or a kid of a goat. By the time the child is two and half years she/he is already following older children or the parents when carrying out livestock activities. Children learn to read the intestines by observing the adults. For the case of *Ng'isiger* children naturally learn to read the intestines. Parents, elders and clan members have the reasonability to train young people to ensure that the skill is maintained by the clan.

In Turkana culture, women and men have equal responsibility in training children in all the cultural skills. Elders acknowledged that the training of women is the most efficient and thorough. Ordinarily a child's interest matters and determines the keenness of their observations as they watch and participate in adult's activities. Children follow the adults and observe and internalize every activity they do, including how to slaughter an animal, skinning, roasting, reading the intestines etc. They will also learn the rituals and spiritual activities related to every event the adults perform. Boys and girls learn all the cultural skills needed for competency. All children are recognized according to their efforts and the competency at which they learn the skills they are taught. Although every young person has a general knowledge of concepts and skills of his/her culture, it is not mandatory that children learn every skill in perfection. Young people perfect only the skills they develop interest from early childhood.

## **Livestock Herding and Animal Husbandry**

Herding of livestock is a specialization children develop interest and associate themselves from childhood with particular herd or species of live livestock. Turkana people keep five species of livestock, which include goats, sheep, cattle, camels and donkeys. Goats graze with sheep, Camels, cattle and donkeys graze separately. Donkeys do not necessarily need herdsman, however, they are monitored from wherever they are grazing and they may return home by themselves or a member of the family especially the father will go for them in the evening. Donkeys are not usually kept in large numbers (2-10 at most). They are the beast of burden, but in rare occasions they are slaughtered for meat. Not everybody eats donkey meat due to its strong smell. Donkey milk is given to young children for immunity against respiratory diseases. Goat, sheep, camel and cows' milk is consumed by both adults and children on a daily basis.

Camels and goats are the most important livestock in terms of day to day dietary intake of a Turkana family. Their browsing ability makes them very resistant to dry weather conditions and can give milk almost throughout the year. Blood can be extracted from a cow, a camel and from a goat by puncturing one of the veins at the neck. The blood from the bleeding animal is trapped and mixed with milk for the herdsman to drink. Sheep's fat (fat from the tail) is used for treatment of illnesses. Most rituals are performed by slaughtering a goat or sheep. These species of livestock are also sold for money, which is used to buy the family other food items (sugar, corn, beans etc.) and tobacco.

Cattle are the most difficult to herd as they require plenty of grazing pasture. They graze mainly on the highlands where there are plenty of grass and herbaceous vegetation and drinking water. However, cows are a good source of milk and are used in performing important rituals and ceremonies like marriages and others. Turkana dances are composed from praises of cattle. Goats and cows feed on grass and particular species of herbaceous vegetations (*Ekopir, Aitamos, Aduar, Ekaletelete, Esuguru*) [Turkana names]. However, goats and camels have the advantage of feeding on trees branches besides feeding on shrubs and their browsing capability. Camels feed on a tree species (*Emekwi*), although they can also feed on grass when the trees dry. Cows and sheep only feed on graze and short shrubs. Cows may also feed on some species of trees (*Ekabonyo and emaritoit*) besides the grass, while the donkeys feed mainly on one type of tree (*Epipa*). Cows, goats, camels are ruminants – they continue chewing long after they have stopped grazing even at night until the grass is very soft. The elders emphasized that the herdsman would never allow camels to graze with other livestock as they will kick and step on them. Calves can graze with goats, but will not sleep in the same Kraal. Goats Kraals are build very well to ensure protection from theft. The pastoralists consider livestock products good for healthy wellbeing. In addition, the livestock are slaughtered when rituals and ceremonies are performed for members of a family and community offerings.

Treatment of livestock is by trial and error. The common treatment is to press the part suspected to be causing the pain to the animal with a hot stone (warmed on fire), or use a hot metal rode or press with a hot brunch of a species

of plant called *Egis* (Turkana name). They will press the hot object on the neck or on the abdomen or on the legs or on any part that is identified as hurting the animal. The activity is performed a few times in a day for a week or so until the pain reduces and the animal regains its strength. They also crush and squeeze or boil plant herbs and use the plant extract to give to the animal. Herbal plants include; *Ng'imusia*, *Echuchuka*, *Erodo*, *emus*, *elila*, *abach*, *Elila* (Turkana names). *Abach* is used for the treatment of coughs and pneumonia (*Loukoi*). Goat diseases include *Etune* and *Naosin* which mainly cause the goats to diarrhea. Some of the diseases that attack the cattle are *Eyala*, *lour*, *apid*, *Lokio*, *Loleo*, *Lokot* (Turkana names) etc. A hot Iron rod or a hot *Egis* stick is used to treat these diseases by pressing them on the affected parts on the body of animals. Tsetse fly, ticks and Trypanosomosis and other types of parasites are the common livestock diseases that Turkana herdsman deal with as they engage in their livestock husbandry. Livestock that die as a result of disease attack are eaten. This fact was emphasized by the elders and it is an issue to follow up with the elders in the future.

The pastoralists believe that livestock diseases are increasing in this modern era. They argued that modern life has come along with diseases because they know they have the medicine for treating them. One elder pointed out;

Even rain has become scarce, because white people know that they have relief food to give us. There used to be Locust which used to destroy all the grass in the community. Livestock suffer as a result of the locust; however, rain comes after the locust resulting to large pastures. Today you cannot see the Locust. It was destroyed by the airplane which powered a yellow drug on the land to kill all the Locusts. After that we no longer see the Locust. This has also lead to frequent drought which has drastically reduced the pasture which used to bring the Locust to our land.



## **Herding Training**

Herding livestock is a skill that Turkana men, women and children master with precision. It is like being connected to the livestock physically to the extent that you can tell any little scars, cracks, cuts etc that are inflicted on the skin or at the hoof of the stock on daily basis. These things count when studying a particular species of livestock to master, for example the marks or the prints made by hooves on the ground. Children as well as adults know by looking at the hooves prints marks on the ground that this stock belongs to their herd or it is a straying stock from a different herd. Turkana herdsman study livestock hoof prints in almost equal accuracy similar to the scientist study of figure prints. An elder turned my shoe upside down and explained;

do you see this shoe, do you see it has prints, the camels hoof is the same. Each camel has prints unique to itself. By studying their hooves, we can tell our camel when it gets lost or when it is stolen by another herdsman by tracking the hooves' prints

By studying the hoof marks on the ground, they will tell that this animal is from the lowland or from the mountains/highland. An elder explained to me that animals that graze on the lowlands have long nails on their hooves and those that graze on high lands or at the foot of the slopes have smooth hooves or broken nails. The highlands are made of coarse sands, gravels, and boulders. The rough coarse terrain eats the hooves of the livestock to alter their shape and structure. Hence the marks livestock make on the ground are characterized by the sharpness or smoothness of the hooves.

The herdsman studies the stock and notices any small cuts or marks that are acquired as the stock interact with the harsh terrain of desert ecosystem. For example if a stone hits the stock, it will most likely hurt its hoof. After this has healed a mark remains. This mark will be used by the herdsman to differentiate his stock from the rest of herds. The herdsman keeps mental records of these physical changes no matter what part of the body of the stock the marks are located. This is something the children have to master as they interact with the livestock from childhood. Marks on hooves, will differentiate the hooves of his livestock from the others and would assist in tracking a lost stock from the rest of the herds. Turkana herdsman use these unique marks to trace specific livestock of their herd when they are lost or stolen.

Turkana people read the footprints of people in just the same way they track livestock by the marks of their hooves on the ground. Individual herdsman master the shoe marks of their relative, friends and neighbors. In most cases Turkana herdsman use the same pair of shoes. It is easier therefore to recognize individuals by the foot prints/marks of their pair of shoes. If individuals wear shoes with the same prints, the herdsman will study the differences in the way the individuals step on the ground. For example, the positioning of the foot to the ground or the amount of pressure exerted on the ground by individuals as they walk etc. People study not just the hooves of livestock but also the footmarks of individuals living in their village and beyond. Studying people's foot prints is important, because livestock stray with individuals. Theft of livestock among the pastoralists is a common cultural practice resulting in frequent conflicts and

livestock rustling among neighboring pastoralist communities. Tracking of people will help the herdsmen to know the presence of strangers in the community as they are likely to be a threat to their livestock.

Turkana pastoralists study the anatomy of most of their herds. They can tell the body structure of the livestock, the length of the bones, and general weight of a particular stock. They have such complex knowledge of livestock including fertility and gestation period, dietary intake and species of forage intake capacity. Elders described a strange situation in which certain individuals adapt to the livestock to the extent that, they can tell from the test of the meat that, the meat belongs to a stock from his herd. These individuals will examine the bones of the dead stock in addition to the taste of its meat to confirm evidence that indeed the stock was slaughtered from his herd without his/her knowledge.

Livestock are also branded and a family will have a general brand that identifies livestock species of their herd. However, siblings who own herds will have another brand unique to each individual to separate their herds from the family herd and to differentiate individual herds.

Turkana people do not count their livestock directly using numbers. Instead they classify them according to their cohorts. Livestock species reproduce in seasons and the herdsmen keep track of the young ones born every season. They classify them into a category or cohort and observe, learn and master their characteristics as they develop to maturity. For instance in each cohort, the herdsmen know the males and the females including the genotype and phenotype characteristics of the livestock species. When this cohort reproduce, another

cohort emerges which is described as the offspring of the first one and this is how the classification is determined. The livestock of a cohort are classified further according to color configurations, shapes of ears, color of eyes, facial appearance, height, structure of bones and the sound made by each animal. Turkana herdsmen assign names to individual livestock and will match the stock's sound with its name. By listening to the sound of your livestock, you can recognize your stock from a distance and at night.

Knowledge about livestock herding is learned from the time the child is born and continues in adulthood. The elders explained that from preschool age, the child accompanies the adults and the livestock. They learn by being present, by watching the adults and by observing every small thing adults do to the stock. The learning is hands-on, for example, children participate in the milking, skinning and treatment of livestock with the help of adults. They develop a connection with the livestock from the time a stock reproduces a young one. The children master how the kids of the five species of their livestock mature and study all the physical and behavioral characteristics including reproduction patterns. Specialization begins to emerge in the children as they become older. Skills began to differentiate in the children and separate into cattle herders, goats' herders or camels' herders etc.

As the children specialize according to their interest in herding of particular species of livestock, other skills are also learned. For example, knowledge of livestock anatomy, reading the intestines, slaughtering and skinning, milking, extracting blood from an animal, tracking, breeding, etc. The father and

the mother are critical in the training of children. The two parents are responsible for day to day instruction of livestock herding. “Take the herds to this particular water source and graze them in this pasture after they have had the water”. “Do not hurt the livestock and be watchful on predators” parents instruct the young herdsman.

The mother and the girls are responsible for giving the livestock water at the well dug at the river bed. A family can own a Water Well that it participated in its exploration and digging at the nearby river beds. Sometimes a Well can be a source of conflict if another family uses it. The parents and older siblings provide guidance to young children. Training continues as parents continue to monitor indicators of competence in children. The support and guidance from adults is gradually withdrawn and children slowly acquire the autonomy to herd. But adults continue to maintain surveillance with a watchful eye indirectly. For example, when the animals return, several indicators are monitored by the parents “ are the herds well fed, have they been given water, are all the livestock back, are the children able to answer any technical questions asked etc.” Other questions include; did the herdsman select the right grazing area and was the herdsman watchful on the predators? The frequency in which the stocks are lost is an indicator of an incompetent herdsman. Girls and boys are trained in the same way. Girls look after the herds just as well as boys. The mother may take the herds to pasture occasionally but with the highest degree of surveillance. The training of the mother is very rigorous. Even though the work of herding is given to the young people, adults will be available to give support where necessary. For

example, when danger is sensed or when an animal is lost adults will be handy to give support to the young herders. The decision to change the area of grazing or to relocate to a different location rests on the parents.

### **Water Exploration**

Water is critical to the herdsman relying on livestock for survival. An Elder, made the following comment; “God is the one that gives water”. Believing in God for the provision of water demonstrates the natural ability of the pastoralists’ to survive water scarcity associated with their desert terrain ecosystem. For instance, the Elders know the likely places along the dry river courses where Wells can be dug to get water for human and livestock consumption. However, when the community is confronted with drought challenges, for, example, when traditional water sources dry up, elders have to use Indigenous knowledge of their ecosystem to examine and explore alternative water reservoirs underground. The Elders study the sand carefully, observing the type of sandy soil on the river courses. White clear sand, grey sand and black fertile agricultural soil observed on the river bed or by the dry river banks indicates the possibility of water table being close underneath. The elders study the characteristics of certain types of plants, for example, *Esirite*, *Atesiro*, *ngikalalio*, *Edome etc.* (Turkana names). Places on the river where these plants grow are associated with closeness of water table to the surface. Generally places along the river where some acacia woody trees appear green for a sustained period of time will be an indicator of water under the surface. The elders study the rocks underground or at a river bend, they observe the leaves of trees, they study

the frequency at which birds and wild animals hang around at some isolated places at the river courses. Elders study the slope of the land and examine places where land flattens at the bottom of the sloppy landscape including river bends. A place where an Ant eater has dug when it is searching for water is almost the surest way the elders use to tell the presence of water at a dry river course.

After examining all possible water indicators, an elder confirm the presence of the water table by dipping a sharp pointed end of his spear into the indentified area on river surface. If water table is close, the tip of the spear will be wet and this will be sufficient indicator to enable the digging for the Well to start.

As one elder narrated;

We test for the presence of water using a spear. We use the tip of the spear to get the indicator that there is water. You spear on the sand on the river. The father does this in the presence of his children (girls and boys). When you spear, the spear goes down through soft sand much deeper. When you pull out the spear, the tip appears wet showing the presence of water. Digging a well is not just the preserve of a particular group. Every body does the digging

A Well can be dug for long hours, sometimes overnight before the water table is reached. The diggers will return to continue digging the following day if they were not successful the first day. Sometimes when the diggers return the following day, they will find the place has over flown with water. The depth of a Well during drought seasons can be estimated to be as deep as thirty meters. The number of people (males and females) who enter the Well at one time to give water to the livestock determines how deep the Well can be. A Well as deep as thirty meters can take approximately up to ten people to line up down to the

bottom of the Well to water the livestock. People stand on steps constructed at a slope along the wall of the Well as the digging progresses down to the water table. The shallowest Well is one with two people passing water to each other. Usually members of the family help each other in drawing water from a deep well for the livestock. But neighbors can assist in cases where members of the family do not have the numbers needed to reach the bottom of the Well.

The Government water engineers use the knowledge of the elders in identifying possible sources of water in the pastoralist areas. Usually where the locals get water, the Government water experts are likely to get water from the same place, but in large quantities. Local water experts believe that the knowledge was given to them by God and argue that the knowledge will be passed to their children.

### **Fire Making**

Fire symbolizes the presence of God as well as the presence of human life in the village or in a home. Besides its use for cooking, fire helps the livestock to trace the home. It is used for branding livestock and as well as for treating both humans and livestock. A woman giving birth should stay in a hut lit with fire to symbolize life as well as lighting the environment of the baby. Rituals performed for the infant are carried out with the help of the fire. For example, women and close relatives visiting the mother will chew tobacco and spit some in the baby's fire.

Turkana make fire from two sticks rubbing on dry donkey dung. The two sticks are obtained from trees known for producing fire. Some of these trees are;



*Edome, ebitwosin, Eurumosing, Eduoite, Eregae, Ewoi, Ekurichanait, Ekadeli Lolei, Esekon, Ekali, Epongae lo-e Emoru* (Turkana names) and others. Men as well as women can make fire from the two sticks. A family carries two fire sticks whenever they move to new locations. The sticks are safely kept in the house, when not in use. Women as well as men make fire. Fire is made by spinning one of the stick into a small groove made on the second stick. One stick has a pointed end and the other a small groove is cut with a knife. The pointed stick is pushed into the second by spinning it hard with both hands on the groove of the other. Human power and energy is required to generate the friction that is required to produce fire from the two sticks and for this reason two men or women spin alternatively until a small fire ball drops. The fire ball is caught by the dry donkey dug which immediately turns into smoke as the herdsman continue to blow on it to produce the flames. Fire making is not an activity that is done on daily basis. It is done only when the home settles in a new place which has no home close by to get fire from. Herdsman hunting will need fire to roast their prey, and fire has to be made from the dry tree sticks. Otherwise traditionally fire continues to exist in the home as the family has the responsibility of ensuring it does not extinguish after it has been used for cooking.

### **National Science Curriculum in Early Childhood Grades**

In this section I explored the content and implementation of the national science curriculum in early childhood grades (preschools to first grade) in Turkana schools and present the findings of my interviews with teachers, education officials, schools principals, curriculum planners at national institutions,

and teacher trainers at colleges. I interviewed curriculum experts in Nairobi, the capital city of Kenya. Then I moved to the community to interview the grassroots education stakeholders. In addition, I did observations of science instruction in early childhood grades (preschool and first grade) and content analysis of syllabuses, textbooks, examination scripts, teachers' lesson plans and schemes of work and official education policy documents and learning materials. In every school I visited, I carefully studied the syllabus and the textbooks to see any materials that related to the cultural practices of the Turkana people besides documenting the scientific concepts or themes children learned in early childhood grades. I also asked to see the schemes of work and the lesson plans of science. I read each of these documents and made notes to get an understanding of the quality of the planning of science lessons and the kinds of materials teachers use in teaching science. The table below captures the themes of science as documented in the various education documents used on the schools. Interviews of curriculum officials in Nairobi and the districts confirmed in addition to the analysis of the syllabus results in the documentation of the science concepts presented in Table 7 illustrated below.

**Table 7**  
**National Science curriculum (Early Childhood through First Grade)**

Early Childhood Science	1 <sup>st</sup> Grade Science
PLANTS AND ANIMALS	HUMAN BODY
External parts of animals and plants	Parts of the human body
Use of human body	External body parts
CLASSIFICATION	HEALTH EDUCATION
Animals and plants	Cleaning body parts
Specimen	PLANTS

Sorting and grouping of items	Different plants in the locality
Senses	Main parts of a plant
EXPERIMENTATION	Edible parts of a plant
Growing of plants	WEATHER
Caring for pets and plants	Observe weather
Water	Weather changes
Light	ANIMALS
Weather	Animals in the locality
Sound	External parts of big animals
Speed	WATER
Force	Sources of water
Mass	Uses of water
Soil	SOIL
Simple recording	Playing with soil
FIELD EXCURSIONS	Feeling soil
Nature walks	Drawing on soil
Field visits	Filling and emptying with
soil	
Farms	FOODS
Markets	Foods eaten in the
community	
Shops	ENERGY
Parks	Light
Orphanages	Sound
Post office	PROPERTIES OF MATTER
	Presence of air
	MAKING WORK EASIER
	Making wheels
	Using wheels

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Source: RoK/MoE (2008, 2002), teachers, and education officials

Table 5 presents the national science curriculum taught in preschools and first grades science content. In preschools, process skills are emphasized and are presented as thematic areas that focus the learning of science. Whereas in first grade, themes of science content areas emerge and process skills are not appearing prominent in the syllabus, suggesting that as science instruction enters formal learning in schools, content is emphasized and process skills de-emphasized. In my observation results discussed in chapter five of the dissertation

I have tried to explain in detail how science experiences are learned by children in early childhood and in first grade classrooms.

However, the main observation in this study is that the content of science in the national science curriculum appears to be congruent or compatible with the traditional Indigenous cultural practices narrated by the elders and practiced by the children. While appreciating the fact that, this study did not bring out all the knowledge of the Turkana people, however, by carefully analyzing the knowledge presented in the first sections of this chapter, it appears reasonable to observe that knowledge from the elders is not fundamentally different from the science knowledge taught to children through the national curriculum. All the cultural knowledge narrated by the elders, for example, fire making, plants, livestock husbandry, weather, the universe, water, soil, the calendar etc appears to conform in general ways with the national science curriculum content. How the two kinds of knowledge are passed into the learners, might be the basis of the argument of their differences. However, the differences may be more attributable to weaknesses, especially in school science in instructional approaches than the fact that one is superior to the other. I will explore the findings related to these issues in depth in next chapter.

### **Chapter Summary**

The findings in chapter Four demonstrated that there was a potential for congruence, in thematic content of science between Turkana Indigenous knowledge epistemologies and the national science curriculum. In school, for example, children learn about animals, plants, weather, water, food, soil etc. The

same skills are learned by Indigenous children from their everyday social cultural practices. The difference is that formal science curriculum organizes these skills in a systematic way such that they are presented as a content to be learned through a planned schedule. Formal science also assumes that children start by learning simple concepts and as they move through grades, the concepts continue to advance in complexity. On the contrary, Turkana Indigenous knowledge is holistic. Society, individuals and knowledge are one and the same thing. Knowledge emerges as children require competence in certain tasks needed to perform a family responsibility. Knowledge has a purpose and skills are learned as children engage in problem solving exercise. In addition, unlike formal science which identifies, skills of science in terms of age of learners, it is not easy to delineate a curriculum of science for children from the adult curriculum in Indigenous cultural practices.

Children are an integral part of the society in which they are developing from and hence the same skills older children learn are the same ones preschool children practice but according to their abilities. Preschool children for example will learn to herd just as the older children, although they will herd the kids of livestock or will simply accompany adults as they herd bigger stocks and continue to learn by observation. Indigenous knowledge requires the individual to be actively involved in community life. Learning this knowledge can be rigorous and comprehensive as it requires the learner to play his/her best role in the life of the community.

Turkana Indigenous knowledge is clouded in myths and beliefs. These beliefs should form the basis of engaging science conversations in the classrooms and may lead to experiment to determine their accuracy. Prediction of rainfall or drought is not determined just by a single belief. If the stars predict drought, this has to be confirmed by other cultural practices which might involve elders reading the intestines of animals, elders interpreting the messages from the shoes or by elders monitoring the pattern of weather conditions as determined by the Turkana calendar. Thinking is more by feeling, memory and intuition. Indigenous knowledge emphasizes observation, memory and use of senses.

Turkana people use prediction as a way of figuring out changes in the environment and understanding natural phenomena. Different cultural methods are used to arrive at an explanation of the natural phenomena. Knowledge of cultural history and of the natural sequence of events such as knowledge of the calendar cycle determines how the future is predicted and how people will strategize and plan for the unforeseeable changes in their environment.

Like traditional scientists who predict by gathering evidence from data, Turkana elders also consult, confirm and do several cultural prediction methods to arrive at an explanation of a natural phenomenon. For example, they will test the meat of a stock, study its bones and confirm from the herd to accumulate evidence that can be used to establish a missing livestock.

The next chapter discusses the findings of my observations in schools and interviews with teachers and education officials regarding science instructions in early childhood centers and lower primary classrooms. These findings explore the

answer to my second research question related to how Turkana cultural practices inform science instruction in early childhood grades in the selected schools visited during the fieldwork.

## Chapter 5

### TURKANA SOCIOCULTURAL PRACTICES AND SCIENCE

#### INSTRUCTION

##### **Introduction**

In this Chapter I will explore and report on findings related to my second research question; how socio-cultural practices of the everyday life of Turkana children inform science instruction in early childhood classrooms. To address this question, I describe Turkana children's play activities in the community; observations of science instruction in first grade science classrooms, and findings from my interviews with teachers and education experts in Kenya.

##### **Sociocultural Practices and Science Instruction in First Grade Classrooms**

One of the general findings in this study was that, even though the schools I selected for fieldwork represented two areas that differ socioeconomically, teachers' instructional strategies and their views about science were very similar. This similarity was not surprising as the findings show that schools follow the same national curriculum. In addition, textbooks used were decided by the Kenya Institute of Education (KIE) nationally and lists of authors with books titles sent to schools to purchase. Shortage of instructional materials, especially those related to science equipments or science kits and additional reference books were experienced in all schools.

During the fieldwork, I carried out observations of science teaching in two schools I selected in *Lokichar* and *Kalapata* communities in Turkana district in Kenya. I did one and half hours of observations in a week for eight weeks. A



teacher was observed in her school for four weeks. My observations in the schools were focused on various aspects of science lessons; for example, I noted how often the teacher used children's everyday knowledge in science instruction; how the teacher made scientific concepts clear to the students; how the teacher maintained a balance between direct instruction of scientific concepts and hands on experiences using authentic hands-on activities of everyday life experiences of home activities; how did the teacher encourage students to learn science as communities of learners; how did the teacher support children's cultural knowledge/experience; what concepts of science did children demonstrate in their play activities at home and at school; what support were the teachers getting etc. The interviews with teachers and education experts were related to how teachers used the local cultural knowledge and social cultural practices in science curriculum and instruction. Education experts included; curriculum developers at the Kenya Institute of Education (KIE), policy implementers at the Ministry of Education (MoE), education administrators at the districts (DEO), principals and teacher trainers at training colleges (primary and early childhood). In addition, I did document analysis of text books, syllabuses, teachers lesson plans and schemes of work, examinations papers etc.

### **Turkana Children's Sociocultural Experiences**

In this section, I will describe my observations of sociocultural everyday life experiences of Turkana children at the village as well as their play activities at the seasonal sandy river courses after school.

After my fieldwork experiences at the schools, I would walk towards the community to interview the elders. On my way usually in company of the teachers or an elder, I enter a river bed (*Lokichar/Kapata* rivers) with the width of approximately a half a mile. The community had received torrential rains two days ago and the river beds had wet sand with water flowing downstream. I would have to walk across *Lokichar* River without my shoes on. The water level was over my feet and walking with shoes on over soft wet sand would make them wet. The main road from *Kitale* to *Lodwar* (see map of Kenya) crosses *Lokichar* river bed. When I turned upstream a mile away I could see buses and trucks still stuck on the river bed reminding me of my experience, when I was travelling to this study area a few days ago, when we were stuck in the sand of another river bed miles away on the same road.

River *Lokichar* does not flow throughout all seasons. It is a seasonal river which gets water only when there are heavy rains in Turkana. For many days this river will just be dry with white sand. However, the river will continue to be a source of water even in dry seasons. The community digs water wells on the river beds which can be as deep as ten meters in times of prolonged draught seasons. When I was conducting this study in April and May this year, water was plentiful in most river beds in Turkana. Water wells were shallow and at the reach of children. In addition, there were ponds of water and streams of flowing water were running downstream on the main river courses. Boys bathed directly using river water or would be swimming in some of the ponds. Girls drew the water and carry it on their heads to their dormitory to use for bathing at night. During the

dry seasons, school children hardly take a bathe as the river beds are sights of dry sand.

As I entered *Lokichar* River and while still figuring out the best place to cross it without wading in too much water and sand, I noticed that the river bed had turned to be a place of busy human and livestock activities. I found that school children were already at the river bed carrying Jerry cans of water and others were having great time playing on the sand. Children were taking water to school and others were drawing for home use. Young children were sitting on the sand and playing with small plastic or metal tins containers. Other children were using their bare hands to construct, model and draw, or build with sand all manners of structures they saw in the school and the community. I watched children playing in small groups of 2-5 together. Girls and boys were playing together, especially preschool-age children. These children were neighbors, siblings, classmates or schoolmates. Preschool-aged children play with the assistance or in company of the older children. The older children provided security to younger ones. Other children would be playing imaginary herding of livestock using small stones or camel dung etc. I watched children digging their own water wells. They pretended they were giving water to the livestock (goats, camels, cattle). Other children are fishing in the river ponds, swimming or hunting frogs. While other children are playing on sand, others are engaged in hunting birds, insects, lizards and all kinds and sorts of animals. I watched other children climbing trees, swinging and jumping on sand from the tree branches.

As I walked towards the homes, another group of children were hanging around their mothers and family relatives helping in small business activities for family income support, for example selling groceries, charcoal, goat/camel milk, firewood etc. When these children are not helping the family, they would start to creatively construct a playing activity with strings tied on their legs or would draw a structure on the ground to start a jumping or hopping activity either on the ground or over a string. For the most part, these children were playing undisturbed, but occasionally one would be asked to help bring up some change and another to sit in parent's place to sell the little groceries. In traditional nomadic rural community, I watched the children milking goats, herding goats and others were in charge of camels. The decision regarding which child was to be responsible for either goats or camels depended on the age and the child's interest.

As discussed in chapter four, nomadic children specialize to be herders of the species of livestock according to individual interest. Herding goats was exciting and challenging and Camels were easier to herd than Cattle. Camel hooves' marks were easier to read on the ground than goats' and cattle hooves. Children learn to differentiate the print marks of livestock as early as preschool-age. Children learn complex skills such as differentiating stock by their sounds, by color, by clan or family brand (every family has symbols to mark on the stock for identification) and hooves' prints etc. As indicated earlier in chapter four, the Turkana count their livestock in chunks or by grouping the cohorts of a breed in one category. The herdsmen knew the quality of the breed of a cohort including

their genetic characteristics (phenotype and genotype). A goat would be identified on the basis of the cohort it belonged. Each cohort was a chunk or a group or a category of livestock bred from a certain season and all the characteristics (sound, color, horns shape, hooves prints, etc) relates to each specific animal of the cohort. By following the cohort from a particular breeding season, children study each animal carefully and learned every property in detail. This was how the child develops expertise of livestock knowledge of the herd under his/her care. This strategy was the same for livestock diseases which they master as they care the animal from it is time of birth.

### **Science Instruction in Early Childhood Classrooms**

To provide a clear understanding of science instruction in Turkana early childhood grades, I describe below an excerpt of a vignette of a classroom observation. I audio taped with the teacher's permission her conversation with the students during a first grade science lesson on the topic "Weather." I will start by describing a typical first grade classroom in Turkana School.

A typical first grade classroom was a standard size (8 by 6 Meters) with two blackboards one at each end stretching across the width of the class. The side walls of the classroom were built half way leaving the rest of the upper section open but protected with mesh wire without shutters. Wind carrying dust would flow into the class unchecked. Nothing would hang on the walls of the classroom in the form of children's projects. In general the classroom was unmaintained and over ventilated. The only furniture in the classroom was the teacher's desk. The class would generally appear to be an empty, unmaintained hall when students

were not inside. Cupboards or any other furniture were missing. Classrooms in early childhood grades were overcrowded due to overcrowding resulting from high enrolments. The class described below had a student population of eighty six children sitting on a dusty floor and writing on exercise books placed their laps.

Teacher: What subject is this...What have I written on the blackboard?

Students: ...science...

Teacher...First graders...who will tell me the meaning of the word...sky

Teacher: What do we see above us?

Students: ... *Jua* (*Jua* is a *Kiswahili* word for sun)... others... "*mawingu*" ... (sky in *Kiswahili*)

Teacher: what is *Jua* in English?

Teacher: it is called sun...

Students: repeat after the teacher...sun...sun...

Teacher: Is there sun at night? What do we see at night? ...

Students: *Nyota* (*Nyota* is *Kiswahili* word for stars)...

Teacher: What is the name of *Nyota* in English?

Teacher: it is called Stars...

Students: repeat after the teacher...stars....stars...

Teacher: above us there is the sky. The sky has stars and moon at night...

Teacher: When there is no moon ...what do you see?

Teacher: (gives the answer)... we see the stars....

Teacher: when there is sun...do we put on heavy clothes?

Students: we put on Jackets...

Teachers: What do we use to prevent us from the sun heat and rain?

Students: *Mafuli* (Kiswahili word for umbrella)

Teachers: What is *mafuli* in English?

Teachers: repeat after me...Umbrella...Umbrella...

Teacher: When the sun is hot we use...Umbrella to cover us from the sun... and we use heavy clothes....Jackets and Umbrella to cover ourselves from the rain...

Teachers: (hanging a chart on the blackboard) I will put the picture here and you tell me what you will see.

Teachers: What brings us rain?

Students: *Upepo... upepo ...*(repeating in Kiswahili)

Teachers: Are you sure it is the wind? What do you call *upepo* in English?

Teachers: it is called wind...say wind...wind...

Students: the words ...wind...after the teacher...

Teachers: clarifies to the students that it is the clouds that bring rain...

Teachers: how do you tell wind is present? Look at this paper (pointing at the chart on the black board)

Teachers: What shape has the sun?

Teachers: The teacher repeats...circle... triangle or circle. Is it like the ball? Is the ball shaped like a triangle?

Students: answers....yes

Teacher: What do you call *Jua* in English?

Teachers: tells them ...say sun...sun...

Teachers: When there is no sun, what do you see in the sky...the sun or clouds?

Teachers: It is a sunny day... when there is sun

Teachers: When there are clouds ...there is rain

Teachers: clouds prevent the sun...teacher told the students to repeat.... a cloudy day...say a cloudy day...a cloudy ... the students repeated these words several times

Teacher: When do we have a cloudy day?

Student: They repeat in vernacular (cannot answer the question)

Teacher: When clouds release rain... we say it is a rainy day

Teacher: What do we say when it is raining?

Student: no answer

Teacher: When there are clouds, what do we say?

Teacher: Why do trees leaves look like this – When there is no wind... we say it is calm

Teacher : (pointing at the chart) asked the students to repeat...the word ...Calm...

when do we experience calmness....When there is no wind, we say the day is calm.....Look at this picture ----What is happening to the trees? They are falling...trees are falling...It is a windy day... when there is a lot of wind we say ...a windy day... What can you see from the sky? Are these rain clouds? When there are clouds...do we see the sun? The sky is dark...When there is cloud cover we don't see the sun....can we say today is raining? Why would we not say today is raining? The sun gives us



light...What do you use to prevent the sun. .with umbrella we can prevent the sun...what does the rain do to us?

Students: it brings water...

Teachers: what do we use water for?

Students: water for drinking... for cleaning a baby's napkins... for cooking food....

The teachers: where does the food come from...? Some children answered from God...

Teacher: name crops grown in Turkana....

Students: ...maize, rice, *basta*, *githeri*, carrots, *uji*, *mboga*, *mchelle*, *viazi*, cabbage, *sukuma* ....students had a very long list...

Science lessons in the schools were generally based on direct instructional strategies. Whether it was a lesson about parts of the body, simple machines, plants, sanitation, weather, water, food, light, soil etc; science instruction in general was reduced to naming of scientific concepts. Few students participated in most lessons, as the majority did not understand English and were not free to speak to the teacher in mother tongue. Typically a small fraction of the students would shout their answers in mother tongue to respond to the teacher not necessarily because they were seriously involved in the lesson as some of the students responses appeared not to be thoughtful. Majority of the students especially the preschool aged children tended to be passive during the lessons and the teacher usually did not pay much attention to them (preschool children were mixed with first graders due to shortage of teachers). Congestion in the

classrooms contributed to lack of individualized attention. Students shoved and squeezed each other during the lesson when the class was in progress. Students sat on the floor and in overenrolled classrooms, some students stood close to the teacher, making it hard for the teacher to give individualized attention to the young learners. One of the teachers commented during the interview;

...I don't know...even class one students don't have desks...I don't know why...may be it is because they are small children... Our classrooms have too much ventilation. We cannot have a nature corner in the classroom...the classrooms are not spacious. With a class of eighty six students, we cannot have nature corners in the classroom. Forty students would be good (1st grade teacher).

As the description of the classrooms indicated, schools in Turkana were built in such a manner that the rooms were over ventilated to facilitate the flow of Air to help cool the classes at day time when the temperatures were extremely hot (Air conditioning facilities are not available). The temperatures in Turkana can be as hot as those of Arizona during summer. The ventilations of the classrooms over exposed the students to extreme wind and dust. In extreme windy days, rain or dust would flow freely into the classes creating very uncomfortable conditions to the students. Opportunities to display children work on the walls to create a friendly learning environment for young learners were rendered impossible by the over ventilated classrooms and wind menace. The unfriendly learning classroom environment added to the challenges of science instruction, which in turn complicated the manner in which students learn science in Turkana. Sometimes as I watched the learning in these classes, I asked myself why not extend learning outside the classrooms? What difference would it make if the children were taught

under the trees shades where they could get enough space to move around and have the freedom to explore Mother Nature in the most authentic ways? Why not teach science at the river beds where there was plenty of sand? I recalled the Indigenous educators who preferred that the environment be the science laboratory where children could engage in learning science using their Indigenous knowledge (Kawagley, 2006).

In general, preschool children and first graders spoke mother tongue (*Ng'aturkana*) with a small group able to speak very limited *Kiswahili* (national language). None of the students spoke English. The students who spoke some *Kiswahili* were the most vocal in class and were the ones who received attention from the teacher. These students constituted a small fraction of the class. It was common to observe many students who did not know what was going on during the science lessons. Another teacher observed during my interview;

With lower classes they are not able to read in English ...so when they see a picture of a certain object even if they don't know it in English certainly they know it in their mother tongue. And so even if they are not able to tell it in English, they are always able to tell you in their vernacular (1st grade teacher).

The translation of vernacular or *Kiswahili* words to English was a strategy for teaching science to third language speakers of English. Teachers insisted they had to speak in English, as it was the language of instruction in Kenya education system. However, during the observations, I thought that the translation interfered with the flow of the lesson and concept integration in the minds of children. The students appeared to be enthusiastic to engage in the lesson with the teacher in mother tongue. The opportunity for a vibrant discussion in mother tongue eluded

the students as their teachers tended to dominate the lesson activities. The most popular materials used in science instruction besides the textbooks, chalk and blackboard were charts, which were usually a carbon copy of the textbook. The teachers used the charts regularly and were recycled from the previous lessons. To facilitate recycling, charts were kept in the staff rooms and not in the classrooms. In one of the school, textbooks were not issued to first graders to ensure they were protected as the young children would destroy them. Hands-on experiences were less often used by the teachers.

Students did not have to be individually accountable to the lessons. Answers were in chorus and were not evaluated by the teacher. Some students' responses were very inaccurate. A typical example of students' rote type of answers, was shown in this vignette, when the teacher asked them to name crops that were grown in their own home district. The students appeared to name any type of crop, for example, rice, potatoes, cabbages, maize, etc. Some of these crops do not grow in a desert environment but students see them in the books. The children's list was endless as they continued to name even prepared food stuffs like "*Githeri*"(maize and beans mixture) "*basta*"(spaghetti) "*uji*"(porridge) "*Viazi*" (potatoes or sweet potatoes) etc. The teacher appeared not to have noticed or heard the students' inaccurate responses.

As I listened to the students and teacher interaction, I was not sure whether students' random responses were misbehavior due to lack of interest in the lesson, or were reactions of miscommunication resulting from poor English comprehension. There were times when the teacher assumed that students

understood her, but in practice students were always struggling to figure the meaning of English words. However, when the learning turned to become a mere procedure, students would resort to rote answers. Aikenhead (2006) described a situation where students start to play games (tricks) in class with the teacher when the lesson turns procedural and boring as “*playing Fatima rules.*” Aikenhead used *Fatima rules* to explain the tendency of students to engage in rote spontaneous answers pretending to be involved in learning when in reality they are not intellectually engaged in the activity.

I observed that science concepts were very familiar and unchallenging to the students. Students master very quickly the concepts as they involved names of natural phenomena. Higher order questions were not elicited during teacher students interactions in the science lessons. There was no waiting time for answering question as teachers tended to rush to answer the questions they asked the students. Students were in most science lessons unengaged and as a result evidence of boredom was common in the learners. The large enrollment of the classes encouraged teaching with very little teacher student interaction. Not one lesson observed resulted to projects for students to continue working on after the lesson at school and at home.

My interviews with Kenyan science teachers and curriculum experts on curriculum and science instruction in Kindergarten and first graders elicited mixed responses of science instructions. Most responses were inconsistent, unsystematic and hard to interpret. The education officials and teachers tended to be defensive and appeared naïve and uncritical of the inconsistencies of the

education system. An example of an interview I had with one of the teachers below describes how teachers defined their teaching strategies;

Researcher: What is your view about how science should be taught?

The teacher: Science should be taught practically. With the “practicals” ... you know it is easier for children to catch or grasp the main objectives of the lesson and it is also easier for them; you know ...it sticks into their mind when they do it practically. With observation they tend to remember a lot. They do a lot of ...they distinguish, differentiate when they see.... and can even tell...

Researcher: What is the practical way of teaching science?

The teacher: If there is an experiment to be done, experiment has to be there. If there are diagrams to be drawn; the diagrams should be drawn for them, and also the tangible diagrams ... they should have them and if possible they should also have the tangible materials.

Researcher: What is science?

The teacher: The study of living things and non-living things. That is our environment...things that surround us.

Researcher: What is the source of this definition?

The teacher: I cannot tell of the author, I haven't seen any definition of science. According to me this just revolves on what surrounds as....may be a book can be found in standard eight... may be I learned from college. When science was introduced in college we were told science is the study of living and nonliving things...

Whether teachers practiced what they told me in the interview was very problematic to figure out. Throughout my observations, I had not seen a single experiment being performed in all the classes I visited. The definition of science appeared equally to be inconsistent raising doubt of mastery of content knowledge, as I continue to illustrate in the next section below.

### **Teachers and Education Experts Definition of Science**

I was curious on how teachers and curriculum experts defined science. In this section I explore further interview descriptions of definitions of science and describe one other observation of science instruction. I begin with a synthesis of teachers' and education officials' answers to the question, "what is science?" I audio taped some of the teachers responses to this question with their permission. The responses of teachers were varied and quote a few of them as follows:

"science is the study of living and nonliving things"

"Something we learn through ourselves and what we do"

"Is all about doing and not being taught in our environment"

"What we see in our environment. The ability to see things in our environment"

"Science is teaching things like machines (generators) which can be explained theoretically using textbooks"

"Science is done in science rooms where experiments are prepared for students to see"

"Culture has some science messages, but using culture in school encourage backwardness"

“Science is teaching health issues such as washing clothes, washing faces, bodies, cutting nails, collecting rubbish, general cleanliness of the environment, cleaning the toilets etc.”

“Science can be taught by drawing charts on the blackboard using chalk”

“Schools in the highway are better to some extent in terms of materials for teaching science”

I also audiotaped Senior Education Officials definitions or ideas about how science is defined and the audiotapes of their response are stated as follows;

“The study of the world. The kind of interaction the learner has with the world. What they can study in the world. All the experiences with the world around them”

”a subject in the curriculum. A practical activity”

“to discover new things through practical activity”

“To use the existing materials to manufacture new things”

“an investigative subject which tries to find the causes of things like diseases to come up with a solution for them”

“To come with a problem that exists in the universe”

“Reasoning and logic”

“growing plants, keeping some pets, sinking and floating, washing handkerchief, listening to sounds, watching cars on the road, learning by doing”



“scientific skills include process skills, e.g. experimenting, hypnotizing etc”

“Science is all that surrounds us”

In these interviews with teachers and education officials I was more curious and intrigued with the way in which both groups seemed not to have a standard definition of science. The implication of this in science instruction appeared to present a major gap in content knowledge of science and how teachers instruct students. I explored this issue further, as I developed curiosity; in how teachers understanding of science affected their instructional strategies in early childhood classrooms. I explored this question and below is a detailed description of a vignette of one of my observation of a first grade science instruction on the topic: “Sanitation”

To illustrate how teachers conceptualize science in classrooms, I observed a lesson on sanitation in first grade science. The teacher started the lesson by telling the students that there were three types of toilets which she wrote on the blackboard as pit latrines, flush toilets and urinals. She explained in *Kiswahili* words the names of the toilets when she found that the students did not understand the English names. Sometimes she would use mother tongue but had a problem because toilets names were not found in the local language as Turkana people did not use Toilets. The teacher then switched to English words (toilets, latrines, flush toilets, and urinals). Throughout the lesson the students listened to the teacher quietly. Some where murmuring quietly the words flush toilets, urinals....etc among themselves. I guessed they were trying to figure the words among

themselves, but did not get the opportunity for a discussion. I could guess by the way the teacher tried hard to explain the English words in *Kiswahili* and in mother tongue that majority of children spoke very little English. *Kiswahili* was equally a challenge to a sizeable number of children. The teacher would ask the students; “what do we use to clean the toilets?” while the students hesitated; the teacher would proceed to answer the question herself; “we use a brush”... she showed them a picture of a toilet brush by pointing at it on the textbook. The teacher would tell the students, “When you use the toilet, always be in your shoes”...She asked the students to open the section in the textbook where the different toilets and the types of brushes were illustrated. The teacher maintained the conversation to herself alternating in mother tongue, “Kiswahili” and English. She would tell the students; “after using the toilet, always wash your hands”... There was little teacher child interaction during the lesson. She would repeat herself, the explanation of the words, toilets, flush and urinals in mother tongue and in “Kiswahili”. Halfway through the lesson, the teacher asked the students to open the appropriate pages in the textbook and copy the illustrations of the three types of toilets in their exercise books. Three students shared one textbook. Under the Free Education programs in Kenya textbooks were given to students which they have to share at least three per textbook. The classroom activity changed to copying illustrations of toilets from the textbook. The students used coloring pencils to color their drawings, so that they appeared as exact copies of the illustrations. As the students were drawing from the textbook, the teacher started checking the work of the students seated at the front of the classroom close to the

blackboard. A tick on a student's drawing and the comment "good work" showed that the teacher had seen the students work. She would not check all the students work by walking around the congested and overcrowded classroom made worse by the students sitting on the floor close to each other (there were over 110 students). As she looked at the few students' work, I heard her make a comment; "I see some of you drawing diagrams that resemble baskets". After making this comment she walked with her textbook to the blackboard and reproduced the same textbook drawings (hers were black and white) on the blackboard and asked the students to copy them. The students switched from copying from the textbook to copying the teacher's drawings. As the students were making sense of her drawings, they started rubbing out their first drawings to replace them with the teacher's. "Why would the students repeat the same drawings, when they had already drawn them"? I asked myself. More so the students drawings based on the textbooks were colored and looked original. However, the students seemed to follow each instruction the teacher said with honesty. Towards the end of the lesson, the teacher sat on her desk and students started streaming to her with their work for her to evaluate with a tick and the word "good work". As I observed this lesson, two questions bothered my mind; what is science? What is the relationship between this lesson to children's everyday activities at school and at home? I can now relate this lesson with how science was defined by one of the teachers;

Science is teaching health issues such as washing clothes, washing faces, bodies, cutting nails, collecting rubbish, general cleanliness of the environment, cleaning the toilets etc (1<sup>st</sup> grade science teacher).

Science in this case acquired the meaning of environmental or body hygiene or sanitation activities. Teachers need to separate the meaning of science as a cognitive activity and the activities that have to do with application of science to society issues such as conservation, sanitation, body hygiene etc.

Based on my observation of the school compound, among the striking challenges were the sanitation facilities. I found that the school had four pit latrines serving over four hundred boys and the same number was used by an equal population of girls. Children in early childhood used the same pit latrines. The latrines were unmaintained with broken doors and smelt bad as they were not cleaned regularly. The boys would rather use the bush on their way to school instead of using the school's dirty latrines. In addition, the school's water problems were very acute with three water taps serving close to eight hundred students. These taps were constantly dry as the solar pump would not pump adequate supply of water to the school as well as the community (the water pump is shared by the community and the school). Students rely on the nearby seasonal river flowing across the community to draw water for bathing and drinking. Boys bathed directly at the river while girls carry water on their heads to the dormitory for bathing and drinking. During draught seasons which are frequent in Turkana district areas, sanitation challenges would be at their worst extreme in the school. Students rarely bathe when the river was dry and girls face the most challenging sanitary problems.

The principal led me to the dormitories for both boys and girls. At the girls dormitory we had to get permission from the girls to enter. The boys' dormitory

was an empty hall with not a single bed or a mattress. The boys slept on the floor with torn mats and blankets brought from their homes. At least the girls' dormitory had beds but very closely packed next to each other. The girls' dormitory was very congested such that 3-4 girls shared one bed. All the over 400 girls in the school sleep in this one dormitory. None of the dormitories had a fence or a proper sense of security for the students. Girls had temporary or improvised bathrooms unlike boys who bath at the river and sometimes slept outside in the open when they cannot bear the congestion in their dormitory.

While at Lokichar Primary school I interacted occasionally with teachers in their staff room. Eleven out of the seventeen teachers were native Turkana and one local teacher was a senior teacher. The management and administrative issues of the school was mainly under the leadership of non Turkana teachers. For example both the principal and his deputy were nonnative. The teachers used a small room carved from a classroom as a staffroom. They had tables and chairs but lacked lockable cupboards to keep their teaching materials. All their teaching materials including students' books that they were grading were on the table. Due to the strong winds the teachers used the stones to protect their textbooks and students workbooks from being blown away. The scarcity of the learning materials was evident as teachers walked from the staffroom to class and back without any teaching equipments in their hands except the textbooks.

The teachers talked to me about technology issues, including internet, emails etc which they would have wished to have just like their counterparts teaching in urban areas. They said that even if they don't have electricity, they

would wish they had a computer even just to tell the students to touch or to see the components. They indicated that examination is national, but they had to teach many things through rote learning. When these teachers compared themselves to their counterparts teaching in Nairobi and other potential areas, they looked very intimidated and inferior. They saw themselves as if they were punished or neglected by the government. These discussions touched my heart and I had to look for an old computer I had in my house in Nairobi, repaired it and brought it to this school for the teachers and the students. I also brought news papers I bought from Nairobi for them to get updated with news of current issues in Kenya. The teachers had no access to newspapers.

As I observed the students I was struck by the resilience of the students who reminded me of my own days in school in this same area (a different school sixty miles away) forty years ago. I found the students experiencing the same challenges I faced during my time in elementary school. Ironically, the challenges I had in school were not as worse as those facing students today in this school. When I was in school I slept with clean new blankets on a bed with a mattress of my own. I had uniform, exercise books, textbooks, pens and games facilities and equipments. I sat on very strong desks. Surprisingly this school, even though it was in existence during my school days over forty years ago, it had only two dormitories without facilities for over eight hundred students. In addition the students experienced shortage of all sorts of learning materials ranging from exercise books, pens, textbooks, games equipment, uniforms, desks etc. These shortages contributed to the students dropping out of school. Unlike these students,

my parents did not follow my progress in school. I learned by myself and I was able to finish school with the help of teachers. The teachers in this school were the only hope for the students, but they were overwhelmed by the problems of lack of facilities and the general laxity of the government in addressing school matters. But with all the challenges facing the students their resilience appeared to have kept them to remain focused to the extent that the students continued to perform well in science and mathematics compared to students learning in urban areas who are endowed economically.

For example, one thing that caught my attention in this school was the grades obtained by students in the national science examinations. For all the years I checked the grades in science, the average performance of the students in science was above 50%. Checking the records, I came across excellent performance in science from both girls and boys. According to the principal the overall performance of students in national examination was a mean score of 260 out of 500.

The students' performance beats the odds of learning facilities available in the school. For example, the school had very limited lighting system which depended on solar. This would only light three classrooms which students from 4-8 grades scrambled at night to do their homework and revision. Even as students struggle with issues of facilities, the school continued to register the highest number of candidates every year in the district. This year the school had over 90 students preparing for national examination.

## **Chapter Summary**

Turkana children's cultural lifestyles expose them to opportunities to naturally engage with Mother Nature in the most authentic ways. This cultural capital was likely to give Turkana children the head start as they enter school with a clear worldview of the natural world even as science instruction in classrooms was dominated by mere listing of names of natural phenomena translated from mother tongue to English.

Children's every day social cultural experiences were not used in creating relevant lesson in school science concepts as teachers tended to dominate classroom instruction. Teachers presented science concepts to students using charts, textbooks, chalk and blackboard. These instructional approaches encouraged rote learning in the students. Hands-on activities using local materials and indigenous knowledge from the children's culture were not used to engage students in any meaningful project activities.

Lack of instructional materials and desks for children compounded by overcrowding in the classrooms are the impetus for direct instruction of science concepts. In addition students were hardly engaged as co-participants in the learning process either as individuals or in small groups and some of their answers were not challenged as children sometimes resort to rote and unreflective answers.

The definition of science appeared to be problematic as there was no consensus between science teachers and education experts on the meaning of the concept of science. Teachers tended to define science as content or list of subject



matter to be learned by students from textbooks and charts. The experts on the other hand appeared to define science as process skills.

In the next chapter (six), I will review a summary of the findings I presented in chapters four and five. I then further present my discussions to link the findings to the literature and to my theoretical framework. Finally, I further explore the implications of the findings to science curriculum and instruction in early childhood education in schools operating in pastoralist nomadic areas.

## **DISCUSSION, CONCLUSIONS AND IMPLICATIONS**

### **Introduction**

In this chapter, the findings and issues raised in all aspects of the study will be discussed. I will begin by a review of the study background and problem statement, purpose and significance of the study, as well as discuss methodological implications and important themes addressed in the literature review. The chapter will also include a summary of major research findings of the study. The final part of the chapter will culminate in a discussion of the implications of indigenous epistemologies to national science curriculum and science instruction in early childhood science education in pastoralist communities in Kenya. The chapter concludes with my reflections of the dissertation process and doctoral program journey.

### **Dissertation Review**

As stated in Chapter One, the dominant society in Kenya believe that primitive cultural practices are the cause of slow progress in education in the impoverished traditional nomadic pastoralist communities (Dyer, 2006; Krätli, 2002). Consequently, the goal of modern education is to wipe out these archaic cultural practices and replace them with modern ideas (Dyer, 2006, 2002, Krätli, 2002; Brock-Urtne, 2000). The assumption of the elite society regarding nomadic people is a demonstration of the failure of the modern world in recognizing the potential of cultural practices as a means of survival of Turkana people. The reality is that nomadic cultural practices cannot be erased from the people in the

march toward development in neocolonial geopolitical contexts. This dissertation is pursuing the argument that instead of supporting education policies directed to erasing nomadic cultural practices, which often prove counter-productive, effort, should be made to educate pastoralist children with curricula that integrate their culture and everyday experiences in science instruction. This will have the effect of making science concepts relevant to the everyday life of children, in addition to improving their skills and competence in science.

The study draws support from a review of studies in culturally responsive traditional Indigenous societies in the United States, Canada, African nations and other parts of the world (Aikehead, 2001, 2000, 1996; Barton & Basu, 2007; Cajete, 1999, 1994; Gitau 2006; Gonzalez, Moll & Amanti, 2005; Jegede, 1997; Kyle 2006; Kawagley, Delena Norris-Tull and Roger A. Norris – Tull, 1998; Moll, 2000; Ogunniyi, 1988; Reyhner, 1992; Teddla, 1996). The dissertation draws further support from sociocultural historical theories that support culture as critical in learning (Bruner, 1961, Gonzalez, Andrade, Civil & Moll, 2005; Moll, 1990; Rogoff, 2003; Vygotsky, 1978). Building upon this growing body of research and theoretical work, this dissertation presents traditional cultural practices of Turkana children and the potential for their compatibility to the national science curriculum taught in the early childhood grades in Kenya. The study is significant in that it provides a strategy for science instruction in early childhood in ways that children's creativity and understanding of the natural world is developed from their everyday cultural experiences.

The research questions addressed in the dissertation were; 1) What are the relationships between Turkana children's everyday socio-cultural practices of pastoralist lifestyles and the national science curriculum taught in early childhood grades in schools in Turkana? 2) How do Turkana children's everyday life socio-cultural practices inform science instruction in early childhood grades (kindergarten – grade one) classrooms? To address these research questions, the dissertation is based on narrative of an ethnographic fieldwork of Turkana socio-cultural practices recorded from Turkana elders and observation of science instruction in two selected schools in Turkana South District. The ethnography is grounded in the Indigenous research and cross-cultural research methodologies that privilege the Indigenous perspectives in research (Barone, 1988; Kaomea, 2003; Kouritzin, 1999; Li, 2002; Maanen, 1988; McCabe, 2004; McCarty, 2002; Mendoza- Denton; 2008; Malinowski, 1922; Thomas, 1993; Moll, Amanti, Neff & Gonzalez, 2005; Mutua & Swadener, 2004; Smith, 1999; Wolcott, 1988). These ethnographic qualitative studies have been used in research in education in Indigenous communities in the United States, Canada and other parts of the world. The study also drew from decolonizing and defamiliarizing research methodologies to frame research on the basis of Indigenous perspective that problematize traditional western studies.

The study was carried out in two schools operating in traditional nomadic pastoralist communities. One community was semi-urban in the context of modern development impact in Turkana, but in relation to the general socioeconomic standards of Kenya, the two communities are regarded as extreme

rural nomadic settlements with one having a little upper socioeconomic status by virtue of having the advantage of the location of the district administration headquarters. The modes of survival in semi-urban community were challenging to describe, as people engaged in many survival activities and micro businesses, ranging from small groceries operating in makeshift shelters, selling of firewood and charcoal, livestock trade and dependency on relief food from the Government. In the typical rural nomadic community, families depended on sell of camel milk, charcoal, sell of livestock and related products, wild fruits and sell of basketry and handcraft products to tourists. However, the main reliable mode of livelihood for both communities was dependency on Government relief food handouts.

Schools in Turkana operated in very harsh semi-arid environments. Access to schools was a challenge to teachers as most areas in the district were underdeveloped and lacked proper road network. School buildings were excellent but lacked desks, learning materials and teachers. On average, enrollment in early childhood grades was over eighty children per class. Teachers in these areas typically felt neglected and effort by the government to recruit local teachers were proving to be helpful. During my interview with the area education official, he indicated that the environment in which schools operated in Turkana require local teachers. He said that local teachers can live with the local people and can walk long distances to get to the schools which non Turkana teachers would not accomplish. However, at one of the remote school I visited during my study, the local teachers also felt neglected. One teacher I interviewed said I quote;

Here we are not teaching because of money. We are sacrificing to be here to do what we can to help the children. What can four teachers do in a school of eight streams? What we do is to put children in upper classes into one class and teach using multi-grade approach.

When I met the principal of this same school, she was living in a local hut constructed by the local people. She used an improvised bathroom and a pit latrine constructed some meters away from her hut. Her hut was built at the front of the girl's dormitory as she also doubles as the watchman for girls. The girls had a dormitory but without beds. The principal had just got them mattresses from a local community development organization. Boys sleep in a dormitory but without mattresses or beds. The principal, a local Turkana woman felt neglected and punished by being sent to a remote rural school far from her family and without proper housing facilities. Whereas it was true that local teachers were critical in teaching rural schools in Turkana, the fact is that even local teachers felt neglected once they are assigned in these harsh terrain schools.

The challenge though was getting locally trained teachers who were usually few as access to education was problematic in nomadic traditional communities.

Dropout rates were high and progress of children to higher education institutions was unpredictable. This is compounded by lack of family support to education of children. In addition to high poverty levels, majority of nomadic people are illiterate and deep rooted to their traditional Indigenous values.

During field work, I interviewed elders, teachers, education officials and curriculum experts. I did observation of science instruction in classrooms and observed children's play activities after school at home and at school and

compiled the data for this dissertation. Presented in the section that follows is a summary (and discussion) of the findings of my study.

## **Summary of Findings**

### **Indigenous Epistemologies and Cultural Practices**

This study's findings indicated that there was a general congruence in thematic content of science between Turkana Indigenous knowledge and the national science curriculum. In school, for example, children learned science through themes that included animals, plants, weather, water, food, soil etc. Science process skills, such as observation, classification, sorting and grouping, recording, hypothesizing, predicting, experimenting and others, were critical in the development of science concepts in children as listed in the national science syllabus and practiced in natural settings by children when acquiring survival Indigenous cultural knowledge. Learning in traditional settings was rigorous as children constantly engaged in carrying out home activities that were very demanding as it involved taking responsibility and being accountable to the family. Most of the time children learned to figure out skills on their own by trial and error and problem solving.

In traditional pastoralist communities, children learned for survival whereas in school, knowledge learned is not necessarily useful immediately to children's everyday life activities including creating projects that are applicable to the activities children carryout in school to support learning. When children learned for survival, they practiced and mastered skills such as classification, sorting and grouping, comparing, experimenting, observation, memory, predicting,

etc, In school these skills might just be listed in the syllabus but not necessarily practiced in science instruction due to lack of instructional materials compounded by large enrollments of children in the early childhood grades. Whereas children in school were perceived by their teachers to require materials for learning science, children in their traditional settings learned using the natural environment to figure out skills needed for competence and survival, which also happened to relate to science concepts.

Science curriculum in school was organized in terms of skills to be learned in a systematic way presented as content to be learned through a planned schedule. The skills of science were assumed to start from simple concepts and continue to advance in complexity as children advanced in grade level. However, teachers in early childhood were challenged in terms of figuring out what was a simple skill of science for this grade. These children ended up learning names of objects and without engaging in abstract thinking required in science. On the contrary, Turkana Indigenous knowledge was holistic. In addition, it was not easy to delineate a curriculum of science for children from the adult curriculum in Indigenous cultural practices. Adults and children followed the same curriculum of Indigenous epistemologies in Turkana cultural practices. Early childhood children learned the same skills older children learned and therefore figuring out what young children learned in Turkana culture did not matter. Knowledge emerged as children required competence in tasks needed to perform a family responsibility. Learning of science was trial and error and problem solving exercise as children seek survival knowledge.



Turkana Indigenous cultural knowledge covered a wide variety of themes such as the lunar calendar, knowledge of the universe, plants, animals, ecosystem, the study of soil, water and plants, fire production, livestock husbandry and livestock diseases and treatment. Children from preschool went through training in a variety of skills that included, livestock reproduction cycles, tracking of livestock, intestines reading and interpretation and training in observation and memory. Counting livestock or people was a taboo. As a result livestock were remembered mentally in terms of a cohort. A cohort represented the breed of livestock that was reproduced in a particular season.

Turkana Indigenous knowledge also operated in myths and beliefs. Prediction of rainfall or drought was not determined just by a single belief. If the stars predict drought, this had to be confirmed by other cultural practices which might involve elders reading the intestines of animals or elders predicting using traditional shoes or use of other strategies like monitoring the pattern of weather conditions as determined by their calendar.

To be able to figure out or predict a natural phenomena a combination of sets of strategies of thinking which involved the use of traditional beliefs and cultural practices in addition to strategies that involved psychological processes such as feeling, memory and intuition were employed by the elders. Observation, memory, use of senses and knowledge of cultural history of the natural sequence of events were critical in keeping records of changes of the natural environment. For example, the presence of water in a place was determined by observing the soil, studying the plants and carefully reading the rocks. Senses and memory were

critical skills for tracking livestock. The Turkana knew their stock by sound and keep a repertoire of the color configuration of all their stocks in memory. The universe in Turkana culture represents their world view and was used to predict weather patterns. The rivers and lakes and other natural phenomenon are also present at the universe.

### **Sociocultural Practices and Science Instruction**

Turkana children's cultural lifestyles exposed them to opportunities to naturally engage with Mother Nature in the most authentic ways. For instance children throughout the day played at the dry river courses where they engaged in various types of experimentation and exploration activities with sand constructions, swimming, tree climbing, birds hunting, fruits gathering, goats herding and watering etc. Consequently, children's everyday social cultural experiences included first- hand knowledge of Mother Nature at the dry river bed courses. These cultural practices naturally gave Turkana children a cognitive head start as they entered school with a clear worldview of the natural world even as science instruction in classrooms was dominated by mere listing of names of natural phenomena translated from mother tongue to English. The classrooms observed were teacher dominated with science instruction that capitalized on use of charts, textbooks, chalk and blackboard often referred to as "chalk and talk" in Kenyan context (Ogeno, 2005). These instructional approaches encouraged rote learning in the students. Hands-on activities using local materials and Indigenous knowledge from the children's culture were practically not a matter of concern even in creating practical meaningful project activities.

Lack of instructional materials and desks, as well as overcrowding in the classrooms were the impetus for direct instruction of science concepts. Instructional practices that encourage community and co-operative learning approaches in students were rare. Opportunities to engage children's cultural experiences either as individuals or in small groups were not exploited in science instruction. Most of the time the views of children were not challenged by the teachers as children sometimes resort to rote and unreflective answers.

Education officials and teachers appeared to have no consensus on how science should be defined. Teachers tended to define science as content or list of subject matter to be learned by students from textbooks and charts. The experts on the other hand appeared to believe that science was the same as process skills. Education in Kenya follows a centralized national curriculum and English is the official language of instruction from early childhood to University. However, Turkana children at the early childhood level were not yet able to speak in English, even as science instruction was in English language.

## **Discussion of Findings and Implications**

### **National Science Curriculum and Pastoralist Cultural Practices**

This section discusses issues raised in Chapter Four that presented findings answering the research question regarding the relationship between Turkana children's cultural knowledge and national science curriculum in early childhood grades. The main findings in this study suggested that the national science curriculum as presented in schools was not fundamentally different from the Indigenous knowledge learned by pastoralist children in Turkana community.

The elders interviewed presented a wide range of knowledge and skills that thematically reflected areas of science taught in schools, such as plants, animals, calendar, the universe, directions, weather, machines, livestock diseases, water, soil etc.

The findings from observations of classrooms indicated the potential for thematic compatibility of science concepts with the Indigenous knowledge. However, observations also showed consistent missed opportunity in science instruction which was not congruent or compatible with the learning approaches used by the elders and parents in socializing children to their Indigenous knowledge and cultural practices. Science concepts were teacher generated from the textbooks and children simply copy the teacher's notes or the text book illustrations. In addition science was taught as names of natural phenomena as demonstrated by the two vignettes presented in chapter five as typical examples of observations of science instruction. In both vignettes the teacher did not link the science themes with those of the community by maximizing on children experiences and hands-on activities.

Science instruction typically occurred inside classrooms in Turkana, even as the environment surrounding schools was open plains of sandy desert soil and hilly rocky terrains. In addition, wide sandy dry river courses cut across most school compounds. Take the example of the lesson on sanitation in the second vignette in chapter five; the school had eight pit latrines serving over eight hundred students including early childhood kids. The latrines were unmaintained with broken doors and were not cleaned regularly. The boys would rather use the

bush on their way to school instead of using the school's dirty latrines. In addition, the school's water supply was unreliable with three water taps serving eight hundred students. These taps were constantly dry as the solar pump could not supply enough water to the school as well as the community. Students relied on the nearby seasonal river flowing across the community to draw water for bathing and drinking. Boys bathed directly at the river while girls carry water on their head to the dormitory for bathing and drinking.

Turkana frequently experiences severe droughts, and the elders reported that the climate of the district was no longer predictable. Sanitation challenges would be at their worst extreme in the school most of the time. Students rarely bathed when the river was dry and girls face the most challenging sanitary problems. Despite these challenges science instruction failed to maximize these into projects addressing sanitation issues in school. Children learned this lesson in the form of names of different types of toilets namely, pit latrine, flash toilet, urinals, etc. In addition, only the pit latrines were available in the school and a few homes own pit latrines at the community. Linking this knowledge to the community and school sanitation issues would have had a practical impact to the children.

In Turkana pastoralist communities there are taboos about urinating or excreting in a pit. Turkana fear using toilets as they associate them to witchcraft. For example it is a taboo for different people to excrete in the same place (same pit latrine). Individuals do not like the smell of others excreta. The people prefer to walk far and excrete in the bush where they can burry their excreta in the

ground or just leave it far away in the bush where others cannot get the smell or will see another person excreting. For Turkana people toileting is done in secrecy and having a toilet close to home is exposing the members of a family (elders, in-laws, women etc) to embarrassment. Further, Turkana men are not comfortable using one toilet with women and in addition, there are taboos against a man sharing the same toilet with his mother in-law. Flies are said to carry good luck if they land on one's food. The person will be happy because this is an indication of more food in the future. Yet science teaches that flies are among the vector bacteria carriers and hence the need to link cultural beliefs with science knowledge to make science directly relevant to the lives of children.

Further exploiting the cultural beliefs and taboos of the students during the lessons of science will create questions that would generate discussions that refute or confirm traditional beliefs. If the teacher comes from the community, it is even easier for her/him to draw plenty of examples cultural beliefs of children which never happened. Bass, Contant and Carin, (2009) emphasized;

when teaching for conceptual change, it is not enough to just discredit misconceptions, nor is it sufficient to merely provide correct explanations, rather teachers should encourage students to test their own ideas, through observation and investigation (p.73).

The tendency of the teachers I interviewed and observed, was to ignore students cultural knowledge as they linked culture to backwardness or unscientific. This is compounded by the fact that local teachers who teach in early childhood grades feel intimidated by nonnative teachers. Feelings of being marginalized in their own schools appeared to be felt by the native teachers. Most often nonnative

teachers were the administrators of the schools and were responsible in ensuring that mainstream learning was sustained in schools. Since nonnative teachers did not understand the culture and the language of the students, they were most likely to ensure that, students did not speak in their mother tongue. Consequently, teaching science using cultural knowledge was likely to be challenging to native teachers as they tended to hold reservations because of the fear of being blamed for turning the school to a local institution. Schools in Kenya are national institutions which operate using a national curriculum and English is the language of instruction from early childhood to University. An education official I interviewed pointed out;

We don't teach culture in schools. Education in Kenya is universal and all children follow the same curriculum. If every community teachers its own culture, how can we test the children and how many textbooks can we write? We have some cultural examples in social studies curriculum. Schools cater for cultural practices through music and drama festivals and in art and craft. We teach mother tongue, not as culture but to promote literacy.

Sometimes I got the impression that the word culture is problematic to the education officials and teachers in Kenya. It is like if you teach culture or if you mention it in school; you would be promoting primitive ways of thinking. This argument puzzles me, because one of the goals of Kenya's education states; "education in Kenya should promote respect for and development of Kenyans rich and varied cultures" (RoK/MoE, 2002: v). Yet, cultural examples would only be appropriate in subjects such as social studies (surprisingly this subject might not have any relevance to Turkana culture) or in co-curriculum activities such as music and drama festivals etc. Teachers I interviewed associated culture with

practices such as initiation ceremonies, early marriages, child labor, herding livestock etc. which they consider as contributing to keeping children out of school. Teachers do not necessarily see culture has a factor in cognitive development. A Subject like science was viewed by teachers as highly technical and culture was not in anyway close to it.

However, an educator teaching science to Turkana children always has to face reality in the classroom, especially when she encounters children who cannot speak English and yet she has to communicate with them. Teachers teaching science in early childhood were forced to adjust even though the situation was hostile to mother tongue and take an instructional strategy Aikenhead (2006) described as “middle of the road” approach, where the teacher had to balance between mainstream teaching and culturally sensitive approach. Even though non native teachers were overwhelmingly in support of pipeline approach(mainstream) in teaching science, local Turkana teachers tended to empathize with students and partially tried their own initiative to help where possible, at least in as far as helping translate English words to mother tongue. The teachers were only limited to language translation and would not engage students in activities that were deeply cultural that might be critical in making learning culturally sensitive.

Moll (1990) wrote, “the objective of knowledge is not to understand the world but to transform it” (p.82). Further, Piaget advised teachers to be careful and provide instruction that support real learning rather than teaching superficially behaviors that are aimed at satisfying school requirements without leading to real



learning (Moll, 1990). Views that argue against learning that has no real meaning to student's life, illustrated an example of teaching that was merely presented for the purpose of achieving procedural display of content knowledge making school places where teachers display the expected behavior by acting in acceptable ways without any real adaptation or any real learning (Moll, 1990).

Among the three types of toilets discussed during the lesson only the pit latrine would be familiar to Turkana children. Students used pit latrines at school and not all of them used it at home. Majority of students use the bush while at home. There was no water for washing hands and students always walked without shoes. A real life practical activity of use of toilets, that had the potential of developing into a highly engaging conversation involving students and the teacher turned into a boring dull and quiet lesson of learning names of toilets. Despite the challenges this lesson had to local everyday cultural life including school issues of sanitation, no attempt was made to relate these science knowledge with these real life experiences of children. Instead the lesson was reduced to a reproduction of a textbook set of skills which students copied to their exercise books.

Science instruction typically treated children's cultural experiences as a by the way kind of issues that when they emerged from the children, teachers laugh them off and continue to refocus children to the mainstream textbooks concepts. For example in other lessons children talked of fire insects, mallets, knives etc. These ideas of children were not considered by teachers as critical in enriching science understanding.

## **Everyday Sociocultural Knowledge and Science Inquiry**

A popular view among scientists is that the place of learning science is the school and that science concepts learned at home or out of school by the children do not constitute scientific knowledge as they are regarded as spontaneous or personal knowledge (Moll, 1990). This thinking appears to suggest that children's everyday experiences are different from school learned concepts. However, these views have received a strong opposing argument that pursues the approach that learning in school and learning out of school are complementary. They argue that, factors that make learning easy to learn out of school are also useful in making learning easy at school (Moll, 1990). Goodman, Smith, Meredith and Goodman (1987) drew a contrast between, public or folk concepts with scientific concepts and argued that scientific concepts are derived from activities of scholars/scientists which are a result of research and theory that lead to an explanation of a phenomena and expansion of their own knowledge and ideas.

These views are similar to those of scientific inquiry that pursue Western science discourses that position science as a field of knowledge that requires a specific scientific understanding, discourse, and disposition of habits of mind (Lee, 2002). In contrast, spontaneous, personal or folk concepts are carried out by means of public communication and vary in the degree of accuracy and sometimes results in hearsay or are considered to be commonsense knowledge of a society. What does this differentiation mean to those engaged in science instruction in traditional cultural communities such as the nomadic pastoralist of Kenya? What does it mean to teach science based on the notion of everyday social

cultural experiences of children? Moll, (1990) and Vygotsky (1978) argued that whether concepts of science are spontaneous or scientific, the way in which both are learned by children is the same. Scientific concepts start as personal and are influenced by everyday experiences. Even though the development of scientific concepts are based on analytic procedures in contrast to everyday science ideas that are developed from concrete experiences, the development of scientific concepts depends on the foundation of the existing set of everyday concepts (Vygotsky,1978).

The question that follows is how would a science teacher in Kenya, teaching sanitation to Turkana early childhood students, use the knowledge of everyday social cultural experiences to develop scientific understanding in the children? Considering that issues of toileting in nomadic people are private matters related to certain taboos, negotiating cultural barriers while at the same time trying to achieve scientific goals in the classroom is a task that may require knowledge of culturally sensitive instructional approaches. The contrasting views of science between the everyday social cultural experiences and school science concepts are debated by the analysis from cross-cultural research literature. Aikenhead, (2001), Jegede (1997) and others have developed the notion of smooth border crossing to argue for science instruction that created harmony between the cultures of home and school science. Instructional strategies that have been regarded as culturally sensitive, culturally relevant and culturally compatible have been used by teachers to inspire children learning science in diverse cultures. Other approaches proposed by multicultural researchers argue on application of

the theories framed on STS and collateral teaching to link science instructions in the classrooms with societal needs, culture and technology in Africa and elsewhere in the world (Aiknhead & Jegede, 1994; Yanger, 1996).

Besides the use of STS in science instruction in many countries in Africa that have embraced multicultural views of science, the scientific inquiry approach in science instruction is not popular in Kenya and a possibility of exploring this approach to teaching science is critical. However, care has to be taken to guard science instruction in traditional cultural society from taking the approach that is modeled on Western science, especially when scientific inquiry has always been defined within the parameters of Western science which teachers often misinterpret as experiment oriented based on control of variables (Lee, 2002). Science teachers in Kenya should offer culturally sensitive science instruction even though science as a phenomenon is universal. As I indicated in the summary of my literature, this dissertation proposes a scientific inquiry that is rooted on the everyday social cultural experiences of learners while ensuring that children are engaged intellectually. Lee, (2002) observed;

Students' intellectual capabilities are constructed in their cultural and linguistic environment and are revealed (or obscured) in contexts that are culturally, linguistically, and cognitively meaningful and relevant to them. Design tools for fostering inquiry need to consider cultural and linguistic as well as cognitive aspects of learning environments (p.29).

In addition, Lee (2002) proposed in her research that when cultural practices are compatible with the beliefs and ways of thinking of scientists, inquiry can proceed in science instruction smoothly. In cases where cultural beliefs and practices are

incompatible with the discourses and thinking of scientists, science instruction will have to negotiate the inconsistencies in ways that the cultural practices are respected but at the same time concepts are made explicit for students to construct the laws of science.

The question that is important for this dissertation is where would Turkana children's cultural knowledge fit in Lee's definition of cultural compatibility or incompatibility? As I had indicated earlier, themes of science content in the national curriculum and syllabus appear to be compatible with cultural knowledge of Turkana children. For example, Turkana children cultural practices such as classifying livestock in terms of cohorts, reading and observing nature, predicting natural phenomena, making fire and knowledge of trees, knowledge of livestock diseases and their treatment etc can be integrated in science instruction in early childhood for better understanding of science as hands-on inquiry activity. However, where there is incompatibility like the case of certain taboos and beliefs, students can turn these taboos/beliefs into inquiry questions which they can develop projects to investigate with their families. Rampal (1994) tried this methodology with children in rural India with experiments with frogs. Aikehead (2001) in a science and technology project named rekindling traditions developed scientific concepts with local knowledge of the Aborigines people. Similarly Kawagley (2006) used Yupiaq technology in teaching science to Eskimo children. The use of funds of Knowledge (Moll, Amanti, Neff & Gonzalez, 2005) as household resources for science instruction in schools in Tucson, Arizona has

been used to theorize this study. These approaches are addressed in the literature review in this dissertation.

Cultural knowledge can be adapted to make it more locally and culturally relevant in Kenya, instead of teaching science as names of concepts. When using toilets as a theme teachers can engage students in activities such as sources of bacteria, decomposition and the role of insects such as flies in the transfer of bacteria across organisms to foster scientific thinking. In teaching weather it would be appropriate to teach names of sky, clouds, water, rain, stars, sun etc while engaging children's cultural knowledge. According to Vygotsky (1978) children come to school having encountered certain forms of knowledge in the way of knowledge that had already matured or developed. For example, when teaching weather, teaching kids the names of the natural world alone may not have added anything new to what they already know. What the teacher should do is to inspire students to think in big ways about the universe and how it works and how it was formed etc. The introduction of the cognitive aspect to the lesson would scaffold students and lift their thinking to the level of ZOPD (Vygotsky, 1978; Moll, 1990). Scientific inquiry would play the role of helping science learning in students to continue learning at ZOPD and would be enhanced by use of appropriate traditional knowledge if well integrated in the learning of science e.g. what do their cultures believe about the rainbow, the phases of the moon and what are their beliefs and myths about the sun etc. At the end of the science lesson students will be happy to go home with questions and projects to investigate with their families at home. Lee (2002), is emphatic on the need to rethink and

reconceptualize teaching and learning of science in ways that classroom instruction ensures equitable opportunities for all students to learn quality science.

Bruner (1960) argued that children in early childhood can have their skills of science developed in ways that are developmentally appropriate if the instructional strategies focus on the learning of structure of a concept rather than emphasis on specific factual knowledge. His views are illustrated in his famous quote; “the fundamentals of any subject may be taught to any body at any age in some form” (Bruner, 1960:12). It is by understanding the fundamental structure of science that makes application of knowledge possible in the everyday life experiences of children outside the classroom and when learning later concepts in science lessons. According to Bruner, earlier learning can render later learning easier, if children are first given a general picture of a concept in ways that the relations between things encountered earlier and later are made as clear as possible. Knowledge or big ideas of science encountered by children at the early stages should keep developing in complexity as students’ progress in the learning process. These views are the equivalence of maintaining children learning at the ZOPD. In Bruner’s views preschool children’s thinking is intuitive rather than analytic. Intuitive thinking is defined as “the intellectual technique of arriving at plausible but tentative formulations without going through the analytic steps by which such formulations would be found to be valid or invalid conclusions” (Bruner, 1960, p.13). Thinking by intuition is entrenched in the training of hunches, characterized by guesswork, novel hypothesis, risk taking, courage to make conclusions etc.

Intuition and scientific inquiry bear similar characteristics as both involve imagination, creativity, problem solving, trial and error, etc. This implies that preschool children are capable of carrying out scientific inquiry in science instruction. But it would not be possible for young children to engage in courageous risks taking of experimenting with nature if science becomes a thing to be taught from textbooks or facts to be given by an expert in a de-contextualized learning environment. Children will not venture into inquiry if teachers present them facts or names (sky, clouds, sun, pit latrines, flush toilets etc). What children need is the opportunity to explore big ideas like how do flies spread diseases or how does decomposition occur etc. The issue is not to do it the right way or give correct explanations but the pursuit for creativity; the chance to make guesses or to formulate questions or hypothesis. This is how Turkana children learn knowledge of their culture that they acquire to build their skills for survival. Turkana children learn by risk taking and problem solving just as Bruner pointed out. Both the children and the elders think intuitively.

The science curriculum in Kenya has concepts that can be linked to pastoralist children's sociocultural practices. For example concepts such as health, animals, plants, soil, the human body, energy etc are reflected in the research of Ellis, Coughenour, and McCabe in the STEP study. The study explored relationship between humans, livestock, wildlife and ecosystem in the pastoralist region of Turkana. Understanding how human body adapts to its environment can be used to make connections of the topic "the human body" taught in the science curriculum and study of human body parts with adaptation to high temperatures of



the harsh terrains of pastoralist ecosystem and how the body survives with minimal energy intake to remain healthy for long periods without modern health provisions or without regular food intake? What about the study of animals in science curriculum? How does the instruction of science in schools relate to the five species of livestock (cattle, sheep, goats, camels and donkeys) that form the herds of Turkana pastoralist? How are students making connections to topics of science such as soil, water, plants etc to the big ideas of science that are critical in understanding how the natural world works? For example connecting traditional ways of figuring out water, soil types, reading rocks, predicting plants and animal life with school science concepts such as Earth and space, plants and animals' life cycles, adaptation and diversity among living things etc.

### **Sociocultural Socialization Practices and Science Instruction**

This section discusses the findings related to my dissertation's second research question that explores the ways in which social cultural practices of Turkana children inform science instruction in early childhood grades classrooms. As outlined in the findings presented in both chapter four and five in the dissertation, it was clear that the life of children outside the school was exciting, natural, relaxed and child like while at the same time continuing to be engaging and challenging. At home children's knowledge was very advanced as the skills children learned for survival demanded higher levels of mental functioning. In contrast, learning at school was less engaging as children went through daily routines of teacher directed instruction using charts or the blackboard without the struggle to figure out concepts by themselves through

problem solving as in the case of learning that takes place at the community. Take for example a traditional child being taught the skills of reading the prints of a species of livestock hooves made on the ground. The process of learning this skill is child centered as adults mediate regularly by checking how much progress was taking place and letting the child to continue figuring out the strategies of learning the skill. It is learning by apprenticeship as the child learns while in the company of adults when both are involved in the herding of livestock. This learning would go on throughout the life of an individual. In chapter four and five the findings indicate that much learning in traditional Turkana community is by observation and memory. Children learn to remember the colors of their stock, the sounds of the livestock and will call a particular livestock by name when they hear its sound. Other children learn to observe soil and how to use it to tell the presence of water.

It follows, culturally, that Turkana children have developed capabilities for learning which in many aspects are similar to the skills of learning science. For example, observing soil and reading rocks or plants characteristics when searching for water cues in the community are skills used by geologists when studying rocks, fossils and soil. The study of livestock cohorts, color configurations, stock anatomy and sounds demonstrate the ability of Turkana children to carry out complex process of science related to classification, prediction, recording, observation, sorting and grouping, experimenting, comparing etc. These skills of science are learned by all ages of children including preschool children.

Turkana children are most likely to join preschools when their parents have already talked to them about natural phenomena such as the sky, sun, clouds, rain, darkness, day time, wind and more critical is the fact that nomadic children literary engage with the natural world most of the time. Consequently to teach the children names of the natural phenomena without challenging questions may result in low motivation in learning. In this way schools may not be places where nomadic children find excitement and interesting learning opportunities. Social cultural historical theory points outs that knowledge can be familiar and stable or knowledge can be challenging and dynamic. If knowledge is familiar, then there will be no need of teaching it. For example, why teach children the names of the sky, sun, clouds, toilets, hammers, etc when they have already heard of them as they grew up with the community? Suppose you advance them to ideas such as what is the sky for? What does it consists of? Why are clouds necessary? etc. then the children will have something new to talk about and this will lead to scientific ideas. Teaching that empowers children intellectually is what Vygotsky describes as learning at the ZOPD.

### **Integrating Turkana Children’s Sociocultural Practices in Science**

#### **Instruction**

Vygotsky (1978) defined ZOPD 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”(p.86). As indicated in the previous section and based on the analysis of ZOPD, Turkana children (including

children of other cultures) are likely to join school with varied levels of mental capabilities. The children would be at the mental processes that have matured or that have established developmentally (actual developmental level [ALOD]) or would enter preschool classrooms with mental functioning that are developmentally in the process of maturing or in the course of maturing (at the ZOPD). The teacher awareness of these developmental stages of the children's mental functioning is critical in designing the curriculum and instructional strategies of science concepts that match mentally with the skills appropriate in advancing the minds of learners to higher level of mental functioning. This instructional strategy is discussed in chapter one as child centered or diagnostic teaching.

Determining what is new in the curriculum and how it should be taught to the students is very important. For example, the teacher should find out if his/her instruction would develop the maturing processes to completion or advance the established ones to higher levels of mental functioning. My observations of science instruction in Turkana early childhood classrooms indicated that teacher instructional strategies lacked the ability to implement Vygotsky's teaching ideas based on learner's ZOPD. Vygotsky, commenting on teachers' ability to conduct instructional conversations in classrooms observed; "they do not know how, because they have never been taught" (Moll, 1990:198).

This study established that the teachers' instructional strategies either kept children at the actual developmental level (ALOD) and for those children who were at ZOPD; they retarded their maturing process or they did not enhance the

completion of the maturing mental processes. For example, listening to the lesson about weather and the teacher introducing new words including sky, clouds, and sun, , children were left having not acquired new skills that would advance their thinking. This was not really new knowledge as these natural experiences were likely to be already established in the minds of the children from their everyday life experiences. According to Vygotsky, this is knowledge at the actual level of development (ALOD). However, children had difficulty understanding the names of the natural phenomenon in English. The teacher tried to bridge this gap by translating the English names to mother tongue or to “Kiswahili” which interfered with the development of science concepts. Respecting the first language of children while supporting the development of science concepts is important in children learning science in English as a second or third language (Fradd & Lee, 1999; Lee, 2002; Rosebery, Warren & Conant, 1999; Brock-Urtne, 2007).

According to Vygotsky; “teaching is good only when it awakens and arouses to life those functions which are in a stage of maturing, which lie in the zone of proximal development” (Moll, 1990:200). Consequently the role of instruction was to ensure that concepts of science that were at the ALOD were stimulated to advance to ZOPD and concepts that were at ZOPD were completed and further questions generated to initiate a new ZOPD (ZOPD advance to ALOD which in turn advances to ZOPD and vice versa). The process is like climbing a ladder, advancing step by step conceptually such that the child is always at higher levels of mental functioning. Vygotsky describes this strategy of teaching in the following manner;

the child receives orientation from an adult; he reaches that goal and another one is offered; he tackles it and solves it independently, if possible, or with the help of the adult. (Moll, 1990:50; Vygotsky, 1978:85).

The purpose of teaching at the ZOPD is to engage students to think at higher cognitive levels. Drawing from ZOPD, Vygotsky emphasized the importance of everyday activities in providing meaning and the conceptual framework for the development of academic concepts (Moll, 1990). Vygotsky argued and I quote; “to make schooling significant one must go beyond the classroom walls, beyond empty verbalisms; school knowledge grows into the analysis of the everyday” (Moll, 1990: 10). Strategies of teaching such as translating “Kiswahili” and mother tongue words to English for the children, without conceptually linking the language to explanations of the natural world are probably what Vygotsky described as “empty verbalism”

With congestion in the classroom, windy classrooms and empty classrooms without learning materials, science lessons would have taken place outside the classroom where children would use the resources of their everyday experiences to learn science through hands-on play activities like those found in the river beds. Vygotsky indicated clearly that school knowledge grows from the analysis of the everyday experiences, because meaning and concept development depends on how children relate what they know from their experiences with new knowledge.

Vygotsky used the ZOPD to emphasize the contribution of social relationships in children’s learning of school concepts. The social system provides

the learning environment that facilitates a collaborative mutually constructed relationship between the teacher and the students. This creates opportunity for both students and the teacher to share ideas and build consensus about a scientific concept, facts or principles. Vygotsky stresses the interdependence between learners and the adults in the achievement of quality of classroom instruction (Moll, 1990) and this means valuing children as having the resources to share in the classroom.

Further support of everyday social cultural experiences draws evidence from the theories of funds of knowledge that situate learning on the nurturing of students strengths and resources and the need to link students' lives, local history and communities' context with classroom instruction (Gonzalez, Moll, Amanti, 2005). Think of a Turkana child who joins preschool having had all the early socialization of his/her cultural knowledge of livestock milking, sound listening, water wells digging and grocery selling or fruit gathering, including the study of prints of goats' hooves on the ground? Science instruction in nomadic schools should proceed in the manner that treats children as potential learners. Water and sand is used in many modern Kindergartens to provide children with opportunities to explore concepts of volume, density, states of matter, categorization and math skills etc (Moll, 1990). Preschool children in Turkana encounter water and sand experiences naturally at the river beds. Should teachers consider water and sand critical in learning science in rural areas? Children in some cultures carry with them knowledge endowed in them through their culture in the form of cultural capital (Krätli, 2001). If water and sand have to be in preschools in Turkana,

teachers would have to figure much higher skills for these children that they would be developing from sand and water, otherwise these children would be encountering in school things they already know leading to learning which is not at ZOPD, which will not result in advancement in intellectual development.

### **Nomadic Children's Play and Science Instruction**

In Turkana, the dry river beds provided a fantastic play environment for children after school. After feeding at school (children do have to rush home to feed as most of their food is found in school) children will continue hanging at the river bed to play with sand, hunt birds, insects etc. Wet river beds would be very conducive to play construction activities with sand and water. At the river beds, I observed children role playing herding activities with dry camel dung (camel dung consists of round black balls). I watched them counting their stocks, assigning names to the camels, milking them, treating a sick camel, separating the young ones and pretending to lock them in separate sleeping areas etc. children's play imaginary activities of camel herding are precisely carried out the way adults do them in reality. On the road, as I walked across the village, I found children constructing a modern house complete with bed rooms, doors, kitchens, sitting rooms etc. with wet sand. These play activities were constructed by preschool children and yet they were very close to real situations. According to Vygotsky;

Play creates the zone of proximal development of the child. In play a child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself. As in the focus of a magnifying glass, play contains all developmental tendencies in a condensed form and is itself a major source of development (Vygotsky, 1978:102).



Children's imaginations of the natural world during play, leading to the formation of real life plans has the potential for being a strategy of enhancing scientific inquiry in early childhood science instruction. Vygotsky (1978) argued that play leads to the creation of voluntary intentions which stimulate the highest level of development in preschool children. At play children imagine and rigidly follow rules to strictly perform adults' roles or mentally represent an imaginary natural phenomena. The result is the creation of a complex imagination of real life representation of a phenomenon. Consequently play is most likely to lead to an imaginary situation which can be regarded as a means of developing abstract thinking in preschool children (Vygotsky, 1978). This means that preschool children are capable of making abstract representation through play.

Consequently play can be an opportunity for engaging children in scientific inquiry activities as it leads to opportunities for abstract intellectual process that is critical for constructing science concepts. This finding underscores the value of cultural knowledge of Turkana children as a resource for learning science.

### **Implications for Science Curriculum and Instruction**

This dissertation has articulated two critical issues that challenge access to the quality of science education in early childhood classrooms operating in traditional nomadic pastoralist communities namely curriculum and instruction. The study through an ethnographic field work has presented the findings that problematized the curriculum and science instruction in early childhood grades in Turkana. The study found that there is a potential for compatibility or congruence in science themes used in science instruction in national curriculum and

Indigenous knowledge epistemologies. This section addresses the implications of this study to science curriculum and instruction in early childhood grades in Turkana pastoralist community.

### **Culturally Relevant Science Curriculum**

The findings from this dissertation indicated that there is potential for congruence or compatibility in thematic content areas of science between the national science curriculum and Turkana Indigenous knowledge epistemologies. For example, the study demonstrated that there is a high potential for congruence in thematic areas such as animals, plants, weather, water, food, soil, tools, the universe, heart, energy etc. Children in school as well as in the community learn various skills using process skills, such as observation, classification, sorting and grouping, recording, hypothesizing, predicting, experimenting etc. However, the national science curriculum and the Indigenous knowledge curriculum operated independently to the extent that there was missed opportunities in engaging students in science understanding. They work in parallel than in harmony with each other even though they are identical in nature. The contexts in which the two curricula work were very different. The school curriculum operated on a Western model based on universal assumptions of science education and driven by science textbooks written on the western context or from the perspectives of authors whose views portray biases to wards their culture.

A science curriculum that is compatible to the cultural knowledge of Turkana children is critical. Turkana children require science experiences in schools that are relevant to their everyday cultural practices to be able to drive the

motivation and interest in learning that will put demand in them to take risks in exploring science questions and curiosity with natural environment. A curriculum that is congruent to Turkana cultural knowledge is most likely to inspire the children's use of the natural environment, which is part of their traditional way of life as they figure out theories of science. It is critical that science educators familiar with pastoralist ecology and environmental conservation issues engage in developing textbooks for science teaching in schools operating in pastoralist communities. Schools in Turkana can implement a science curriculum modeled from the use of funds of knowledge. González, Andrade, Civil and Moll (2005) pointed out and I quote;

when someone with the authority of a teacher, say, describes the world and you are not in it, there is a moment of psychic disequilibrium, as if you looked into a mirror and saw nothing (p. 258).

This is exactly how the textbooks of science portray Turkana children. They read the books that do not represent their world view and books that assume that Turkana knowledge, culture and ecology do not exist.

To ensure the curriculum is relevant to children experiences the syllabus which is the curriculum tool of implementing science content in Kenyan schools need to be explicit with regards to the materials and resources essential for supporting science content knowledge in pastoralist communities. The science syllabus in Kenya is open on issues of materials and culture, however, it is not specific enough to stress the need for appropriate textbooks especially for schools operating in desert ecosystems whose survival is dependant on Indigenous

knowledge systems. This lack of clarity in the syllabus has led to the exploitation of Indigenous children by scholars from the dominant society that forces inappropriate learning materials to the local culture. This has both intellectual disadvantage and cultural assimilation tendencies. Again I will draw from González, Andrade, Civil & Moll, (2000) quote below;

Hegemony is not only characterized by what it includes, but also by what it eludes; by what it renders marginal, deems inferior and makes invisible. Minority and linguistically diverse students in general have not been construed as visible players within mathematics discourses either in or out of schools (p. 258).

Indeed Turkana children are invisible in their own schools and even their fellow Turkana teachers feel inferior in schools in their own locality.

Science curriculum in Indigenous schools should be responsible for the sustenance of environmental education through the preservation and maintenance of Indigenous environmental knowledge epistemologies. The knowledge of the environment as narrated by the elders should be a core theme in science education in pastoralist schools to ensure the elders have feedback and reference resources they can draw their knowledge from. The schools can nurture and develop the elders' knowledge for school children to form intergenerational knowledge systems critical for the coexistence of the community with its natural ecosystem.

Based on findings of this study, a hybrid science curriculum is recommended, that emphasizes the strength of each of the Western model and Indigenous epistemologies. A curriculum model close to that Aikenhead (2006) proposed as humanistic science curriculum, that relates science and technology to

human, social and economic affairs. Akenhead argued that science curriculum should build a connection between schooling and society so that science and technology are closely tied to human affairs and social progress.

Kenya has adapted a new constitution which is most likely to lead to decentralization of her education system that empowers counties to be the managers of education especially in relation to curriculum issues. This dissertation believes that this is the opportunity to implement a culturally relevant science curriculum policy in pastoralists' communities. This study recommends that education system in Kenya should indigenize or should Africanize the curriculum to include traditional African education by integrating Indigenous knowledge in science teaching and other subjects. Future reforms in education should be based on societal needs analysis and should involve the participation of local people in the planning of education policies (Dyer, 2006). This consideration is important when implementing appropriate education for children, especially in nomadic communities. Kenya should review and reform the content of education curriculum, textbooks and instructional methods to reflect the African environment and cultural practices; African methods of child development; cultural heritage, and value cultural technology in socioeconomic development (Brock-Utne, 2000).

### **Culturally Sensitive Science Instruction**

Compared to Indigenous socialization strategies of problem solving, risk taking, trial and error with adults monitoring and scaffolding, science instruction in early childhood classrooms in Turkana was characterized by underutilization of

children's intellectual potential of their everyday cultural experiences. Adapting Vygotsky's theory, science instruction was at ALOD rather than at ZOPD. This means that science instruction in early childhood classrooms was not sensitive to their cultural experiences which shaped the way in which children engaged in asking questions and generate investigations leading to explanations of their natural world. This would have stimulated the development of abstract thinking required for scientific endeavors. Science was treated as content knowledge to be drilled to children as facts or as names of concepts as read in the textbooks. Process skills of science; observation, classification, predicting, hypothesizing, experimenting, comparing, communicating, measuring, recording data, inferring (Bass et al, 2009; Millar, 1989) etc. are still very valid as strategies for learning science but could be adapted to reflect the ways in which Indigenous children structure and figure out their natural world. The findings showed that Turkana children demonstrated complex ability to do classification, prediction, observation, experimenting with their lifestyles practices of livestock herding, fire making, water exploration and understanding of the universed etc. Instead of adapting children skills of learning and integrate process skills, teachers continued to dominate science instruction. Hands-on experiences would be developed from children's cultural knowledge while integrating Western science ways of learning. Observation of Turkana children showed that these children were in constant encounter with the natural world every hour of day. Children explore Mother Nature in the river courses as they interact with sand, water and engaging in birds hunting, trapping, insects catching and various forms of livestock activities. These

children could be said to be always at ZOPD, a strategy that schools were unable to develop as they use scientific inquiry approaches science instruction.

This dissertation recommends science instruction that draw from Vygotsky's ZOPD teaching approach that is responsive to the cultural knowledge of children. ZOPD instructional strategy balances between the children's potential and adult's assistance. The approach may involve children working individually or as a group using culturally relevant materials to figure out scientific concepts. It also draws from funds of knowledge teaching approaches emphasizing teaching approaches that are learner centered or teaching approaches that embrace "culturally responsive", "culturally sensitive", "culturally appropriate," "culturally compatible," and "culturally relevant" learning classrooms (Bransford, Brown & Cocking, 2000; Gay, 2000). The study recommends an instructional approach that develops from constant evaluation of the children's thinking as in diagnostic teaching.

Science instruction based on culturally relevant materials ensures that learning is developmentally appropriate for young children. It conforms to Bruner's assertion that any content can be taught to a child at any age as long as it is developmentally appropriate. Science instruction should adapt instructional approaches that exploit the observational skills of Turkana children, who learn their cultural knowledge by being present and close to the adults. Observational or intent participation is reported as key in influencing children learning in Indigenous cultures of the Native Americans, Latino, Inuit and traditional cultures in Africa (Gaskins & Paradise, 2009; Rogoff, Paradise, Arauz, Correa-Chavez and

Angelillo (2003). These studies reported learning approaches in children similar to Turkana sociocultural socialization practices in which children as young as preschool age learn the same skills learned by older children, but practice with activities relevant with their age like looking after the young kids of goats. The learning of science by children in traditional African communities should draw from and respect the traditional anthropomorphic world view of African values (Jegade, 1994) and respect of Indigenous world views and spiritual beliefs (Brayboy & Maughan, 2009; Cojote, 1999, 1994). Findings from observations of natural play activities of nomadic children and evidence from their socio-cultural every day activities demonstrate that these children have well developed science process skills. This cultural capital should be enhanced in science instruction that adapts use of natural environment and deemphasize the use of traditional classrooms.

### **Language Challenges in Science Instruction**

Education in Kenya is based on a centralized national curriculum and English is the official language of instruction from early childhood to University. However, Turkana children's English skills were observed to be developing in ways that children were not yet able to articulate science concepts or their cultural experiences in English. This probably limited their creativity and ability to interact in class with the teachers. As the teacher in one the first grade classes I observed noted;

With lower classes they are not able to read in English ...so when they see a picture of a certain object even if they don't know it in English certainly they know it in their mother tongue. And so even



if they are not able to tell it in English, they are always able to tell you in their vernacular

The teachers in schools knew the challenges of teaching young children in English even though the education system considers English to be the language of instruction. However, knowing the challenge children faced in speaking English did not necessarily translate to a significant change in instructional strategy to accommodate children's language problems. Vygotsky (Moll, 1990) pointed out that learning English as a second language requires the use of everyday cultural experiences of children which imply the use of mother tongue. Vygotsky emphasized that ability to articulate concepts in mother tongue is critical in empowering learners to learn to use a second language. This means that the foundation of learning should start in mother tongue as children skills in a second language are supported to develop gradually.

Brock-Urtne's (2007) research in Tanzania supported the use of home language or second language in ensuring productive creative participation of children in science learning. The use of mother tongue enables children to draw examples of science from their cultural experiences to enhance their science concepts in the classroom. In Kenya (MoE, 2002), the early childhood and lower primary curriculum pointed out that instructing children in mother tongue, facilitated their thoughts and ideas to emerge in the most authentic form and allows deeper understanding as home language enables children to freely bring their cultural knowledge into the learning process. The syllabus further stress that when instructing children in mother tongue, children are able to link content areas

such as science concepts to the society and helps children to avoid learning content areas such as science skills in isolation using rote or drill methods (MoE, 2002).

The challenges facing children who use English as a second language are documented and addressed in science instruction and other areas of learning in diverse cultures, especially in the United States (McCarty, 2009; Lee, 2002; Lee & Fradd, 1999; Rosebery, Warren & Conant, 1999). Kenya education system especially at the early childhood level, should consider issues of language more seriously as lack of fluency in a second language might be a hindrance in children's confidence and self esteem in learning. This should not be a problem as the Kenyan curriculum already is clear on the use of home language in learning. Teachers in Kenya, especially those teaching in rural indigenous communities continue to teach in English even as many studies done in many countries in Africa, for instance Zambia, Malawi, Nigeria, Zimbabwe etc continue to demonstrate that English as a medium of instruction has a negative effect on overall student's performance (Bamgbose, 2000; Skutnabb-Kangas, 2000). Language studies in Africa continue to show that, language planning policies that place emphasize on the use of foreign languages in teaching contributed to the stunting of students in cognitive development, especially in relation to the extent and depth of the acquisition of knowledge in classrooms interactions (Brock-Utne & Hopson, 2005). For example, a study done in Nigeria showed that students who were taught in the medium of their Yoruba language were more proficient in school subjects including achieving mastery in articulating English (Brock-Urtne,

2000). Poor performance of students in schools in Africa will continue to persist in the learners who use languages other than their mother tongue especially in their elementary education.

In an observation I did of a preschool teacher in Nairobi (my masters study), I was attracted by one little kid left sitting alone in the corner of the class. The teacher and the rest of children were not talking to him. I was very curious and I asked the teacher; why the child was sitting by himself and why she was not taking to this child?" The teacher's response was as follows:

This child is "dumb" He can't speak in English. He has just come from his rural home and I have difficulty in communicating with him because he doesn't speak any English. He keeps talking to me and the students in his mother tongue and might influence the other children not to speak in English. I have to isolate him from other children and that was why he sits on his own until when he can communicate in English (preschool teacher in Nairobi)

This observation illustrated the tendency of teachers especially at the early childhood level not to engage young children in science learning due to the perception that the subject requires a technical language. In addition teachers tend to follow blindly school English teaching policies to the disadvantage of children's emotional and interpersonal relationships which are critical in learning. In Turkana schools, children's scientific conceptual understanding in English language was a major challenge as teachers were not flexible to allow multiple ways of learning that embrace mother tongue while slowly scaffolding the learning of science terminologies in English.

In terms of how children develop language skills, inquiry is described as the process by which children interact verbally with the world in order to help

them make clarifications and concretize their understanding of the world.

Lindfors (1999), defines inquiry as the language act that the child uses to attempt to elicit another person's help in going beyond her own present level of understanding. Scientific inquiry is the process of doing and interacting with science activities and processes through experiments, collecting data and generating explanations. Learning science as inquiry is providing the enabling learning environment to nature the child's curiosity and the wondering spirit is supported to evolve.

Since inquiry is critical in determining how a child uses language to interact with academic content areas, especially in science, educators are concerned that, children from non English speaking communities may be challenged in learning science as inquiry. For example, Lindfors (1999) argues that in the process of inquiry, the relationship between the child and the adult is determined by power, distance and rank. Power relates to social status. The teacher is considered as having power over the child. In Early Childhood this power difference is very important. Power also relates to the age of the person, the greater the age, the greater the power difference. Distance is how close the adult is to the child. For example how close is the teacher to the non English speaking child will determine the amount of inquiry questions the child will ask in the classroom? The last factor is the rank of the person. This has to do with social status. Social class differences may influence classroom scientific inquiry relationships. This means that in diverse cultures, power, distance and rank determine to a large extent, the success of science interactions in Early Childhood

and Elementary classes. Just imagine, how an English speaking teacher, who is probably from a different culture interact with a child who has no English background. Although the teachers I observed in Turkana spoke the language of the children, the issues of power, distance and rank determined their interactions with children and the degree to which children participated in the discussion of science concepts.

### **Researcher Reflection**

I experienced intimate rewarding interactions during my fieldwork visits in the community and at the schools. This dissertation connected me to school children and teachers in Turkana in ways that were spiritual and inspiring. I cannot wait to go back and be part of the learning in these schools and be part of the struggle of the elders and teachers in supporting Turkana children's education. Even though I had taught in Turkana for close to twelve years, to see children in Turkana experiencing the same challenges of schooling I had encountered forty years ago when I was a child in school opened new insights on the nature of education in Turkana. I saw the unending journey of children in education and thus a journey that takes them to nowhere even as children cling to education as their only hope.

During field work, I had an opportunity to interact with Turkana people both as an insider and an outsider. As an insider, I had the opportunity to be in a community that is familiar to me and which recognizes me as their son and an education leader. The community appreciated my education and was happy and more than willing to support me do my research with them. The Elders were

welcoming, warm and very respectful. As an insider I knew what to expect and questions to ask and I new local customs and traditions and will easily fit in my community culture. I travelled in different places as long as the Elders felt it was safe. I walked long distances on foot with the Elders during the period of my fieldwork. I ate their food without difficulty and slept in their traditional huts and sleeping materials (skins). As an insider, I knew the teachers, the schools' principals and education officials. They had no problem allowing me to do research in schools and I was able to schedule appointments for my interviews without reservations.

As an outsider, I learned a lot from the Elders and I had the opportunity to relearn my lost cultural knowledge. The Elders were surprised that I was ignorant of their cultural knowledge even though I was educated. They were surprised at the questions I asked them and were able to correct me and focus my questions. I looked like a child in the presence of elders. They knew more than I did. Smith (1999) problematizing the outsider – expert Indigenous researcher perspective argued; “when I began the discussions and negotiations over my research, however, I became much more aware of the things which made me an outsider, (p. 130)”. Like Smith, I looked strange to the Elders sometimes even though they knew me as one of them. To the extent that the Elders in certain occasions, did not understand why an educated person was seeking cultural information. The Elders would ask me questions like....

What are you going to do with this information? You mean you don't know these things? You mean school has made you lose your cultural knowledge? So these school people are ignorant?

The Elders would pose all these challenges to me but in a friendly way. However, in the broader way the elders were happy that an educated person can interact with them. They felt that I had privileged their knowledge by making it part of the school curriculum of their children. Privileging elders' knowledge and recognizing its role in the curriculum for school children agrees with Brayboy and Deyhle (2000) views that participants and the researcher can play a complementary role in the research process as co-constructors of data. Brayboy and Deyhle argued that to be an insider-outsider researcher, one has to wear several hats. In my case for example, I had to put a hat of a Turkana indigenous son, that of a friend and the hat of an educated outsider researcher. Smith (1999) argued that as an outsider, she received respect and the practice that were usually accorded to strangers.

This dissertation has offered me an opportunity to read and do research in my own culture and learn in greater depth education relevant to children of my community. I feel I have achieved my goals for education that I started over forty years ago when my mother put me on her back with the intention of escaping with me from hunger and incidentally resulting in the start of my school life.

Arizona State University professors made my dreams come true. I was able to pursue a doctoral program that met my goals of education in ways that I would not likely have been able to achieve in the Kenyan system of education. I feel confident that my research will contribute to the growing body of literature in Indigenous knowledge epistemologies that are already available in the United

States and the rest of the world. This study will contribute to scholarship in Indigenous science epistemologies in Kenya and inspire debate on education appropriate for pastoral communities.

Future research that will be a follow up to this study will be the understanding the relationship between cultural practices of nomadic children and their performance in science and mathematics in national examinations. During my research I countered an interesting findings from the analysis of the national examinations that nomadic children do relatively well in science and mathematics as compared to children in urban areas. This finding was interesting and I was curious that a systematic study will be critical to establish the validity of these facts and factors contributing to children performance.

A possible study to be carried out would be one exploring Indigenous environmental conservation methods and examines how traditional beliefs and worldviews that help nomadic people to relate to their environment even though the environment is unpredictable. Today as a result of climate change traditional people cannot apply their traditional methods of climate monitoring because of dependency on modern methods which seem not to work or are not familiar to the local people to help in creating confidence in the management of their lives.

My research was focused on issues that were related to my research questions. Unfortunately, I would have wished to say more than what my research questions asked, which I was not able to do as I had to focus on my research questions. I feel a sense of missed opportunity that I did not say all that I saw in the field which probably was more urgent to talk about. For instance, to do a



study of the process of education in schools that operate in abject poverty characterized by lack of learning facilities was really problematic. Trying to focus on some variables to study in schools that lacked almost all the basic infrastructure critical for good education was rather tricky for this study.

However, despite the challenges facing school children in Turkana, all is not lost in Turkana. I admired the resilience of children and their solid passion for learning. Fortunately, increasingly a few more resources that were available, especially in boarding section were given to the girls, although still not adequate. I honored the teachers' commitment and sacrifice to teach in schools in harsh terrain to keep the dreams of young people in Turkana with optimism. Like all children throughout the world, Turkana children dreams were to become doctors, lawyers, teachers etc. and they hoped to see these as achievable through the process of education.

In conclusion, I feel gratified that the process of my search for nomadic pastoralist education, that started in Kenya and ended in the United States, has finally achieved a critical milestone. I am happy that I have fulfilled my passion to write a dissertation that reflected my dreams of a theory of education for Indigenous pastoralist communities in Kenya. Arizona State University has made my dreams a reality through an opportunity to meet Professors who inspired me to pursue my vision. I learned from Dr. Brayboy and Dr. McCarty and from reading the scholarship of Dr. Cajete, Dr. Kawagley and other Indian educators that my research goals can be realized. Their research in Indigenous education transformed my dreams into reality as I found myself surrounded by role models

and mentors in the United States who were supportive and ensured I continue to develop my interest and knowledge I needed to write this dissertation.

I feel that in this dissertation I have demonstrated that Indigenous communities are rich resources of knowledge which can be used in schools to stimulate the development of scientific concepts especially at the early childhood level of education. I am aware of the nature of scientific argument pursued by scientists as reflected through scientific inquiry, that view science as an abstract cognitive construction of an understanding of a natural phenomena . However, I am also concerned that decisions about the complex nature of teaching science to young children are hard to be determined (Bruner, 1960, Fried & Eshach, 2005). For example, the competence of young children to conceptualize the ideas of science has been argued to be problematic even though many psychologists see children as naturally creative and curious.

In addition the ability of young children to separate scientific thinking from every day spontaneous or commons sense reasoning and problem solving has also been viewed to be challenging. This dissertation has argued that young children see the world in very natural way based on everyday Indigenous cultural knowledge of their families. Through this research I believe I have proposed the possibility of a strategy of engaging young children to scientific experiences using concrete hands-on experiences based on their cultural knowledge. I believe that teaching young children using an Indigenous perspective will lay the foundation for later abstract thinking as children mature in terms of how they can engage in more complex learning activities.

The dissertation has stimulated a passion in me to write a book for Turkana children that they would use in school to bridge cultural experiences with school science concepts. This study has marked a new beginning of another long journey of research in science education in pastoralist areas in Kenya.

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APPENDIX A

LETTER OF CONSENT FOR TEACHERS

Kenyatta University  
Department of Early Childhood  
Studies  
P.O BOX 43844,  
Nairobi, 00100, Kenya

Mobile: 0719-890-857

RE: LETTER OF CONSENT (Teachers)

Dear Sir/Madam,

I am a graduate student under the direction of Professor Elizabeth Beth Swadener in the Mary Lou Fulton College of Education Leadership and Advanced Studies at Arizona State University. I am conducting a research study *to find out the use of Turkana children's sociocultural practices of their everyday pastoralist lifestyles in science curriculum and instruction in science classrooms.*

I am requesting your participation, which will involve an interview with you that will last approximately one hour and an observation of your science lessons for thirty minutes. The observations will continue for three months. Please let me know if you do not want the interview to be taped; you also can change your mind after the interview starts, just let me know. The tapes will be locked in the researcher's file cabinet and kept for reference for 3 years after which the audiotapes will be erased and the transcripts shredded.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty and the relationship between you and the researcher will not be affected in any way. The results of the research study may be published, but your name will not be used. Although this study may have no direct benefit to you, the possible benefit of your participation is your contribution to the researchers doctoral dissertation and future recommendations in making science education culturally relevant to the children of Turkana. If you have any questions concerning the research study, please ask me directly before the interview.

If you have questions please contact me at: 0719-890-857

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Please indicate if you wish to be part of the study.

Sincerely,

John Teria Ng'asike

APPENDIX B

LETTER OF CONSENT FOR ELDERS AND EDUCATION OFFICIALS

Kenyatta University  
Department of Early Childhood Studies  
P.O BOX 43844,  
Nairobi, 00100, Kenya  
Mobile: 0719-890-857

RE: LETTER OF CONSENT (Adults/Elders/Educations officials)

Dear Sir/Madam,

I am a graduate student under the direction of Professor Elizabeth Beth Swadener in the Mary Lou Fulton College of Education Leadership and Advanced Studies at Arizona State University. I am conducting a research study to *find out the use of Turkana children's sociocultural practices of their everyday pastoralist lifestyles in science curriculum and instruction in science classrooms.*

I am requesting your participation, which will involve an interview with you that will last approximately one hour. The interview will not be recorded without your permission. Please let me know if you do not want the interview to be taped; you also can change your mind after the interview starts, just let me know. The tapes will be locked in the researcher's file cabinet and kept for reference for 3 years after which the audiotapes will be erased and the transcripts shredded.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty and the relationship between you and the researcher will not be affected in any way. The results of the research study may be published, but your name will not be used.

Although this study may have no direct benefit to you, the possible benefit of your participation

is your contribution to the researchers doctoral dissertation and future recommendations in making science education culturally relevant to the children of Turkana. If you have any questions concerning the research study, please ask me directly before the interview.

If you have questions please contact me at: 0719-890-857

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Please indicate if you wish to be part of the study.

Sincerely,

John Teria Ng'asike



APPENDIX C

ARIZONA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD APPROVAL

**To:** Elizabeth Swadener  
EDUCATION

**From:** Mark Roosa, Chair *MR*  
Soc Beh IRB

**Date:** 03/31/2010

**Committee Action:** Exemption Granted

**IRB Action Date:** 03/31/2010

**IRB Protocol #:** 1002004831

**Study Title:** Turkana Children's Sociocultural Practices of Pastoralist Lifestyles and Science Curriculum and Instruction in Kenyan Early Childhood Education

The above-referenced protocol is considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(2).

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

You should retain a copy of this letter for your records.

APPENDIX D

RESEARCH PERMIT FROM THE GOVERNMENT OF KENYA

REPUBLIC OF KENYA



**NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY**

Kenya Science Centre  
P.O. Box 30222-00100  
Nairobi, Kenya  
Telephone: +254 20 241 945 / 231 110  
Fax: +254 20 231 1215 / 318845 / 318249  
Website: [www.ncst.go.ke](http://www.ncst.go.ke)

P.O. Box 30222-00100  
NAIROBI, KENYA  
Website: [www.ncst.go.ke](http://www.ncst.go.ke)

Date: **4<sup>th</sup> February 2010**

Our Ref: **NCST/RRU/12/ISS/05**

**John Terin Nig'asile**  
Kenya University  
P.O. Box 48833  
NAIROBI

**RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on "*Turkana Children's Socio-cultural Practices of Postnatal Lifestyles and Science Curriculum and Instruction in Kenyan Early Childhood Education*" I am pleased to inform you that you have been authorized to undertake your research in *Turkana District* for a period ending **31<sup>st</sup> December 2010**.

You are advised to report to the *District Commissioner* and the *District Education Officer of Turkana District* before embarking on the research project.

On completion of the Research you are expected to submit two copies of the research findings to our office.

**PROF. S. A. ABDULRAZAK PH.D. MBS**  
SECRETARY

Copy to:  
The District Commissioner  
Turkana District