European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejes.v7i7.3159 Volume 7 | Issue 7 | 2020

CULTURAL FACTORS AFFECTING THE TEACHING AND LEARNING OF SOME SCIENCE CONCEPTS

Philip Dorsah[1i],
Mary Okyer[2]
[1]Science Department
Gambaga College of Education,
Ghana
ORCID: 0000-0002-3314-2203
[2]Science Department,
OLA College of Education,
Ghana

Abstract:
According to Maddock (1981) "*science and science education are cultural enterprises which form a part of the wider cultural matrix of society and that educational considerations concerning science must be made in the light of this wider perspective*" (p. 10). The purpose of this study was to find out how cultural factors and beliefs affect the teaching and learning of some science concepts. The study focused on how students' religious and cultural beliefs and their backgrounds affect their understanding of phenomena such as rainfall, earthquake, thunder, floods, eclipse and lightening. Individual interviews were used to obtain students views and opinions. Students' views and their understandings of rain formation, lightning, thunder, earthquake, drought and how floods occur are influenced by their religious beliefs and cultural backgrounds. Students made reference to beliefs such as taboos, belief in gods, and supernatural powers. Although students were able to explain correctly how some natural phenomena occur, they held certain conceptions and views that are not scientifically accurate. These possibly were transmitted from their cultural backgrounds into the science classroom. Students also held misconceptions about particular natural phenomena. These cultural beliefs and taboos interfere with science teaching and learning and thus make the learning of science a difficult task for students.

Keywords: cultural beliefs, teaching science, misconceptions, border crossing

[i] Correspondence: email pdorsah@gmail.com

1. Introduction

Constructivist Learning Theory maintains that learning is the result of what students do with the new information they are presented (Sewell, 2002). New learning occurs if the new information fits with existing knowledge (Sewell-Smith, 2004). Sewell and Smith (2004) posited that "*What a student already knows, then, is critical to the learning process*" (as cited in Fairbanks, 2011). Learners' prior knowledge interacts with the knowledge presented to them through formal instruction and this can result in a diverse set of unintended learning outcomes (Sewell, 2002). According to Arnaudin and Mintzes (1986), students sometimes misinterpret content presented by their teachers and use it to support their own beliefs (as cited in Fairbanks, 2011).

To understand and facilitate learning in any area of the curriculum, teachers should know how it relates to what has already been learned by the child. The learning of culture begins with a child's first experiences with the family into which he is born, the community to which he belongs, and the environment in which he lives. By the time children begin their formal education, they have already internalized many of the basic values and beliefs of their native culture, learned the rules of behavior which are considered appropriate for their role in the community, and established the procedures for continued socialization; they have learned how to learn (Saville-Troike, 1978).

The culture of a people includes their beliefs, rules of acceptable behavior, language, rituals, art, technology, and styles of dress, ways of producing and cooking food, religion, and political and economic systems (Bodley, 2009).

Culture has been defined, in simple terms, as the way of life of any society. Technically speaking, the term applies to a complex system which includes methods of doing things, patterns of behavior, attitudes, values, knowledge and material objects which are shared and transmitted from generation to generation (Okagbue, 1993). Children are born into social units that make up the society. This means that children have no option of where they want to be born into. In Africa, beliefs constitute the people's world-view, which in turn influence their culture. Most children go to school with mental ideas and beliefs which were learnt from families, friends and the community at their earlier stages of mental development.

1.1 Problem

Ausubel (2000) have argued that the construction of new knowledge in science is strongly influenced by prior knowledge that is conceptions gained prior to the new learning. Okoye and Okeke (2007) noted that it is very difficult to explain most natural occurrences and issues in African setting using scientific knowledge because most of the people's beliefs have been crowded with mythology and superstitions. They explained further that this problem it is mostly based on power of witchcraft and evil spirits which is a departure from scientific explanations.

Sutherland and Dennick (2002) have observed that culture is one factor within the learner's social environment that is an area of interest to social constructivists' examination of science learning. They assert that culture includes the expectations,

beliefs, attitudes, language, systems, and values that influence an entire community of people. It provides the rules and guidelines for appraising and interpreting interactions with events, people, or ideas encountered in the everyday life of a community. Samba (2003) found that students cannot learn new concepts if alternative models that gives explanation about a phenomenon exist in their mind except a platform is made available to them to confront their misconceptions, reconstruct and internalize their knowledge.

According to Yip (2001), personal experience and opinion are related to cultural factors prevalent in the society. This is because cultural situation at home give room for conflicting traditional beliefs and superstitions which cause misconceptions that lead to underachievement in the related subject where misconceptions are held.

It is well accepted that learning science is by itself an exercise of transitioning between subcultures (Aikenhead, 1996; George, 1999) and that the transition from one worldview to the other creates substantial cognitive dissonance. George (1999) points out that learning science is learning that extends from across the boundaries of home, family, and culture into the grounds of western concepts. Research has shown that the understanding and interpretation of concepts are mediated by language, culture, environment features and events. Science education researchers recognize that students' views and beliefs are significant and predictable of the type of science learning achieved in schools (Aikenhead, 1996; Coben, 1997; Ogawa & Omofio, 2002).

Jegede, Fraser and Okebukola (1994) established that a learner who is not positively disposed to or has a socio-cultural background that is indifferent to the learning of science would find it hard to learn science effectively. They found that science instruction which deliberately involved the discussion of socio-cultural views about science concepts alter student's attitudes toward the study of science. Aikenhead and Jegede reported that learners feel that science is like a foreign cultures to them, because the culture of western education is different from their indigenous cultures, which therefore needs cultural border crossing. Research on students thinking is generally limited (Fleer & Robbins, 2003). This paper wants to ascertain students' views, their beliefs and understanding of natural phenomena and how religious and cultural beliefs can influence their views and explanations of these natural phenomena (rain, thunder, lightning, earthquake, floods). These particular phenomena were chosen because they are very common to the students' everyday life experiences.

1.2 Objectives

The main objective of the study was to investigate cultural factors affecting the teaching and learning of some science concepts.

1.3 Research Questions

The study sought to answer the following questions:

1) What are students' views of the shape of the earth?
2) What are students' views and beliefs about natural phenomena (rain, thunder, lightning, earthquake, floods and hurricanes)?
3) What are students' views about eclipse?

4) What taboos are associated with the cause of natural phenomenon?
5) What are students' views and beliefs about magnetic attraction?
6) How does the moon give off light?

2. Literature Review

2.1 Culture and Science

Science is sometimes considered a culturally neutral area of the curriculum, but many of the topics taught under that label are loaded with culture-specific beliefs, values, and behavioral rules (Saville-Troike, 1978). While many students succeed in keeping the theories learned at home and school compartmentalized so they may believe both concurrently, with one or the other called to consciousness depending on the context and even the language being used, many others find this area of the curriculum a source of cultural conflict and confrontation (Saville-Troike, 1978). Scientific theories derive their meaning and force from human agency and intentions. If science can take some of the characteristics of mythology then it is true that science, being part of the culture produced by human beings, cannot remain immune from other cultural and ideological influences (Lindberg, 1992).

According to Samuel (1996), science embraces every attempt of humans to explore, interpret and manage the natural world. It is dynamic and essentially concerned with the search and explanation of both regularities and irregularities in nature. It involves the quest for actions and reactions, causes and effects in the environment. Samuel added that the purpose of science is to transform the environment towards improving the general quality of life, thus making the world a better place in which to live. Science is primarily concerned with the intellectualization of facts and values in an unbiased manner (Samuel, 1996).

Closely aligned with western science is school science, whose main goal has been cultural transmission of both the subculture of science and the dominant culture of a country (Aikenhead, 1997).

A cultural perspective on science education views teaching as cultural transmission and views learning as culture acquisition (Aikenhead, 1997), where culture means "*an ordered system of meaning and symbols, in terms of which social interaction takes place*" (Geertz, 1973, p. 5 as cited in Aikenhead, 1997).

Transmitting a scientific subculture can either be supportive or disruptive to students (Cobern & Aikenhead, 1997). If the subculture of science generally harmonizes with a student's everyday culture, science instruction will tend to support the student's view of the world, and the result is enculturation (Contreras and Lee, 1990; Driver, Asoko, Leach, Mortimer and Scott, 1994; Hawkins and Pea, 1987; Aikenhead, 1997; Cobern & Aikenhead, 1997). If the subculture of science is generally at odds with a student's everyday world, as it can be with First Nations students, then science instruction can disrupt the student's view of the world by forcing that student to abandon or marginalize his or her indigenous way of knowing and reconstruct in its place a new (scientific) way of knowing.

2.2 Alternative Conceptions

Learners come to formal science instruction with a diverse set of alternative conceptions concerning natural objects and events (Wandersee, Mintzes & Novak, 1994). Alternative conceptions span the fields from physics and earth & space science to biology, chemistry, and environmental science. Each associated subfield within the disciplines seems to have its alternative conceptions. The alternative conceptions that learners bring to formal science instruction cut across age, ability, gender, and cultural boundaries. No matter how gifted a group of students concerned, each group will have students with alternative conceptions regardless of background (Jegede, Fraser & Okebukola, 1994).

Alternative conceptions are tenacious and resistant to extinction by conventional teaching strategies. Students' alternative conceptions are very difficult to change; only very specific teaching approaches have shown promise of getting students to accept new explanations. Alternative conceptions often parallel explanations of natural phenomena offered by previous generations of scientists and philosophers (Agogo & Agogo, 2014).

Alternative conceptions have their origins in a diverse set of personal experiences including direct observation and perception, peer culture, and language, as well as in teachers' explanations and instructional materials (Jegede, Fraser & Okebukola, 1994). The many sources of alternative conceptions are at best speculative, but research and inference suggest that a student's worldview is strongly influenced by his or her social environment. Learners' prior knowledge interacts with knowledge presented in formal instruction, resulting in a diverse variety of unintended learning outcomes. Not only can alternative conceptions be a hindrance to new learning; they can also interact with new learning resulting in mixed outcomes. It is not unusual to see different students draw different conclusions from the same experiences and observations (Jegede, Fraser & Okebukola, 1994).

Mintzes and Wandersee (1997) proposed the following about misconceptions:

1) Learners are not empty vessels or blank slates; they bring with them to their formal study of science concepts; a finite but diverse set of ideas about natural objects and events; often these ideas are incompatible with those offered by science teachers and textbooks.
2) Many alternative conceptions are robust with respect to age, ability, gender, and cultural boundaries; they are characteristics of all formal science disciplines including biology, chemistry, physics and the earth and space science; they typically serve a useful function in the everyday lives of individuals.
3) The ideas that learners bring with them to formal science instruction are often tenacious and resistant to change by conventional teaching strategies.
4) As learners construct meanings, the knowledge they bring interacts with knowledge presented in formal instruction; the result is a diverse set of unintended learning outcomes; because of limitations in formal assessment strategies, these unintended outcomes may remain hidden from teachers and students themselves.
5) The explanations that learners cling to often resemble those of previous generations of scientists and natural philosophers.

6) Alternative conceptions are products of a diverse set of personal experiences, including direct observation of natural objects and events, peer culture, everyday language, and the mass media as well as formal instructional intervention.

It is thus clear that alternative conceptions emanate among others from children's social and cultural background. These misconceptions hinder the teaching and learning of some science concepts.

2.3 Learners' Worldview and Science

Science and science education are cultural enterprises which form a part of the wider cultural matrix of society and that educational considerations concerning science must be made in the light of this wider perspective (Maddock, 1981, p. 10).

Learning is about making meaning within a cultural milieu, we must ask ourselves such questions as: Within a cultural milieu of a particular student, what knowledge is important? What knowledge is meaningful? And how does scientific knowledge relate to his/her cultural milieu? (Cobern & Aikenhead, 1997).

Worldview provides a non-rational foundation for thought, emotion, and behavior. Worldview provides a person with presuppositions about what the world is really like and what constitutes valid and important knowledge about the world (Kamanzi, 2014). How people see the world is of very much interest. Scientists and science educators are interested in how people see the world Bennett (1999). According to Inokoba, Adebowale, and Perepreghabofa (2010), the concept is a term derived from the German word "*Weltanschauung*" meaning a "*look onto the world*" (Wikipedia, 2001). Inokoba and his colleagues defined worldview as the framework of ideals, values and belief systems through which an individual interprets the world and interacts in it (Inokoba, Adebowale & Perepreghabofa, 2010). Worldview could also be seen as "*mental lenses*" or cognitive and perceptual maps that are we continually use to find our way through the social landscape and surrounding. According to Olsen *et al.* (1992), the dominant worldview in the culture of a society normally pertains to the totality of human existence and most aspect of social life. Virtually everything that we experience is shaped by the perception provided by our view of the word. Since the dominant worldview is generally hold by most member of that society, it normally establishes the culturally accepted definitions of social reality.

Inokoba *et al.* (2010) classified worldviews into two broad types: the metaphysical worldview and the scientific worldview. They explained that where the generally accepted worldview of the society is characterized by scientific traits of rational, logical, inquisitive and analytical reasoning such society is said to have a scientific culture (i.e. it is scientifically literate). On the other hand, a society that is permeated by perceptions and belief systems that encourage superstition, magic, animism, cosmetology (faith in nature) and theology (faith in God), is said to be a one that has metaphysical worldview.

Science as an endeavor and phenomenon is not conceived and operated in a cultural and environmental vacuum (Inokoba, Adebowale, & Perepreghabofa, 2010). Inokoba et al (2010) added that science is a social phenomenon and is greatly influenced by the prevailing cultural traits and worldview of a people such as their social values,

priorities, ideas, skills ethics, and perception of social reality and belief systems. Basically, the worldview of a people is the way they think of themselves, their problems, others and their material environment. According to Bennett (1990), Worldview refers to the way people characteristically look out on the universe. It consists of values, beliefs and assumptions, or the way a cultural group perceives people and events. What we see as good or bad depends on whether or not it supports our view of reality. According to Olsen *et al*. (1992), the dominant worldview in the culture of a society normally pertains to the totality of human existence and most aspect of social life. Virtually everything that we experience is shaped by the perception provided by our view of the world. Since the dominant worldview is generally hold by most members of that society, it normally establishes the culturally accepted definitions of social reality. It is learned through processes of socialization and social interaction and is constantly being reinforced by the culture of the society throughout its lifetime. Children obtain some information about their geographical environment from direct experience before taking any formal instruction (Cin & Yazici, 2002). They also receive information about distant places through indirect information, such as picture books, radio, television programmes, newspapers and hearsay (Wiegand, 1992). They also gain geographical information about far environments through the Internet, CD-ROMs, multimedia resources, electronic mail, and so on (Moseley, 2001). According to Palmer (1993), the knowledge children construct can either be rudimentary or sound, depending on the way they received and assimilated information, and that the knowledge they build through indirect experience might be incomplete or even false (as cited in Cin and Yazici, 2002).

For example previous studies identified that children construct their own explanations to how rain is formed by involving certain entities that can be seen when it rains; such as clouds, the sun and the sky (Christidou & Hatzinikita, 2006; Villarroel & Ros, 2013).

2.4 African Worldviews and Belief Systems

Traditional African ways of thinking and reasoning differ in many respects from the dominant international approach despite generations of western influence (Millar, 2004). Mbiti (1969) identifies five categories that are mentioned consistently the various African religious practices. These are: God as the ultimate explanation of the genesis and sustenance of man and all things; spirits, made up of superhuman beings and spirits of ancestors; man, including human beings alive and those not yet born; animals and plants or the remainders of biological life; and phenomena and objects without biological life. In addition to these five categories, a vital force, power or energy permeates the whole universe. For the Africans, every plant, animal and natural phenomenon is a carrier of the divine (Neba, 2011). According to Neba (2011), Africans belief that God is the source and the ultimate controller of these vital forces, and the spirits have access to some of them. Selected human beings, such as medicine men, witches, priests and rainmakers, have the knowledge and ability to tap, manipulate and use these forces; some use it for the good and others for the ill of their communities (Neba, 2011). In order to appease the gods, people have to perform rituals and make sacrifices. There are numerous rituals

such as those for the fertility of humans, crops and animals; for birth, initiation, marriage and death; for rainmaking, planting and harvesting (Haverkort and Hiemstra, 1999).

Emegiawali (2003) suggests that the African way of knowing seems to be relatively less transferable than conventional science, given its holistic socio-cultural and even spiritual dimensions. Goduka (2000) characterizes African knowledge as spiritually-centred wisdoms. In traditional African view, the universe is a spiritual and a material whole in which all beings are organically interrelated and interdependent.

The most serious cultural violations occur in cases where particular animals have religious significance, and where even talking or reading about them is restricted or prohibited.

3. Methodology

3.1 Participants and Instrument

The sample consisted of four Senior High School (Form 2) science students. Their ages range from 15-19. The sample was purposively selected and included three male students and one female student.

The instrument was adapted and modified from "The Survey of Understanding of the Water Cycle" designed by Miner (1992) to measure children's understanding of the water cycle. Miner (1992) used guidelines suggested by Sedlak and Kurtz (1981) by using familiar events, thus increasing the reliability and performance of the students' answers. It used some questions from the clinical oral interview method of Piaget. It considered the interview procedure "*interview-about-events*" developed by Roger Osborne where views of everyday phenomena are discussed (Osborne & Freyberg, 1985).

Miner (1992) identified four major concepts within the water cycle; the nature of rain, the source of rain, the connection between rain and clouds, and the displacement of rain water. The same sets of questions were used by Sackes *et al.* (2010). Similar questions were also used by Villarroel and Ros (2013).

In the current study, the following questions were used to explore students' conceptual understanding of the sun, moon, eclipse, rain, lightning, thunder, earthquakes, droughts and floods.

1) What do you think is the shape of the earth?
2) What beliefs and practices are associated with the sun and moon (including eclipses and phases of the moon), comets, and stars?
3) Who or what is responsible for: Rain? Lightning? Thunder? Earthquakes? Droughts? Floods?
4) Are taboos associated with natural phenomena? What sanctions are there against individuals violating restrictions or prescriptions?
5) How do magnets attract objects?
6) Does the moon gives off light?

The questions used by Miner's (1992) 'Survey of Understanding of the Water Cycle' to measure children's understanding of the water cycle are given below:

1) Have you ever seen rain fall?

2) What do you think rain is?
3) Where do you think rain comes from?
4) How do you think rain is made?
5) Where do you think rain goes after it falls to the ground?
6) What things are made out of raindrops?
7) Where do you think the water go when puddles and water on the ground dries up?
8) Have you ever seen a cloud before?
9) What do you think clouds are made of?
10) How does water get in the clouds?
11) Have you ever noticed that clouds look different on some days?
12) How do clouds look different when it rains?
13) What would happen if it didn't rain?
14) What other reasons might we need rain?
15) Could you tell me what other things you know about rain?)Miner, 1992)

3.2 Design and Procedure

A descriptive survey design was for the study. Data was collected with the use of personal, semi-structured interviews. Individual, in-depth interviews were used to explore the research questions. The questions sought students' opinions about natural phenomena such as rainfall, eclipse, clouds, thunder, lightning, floods and students' religious or cultural beliefs about natural phenomena and taboos. The interview on rain formation for example, required the students to describe where the rain comes from, and to explain the mechanism of rain formation.

Students were individually interviewed, and the interviews were recorded in writing. Students were assured of the confidentiality of the interviews. The interview transcripts were used as the primary source of data for analysis drawing conclusions about students' views about natural phenomena. To ensure reliability, the transcripts were given to a colleague (co-author) to read through and do an independent coding.

3.3 Data Analysis

Data was analyzed using MAXQDA (2018). Patton (2002), posits that qualitative analysis transforms data into findings (as cited in Vosloo, 2014). This involves reducing the volume of raw information, sifting significance from trivia, identifying significant patterns and constructing a framework for communicating the essence of what the data reveal.

The data analysis focused on the different explanations that the students gave about rain formation, eclipse, earthquakes, floods, lightning and thunder. Students' explanations of natural phenomena were sorted, coded and categorized. To reveal patterns of children's understanding of the mechanism of rainfall and other natural phenomena, the responses to the semi-structured interview questions were analyzed, under themes and categories. Data were organized into categories depending on the nature of their response. Thematic content analysis was used to generate themes from

across the data set based on the content. Interpretation was based on the themes generated and the connections between the themes. Generally, thematic analysis is the most widely used qualitative approach to analysing interviews (Jugder, 2016). According to Braun and Clarke (2006), thematic analysis is a method used for "*identifying, analysing, and reporting patterns (themes) within the data*" (p.79). What counts as a theme is that which captures the key idea about the data in relation to the research question and which represents some level of patterned response or meaning within the data set (Braun and Clarke, 2006, p.82; Jugder, 2016).

4. Results and Discussion

4.1 Students' View about the Shape of the Earth

The results show that three (3) of the students explained that the shape of the earth is spherical and one (1) said that it is circular. However, three students said that initially they thought the earth was flat.

Document	Responses	Theme
Nicholas	*The shape of the earth is circular. I learnt at the Junior High school that the earth rotates in a circular path.*	Circular
Bernard	*… before I went to school I heard that the earth was flat.*	Spherical
Nathaniel	*Spherical… before I went to school I thought the earth was flat.*	Spherical
Wasila	*The shape of the earth is spherical…. At home I learnt that it was like the shape of an egg.*	Spherical

It was clear from the results that students held some misconceptions that the earth is flat. These are misconceptions which were carried from their homes to the classroom. For example, *Bernard* said he heard that the earth is flat before he learned that it was spherical in school.

4.2 Students' Explanations of the Causes of Natural Phenomena

The natural phenomenon includes rainfall, lightening, thunder, earthquake and drought. The factors involved in students' explanations of natural phenomena are presented in table 2 below and include: clouds, water vapour, natural, metaphysical or supernatural (gods and spirits), bad weather, deforestation, and human activities.

4.2.1 Students' View about Rainfall

From the results, majority of the students attributed the cause of rain to clouds. Some students however explained that rain is formed from water vapor evaporating from water bodies to the skies, forming clouds, condensing and falling back as rain. Some also explained that rain is a natural phenomena and comes naturally. The following excerpt revealed students' views about rain.

Researcher: Who or what is responsible for rain?

Document	Responses	Theme
Nicholas	*Rain is caused by clouds coming together…when smoke goes up to the skies they form clouds and produce rain.*	Clouds
Bernard	*Rain is caused by the clashing of clouds and the amount of smoke in the air.*	Clouds
Nathaniel	*Rain is caused by….it all happen when water evaporates into the atmosphere and form clouds…as water vapour accumulates the clouds becomes heavy and fall back as rain.*	Evaporation/ condensation
Wasila	*Rain…it is a natural thing. As the sun burn and the vaporizes up and condenses and fall back as rain….when the vapour becomes heavier it falls back as rain.*	Evaporation/ condensation

4.2.2 Students' View about Lightning

The explanation of lightning is categorized into climatic factors and metaphysical reasons (gods/beliefs). Two students explained that lightning occurs during rain (climatic) whiles two students also attributed lightning to metaphysical or supernatural forces and spirits. The students explained that lightning occurs when the gods want to punish someone for doing evil. These beliefs exist across most cultures in Ghana. Most Ghanaian cultures beliefs that the gods can be invoked to cause lightning to strike and kill evil doers. This implies that students come into the classroom with ideas and concepts which are reflections of their socio-cultural backgrounds. The following excerpt revealed students' views about lightening:

Researcher: Who or what is responsible for lightning?

Document	Responses	Theme
Nicholas	*For rain to fall there must be lightning before thunder. This is because light travels faster than sound.*	Climatic
Bernard	*When it is about to stop raining the lightning occurs.*	Climatic
Nathaniel	*In ancient times there was a Greek god called Thor… she was the god of thunder and lightning. She was responsible for lightning.*	Gods/ beliefs
Wasila	*That if anyone wants to do bad to you… they call the lightning to strike you…*	Gods/ beliefs

4.2.3 Students' View about Thunder

From the results, students explained that thunder is caused by gods (metaphysical factors). Students think that thunder is caused by a god called Zeus and that thunder occurs when the gods are angry and want to punish evil doers. Students also explained that thunder is caused by clashing of clouds that create sparks as a result of electrical charges. The following extract revealed students' views about thunder:

Researcher: Who or what is responsible for thunder?

Document	Responses	Theme
Nicholas	*no idea*	
Bernard	*Thunder is caused by a god called Zeus.*	Gods/beliefs
Nathaniel	*Thunder is caused by collision of clouds.*	Clouds
Wasila	*…if there is anything evil then thunder will strike.*	Gods/beliefs

4.2.4 Students' View about Earthquake

Students gave various explanations to the causes of earthquake as follow: Clashing of rocks, remains of bombs under the earth, volcanic eruptions, shake in the interior core of the earth and Magnetic field under the earth. Students did not attribute earthquake to any supernatural power or to any spirit or gods. The following extract revealed students' views about earthquake.

Researcher: Who or what is responsible for earthquake?

Document	Responses	Theme
Nicholas	*I learnt that earlier on when there wars …..They threw atomic bombs. The parts of the bombs that remain under the earth are now causing the earth to shake.*	Bomb under the earth
Bernard	*Earthquake is caused by the clashing of rocks beneath the earth.*	Rocks
Nathaniel	*Earthquake is caused by volcanic eruptions and some are caused by a shake in the interior of the earth.*	Volcanic eruption
Wasila	*There is a magnetic field under the earth……and when the time comes it shakes. At times I thought it was due to volcanic eruptions.*	Earth's magnetic field/ Volcanic eruption

4.2.5 Students' View about Drought

All four students almost gave the same explanations for drought. Three students (75%) said that drought is caused by the indiscriminate cutting down of trees (deforestation) and one student representing 25% attributed drought to severe sunshine or absence of rain. Students did not give any metaphysical reason for the cause of drought. Students seem to understand the relationship between trees and rainfall and also the relationship between trees and drought. Thus, they were able to correctly link the cause of drought to deforestation. The following extract revealed students' views about drought.

Researcher: Who or what is responsible for drought?

Document	Responses	Theme
Nicholas	*It occurs when there is absence of trees.*	Deforestation
Bernard	*When trees are cut down and there is no tree in the environment… the environment will dry up.*	Deforestation
Nathaniel	*Droughts occur when people cut down trees.*	Deforestation
Wasila	*….. Droughts occur when water bodies dry up. It happens when rain is not falling…and the sun shines on the water bodies and they dry up.*	Sunshine/ temperature

4.2.6 Students' View about Floods

Two students representing 50% said that floods are caused by excess rainfall. One student representing 25% said that floods are caused by bad weather condition, 25% also said that flood occurs as a result of human activities such as poor drainage systems and practices and erosion.

Researcher: Who or what is responsible for floods?

Document	Responses	Theme
Nicholas	*Too much of rain.*	Rain
Bernard	*Flood is caused by excess rainfall.*	Rain
Nathaniel	*Hurricanes occur when there is an extremely bad weather.*	Weather/climate
Wasila	*too much rain can fall but it may not cause floods. Floods occur when gutters are choked... and also due to erosion. Improper situation of buildings.*	Rain/ environmental

4.2.7 Students' Beliefs about Eclipse

In total, seven explanations were recorded concerning beliefs about natural phenomena. Some of the students gave more than one explanation or reasons. Student's explanations were categorized into beliefs, cultural beliefs, cultural/religious. It appears that all the students associated some beliefs with the sun, moon and eclipse. The results suggest that religious and cultural beliefs have significant effect on students' worldview and their explanations of natural phenomena.

Researcher: What beliefs and practices are associated with the sun, moon (including eclipse and phases of the moon), comets and stars?

Document	Responses	Theme
Nicholas	*When an eclipse occurs, they say darkness has covered the earth.*	Beliefs
Bernard	*When the moon comes in between the earth and the sun……. some people think that the world is coming to an end.*	Cultural/ religious
Nathaniel	*People worship the sun…. some people think eclipse is the end of the world……some people say the gods are punishing them. I heard that the devil fell like a comet to the earth.*	Cultural/ religious
Wasila	*When eclipse occurs, they say that the sun has swallowed the moon.*	Cultural/ belief

4.2.8 Taboos Associated with the Causes of Natural Phenomena

The results revealed some taboos that are associated with natural resources. These include taboos that prevent people from doing evil or bad things because the gods will punish them. Some of the taboos also prohibit fishing or hunting on certain days or seasons. Anyone who violates these taboos will be punished by the gods by drowning or something evil happening to them. Students also believe that drought occur as a result of punishment from the gods. They further explained that people can be cursed with lightning to strike them dead. In general students hold metaphysical beliefs about taboos associated with natural phenomena.

Researcher: what taboos are associated with natural phenomena?

Document	Responses	Theme
Nicholas	They said when someone did something bad and the gods are angry, they use lightning to strike the person.	Gods
Bernard	Fishermen do not go to the sea on Tuesdays….. If they do they will get drowned.	Cultural belief

Nathaniel	When people do wrong things, the gods get angry and bring drought…….scientifically all these happen to bring about balance.	Gods
Wasila	People normally say drought is punishment from gods. With lightning it is believed that it occurs when one is cursed, and the lightning strikes the person and kill the person.	Gods

4.2.9 Students' View of Magnetic Attraction

All the students had some fair understanding of magnetic attraction. Students understand that magnetic forces are essential for a magnet to attract. In their view, magnetic forces are responsible for the ability of a magnet to attract. This is what students had to say in the excerpt below:

Researcher: How do magnets attract objects?

Document	Responses	Theme
Nicholas	For a magnet to attract an object there must be a magnetic material in order for the magnet to attract it.	Scientific
Bernard	When unlike poles come together, they attract.	Scientific
Nathaniel	Magnets are special rods which have the ability to attract magnetic substances.	Scientific
Wasila	Magnets attract by magnetic forces. They have two poles, which are opposite which attract by magnetic forces.	Scientific

Students' view of how magnets attracts are scientifically correct. No student gave metaphysical reason or explanation.

4.3 Students' View of how the Moon Gives Light

Majority of the students (3) said that the moon does not give off light on its own, but reflects light from the sun to earth. This suggests a fair understanding of how the gets it light. One student had the misconception that the moon gives off light by itself.

Researcher: Does the moon gives off light?

Document	Responses	Theme
Nicholas	Yes the moon gives off light.	Misconception
Bernard	No it gets its light from the sun.	Understanding
Nathaniel	No… but it transmits light from the sun to the earth.	Understanding
Wasila	The moon does not produce its own light. It gets it light from the sun…it gives off light but does not produce it on its own.	Understanding

5. Discussion

Ozsoy (2012) found that nearly 60% of children drew the unconventional scientific version of the Earth. The drawings show some variety among them however, they can easily be grouped into the alternative models of the Earth defended by the mental theorists. These findings are consistent with the results of prior research claiming that children have difficulty in understanding that the Earth is spherical and form various misconceptions regarding its shape (Nussbaum, 1979; Nussbaum & Novak, 1976). Ozsoy

(2012) however reported that children have some scientific knowledge about the shape of the Earth.

Concepts such as evaporation, condensation and gravity can be abstract for children, and subsequently challenging to comprehend. Previous studies identified that children construct their own explanations as to how rain is formed from a very young age, by involving certain entities that can be seen when it rains; such as clouds, the sun and the sky (Christidou & Hatzinikita, 2006; Villarroel & Ros, 2013). Villarroel and Ros (2013) in their study found that two children's accounts were found where the concept of water transformation after falling to the ground was beyond their comprehension. Nonetheless, they pointed out that rain remains on the ground, without considering the matter further.

Villarroel and Ros (2013) found that children undoubtedly pointed out clouds as the origin of rainfall, but a significant number of children linked the origin of rainfall to the sky or to a general supposition, causally saying "above".

Savva (2014) found that majority of children explained that rain comes from clouds. Savva also found that children referred to God as the cause of rain (e.g. rain is God's tears, it rains when God has a shower, God makes rain with his special water power). They also included the possibility of clouds or the sky being involved in the formation of rain. The majority of the children that did not recognize clouds as the source of rain identified the sky as the origins of rain instead.

Savva reported *"The majority of responses in year 3 associated rain with grey clouds, whereas in year 5 the most popular association with rain was black clouds. Four children in each year used a combination of colours to describe the connection between rain and clouds (i.e. clouds are black, grey and white when it rains, clouds are black or grey when it rains, clouds look darker and grey when it rains); whereas the majority of children chose a single colour"* (Savva, 2014).

Research such as (Christidou & Hatzinikita, 2006; Savva, 2014; Saçkes, Flevares & Trundle, 2010) reported that, while children have some general opinions about rain, they experience some difficulties in understanding the formation of rain.

Za'rour (1976) found that children in the fourth grade and above had a much greater understanding of the basic idea of clouds and rain. At this age, they also began understanding evaporation and condensation. Za'rour (1976) pointed out that at age 8 and 9; few misconceptions still exist with regards to evaporation and condensation. For example, some children still believe that water is absorbed in the floor or give a physical description of the water rather than an explanation, but over 60 % attribute evaporation to the wind, sun, or drying up. However, at age 8-9 children develop a clear understanding of the water cycle.

He added that most 8-9 year olds do not use descriptive words like "clouds." Za'rour believes that the children who were able to answer about evaporation and use the scientific terminology were merely given rote responses they had heard adults use (Za'rour, 1976).

Cin, and Yazıcı (2002) examined whether children's ideas about the origins of the natural phenomena are influenced by their first-hand experience. They found that majority of the children who made up half of the whole sample appeared to hold the

artificial view. These children stated that a lake was created by either humans or God. They also found that about 92.5 % of children gave artificial responses. They attributed the formation of a river to humans or God. They suggested that the fact that the children gave more artificial explanations than natural explanations might be explained by the fact that the children may have adopted the belief that everything is created by God, which might be attributed to the religious environment in which they lived. Again, Eyres and Garner (1998) have suggested different causes why children have artificial ideas about the formation of the natural phenomena. They stated that when children cannot provide a reasoned explanation of a physical process, they tend to give responses involving a religious explanation. Another reason why the children gave artificial responses might be that young children construct their own ideas by observing the interaction between the environment and humans.

Piaget (1929) found that children (aged up to 7 or 8 years on average) explained the formation of some physical landscape features, such as the sea, a lake, and a river, as being entirely made by God or man (as cited in Cin & Yazıcı, 2002). During the second stage, the explanations of the children (up to 9 or 10 years) suggest that the origin of the water is natural, but water-based landscape features (e.g. a river bed) is made by humans.

Smith and Dougherty (1965) suggested that there is no age-related stage in children's thinking. In their investigation, 282 children in Grades One, Two, Four and Six (aged 6 to11) were asked to explain the formation of some natural phenomena. The results indicated that the majority of the explanations were naturalistic in 8-yearolds (as cited in Cin & Yazıcı, 2002).

Stepans and Kuehn (1985) revealed similar results. Stepans and Kuehn (1985) examined second and fifth grade children's understanding of wind, clouds, thunder, lightning, rain, snow and rainbows using interview techniques. Two stages which are particularly significant are 'religious finalism' (in which the child refers to supernatural causes such as God and men) and 'true causality', where the child provides a natural explanation of the physical phenomenon in questions. A further analysis of the children's responses revealed that the majority of the children from both grades gave natural explanations to physical phenomena (as cited in Cin, & Yazıcı, 2002).

Bar (1989) found that young children held artificial views. He tested 300 children (ages ranging from 5 to 15 years) to find out their ideas about the water cycle. He asked the children to explain the source and formation of clouds. Analysing the children's responses showed that younger children had the idea that the formation of the rain and clouds is related to humans or God.

Cin, and Yazıcı (2002), suggested that teachers should consider children's artificial views explicitly as a starting point for teaching.

Savva (2014) found that children demonstrated that elements of the water cycle were as a result of evaporation rather than condensation. They observed that those children that were aware of changes in the colours of clouds before rainfall were also able to identify clouds as the source of rain. This indicated that if children can notice the changes in clouds when it rains, then the connection between clouds and rain can become an easier concept to understand. Majority of children were able to identify the clouds as

the source of rain, however, their understanding of what clouds are made of was limited. Understanding the composition of clouds is a crucial element in understanding the water cycle, since it involves both concepts of evaporation and condensation (Savva, 2014).

6. Conclusion

The results agree with the fact that knowledge and sciences are shaped resulting from the worldview of students. Besides the academically established sciences there are sciences rooted in different cultures. The analysis of the results revealed sufficient evidence of different forms of cultural beliefs and misconceptions that students bring into the science classroom.

Ozsoy (2012) asserted that exploring children's misconceptions about nature and natural phenomenon and the sources of their knowledge may strengthen teachers' efforts to improve their teaching practices with regard to science concepts. To understand the natural world, children should be provided conditions for developing positive experiences, imagination, increased sense of wonder, creativity and observation skills. Ozsoy (2012) added that Science educators should create such learning environments in which children meet challenges that can encourage them to activate and evaluate what they already know in the light of scientific knowledge that they encounter in the school. By this way it will be possible to promote a conceptual development which is consistent with our existing scientific knowledge about the nature. According to George (1999) there is a need for a science curriculum that would require a science education perspective that views science learning as a process of crossing the boundary between the students' worldview and science worldview (as cited in Fakudz, 2004). Fakudz (2004) opined that this type of curriculum approach requires teachers to understand the students' fundamental, culturally-based beliefs so as to teach a kind of science that coincides with the intellectual interest and socio-cultural setting of such students. Science teachers should become aware of the impact of cultural variables such as traditional beliefs and religious affiliations in their teaching efforts (Jegede & Okebukola, 1991). Several studies such as (Allen & Crawley, 1998; Kawagley *et al.*, 1998) have shown that a curriculum that is not sensitive to the students' cultural background tends to produce passive students. To alleviate the consequences of such a curriculum, the students should not be made to abandon their cultural background knowledge for conventional science, but instead are encouraged to connect the two worldviews.

One major influence on science education identified on students is their feeling that science is like a foreign culture to them (Maddock, 1981). This feeling stems from fundamental differences between the culture of western science and their indigenous cultures (Aikenhead, 1997; Jegede, 1995). The transition from a student's life-world into a science classroom is a cross-cultural experience for most students. Fakudz (2004) used the socio-cultural instructional model (SCIM) in a study about Learning of science concepts within a traditional socio-cultural environment. The socio-cultural instructional model (SCIM) is an intervention that integrates indigenous knowledge with school

science on the students' conceptions. The SCIM was based on the recommendations from different studies which include:

a) Generating information about the student's everyday environment to explain natural phenomena (Jegede, 1995).
b) Teaching/learning materials that are simple, relevant to the context, and matching the developmental level of the students should be provided.
c) Class discussions should include considerations of worldview cultural perspectives and other more metaphysical concepts.
d) The time for discussion in class should be increased because of the differences in the perceptions of the students.
e) The teaching manner and style should provide intellectual independence thus respecting the students as thinking individuals, Encourage active observation, interpretation, and explaining on the part of the students and finally the teaching approach should be accompanied by exposure to a variety of alternative modes of explaining so that the students would test their views against other views (Fakudz, 2004).

The capacity and motivation to master and critique scientific ways of knowing seem to depend on the ease with which students cross cultural borders between their everyday worlds and the world of science (Aikenhead, 1997). Aikenhead concluded that one curriculum implication, therefore, is to develop instructional materials that make border crossings explicit for students, one that will facilitate border crossings, that substantiate the validity of students' personally and culturally constructed ways of knowing, and a curriculum that teaches the knowledge, skills, and values of Western science and technology in the context of societal roles (Aikenhead, 1997).

Jegede (1995) described five major cultural inhibitions to learning science in Africa. These are: authoritarianism, goal structure, traditional worldview, societal expectations, and sacredness of science. A traditional worldview "*holds the notion that supernatural forces have significant roles to play in daily occurrences*" (p. 114). Such a view of nature makes it difficult for African students to cross the cultural border into the mechanistic reductionist rationalism of Western science to construct meaning of natural phenomena (Cobern, 1997).

According to Cobern (1997), cultural aspects of learning science means that learning should result from the organic interaction among:

a) the personal orientations of a student,
b) the subcultures of a student's family, peers, community, tribe, school, media, etc;
c) the culture of his or her country or nation; and
d) the subculture of science and school science.

Consequently, it is important to develop appropriate teaching strategies to integrate new ideas into children's existing knowledge, because as Vosniadou (1991) indicated, a learner's ability to learn something new depends on the interaction between the information that currently exists in the knowledge base already available and the new information to be acquired. When there are gaps in the knowledge base, the result may not be successful learning.

Therefore, it is important to know about the ideas that children develop before formal instruction. In addition, children's pre-instructional knowledge may contain alternative conceptions. Osborn and Gilbert (1979) and Nussbaum and Novick (1982) argued that children bring to the classroom views which are usually different from those that are held in schools and by scientists. These views are referred to as misconceptions.

References

Abrahams, R. D. & Rudolph C. (1972). eds. *Language and Cultural Diversity in American Education*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Agogo P. O. & Agogo E. A. (2014). *Effects of African Cultural Beliefs on the Development of Basic Science and Technology Education Among the IGEDE Ethnic Group of Benue State, Nigeria.* Journal of education and curriculum development research (JECDR) ISSN: 2328-5303 Vol. 2(2), pp. 41-48, February 2014 ref number: 0420140422.online: http://www.projournals.org/jecdr

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

Arnaudin, M., & Mintzes, J. (l986). The cardiovascular system: Children's conceptions and misconceptions. Science and Children, 23, 48-51.

Baker, D. & Taylor, P. (1995). The Effect of Culture on the Learning of Science in non-western Countries: the result of an integrated research Review. International Journal of Science Education. V. 17, pp. 695-704.

Bennett C. I. (1999). *Comprehensive Multicultural education. Theory and Practice*. 4th Edition. Boston. Allyn and Bacon.

Berry, B. (1968). *The Education of American Indians, a Survey of the Literature*. Columbus: Ohio State University. ERIC ED 026 5451.

Berzonsky, M. D. (1971). The Role of Familiarity in Children's Explanation of Physical Causality. Journal of Child Development. Volume 42, pp. 705-715.

Braun V. & Clarke V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology 3, pp.77-101. www.QualResearchPsych.com

Brière, E. J., ed. (1978). *Language Development in a Bilingual Setting*. Pomona, CA: Multilingual Multicultural Materials Development Center.

Cárdenas, J. A. & Cárdenas B.(1972). *A theory of incompatibilities*. *Today's Education* (February 1972).

Christidou, V. & Hatzinikita, V. (2006). Preschool children's explanations of plant and rain formation: A comparative analysis. Research in Science Education, 2006(36), 187-210.

Christidou, V. & Hatzinikita, V. (2006). Preschool Children's' Explanation of Plant Growth and Rain Formation: A Comparative Analysis. Journal of Research in Science Education. Volume 38, pp. 187-210, 2006. DOI: 101007/s11165-005-9006-1.

Cin, M., & Yazıcı, H. (2002). The Influence of Direct Experience on Children's Ideas about the Formation of the Natural Scenery. *International Research in Geographical and Environmental Education, 11*(1), 5-14. doi:10.1080/10382040208667459.

Coben, W. (1991). Worldview Theory and Science Education Research. Monograph No. 3. Manhattan, KS: National Association for Research in Science Teaching (NARST).

Cobern, W. W., & Aikenhead, G. (1997). Cultural Aspects of Learning Science. *Scientific Literacy and Cultural Studies Project, 13*. Retrieved from: http://scholarworks.wmich.edu/science_slcsp/13

Eleuterio, S. (1997). *Folk culture inspires writing across the curriculum*. *C.A.R.T.S. Newsletter*

Emeagwali, G. (2003) African Indigenous Knowledge Systems: Implications for curriculum, in Toyin Falola (ed), Ghana in Africa and the World: Essays in Honor of Adu Boahen, Africa World Press, New Jersey.

Eyres, M. & Garner, W. (1998). Children's ideas about landscapes. In Scoffham (ed.) Primary Sources. Sheffield: Geographical Association and Thanet Press. accommodation. Instructional Science 11, 183–200.

Fairbanks, J. L. (2011). Misconceptions in middle school life science and strategies teachers can use to change them. *Graduate Research Papers, 179*. Retrieved from https://scholarworks.uni.edu/grp/179

Freshman P. (1988). *Familiar but Different: Some Dilemas and New Directions in Science Education*. In Peter F. (Ed). *Development and Dilemas in Science Education*. London. The Falmer Press.

Gelman, S.A., & Kremer, K.E. (1991). Understanding Natural Cause: Children's explanations of how objects and their properties originate. Journal of child development. V. 62, pp. 396-414.

George, J. (1999). Worldview Analysis of the Knowledge in a Rural Village: Implications for Science Education. Culture and comparative studies. V. 83, pp. 77-95.

Ghana in Africa and the World; essays in Abu Boaden, Falola T. (ed), African World Press.

Goduka, I. (2000).*African/indigenous philosophies: Legitimizing spirituality-centred wisdoms within the academy,* Central Michigan University.

Hatzinikita, V. (1995). Pupils Representations of Changes of Matter: Types, Causal Relations, and Mechanisms. Unpublished Doctoral thesis, Patras (Greece): University of Patras, Department of Education.

Hoelscher, K. J. (1999). *Cultural watersheds: Diagramming one's own experience of culture. Social Studies & the Young Learner. volume 12*(2), 12-14. Library of Congress American Memory Collection From http://memory.loc.gov/ammem/amhome.html on 10/05/2015.

Inokoba, P. K., Adebowale, A.-S., & Perepreghabofa, J. (2010). The African Metaphysical Worldview and Its Prostrate Condition of Backwardness. *J Hum Ecol, 29*(1), 23-31.

Jegede, O. (1994). Traditional Cosmology and Collateral Learning in non-western Science classrooms. Toowoomba, Queensland: Research and Evaluation Unit Distance Education Center, University of Southern Queensland.

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

Jegede, O. (1997). *School science and the development of scientific culture: A review of contemporary science education in Africa*. International Journal of Science Education, 19, 1–20.

Jegede, O. J. & Aikenhead, G. S. (n.d). *Transcending Cultural Borders: Implications for Science teaching*. www.ouhk.edu/cridal/misc/jegede.htm Retrieved on 30th November, 2013.

Jegede, O. J. Fraser, B. J. & Okebukola, P. A. (1994). *Altering socio-cultural Beliefs hindering the learning of science. International Science, 22*(2), 137-152.

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

Jugder, N. (2016). The thematic analysis of interview data: an approach used to examine the influence of the market on curricular provision in Mongolian higher education institutions. *Hillary Place Papers, 3rd edition (Jan 2016), University of Leeds*, 1-7.

Kamanzi, A. (2014). *Connectedness in Evolution: The Discourse of Modernity on the Ecosophy of the Haya People in Tanzania*: Africa Institute of South Africa.

Maddock, M. N. (1981). Science education: An anthropological viewpoint. Studies in Science Education, 8, 1-26.

Mansour N. (2008).*Science Teachers' Beliefs and Practices: Issues, Implications and Research Agenda.* International Journal of Environmental & Science Education Vol. 4, No. 1, January 2009, 25-48.

Medina-Jerez, W. (2007). Between Local Culture and School Science. Journal of Research in Science Education. Volume 38(2), 2008, pp. 189-212. DOI 10.1007/s11165-007-9044-y.

Millar, D. (2004). *Interfacing two knowledge systems: Local Knowledge and Science in Africa*. Paper presented at the Bridging Scales and Epistemologies: Linking Local Knowledge with Global Science in Multi-Scale Assessments, Alexandria.

Miller D. (2006). *African knowledges and sciences: Exploring the ways of knowing of Sub-Saharan African* in *David M., Stephen B. Kendie, A.A.A. and Bertus H. (Editors).* African knowledges and sciences. *Understanding and supporting the ways of knowing in Sub-Saharan Africa.* Compass series on Worldviews and sciences 3.

Miner, J. T. (1992). An early childhood study of the water cycle. Unpublished Master of Art Thesis, University of Nevada: Las Vegas, NV.

Mintzes J. J., & J. H. (1997). *Research in Science Teaching: A Human Constructivist View*. In Joel J. M., James, H. W., & Joseph D. N. (2005) (Eds). *Teaching Science for Understanding. A Human Constructivist View*. London. Elsevier Academic Press.

Moseley, W. G. (2001). Computer assisted comprehension of distant worlds: Understanding Hunger Dynamics in Africa. Journal of Geography 100 (1), 32–45.

Nass, M. L. (1956). The Effect of Three Variables on Children's Concepts of Physical Causality. Journal of Abnormal Social Psychology. Volume 53, pp. 191-196.

Nussbaum, J. & Novick, S. (1982). Alternative frameworks, conceptual conflict and accommodation. Instructional Science 11, 183–200.

Okoye, B. E. & Okeke, O. C. (2007). Efficacy of eliminating superstitious beliefs strategy on achievement and knowledge retention in genetics among secondary school students. Journal of Science Teachers Association of Nigeria (STAN).; 42 (1&2); 73-77.

Olsen M. E., Lodwick D. G., Dunlop R. E. (1992*). Viewing the world ecologically*. Boulder, CO: West view Press.

Osborne, R., & Freyberg P. (1985). Learning in science: The implications of children's science. London:

Osborne, R. J. & Gilbert, J. K. (1979). A technique for exploring students' views of the world. Physics Education 15, 376–9.

Özsoy, S. (2012). Is the earth flat or round? Primary school children's understandings of the planet earth: The case of Turkish children, International Electronic Journal of Elementary Education, 4 (2), pp. 407-415, 2012.

Palmer, J. (1993). From Santa Claus to sustainability: Emergent understanding of concepts and issues in environmental science. International Journal of Science Education15 (5), 487– 95.

Palmer, J. (1993). From Santa Claus to sustainability: Emergent understanding of concepts and issues in environmental science. International Journal of Science Education15 (5), 487– 95.

Patton, M. Q. (2002). Qualitative Research and Evaluation Methods. Thousand Oaks, CA: Sage.

Piaget, J. (1929). The Child's Conception of the World. London: Routledge and Kegan Paul.

Sackes, M., Flevares, L. M., & Trundle, K. C. (2010). Four-to six-year-old children's conceptions of the mechanism of rainfall. Early Childhood Research Quarterly, 25(4).

Saçkes, M., Flevares, L., M. & Trundle, K. C. (2010). Four to-six-year-old children's conceptions of the mechanism of rainfall. Early Childhood Research Quarterly, 25(2010), 536-546.

Samba, R. M. O. (2003). Promoting students' understanding of photosynthesis and respiration: An evaluation of the potency of a conceptual change instructional strategy The Benue Valley: Journal of Inter disciplinary Studies; 2: 100-114

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

Saville-Troike M. (1978). *Guide to Culture in the Classroom. National Clearinghouse for Bilingual Education,* 1978. Teacher's Guide to Folklife Resources for K-12 Classrooms. Retrieved from http://www.loc.gov/folklife/teachers.html. On 05/5/2015

Savva, S. (2014). Year 3 to year 5 children's conceptual understanding of the mechanism of rainfall: A comparative analysis. Ikastorratza e-Revista de Didáctica 12. http://www.ehu.es/ikastorratza/12_alea/rainfall.pdf.

Sedlak, A. J. & Kurtz, S. T. (1981). A review of children's use of causal inference principles. Child Development. 52,759-784.

Sewell, A. (2002). Constructivism and student misconceptions: Why every teacher needs to know about them. Australian Science Teachers' Journal, 48(4), 24-28.

Sewell-Smjth, A. (2004). Teaching does not necessarily equal learning. Teaching Science, 50(1), 22-26.

Smith, F. & Dougherty, J. H. (1965). Natural phenomena as explained by children. Journal of Educational Research, 59 (3), 137–40.

Springer, K., & Keil, F. C. (1991). Early Differentiation of Causal Mechanisms appropriate to Biological and Non-biological Kinds. Journal of Child Development. Volume 6, pp. 767-78

Stepans, J. and Kuehn, C. (1985). Children's conceptions of the weather. Science and Children (September).

Sungur, S., Tekkaya, C., & Geban, O. (2001). The contribution of conceptual change texts accompanied by concept mapping to students' understanding of the circulatory system. School Science and Mathematics, 101(2), 91-101.

Villarroel, D. J. & Ros, I. (2013). Young Children's Conception of Rainfall: A Study of Their Oral and Pictorial Explanations. International Education Studies, V.6 (8), 2013.

Vosloo, J. J. (2014). Chapter 6: Data analysis and interpretation. Available: https://dspace.nwu.ac.za/bitstream/handle/10394/12269/Vosloo_JJ_Chapter_6.pdf?sequence=7&isAllowed=y

Wandersee J. H., Mintzes J. J. & Novak J. D. (1994). Research on alternative conceptions in science. In: Gabel DL (ed.). Handbook of research on science teaching and learning: 177-210. New York: MacMillan.

Wiegand, P. (1992). Places in the Primary School: Knowledge and Understanding of Places at Key Stages 1 and 2. London: Falmer.

Yip, D. Y. (2001). Promoting the development of a conceptual change model of science instruction in prospective secondary biology teachers. International Journal of Science Education; 23(7): 755-770.

Za'rour, G. (1976). Interpretation of natural phenomena Lebanese school children. Science Education. 60(2), 277-287.