

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

There is not much information from both the theoretical and empirical literature about the answers to the three questions my study attempted to answer. The sections below discuss answers from the few sources I found, starting first with my theoretical framework.

2.2. Theoretical framework

Cobern (1994) cited in Cobern (1996, p. 590) argues that “constructivism suggests that the concepts of knowledge and belief are not strictly separable”. He argues this point further in Coben (1996) indicating that it is with this idea that one can begin to understand how worldview directly influences conceptual development and change. Jegede and Okebukola (1991) have also argued that since early times human beings have always interpreted nature from two distinct viewpoints of anthropomorphism (traditional worldview) and mechanism (scientific worldview). According to Ogunniyi (1988), a person’s worldview has an organising value for experience. It is not only a mechanism for organising an individual organically into a socio-cultural milieu, but also a dynamic cultural framework that determines the likelihood in which a new idea is simulated in the cognitive structure.

In the development of this theoretical framework I saw the relevance in the comparison of Vygotsky’s and Piaget’s theories of concept development. It should be remembered,

when this comparison is made, that Vygotsky's was especially interested, as he pointed out, in improving instruction in school while Piaget's research did not directly address the influence or effects of schooling. Nevertheless, important practical implications for science education emerge from comparison of the two theoretical positions. (Howe & Moses, 1999). Thus, this study was embedded within both the anthropomorphism (traditional worldview) and mechanism (scientific worldview) as they pertain to Vygotsky's concept of development.

2.3. Definition of science

There are numerous versions of what science is and what counts as scientific Snively & Corsiglia (2001). There are scholars who conform to indigenous science. and those who conform to western modern science (WMS). This study seeks to negotiate a balance between the Western Modern Science and Indigenous Science. According to Ogawa (1995), science is a rational perceiving of reality. This definition implies that science is not a rigid but is a dynamic subject. Every culture has its own science (Elkana, 1981 in Snively and Corsiglia, 2001). Elkana (1981) cited in Snively and Corsiglia, (2001) argues that Western science is only one form of science amongst other sciences in the world.

Ogawa (1995, p. 588) refers to science at the cultural or society level as indigenous science. He defines indigenous science as "a culture dependent, collective, and rational perceiving of reality. [It is safe to] note that indigenous science includes the knowledge of both expansionist cultures and it is a fundamental principle taught by indigenous elders". Therefore, as far as I am concerned, science is not rigid but dynamic and it is a

human construction rather than absolute true body of facts about nature as claimed by some of the conventional scientists.

2.4. African conception of lightning

Most of the African conceptions of lightning originate from indigenous communities, and are transferred from generation to generation merely by invisible or non-formal settings (Ogawa, 1989 cited by Snively and Corsiglia, 2001). According to du Toit (1997, p. 12):

To understand the place of science in any society one has to look holistically at the general make up, world-view, belief systems, relationships and contexts in which such society stands. Understanding science in Africa is impossible without coming to grips with what can symbolically be called the soul of Africa. Neither can it be understood without taking the physical context of poverty and illiteracy into account.

From what I know, in different African communities it is seen as a natural phenomenon that can be utilised by witchdoctors to destroy their rivals' property and or to kill them. Some Southern African communities believe, the chiefs have control over this natural phenomenon and can use it to establish stronger kingdoms.

2.5. Western conception of lightning

In the western science, lightning is formed as the ice particles within a cloud (called hydrometeors) grow and interact, collide, fracture and break apart. It is thought that the smaller particles tend to acquire positive charge, while the larger particles acquire more negative charge. These particles tend to separate under the influences of updrafts and gravity until the upper portion of the cloud acquires a net positive charge and the lower portion of the cloud becomes negatively charged. This separation of charge produces enormous electrical potential both within the cloud and between the cloud and ground. This can amount to millions of volts, and eventually the electrical resistance in the air breaks down and a flash begins. Lightning, then, is an electrical discharge between positive and negative regions of a thunderstorm. Sound is generated along the length of the lightning channel as the atmosphere is heated by the electrical discharge to the order of 20,000 degrees Celsius (which equals to about three times the temperature of the surface of the sun). This compresses the surrounding clean air producing a shock wave, which then decays to an acoustic wave as it propagates.

A lightning flash is composed of a series of strokes with an average of about four. The length and duration of each lightning stroke vary, but typically average about 30 microseconds. The average peak power per stroke is about 10^{12} watts. Although the flash and resulting thunder occur at essentially the same time, light travels at 186,000 miles in a second, almost a million times the speed of sound. Sound travels at the relatively snail's pace of one-fifth of a mile in the same time. Thus the flash, if not obscured by clouds, is seen before the thunder is heard. By counting the seconds between

the flash and the thunder and dividing by five, an estimate of the distance to the strike (in miles) can be made ([http://www. A lightning Primer from the GHCC.htm](http://www.AlightningPrimerfromtheGHCC.htm)).

2.6. Learning similar conceptions embedded in different cultures

Does an African conception of lightning inhibit the learning of the Western conception of lightning? There are arguments for and against this question. One of the arguments for the inhibition is that African worldview is monistic. It means that Africans lack a sense of causal reasoning. This makes it difficult for African learners to understand Western science conceptions. Obhiambo (1972) in Dzama and Osborne (1999) maintains that:

*An African must find a connecting link between the principles of natural
[European] science and basic assumption of his worldview [African science],
or he is lost...the fact of the matter is that the idea of cause and effect is
foreign to African cosmology*

Initially, Jegede (1990) cited by Dzama and Osborne (1999) agreed with Obhiambo's position. He also argued that African worldview has no cause and effect. That is:

Perhaps with the realisation of the difficulties western [European] scholars have with understanding African Culture, and the need to inform African scholars and others about the African mode of thought, a sizable amount of intellectual effervescence has been generated. Various field data,

personnel accounts and position papers... now confirm the position that the African has an anthropomorphic view of nature as opposed to the mechanistic view of nature indicative of western [European] science.

Jegede made a turn around in his paper in 1995 where he now claims that Africans do have a sense of cause and effect, which is different from that of Europeans:

The psyche of the African is controlled by the concept of causality. The concept of causality is quite different from the positivist-empiricist disposition of western culture. Things do not just happen in the traditional African societies, as every event is ascribed to a cause interpreted in personal terms. These personal terms constitute other humans, ancestors, spirit or god (Jegede, 1995, p.8).

Based on the arguments above I can then conclude that Africans have their own way of interpreting events in the world that is different from Europeans.

According to Kahn & Rollnick (1992) the simplistic use of the words Western and African begins to indicate that there is a non-lapping mental identity for residents of Europe and America and those of Africa. But the fact of the matter is that Africans have a sense of cause and effect. When one goes through African children's stories there are many examples indicating that African people have a sense of cause and effect. However,

some African scholars argue that although Africans do have a sense of cause and effect, such thinking about cause and effect is based on superstitions.

Africans have been attentive to nature, and are able to demonstrate a sense of cause and effect that is not linked to ancestors and spirits (Dzama & Osborne, 1999). For example Africans invented what is called terrace farming. It is a skill of knowledge to cultivate around the hills and mountains, such as in KwaZulu Natal (Vilakazi, 1997). This is the reason why crops on hillsides are not washed away by rain and wind.

Generally the paper by Dzama & Osborne (1999) indicates that the inhibition of science in Africa is not as a result of Africans being unable to conceptualise the concepts of science, but

The success of the educational endeavour in science education is as dependent, if not more, on the factors exogenous to the school than it is on internal issues of curricular, time, status, or teacher quality. Such external factors are the availability of reasonable careers for science graduates, state participation, and society attitudes to learning science (Dzama & Osborne, 1999, p.397).

Based on the history of the development of science in Japan, England and India, what is important here is that these countries may be developed in terms of science at this stage but in the beginning they experienced similar problems to those experienced by Africa. Science was taken to be impious and a waste of time by the Japanese (Dzama and

Osborne, 1999) and its introduction in schools was opposed by the society in the 19th century (Waring, 1979; Allen, 1978) cited by (Dzama & Osborne, 1999, p.401).

2.7. Teaching similar conceptions embedded in different cultures

Is it possible to teach science to African children without changing their cultural beliefs? Specifically is it possible to teach African learners about Western conception of lightning without changing their African conceptions? According to Snively and Corsiglia (2001, p. 27) “educators need to know that it is possible to teach Western scientific concepts to native students with a preferred spiritual view of the world, without changing in the sense of replacing the students’ preferred orientation”. The above statement encourages educators to avoid the temptation of concept replacement. The challenge is to teach and help “students understand science concepts and explore the differences and similarities between their own beliefs and Western science concepts” (Snively and Corsiglia, 2001, p. 26). Here the author talks about being careful about wanting to change a grounded belief instead of changing existing misconceptions:

The fact that students bring to the classroom ideas based on prior experience and that children of different cultural backgrounds frequently interpret science concepts differently than the standard scientific view, suggested that teachers must begin the exploration of multicultural science instruction with the prior knowledge that children bring to the classroom (Snively and Corsiglia, 2001, p. 26).

2.8. Conclusion

In conclusion most students are not about to risk altering a useful commonsense conception in favour of a counter-intuitive abstraction advanced by a teacher or textbook (Cobern, 1994; Hills, 1989 cited by Aikenhead, (1996, p. 3). Educators or science teaching in general must acknowledge that students' social worlds influence the way students make sense out of the natural world (Aikenhead, 1996)

My literature review gives me generic ideas about how to teach both conceptions (see above) but no details, hence the need for research. Because of the limitations or shortcomings of the literature, I decided to go ahead with the research study. In the next chapter I describe how the study was designed.