The relevance of integrating Ethno-Science (Indigenous knowledge) into Upper Primary Natural Sciences and Health Education School Curriculum in the Zambezi Region

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Abstract

There is widespread concern about the outcomes of science education in Namibian schools. The representatives of industries say that they need high-grade scientists, technicians and engineers if Namibia is to successfully compete in technology-intensive global markets by 2030. Ethno-science is a specialisation of indigenous knowledge (IK). It focuses on a scientific perspective of culture. The research that resulted in this article critically analysed the relevance of integrating ethno-science (IK) into the Upper Primary School curriculum in Namibia. The research further looked at how the people in the Zambezi region have developed a working terminology that produces taxonomies related to ethno-science. Research has shown that most anthropologists have carried out studies in ethno-science based on native perceptions. This research relies on a quantitative research approach in order to gather data from a population on the general understanding of ethno-science. It can also reveal that 10 parents were involved in the research. This research is of the utmost importance to the different sectors of the industry, teachers, learners, the National Institute For Educational Development (NIED), parents and institutions of higher learning as well as for the nation that needs to produce more science specialists at all level; a society that needs technicians as well as world-class researchers in order to increase the public's ability to engage with scientific knowledge and choices.

Introduction and background of the research

Education in Africa is still too Eurocentric, meaning that it is still dominated by European worldviews (Kaya & Seleti, 2013). The implication of this in the teaching and learning of the Natural Sciences, particularly in Namibia, is that schools have been reduced to the reproduction of the intellectual outputs of thinkers with Western-oriented ideas, including the theories and methodologies of those ideas. Out of the 14 regions in Namibia, the focus is on the Zambezi (formerly known as Caprivi) region. The inhabitants of this region have adopted Silozi, a Zambian indigenous language, as a com-

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mon medium (*lingua franca*) of communication. This region shares its borders with four other countries: Angola, Zambia, Botswana and Zimbabwe, which are all members of the Southern African Development Community (SADC). This research paper examined conceptual issues associated with Indigenous Knowledge (IK) in the Zambezi region, including the nature of the intersection between IK and Conventional Science/Academic Knowledge. In this paper IK is defined as set of ideas, beliefs and practices of a specific local people to interact with their environment, and with other people over a long period of time (Mawere, 2015, p. 59). The research paper also explored the multiple linkages between IK and the school curriculum in terms of needs, goals, teaching strategies and instructional resources of various kinds.

The study intended to be a participatory type of research that valued and included IK and the local people. The study assumes a methodology of predominantly Western-oriented academic investigation, and it assumes that in this type of investigation African voices are either sidelined or suppressed because indigenous knowledge and methods are often ignored or not taken seriously. It is argued that knowledge or science and its methods of investigation cannot be divorced from a people's history, cultural context and worldview (Owusu-Ansah & Mji, 2012). This research paper opens avenues for the inclusion of indigenous knowledge, particularly in the Zambezi region, to be documented by researchers because currently the indigenous knowledge is mainly in oral form and not in written form.

Theoretical Framework

This research is informed by the theoretical framework on African indigenous knowledge embedded in one of the best kept secrets of academia: Cultural Historical Activity Theory (CHAT), with its roots in the work of Lev Vygotsky (1978). The theory mainly rests on the premise that culture and history are part of the search for knowledge of communities in order to sustain and uplift the living standards of the particular community ever since human society emerged from its primitive state.

Literature Review

Research has shown that all knowledge has cultural relevance and must be examined for its particular cultural focus (Asante, 1987). Africa's richest cultures are informed by the complexities of community ceremonies and rituals, such as story-telling, proverbs, folktales, recitation, demonstration, sports, epic, poetry, reasoning, riddle, praise, song, word games, puzzles, tongue-twisters, dance, music, and other education-centered activities (Ngara, 2007). In support of the notion according to Mwamwenda (2004, 400), traditional African communities educated their young ones in their cul-

tures and skills. In “old Namibian societies”, the purpose of education was to prepare a young person for adulthood. It was not the responsibility of a specialist labour force, now called “teachers”, “principals”, “coordinators”, “consultants”, or “supervisors” (Auala, 1989). Instead, it was the responsibility of all parents to teach, correct, or even punish children when they did something wrong. The roles and skills of adult members were learnt through poetry, riddles, proverbs, storytelling, memory tests, racing, wrestling, demonstrations, as well as through traditional songs, dance and games (Ellis, 1984; Ndilula, 1988; Mwamwenda, 2004).

In addition, there were various activities children practised to learn traditional skills. For example, they did carpentry, made drums, built houses, and weaved mats and baskets. This traditional education involved a life-long process where individuals passed through different learning processes in their lives. It aimed at transmitting the people’s cultural heritage, beliefs, behaviour patterns, attitudes, values and skills from one generation to another. Recent ethno-mathematics research has shown that there is a wide variety of mathematical and scientific ideas found in traditional cultures (Vithal, n.d., in Ilukena, 2008).

Since the focus of this research paper is the integration of IK into the Upper Primary Natural Sciences and Health Education curriculum, the curriculum, if implemented, would provide learners with the following three major opportunities as outlined by Battistle (2002): Firstly, learners are equipped with opportunities to learn correct community attitudes and values for sustainable livelihood. This is because IK communities have lived in harmony with their environment and utilised natural resources without impairing nature’s capacity to regenerate these. In this way, learners can develop and promote these sensitive and caring values to the regenerative advantage of the environment. Secondly, learners will be able to learn through culture. This is due to the fact that IK is stored in various cultural forms, such as folk stories and drama, songs, proverbs, games, dances, myths, as mentioned above. They learn to conceptualise IK. Lastly, involving community knowledge in research, teaching and learning, enables learners to learn across generations, hence making them appreciate and respect the knowledge of elders and other community members. In support of Battiste (2002), Mawere (2015) is of the opinion that through the inclusion of IK into the curriculum, learners are afforded the opportunities to compare and contrast various forms of knowledge for their own good and that of the society of which they form part. Mawere’s analysis shows that “traditional” communities have the same content areas as those found in formal (Western) education. This implies that, if IK is incorporated in the curriculum, Eurocentric theories, beliefs and methodologies are broken. It empowers, motivates, and bolsters the intellectual fortunes and interests of learners as they recognise

and realise what they already do, know and say in their own communities. This resonates well with the adage “From the known to the unknown”. In this way the learners make their own decisions and chart their own destinies, based on what they learn at home being in congruence with what is being systematised at school.

Research Methodology

The participants involved in this research were 10 parents for cross checking of ideas and facts. Purposive sampling was used to select the participants and a snowball research approach was used to verify ideas and facts. The following research instruments were used to gather data: semi-structured interviews and observation. The participants were probed on IK and how they carry out IK based activities, while observation was used to observe the activities mentioned in this research paper.

Results and Discussions

The results and discussion focused on the following findings:

i) Traditional Weapons

The most commonly used tools in the eastern part of Zambezi region are *mulinga* (flat-spear), *muso* (scaling-spear), *uchapu* (axe), and the *ihamba* (hoe). According to Ba Leonard Sichombe & Ba Boniface Sichombe, (Communication, 25 August 2015), the Blacksmith exposes the metal to the fire at high temperature into the furnace/hearth, and shapes iron with a hammer when it is hot and malleable to the required shape or size (physics). There are three procedures of taking out hot iron from the fire. It is either by holding two wet barks of a tree (*Mahande*), or by using two *zikunku* (maize cobs) fixed in a short scaling-spear, or using *zisila* (old cloths), according to Ba Chrispin Pele-Pele Muhinda (Communication, 8 August, 2015). Furthermore, the Blacksmith will continue heating the piece of metal until the desired shape is formed, whereafter the shaped tool is immersed in water to cool down.

The physics applied, is to first put the iron into fire; the potential energy (in cold iron) is converted into heat energy. This implies that the Blacksmith is transferring energy into the iron in order to make the particles vibrate more. Secondly, heating the iron (thermal expansion) weakens the bonds holding the shape particles together, which makes changing the shape much easier. Lastly, putting the iron into water, hardens the iron (contraction).

The handles of these traditional tools are made from wood. These handles are called *lutondo* (for *mulinga* and *muso*) and *muhini* (for *uchapu* and *ihamba*), respectively. The *lutondo* and the *muhini* can be put in fire to straighten them if they bend. Decorations can be applied on the handles. Three participants stated that the wood is preferred to iron for making handles because wood is lighter than iron, and wood also functions as an insulator. In addition, wood is made of cellulose. Cellulose, a polysaccharide, has a complicated structure in which carbon, hydrogen and oxygen are bonded covalently to form a polymer, and wood has strong intermolecular forces, which makes it strong.

The *mulinga* (flat-spear) and the *muso* (scaling-spear) are used for hunting and fishing, while the *uchapu* (axe) is used for various purposes, such as cutting wood, slaughtering animals, and opening the heads of big fish, goats or pigs, and the i*hamba* (hoe) is used for ploughing or weeding purposes.

ii) Clay pots (*kapali* or *impoto*: hand-made pot)

The people in the eastern part of the Zambezi region in Namibia use clay pots for cooking, storing food or traditional drinks as well as for other necessities. Clay pots are made of a composite of clay and water. They are molded into shape when wet, Agnes Namasiku Kamwi (Bana Mukanwa - Communication, 11 August, 2015) informed us. They are hard when dry, because they are made from crystals that are locked together. She also said that they are burned/heated in an underground hole (furnace/hearth) at a high temperature so that they become very hard. This process makes the clay pots versatile and durable and this further enhances effective cooling.

In ancient times, the people in the eastern part of the region did the cooking in hand-made pots made from clay. The two-piece *impoto* had a bottom part that was a broad, shallow bowl, while the top was a longer, and cone- or dome-shaped. The lid (*chifupi*) condensed the raised steam and allowed the moisture to roll back down into the dish or food (steaming). This method of cooking food with clay pots has been replaced by pots made from metal, and modern food steamers. The clay pots could also be used for the storage of grains and beverages.

iii) *Bujwala* (traditional beer called Seven Days)

The brewing of *bujwala*, commonly known as Seven Days, involves malting, drying, milling, souring, boiling, mashing and alcoholic fermentation (Mwaka Simataa-Bana Lungowe, Communication, 10 August, 2015). The traditional *bujwala* brewing process starts with malting, steeping, or soaking of white or red sorghum grains in order to produce a substance called *mulungo* (germinated sorghum grains). Sorghum grains are soaked in water for at least 24 hours at room temperature. After steep-

ing, the sorghum grains are spread out on a germinating device and kept covered for at least 2 days to germinate.

The kilning (removal of moisture) process follows next; the germinated sorghum grains are sun-dried and stored under protection during the night to avoid rehydration. After this stage, the dry malt grains are pounded, crushed and grounded in the mortar to make sorghum flour. The flour is sieved using a nylon cloth stretched over a bowl, and raked with a wooden stick or the process locally called *kufefula* (using traditional baskets to sieve the chaff, according to Bana Ilukena and Doreen Mpule-Ilukena (July 1, 2015; also Ba John Sinvula Simasiku, communication, August 12, 2015). The sorghum flour is then mixed with maize flour in a drum or clay pot and then hot water is poured onto the mixture. The mixture is stirred homogeneously, and then cold water is added. The mixture is then left at ambient temperature for the duration of the night. On the 4th day, the soured product is boiled for about 6-8 hours. The boiled *chiluvu* is then allowed to cool down between the 5th to 6thday. A bit of the *mulungo* flour and water are added to the cooled *chiluvu* on the 6th day. The mixture is left to ferment for about 7-8 hours. According to Bana Mukanwa and Agnes Yambwa, the process of *kututa* (filtering) the *bujwala* using traditional sieve, called *mutepiso* or *mutotu*, is carried out. The *mutepiso* is squeezed to filter *bujwala* and the residue is left in the *mutepiso* (sieve). The process is repeated and the alcoholic product, called *Bujwala* (seven days), is ready for consumption. The *bujwala* is served using a *mukope* (traditional cup).

iv) Water waves (*mandinda*) and sound waves (*mulumo*)

Water waves (*mundinda*)

Water waves are created when the smooth surface of water is disturbed by a breeze (*luhuho*), *bwato* (canoe), fish (*iswi*), floating birds (*chifuli, ichekwe*), hippo (*unvuvu*), or any creatures in the water, or a person dropping a pebble into water. According to Ba Leonard Sichombe, water waves can be classified into three categories: small, medium and large, depending on the type of wind blowing, or floating birds, or animals in the water. Many *mandinda* are created in such a way. These are travelling water waves. The distance between the humps (or crests) of the waves is called the wavelength. The science of the objects in or on the water causing waves, such as floating animals, birds or anything in water is described by the concept of density.

These waves also carry energy and vibrations from place to place, without the water flowing. Further, water can be reflected, refracted and diffracted. Waves are reflected when they hit a rigid *mu-*

nanga (bank of the river) and they leave the *munanga* at the same angle as the incoming waves, and travel at the same speed.

Sound waves (*mulumo*)

Two participants (Ba Leonard and Ba Chrispin Muhinda) associated sound waves with echo. They gave two examples: If one is standing at the bank of the river and shouts loud, the voice will be heard across the river twice. However, if one shouts loud during the day in the forest, other people cannot hear, but at night they can hear, because shouting at night causes sound to travel faster due to less disruptions. Three consequences to these observations followed: Firstly, the village head-man or head-woman gave a message or announcement by standing in the middle of the village and shouted. Secondly, advice is given that one should shout if lost at night so that people at the village or passers-by can hear and the person can then be rescued. Further, the traditional healers performed their dances at night for the clearer transmission of their messages via drums.

The scientific insight behind this is that echoes are used to estimate how far away a person is from a particular object. The sound wave is causing an echo which travels to the object and back. If the echo is heard two seconds after one has shouted, the sound has taken a second to get to the other object and another second to get back. It is also evident that sound travels much better through wood and metal than through air. Furthermore, it is also evident that, from the examples given, the two waves, transverse and longitudinal, are known even though they do not have the same names in the traditional culture.

v) Water transport (bwato - canoe)

We found that, when crossing a fast flowing or wide river by *bwato* (canoe), the paddlers point the canoe in the direction where the water is coming from. The action is called *kusweeta*. This allows the paddlers to arrive at the desired point without being pushed away by the water or capsizing. Instead of the wider areas of the river, paddlers use the narrow areas. According to Bernoulli's theorem on fluid dynamics, the velocity of flowing water is less in these areas than at the narrow areas of the river.

Paddlers will further argue that even though they do arrive at their desired destination without being pushed away by the water, unbalanced forces act on a moving canoe to oppose its motion, causing it to move more and more slowly. This happens when the paddler opposes the direction of the water with the moving canoe. Normally the opposing forces are decelerating (retardation) the canoe. In other words, a frictional force is at work.

vi) Calabash (*chitene*)

The *chitene* is subdivided into two sections: the top is called the *Chifupi* (lid), and a small hoe made at bottom of the *chitene* is called the *intibula*. The *Intibula* is used to decant the liquid settled at the bottom of *chitene*, leaving the insoluble solid, *masanza* (sour milk), inside. If liquid cannot be decanted, a long stick is used to decant the liquid.

vii) Levers

When paddlers come across dried or shallow places, they use their paddling sticks (*zilaho*) as levers by laying them on the ground and pushing their canoes to the next swamp or river or tributary. We were informed that a paddler should always carry extra paddling sticks for any eventuality. We were also informed that when carrying logs, sticks can be used, depending on how light or heavy (density) the logs are. Every lever has a point of support, called the *fulcrum* (pivot or axis), about which it turns or tends to turn. In science, a rigid (stiff) rod or bar that turns freely about a fixed point of support, the *fulcrum*, serves as a lever. A person carrying a heavier load (Muziyo) on a stick balancing the load on the shoulder applies the scientific principle that objects of equal mass placed on the ends of a long pole or stick and supported by the center lever, balance each another.

Viii) Houses or huts (*inzubo*)

Traditionally, houses are constructed with poles, grass and loam soil mixed water (mud). The traditional thatch is cheap, and is cooler in summer and warmer in winter than houses with metal roofing. The participants informed us that thatched roofing is a good insulator, while metal is a good conductor of heat. They further elaborated that the thatch kept the heat out on a hot day and in on a cold day. Their houses do not have ceilings, in comparison to modern houses in towns or cities; the ceilings in these town and city houses are installed because air is trapped between the ceiling and the roof which helps to insulate the house from the sun, and serve the same goal as the air in a thatched roof house.

On the issue of the country not having enough grass to feed animals, and thatched houses easily catching fire, the informants maintained that their houses are cheap and that building materials are easily accessible and abundant. When plastering their houses, they use cattle dung and clay soil mixed with water. In this case, there are no expenses involved. Even though they are aware of durability of zinc roofed houses, they prefer the grass thatched houses.

ix) Kraal (*mulaka*)

The kraals for cattle, goats or pigs are situated at the western part of the village in order to avoid the smell from animals spreading into the village, especially during summer. The wind mostly blows from east to west; therefore it is appropriate to locate the kraal at western side. In science, this action takes into account the laws of diffusion and effusion. Diffusion is the movement of molecules from a high concentration to a low concentration of material (e.g. air, water), while effusion is the rate at which gas escapes through a particular point (e.g. a pinhole) into a space of lesser concentration or a vacuum.

x) *Chiime* (oxen-whip)

According to Ba Jonathan Mungole Mwanangombe, Ba Leonard Sichombe and Ba Dennis Mwiya Sikabongo (Communication, 12 August, 2015) oxen-whips are prepared from either *iwabo* (palm leaves), *Inkwele* (cattle hide), *makuku* (barks of a plant germinating only at the *Chaana*), barks of the tree called *muguva*, or threads from sacks. The materials are woven together tightly whiles the material used is wet in order to make a deep coiled whip. The thong (which can any length required by the owner) is braided over a three meter long vinyl covered cable, and finishes with a twisted sea grass cracker. It is set on a notch on the handle as a swivel sling. Four or more oxen would be harnessed to a sledge that is loaded with baggage or luggage for departing. The driver lines up the oxen in a long trek chain, and if they are properly trained, they meekly accept their yokes and form up two by two. After spanning the oxen, the driver cracks the long whip, giving a fearsome yell and off the oxen go. The whip is used for great a variety of uses. It is used as a means of communication, when cracked (the *fosilaha*); people in a village are, for example, alerted of someone's arrival. It is also used to scare wild animals, such as elephants, lions, hyenas, and it is used to scare weaverbirds in the fields of sorghum or millet.

Conclusion and Recommendation

In conclusion, it is evident that ethno-science is a specialisation which forms part of, and relies on indigenous knowledge (IK). It focuses on culture from a scientific perspective. It is of critical importance to analyse the relevance of integrating ethno-science (Indigenous knowledge) into the Upper Primary School Curriculum in Namibia. Based on such an analusis, the taxonomy related to ethno-science can be developed and linked to the Upper Primary Curriculum. It is therefore recommended that:

- Curriculum developers start integrating IK into the Upper Primary Education Syllabus
- Authors of textbooks start to include IK in their writings
- Science teachers start integrating IK in their teaching and learning activities
- Institutions of higher learning see to it that students integrate IK in their classrooms.

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