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Integrating Cultural Knowledge In Science Teaching At Ordinary Level In Bulawayo, Zimbabwe

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Abstract

The Zimbabwean Competence based curriculum framework (2015-2022) recognizes the importance of cultural knowledge in school science teaching. The framework stresses that competences to be taught in science lessons should be informed by cultural knowledge. Despite this recognition, the Zimbabwean Ordinary Level science teaching has remained the same without adopting this new approach. This study sought to establish the cultural knowledge held by different communities around Bulawayo which is relevant to the Ordinary Level school science and how that knowledge can be used in the teaching of science at this level. Through a qualitative research approach, data were gathered from a sample of ten elders who were 60 years old or older who originated from different Zimbabwean communities and five Ordinary level science teachers. The elders were purposively chosen for their experience and expertise in cultural knowledge and were asked to explain the cultural knowledge held by their communities. The teachers were randomly selected from Bulawayo urban schools and were asked to explain how the cultural knowledge cited by the elders could be integrated with science teaching. Data from participants were gathered through interviews. The results from the study indicated that there is a vast and rich cultural knowledge base held by communities which could be integrated with school science. The paper concludes that there is a lot of potential in integrating cultural knowledge with school science. Such an approach to science teaching would make science lessons more relevant and accessible to the learners from different cultural backgrounds.

Keywords: Cultural knowledge; curriculum; integration; school science

1. Introduction

The Zimbabwean school science curriculum was dominated by Western values until the Competence based curriculum was enacted in 2015. The Competence based curriculum framework is characterized by a paradigm shift towards recognizing cultural knowledge in school science teaching. The framework stresses that competences to be taught in science lessons should be informed by both cultural knowledge and other knowledge systems. Despite this recognition, the Zimbabwean Ordinary Level science teaching has remained the same without adopting this new approach. The Competence based

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curriculum responds to the local, regional and global calls such as one made in 1999 at a conference in Mathematics, Science and Technology Education hosted at the University of Zimbabwe. Participants at the conference made a strong statement that the way science was being taught in Zimbabwe made it irrelevant to the learners. This was because schools teach science to learners whose worldview is different from those on whose culture school science is based. School science is based on Western culture (Aikenhead, 1997). The result of such practice is that learners end up finding it difficult to access, acquire and develop science concepts and to develop an interest in science careers (Gwekwerere, Mushayikwa & Munokore, 2013). The conference suggested contextualising science teaching through production of materials that would use learners' everyday experiences. The participants believed this would make school science accessible and relevant to learners.

Integrating cultural knowledge with science teaching should be understood within the context of three interconnected dimensions driving the current thinking in the teaching of science. Firstly, the Zimbabwean school science curriculum was based on a Western culture which is alien to learners (Aikenhead, 1997). Schools are teaching science to learners whose world view is different from those on whose culture school science is based. Current thinking is that school science should be integrated with cultural knowledge (Mushayikwa and Ogunniyi, 2011; Moyo, 2012). The argument is that science is a product of different cultures whose understanding of the natural world differ, as people use different cultural lenses to understand phenomena. Mazzocchi, (2006) is of the view that any form of knowledge is sensible and relevant to those who produce it.

Secondly, the scientific knowledge domain that learners bring into the science class referred to as cultural knowledge which is known by different names - *peoples' science, indigenous knowledge*, *village science and local knowledge* (Ward, 1989) has been in place since time immemorial, stretching from the pre-colonial era. Several researches are

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making calls for the restoration of the cultural knowledge which was marginalized by the colonial settlers (Olugbemiro & Aikenhead, 1999; Ogunniyi, 2011; Khupe, 2014 and Msimanga & Shizha, 2014). Cultural knowledge is a product of many years of accurate observations and experiments by indigenous people (Ward, 1989). Its importance has been demonstrated in several areas that include agriculture, ecology, animal husbandry, craft skills, climate and medicine (Risiro, Tshuma, & Basikiti, 2013). Despite the contributions of cultural knowledge in these areas of life, it has been relegated and marginalized or even demonized for reasons that include prejudice, lack of documentation, professional pride, language problems and political power by settlers (Webster, 1990).

Thirdly, exploring the worth and contribution of cultural knowledge systems and beliefs in science teaching will help learners understand its worthiness and teachers will have a living laboratory to draw examples from for their teaching allowing for diversity, equity and fairness to the learners.

The Competence Based curriculum framework recommends integrating cultural knowledge with school science but does not explain how the integration process should be carried out. This knowledge gap has motivated this research to explore the cultural knowledge that communities hold and how the knowledge can be integrated with school science.

Research questions

This paper responds to 2 questions:

- What cultural knowledge, relevant to Ordinary Level Combined Science, do communities around Bulawayo hold?

- How can that cultural knowledge be integrated into the teaching of Ordinary Level Combined Science in Bulawayo secondary schools?

Literature Review

Comparing cultural knowledge and school science

Risiro, Tshuma, and Basikiti (2013) describe cultural knowledge as knowledge that is locally produced and is of relevance to that society. The knowledge is used to solve different societal problems. Khupe (2014) alludes that elders of particular societies are the experts and custodians of cultural knowledge which they orally pass from generation to generation for their physical and social survival.

Referring to culturally produced knowledge in Zimbabwe, Garlake (1982) says that technology was not brought by colonialists but was already there when they came. As an example, the author cites iron smelting that was already taking place in Zimbabwe before colonization. Mutasa (1990) highlights success in architecture and technology, sighting examples of expertise in the construction of structures such as the Great Zimbabwe Monument by the local Shona tribes. In terms of education, Mapara (2009) posits that education was in existence when colonialists came. Indigenous people had ways of educating their children through modelling and imitating, storytelling, songs and proverbs. Puzzles were also used to evoke critical thinking. These methods of teaching were so powerful that it was very difficult to forget what had been taught although it was not written down. The author further states that in the field of medicine, indigenous people had a wealth of knowledge that sustained them before colonization. The same knowledge has continued up to today. Teachers can draw from the methodologies, knowledge and skills held by indigenous communities to foster deeper and richer concept formation and development which could lead to the construction of new knowledge and skills. Cultural knowledge has distinctive characteristics which Matsika (2012) identified as being:

a) knowledge that results from everyday experiences and used in solving societal problems.

b) a type of knowledge orally disseminated from generation to generation.

c) knowledge that is not static but responds to changes in societies.

School science on the other end is based on Western culture and refers to science introduced by colonialists who imposed it on the indigenous groups of learners. Unlike cultural knowledge, school science is a universalist system used to empirically judge and test other ways of knowing (Cobern & Loving, 2000). Cultural knowledge, on the other hand, relies on different aspects that include belief and value systems that a society has developed (Bullivant, 1981). The author further argues that society continually updates its knowledge to confront future problems. Teaching of science to non-Western learners in Africa, has favoured the *mechanistic worldview* that posit that the natural world can be understood through empirical research methods (Ogunniyi, 2007 b). On the other hand, cultural knowledge evolved through observations of nature (Kawagley, KaNorris-Tull and Norris-Tull, 1998). Though the two worldviews have different approaches to understanding the world, i.e. although their epistemology and ontology differ, they both have the potential to solve the human problems in almost equal terms hence their integration would greatly improve science education.

What is integration?

Davis and Linn (2000) define integration as the process of examining and linking the knowledge a learner already has acquired and the new knowledge the learner is exposed to in the school about a concept or phenomenon. The authors argue that this process results in some modification or accommodation of the old and the new knowledge.

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According to these authors, the learner ends up with a broader, deeper and clearer understanding of the concept or phenomenon. The study takes new knowledge to mean the school science explanations and the already held knowledge as the indigenous knowledge explanations of a concept or phenomenon.

Forms of integration

Ng'etich (1995) summarised the forms of integration in three distinct categories as depicted in table 1 below.

Table 1: Nge'tich's (1995) model of integration

Integration form	Symbolic representation	Description of strategy
IKS into science	IKS → science	Unidirectional. IKS smaller, less valuable, less useful, less important, less grounded
IKS with science	IKS ↔ science	Bi-directional. The two world views are of equal importance.
IKS and science	IKS — science	Non- directional. The two co-exist independent of each other

From Table 1, the Indigenous Knowledge System (IKS) into science form of integration means that indigenous science is considered of less importance and value. In this scenario IKS is absorbed by science. The school science explanation is taken as the correct explanation of a given phenomenon. Only those aspects of cultural explanation that fit into the school science explanations are considered as important. The IKS with science form of integration is where the two worldviews are taken as equal. In this form of integration, the explanations from the two worldviews are identified and their complementary relationship is established.

Giving an example of integrating cultural explanations and school explanations of lightning, Moyo and Ramirez (2017, p. 330) write:

> In school science, learners are taught that light travels faster than sound. In our folk tales we are told that lightning is an energetic, ill tempered, destructive, quarrelsome young man while thunder is the young man's mother. Both were banished from the earth because of the unacceptable and destructive behaviour of the son. They now live in the skies. The young man is still very angry. Now and again he visits the earth to cause havoc perhaps as a revenge for his banishment. Whenever he comes down, his mother comes after him shouting to restrain him but he is fast and she is old and slow. She never catches him. When she arrives he will have destroyed property and people.

This could be used to teach that lightning is very destructive and dangerous and that light travels faster than sound.

The IKS and science form of integration means that the two worldviews are parallel to each other, they are independent of each other, with no relationship between them. The explanations of a phenomenon from a cultural knowledge perspective and from a school science perspective are both given by the school. Learners interact with and interrogate both explanations to determine the one that makes sense to them. Depending on the context, the learners may oscillate between the two world views choosing the explanation that makes sense at that time. This means that. they choose one explanation over the other or they may borrow from both explanations for a fuller understanding of the phenomenon under study. An example is the explanation of the origin of the universe. Is it creation or evolution? Both creation and evolution are explained in the school system. The reason for this position is that although the learners receive school

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science, their home knowledge will remain entrenched in their minds. Ogunniyi (1988) posits that attempting to substitute indigenous knowledge with Western science does not produce desirable results. Several decades of colonization in Africa, for example, failed to do so despite the concerted effort by the colonialists to decimate and demonize it. Fanon (1982, p. 17) supports this thinking when he writes: “they can’t choose; they must have both. Two worlds: they dance all night to appease their ancestors but fill the church in the morning to receive mass”. Such a situation may result in contradictions leading to learners failing to determine correct explanations.

This paper is informed by the, IKS with science form of integration. This means that in this paper, integration takes the two systems on an equal footing and that the two complement and reinforce each other. The paper is of the view that no worldview should be used to assess other worldviews as being worth or not. This view means that links between the worldviews should be determined to illustrate how they support each other.

Why integration of the worldviews is useful

Moyo (2012) posits that in order to avoid the cognitive dissonance that occurs when learners confront school science with their prior knowledge, the two worldviews should be integrated. The author propounds that the learners’ worldviews brought into the science classrooms have significant impact on issues such as the extent of participation and meaning making. Teachers of such classes should ensure full participation of every learner. The author feels that a deliberate exclusion of indigenous knowledge – prior knowledge of learners – curtails educational objectives of science learning.

The diverse knowledge systems (science and indigenous knowledge systems) can benefit learners significantly (Mazzocchi, 2006). Siegel (2002) praises school science as being effective and dependable in knowledge construction as it is evidence based and experiments can be replicated in different contexts and is not culture based. Kawagley, KaNorris-Tull and Norris-Tull (1998) criticise such a view that present school science as the only true science and the authors posit that indigenous knowledge has served generations without fail and hence its legitimacy must be upheld.

Instead of favouring one view over the other, this paper calls for an approach that integrates the different knowledge systems as suggested by Davis and Linn (2000) that science learning is a process of integrating ideas. Kawagley, KaNorris-Tull and Norris-Tull, (1998) insist that the methodology for teaching Western science does not take into account the student's cultural experiences, the approach disadvantages these learners in several ways that include the content itself and teaching approaches. The authors claim that infusion of school science and indigenous knowledge will improve science learning by indigenous learners.

The possibility of the integration has been explored through several research conducted in South Africa (Ogunniyi, 2011; Khupe, 2014 and Msimanga, 2014), which have suggested how cultural knowledge could be integrated in the South African schools' context. These researches are fairly recent and exploratory. Some researchers have questioned the preparedness of teachers in the implementation process and their understanding of the cultural perspectives. For example, Otulaja, Cameron and Msimanga (2011) posited that most suggestions on curriculum reform have raised the issue of indigenous knowledge integration with science lessons but there are still no specific guidelines of the integration process at school level. It is not clear how the instruction for cultural perspectives inclusion can be handled (Ayodele, 2009). While Mushayikwa and Ogunniyi (2011) and Moyo, (2012) propose the use of argumentation, Msimanga and Shizha (2014) argue against this proposal indicating that there is need for documentation of the knowledge before teachers can use it in their classrooms. It is therefore the goal of this research to explore the cultural knowledge held by communities which is subsequently passed on to learners and how the integration of this knowledge with the school science could be achieved.

Science teachers' roles in culturally sensitive classes

The teachers should be knowledgeable and sensitive to cultural differences existing in their science classes and then borrow from that diversity to teach school science concepts. Teachers must integrate cultural knowledge with the Zimbabwean Combined Science syllabus in such a way that the scientific content from both school science and cultural knowledge is organised side by side for each topic to enable teachers to draw examples from the cultural knowledge content. This will help in using learners' background knowledge in teaching school science concepts. Table 2 illustrates what the teacher could come up with as syllabus organization.

Table 2: Proposed structure of a combined science syllabus

Topic	**Objectives** Learners will be able to:	**School science content**	**Cultural knowledge content**
Organic Chemistry • Fermentation and ethanol production	Describe a) Fermentation b) the production of ethanol c) role of ingredients	Ethanol • Fermentation • pH • role of yeast • ideal conditions for fermentation e.g. warm temperature	Teachers to a) use the processes of brewing the traditional beer known as – '**seven days**' and the brewing of a traditional drink (meal solution) known as **mahewu** made through fermenting sugar solution and maize. b) State the required ingredients, their function and process.
Learners will then be asked to compare the two methods of fermentation and ethanol production in terms of similarities and differences.			

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Challenges of integrating cultural knowledge with school science

Seehawer (2018) lists several challenges that impede the integration process. Firstly, the author questions how possible it is for teachers to integrate cultural knowledge with school science if teacher training does not include the idea of integrating the two knowledge systems. Teachers maybe under tremendous pressure to teach for examinations which do not include questions which relate to the integration of the two knowledge systems. The lack of teaching materials that incorporate cultural knowledge is also another challenge. In addition to these challenges is the fact that learners under the same teacher have different cultural backgrounds hence may have different cultural knowledge which posits a dilemma on which culture to integrate with school science.

Theoretical Framework

A constructivist theoretical framework that rallies on the view that students' predisposition to learn is greatly influenced by their prior knowledge guides this study. Linn & Burbules (1993) points out the relevance of the learners' prior knowledge in meaning making in new situations. The constructivist framework supports the view that the relationship between prior knowledge and the encountered knowledge shapes the leaners' understanding of the new content taught. (Yager, 1995 in Pabale, 2005). From a constructivist point of view, meaning making is achieved when leaners are able to use the prior knowledge to learn new concepts. (Berk & Winsler, 1995). Supporting the same views, Rivard and Straw (2000) argue that:

> Constructivism posits that personal knowledge and understanding result from the myriad connection that learners make while integrating new information with prior knowledge. Some constructivist approaches have emphasized the personal construction of knowledge in which the individual's idiosyncratic experiences within the learning environment are paramount, whereas others have underlined the importance of social

> processes in mediating cognition. Science education would benefit from a synthesis of these two perspectives. (p. 567-568)

This means that for learners to develop their cognitive abilities they should construct knowledge on their own and with others through socialisation using what they already know. This same view is posited by Driver, Asoko, Leach, Mortimer, and Scott (1994) who put it that for learning to take place the learner should make use of their prior knowledge since learning is an activity based on the principle of moving from known to unknown.

The constructivist framework has relevance to the present study as it seeks to consider and bring into the science teaching and learning the knowledge students bring from their interaction with the communities.

Methodology

Elders from different cultural groups that included members from Nkayi representing the Ndebele people, Tsholotsho representing Abatwa people, Binga representing the Tonga people, Mberengwa representing the vaRemba, Plumtree representing the Kalanga people, Gwanda representing the AbeSuthu people, Lupane representing the Dombe people, Bubi representing the Xhosa people, Hwange representing the Nambian people and Beitbridge representing the Venda people were involved in this research. A number of tribes were represented so as to capture a wide cultural spectrum. These are the communities where the majority of the students in Bulawayo urban secondary schools came from. Purposive sampling was used to select ten (10) elderly participants who were over 60 years of age. These elders were chosen because of their experience and expertise in the cultural knowledge systems of the tribes they represented. Five Ordinary Level Combined Science teachers were randomly selected from five schools in Bulawayo to find out how they would integrate the cultural knowledge stated by the elders with school science. Interview guides for elders and teachers were used to solicit information on the scientific knowledge communities held and how it might be integrated into school science. Their responses were recorded on tape and transcribed for analysis. For ethical reasons, pseudo names for the participants have been used. The focus of the research was on cultural technology, cultural metallurgy, cultural beer brewing, folklore and cultural practices and their relationship with school science concepts.

Results and discussions

This section discusses some of the cultural knowledge held by communities as depicted by the elders. The section also explains how such cultural knowledge could be integrated in science lessons at Ordinary level. Examples of the school science concepts used in this paper are taken from sections of the Ordinary Level Combined Science syllabus in Zimbabwe to show how this integration could be done.

Cultural technology and school science

Technological advances in indigenous communities are demonstrated in the constructions of huts by the different communities. The participants were asked about whether there were any special considerations when constructing huts. Mr. Lameck Mloyi, an elder, explained that huts are constructed using poles cut from trees, mud from anthills and grass for thatching. Their roofs are conical in shape. The walls of the huts are cylindrical in shape. The elder explained that the use of grass for thatching is because it is cooler during summer and during the day when the outside is hot and warmer in winter and at night when the outside is cold.

Mr. Sibanda, a science teacher, explained that when there are strong winds, round houses were not easily destroyed as the wind could go around the wall instead of exerting force onto rectangular or flat walls. Concepts such as force per unit area can be

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learnt using this information. On the use of grass in thatching, he said the air trapped between the grass insulates the hut from the sun and retains the heat when it is cold. Learners can use this information to learn about heat transmission and insulation. The shapes on the hut such as circular floor, cylindrical wall, and conical roof, can be used to teach volume and area of 2D and 3D shapes which is part of the section on measurement in the school science syllabus. The calculated area and volumes can be used to further calculate the amount of space and oxygen in the huts to determine its adequacy for its occupants and purpose and the amount of material required to make the wall, the roof and circular floors. We believe that such an approach to science teaching would be both relevant and stimulating.

Cultural iron ore smelting and tool making and school science

Elders Mr. Mzingeli Sibanda, Mr. Ntandoyabo Dube and Mr. Lameck Mloyi explained the making of tools by blacksmiths. A blast furnace made of thick walls from clay and stones is constructed. The furnace is used to make iron from the iron ore. At the top, the furnace has an opening used to feed the iron ore and charcoal. About midway it has blowing holes through which air is pumped into the furnace using bellows. At the bottom there are outlets through which slag is taken out as liquid. The hot bloom is collected through an opening in the furnace and trapped impurities are removed from the bloom by hammering it. After that it can then be shaped into desired shapes such as spears, axes etc. using a hammer. The formed object is cooled by putting it into cold water. Figure 1 below is a sketch diagram of the blast furnace drawn by the authors of this paper, from the verbal descriptions by the elders.

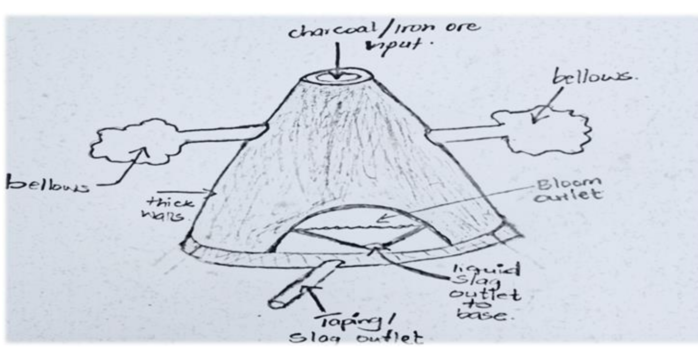

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Figure 1: Indigenous blast furnace: Authors' drawing from descriptions by elders

Explaining the scientific processes that take place in the furnace, Mr. Mandigora, a science teacher said, a mixture of fuel (charcoal) and iron ore is poured through the top of the furnace. The mixture is then burnt. Two reactions occur during this process: iron oxide is reduced to iron and liquid slag is formed. The process, results in carbon monoxide formation caused by oxygen (from the air) and carbon reaction. The carbon monoxide then reacts with oxygen atoms in the iron ore reducing it to metallic iron. High temperatures are achieved through pumping in air into the furnace through bellows connected to the furnace. Having roasted the ore into hematite – (Ferric oxide) through the formula 2FeO (OH) → Fe_2O_3+ H_2O, water is driven off by heat from the hydrated iron oxides.

The following are the oxidation-reduction reactions that take place in the furnace:

1. $O_2 + 2C \rightarrow 2CO$
2. $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$ and
3. $Fe\ O + CO \rightarrow Fe + CO_2$

Another reaction that occurs in the furnace is the formation of slag from some iron oxide and other impurities. Slag is then separated from the metal through liquating slag which then drops to the base and channeled out through tapings. The bloom is then taken out hot and is hammered to remove slag that will be trapped in it. After slag removal, the bloom can then be used to make tools.

Asked about the relevance, to school science, of the knowledge about iron ore smelting and tool making that the elders had explained, Mr. Mandigora, made reference to oxidation and reduction, effect of heating substances, energy transfer, expansion and contraction which are part of the Combined Science syllabus. The teacher said, after explaining and illustrating these processes, the teachers could then ask questions about *the importance of the structure of the furnace and the processes that take place in it*. The teachers can ask for example, *Why thick clay walls? What is the purpose of the charcoal, air, heating and cooling?*

The indigenous blast furnace can be constructed at the school and used to demonstrate the cultural process of iron smelting and tool making. Elders could be invited to the school to demonstrate the iron ore smelting process. The class could also make visits to communities to witness the iron ore smelting and tool making process being carried out by elders. The class could also visit iron ore smelting companies or factories and then compare the two methods in terms of similarities and differences. Again, we believe that such an approach to science teaching would be both relevant and stimulating.

Cultural beer brewing and school science

The elders Ms. Sanele Pawula, Mr. Mailos Sibanda, and Mr. Thabani Nyoni explained the process of beer brewing as follows: Sorghum (*amabele*) is first socked in water and then put in closed sacks until it germinates (into *umthombo*). After germination is dried. The dried germinated sorghum is ground to make flour. This sorghum flour is mixed with maize flour and warm water is poured into a container with the mixture and homogeneously stirred using wooden log, cold water is then added. The mixture is left at ambient temperature overnight. On the 4th day, the soured mixture is boiled for longer periods. After this boiling the mixture is left to cool down for two more days. On the 6th day a bit of the mixture of sorghum flour, maize flour and water are added to the cooled mixture. The product is left to ferment for the next hours and on the 7th day the mixture is sieved to separate beer and the chaff.

The science teachers were asked to explain the relevance of the beer making process to science teaching. Mr. Sibanda, a science teacher, said the knowledge is related to conditions necessary for the germination of seeds, fermentation and separation of mixtures. He explained that the sorghum is soaked to initiate germination. Germination of the sorghum is done to promote the development of hydrolytic enzymes (α and β) needed for the degradation of starch and proteins, which means breaking down of starch and protein. Fermentable worts (sucrose: $C_{12}H_{22}O_{11}$) are produced. This is achieved under certain temperatures hence the boiling and cooling. The fermentation process produces ethanol (C_2H_5OH). The alcoholic fermentation equation is:

$$\mathbf{C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2.}$$

GLUCOSE → 2 ETHANOL + 2 CARBON DIOXIDE

Folklore as cultural methods of teaching science

In relation to pedagogy, the elders were asked how they taught their children at home. They pointed out that they use folklore, stories etc. Folklore can be defined as the old traditions, customs, beliefs and stories of a community that are passed on in a spoken form through generations (Moyo & Ramirez, 2017). A story about a phenomenon is narrated in an interesting manner such that children will always remember the story and will be able to retell it over and over.

The science teachers were asked how it was possible that people remember a lot of what happened and was said during their early socialisation years but forget what they were taught in school only recently. Mr. Mandigora, a science teacher, said that the answer lies, at least in part, in the way the two teachings were or are done. Culturally, people are taught in ways that are difficult to forget. School science teaching could benefit if it borrowed from cultural pedagogical methods. For example, using legends, myths or folktales that describe or explains a natural phenomenon is one such way of cultural teaching. Culturally responsive teaching would make use of these methods of teaching

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and then compare the myth or legend with how scientists describe or explain the same phenomenon. Asked to give an example of such folklore used culturally which could be of relevance to science teaching, the teacher said:

> 'Culturally, lightning is a hen that lays its eggs in one place. The hen then comes back either to lay more eggs or to check its eggs. In school science learners are taught that certain places are prone to lightning i.e. some places are struck by lightning again and again. These two ideas can easily be linked. It would be unfair and unreasonable to ask: Have you ever seen those eggs? because it can also be asked: Have you ever seen those electric charges?'

Such tales about natural phenomena are of importance for their motivational and captivating value more than for their factual accuracy.

Cultural practices and school science

Separating mixtures

Elders were asked how they separate substances traditionally. Several examples of separation of mixtures were explained. One example cited was the separation of small grain such as rapoko or sorghum and chaff. The elders Mr. Lameck Mloyi and Mr. Thabani Nyoni explained that '*amabele ayeliwa, umoya uyaphephetha amahlanga lotshani*' meaning that chaff is removed through winnowing. Some examples included sieving of beer. The science teachers were asked the relevance of the cultural ways of separating substances to science teaching. Mr. Sibanda explained that these would serve as examples in the teaching of the *separation of mixtures* in the Combined Science syllabus. He explained that school science teaches the separation of many different

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substances through a variety of methods such as the use of magnets, filtration, evaporation, distillation, and fractional distillation**.** The substances used to illustrate these methods, such as Sulphur and iron filings, are often taken from the science laboratory. The many different mixtures separated daily in the learners' home environments are not referred to. The separation of maize seeds from nuts by hand when eating a mixture of the two; the separation of grain from chaff through winnowing; the use of sieves to separate chaff from beer, cow dung from milk; the separation of salt from soil to get salt from the earth using filtration and evaporation; the brewing of *kachasu* and *tototo* (highly intoxicating liquor) through distillation should be included in the science curriculum. This way, learners would link home and school and find relevance in what they learn in science lessons.

The teacher alluded that it would be remote and meaningless if, for example, a teacher in a remote rural area in Zimbabwe teaches about *Fractional distillation of liquid air*. The students have problems in visualising liquid air and worse still, distilling it and the teacher cannot help much since he/she too does not have any relevant experience of the phenomenon at all. This is not to say that fractional distillation of liquid air and such alien concepts, should not be taught in science lessons, because while science lessons must be based on the cultural perspectives of the learners there must be an extension of that cultural heritage.

Conclusions and Recommendations

The research found that communities have significant cultural scientific knowledge and teachers were able to explain how that cultural knowledge could be used in school science lessons.
The authors recommend the following:
A wide scale research and documentation of cultural knowledge held by communities be carried out in Zimbabwe.

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That curriculum design takes a bottom-up approach as opposed to the top-down approach since the knowledge is embedded in the communities that originate it. Communities should inform curriculum development.

Community elders be engaged as resource persons on issues to do with cultural knowledge in science teaching.

Community visits be organized so that learners are exposed to cultural knowledge that are available in different communities.

Other researchers could investigate how different explanations of the same phenomena given by different worldviews can be reconciled in a science lesson. They could also investigate whether integration really results in better school science education.

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