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Zulu Primary School Learners' Conceptions of the Roles and Functions of the Liver

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ABSTRACT Formal schooling in many developing countries has tended to propagate a Western view of mainstream school science, almost oblivious to the worldviews learners bring to the classrooms. The objective of this study was to document grade 6 learners' conception of the role and functions of the liver. This was a survey involving 197 grade 6 learners from Kwa-Zulu Natal, South Africa. Data was collected with the use of a paper-pencil instrument consisting of one open-ended task to tap into the respondents' home knowledge about the roles and functions of a liver in the human body. The study revealed that learners held various notions, including a number of misconceptions, about the role and function of a liver in a living human body, many of which were not aligned with scientific notions espoused by the school curriculum. The implications of these findings for classroom practice are discussed.

INTRODUCTION

As humans, children "develop strategies to interpret the world so that it makes sense" to them (Konicek-Moran and Keeley 2015: xiv). As such, children "cannot be considered as empty containers or 'blank slates', which can be loaded by academic knowledge, but they have rich experience, knowledge and their own beliefs about the phenomena that occur in nature" (Seligin 2015: 72). However, in the process of interpreting the world their own way, children develop some misconceptions about various scientific phenomena (Barke et al. 2009; Yakisan 2013; Geerdts 2015; Prokop et al. 2015). Sadly, such misconceptions could impede school learning where the children's notions about scientific notions are at variance with those espoused in the school curriculum. For this reason, "the importance of identifying misconceptions has been emphasized on many occasions in literature" (Vitharana 2015: 276). Commenting on the same issue, Galvin et al. (2015: 2) point out, "biology misconceptions have been recognized as a major factor affecting the students' understanding of science at the secondary school level with many misconceptions carried onwards to university studies." In order to address this, Vitharana (2015: 276) is of the view that "teachers need to know ideas of scientists about the concepts to be taught as well as the misconceptions of students in order to promote effective science teaching."

Inagaki and Hatano (2006: 177) report that children as young as 5 years of age "possess a theory-like knowledge system that can be called *naïve biology*, which involves a set of causal devices enabling children to offer coherent predictions for biological phenomena." Further, Inagaki and Hatano (2006: 178) observe, "Young children before schooling have an understanding of biology separate from their understanding of psychology." Likewise, Prokop et al. (2007: 62) hold the view that "ideas about the biological world are developed in early childhood prior to children reaching the school age." However, many of these ideas "often differ from those of scientists" (Prokop et al. 2015: 1) and persist for a long time beyond childhood (Yakiºan 2013). According to Yakisan (2015: 813), "previous research has demonstrated that students and pre-service teachers at different grade levels have various alternative conceptions concerning basic biology concepts."

Akerson et al. (2000: 364) define the children's ideas "as experience-based explanations constructed by the learner to make a range of phenomena and objects intelligible." As children grow up, their experiences broaden from those arising from their immediate home environments to include those arising out of a wider environment, including the school, and at school, "pupils and students need to integrate newly acquired school knowledge and daily life experiences into their conceptions" (Fremerey et al. 2014: 1113). Indeed, "ideas change over

time, and each time they change, one comes closer and closer to ideas that are more 'adequate' than the last ones." (Konicek-Moran and Keeley 2015: xiv). However, in most developing countries, learners experience severe conceptual dissonance in trying to reconcile home knowledge with school knowledge, and this is largely because the two are based on very different cultural and conceptual assumptions and frameworks. Another reason is that most developing countries have either modeled their curricula on those found in foreign countries or have simply adopted foreign curricula, most times without much critical reflection. What this does is, it foregrounds the foreign cultural and conceptual ways of knowing and relegate the people's own knowledge and worldviews to the periphery, often treated as an afterthought, or worse still, as an irritation or interference. The effect of this is that the conceptual and cultural gaps between the learners' home knowledge and the espoused knowledge of the school remain wide. Certainly, by adopting foreign school curricula without attempting to adapt them to local conditions, including seeing these curricula in the eyes of indigenous knowledge systems, most developing countries have imbibed the notion that Western-construed science curricula are equally good and appropriate for their countries. According to Lundegard and Hamza (2013: 128), this type of generalization amounts to circular reasoning.

We argue that this practice often involves circular reasoning, because the legitimately construed generalizations are, non-legitimately, turned into objects that acquire an ontological status instead of a purely analytic one. Consequently, the generalizations tend to be treated as entities that underlie, and thus, ultimately cause the activities from which they were generated in the first place.

In developing countries, one needs to be more critical about the knowledge that is imported into the school curricula, and demonstrate great awareness about the dissonance that this knowledge brings to the classroom. Indeed, the question that currently concerns educators in most developing countries is how to address the cultural and conceptual gaps that exist between the home knowledge that learners bring to school, and the espoused and dominant school knowledge, which most learners find foreign and disorientating. McKinley and Gan (2014: 289) make this observation by pointing out that "students often come to the science classroom with prior knowledge, cultural norms, and practices that are incongruent with those of school science." Taber (2012: 6) earlier expressed the same point as follows,

Where life-world beliefs are relevant to school science, perhaps contradicting scientific principles, perhaps apparently offering an explanation of some science taught in school, perhaps appearing to provide familiar examples of taught principles, then it is quite possible, indeed likely, that such prior beliefs will interfere with the learning of school science.

In itself, the notion that home knowledge could 'interfere' with the learning of science in the classroom is value-laden and problematic. It perpetuates and emphasizes the idea that school knowledge, which is oftentimes foreign to the African learner, is important, whereas home knowledge is largely undesirable. It is a warning to teachers to watch out and take steps to ensure that the learners' home knowledge does not interfere with their acquisition of the more authentic espoused school knowledge.

With particular reference to this study, mainstream school science (MSS) espouses the view that the human liver has a multitude of very important functions, including (a) manufacturing (synthesizing) proteins, such as albumin, which helps maintain the volume of blood within the body, as well as blood clotting, (b) synthesizing, storing and processing (metabolizing) fatty acids (used for energy) and cholesterol, (c) metabolizing and storing carbohydrates, which are used as the source for the sugar (glucose) in blood that red blood cells and the brain use, (d) forming and secreting bile that contains bile acids to aid in the intestinal absorption of fats and the fat-soluble vitamins A, D, E, and K, (e) eliminating the potentially harmful biochemical products produced by the body, such as bilirubin, from the breakdown of old red blood cells and ammonia from the breakdown of proteins, by metabolizing and/or secretion, and (f) detoxifying drugs, alcohol, and environmental toxins, by metabolizing and/or secretion. It was with these functions in mind that the researcher set out to find out how many of the above MSS functions of the liver do primary school Zulu learners espouse at the grade 6 level. In terms of the South African school curriculum, grade 6 learners have not yet been formally introduced to the topic. Thus, the researcher wished to tap

into the learners' home knowledge and understanding of the role and function of a liver in a living human body.

Research Objective

The research objective of this study was to identify and document grade 6 Zulu learners' notions of the roles and functions of a liver in a living human body.

RESEARCH METHODS

This was a survey study focusing on the respondents' own qualitative descriptions of what they considered to be the main role and function of a liver in a living human body. The participants came from a predominantly rural area of KwaZulu Natal, South Africa. For the majority of these learners, exposure to the scientific world is very limited and the tenets of MSS are encountered mainly through school teaching, while their traditional life and culture remain their dominant sources of both informal and non-formal learning. Altogether, there were 197 participants, 101 (51%) boys and 96 (49%) girls, all studying in grade 6, and drawn from four primary schools in the KwaMbonambi area.

Data collection was completed through a researcher-designed instrument consisting of only one open-ended question, formulated as follows:

Please, describe what you understand to be the role and function of a liver in a living human body.

This was formulated as follows in isiZulu:

Ngicela, uchaze ngokwakho ukuqonda ukuthi iyini indima nomsebenzi wesibindi emzimbeni ophilayo.

Data comprised passages written by the respondents in response to the research question. A first language speaker of isiZulu, holding a degree in English language, served as translator of the data collected. The data analysis involved the identification and coding of emerging themes of the qualitative data gathered (Alhojailan 2012; Isaacs 2014). The emerging themes were defined and redefined into progressively fewer categories under which the various responses were classified and finally, five categories were used.

RESULTS

The results are presented and discussed below under various sub-headings.

Demographics

The research sample consisted of a total of 197 grade six respondents, comprising slightly more males (51%) than females (49%), with ages ranging from 11 to 16, and above (see Table 1).

In addition to the information in Table 1, all respondents indicated that their home language (HL) was isiZulu and their first additional language (FAL) was English. The language of instruction across all subjects at the grade six level is officially English, although isiZulu is quite dominant in the rural area where this study was conducted. The implication of this was that a language barrier would have been a major limiting factor, had the learners been asked to answer the above question in English. For this reason, they were asked to express themselves in isiZulu. It was further envisaged that this would allow them space to express constructs and notions in ways that would be typical of their culture and social conditions.

The Role and Function of a Liver

Nguyen and Rosengren (2004: 412) define biological misconceptions as "conceptions that are either inaccurate or in contrast to the accepted scientific viewpoint." Data analysis produced a number of categories, which were progressively reduced until the researcher settled on the following: *mainstream school science, pretenders, alternative conceptions/misconceptions, culturally imbedded responses*, and *waffling*.

Many responses ascribed more than one function to the liver. Thus, the precise categorization used was made to reflect the main point the respondent was judged to be making, and should not be seen as ignoring the other points

Table 1: Age of participants, n=197

	Age (in years)								
	11	*12*	*13*	*14*	*15*	*16+*	*Unknown*	*Total*	*Percent*
Male	10	29	24	19	4	7	7	100	51
Female	35	28	20	3	3	0	8	97	49

made by the particular respondent. Table 2 presents a frequency count of the response types obtained in this study in order to show the prevalence of the various responses.

Response Type Frequencies

The total number of response types in Table 2 does not correspond to the total number of respondents because some of the responses coded under different categories would have come from the same respondent.

Table 2 shows that, by far, most responses were culturally imbedded. One would say that this was not unexpected, and only goes to confirm the importance and pervasiveness of culture in people's understanding of the world. The second highest frequency count went to the respondents' propensity to just waffle and provide some kind of answer even when they, most likely, did not know the answer to the question. The researcher found this rather puzzling. The researcher could not understand why the respondents would display so much commitment to giving answers when they most likely were not sure of the answer. The next highest category was that of the alternative conceptions, followed by the pretenders. Quite clearly, very few responses came close to MSS.

Table 2: Frequency of response types

Response type	*Frequency*		
	F	*M*	*Total*
Culturally imbedded	33	59	92
Wafflers	30	15	45
Alternative conceptions	06	15	21
Pretenders	08	10	18
Western Mainstream Science	01	01	02

After each direct quotation presented below, an 'F' or 'M' is given to representing female and male, respectively. This is followed by the age of the respondent.

Mainstream School Science (MSS)

This category was meant to represent learner responses in agreement with the notions of science as promulgated in the school curriculum. In the end, there was hardly any response that fell under this category. This finding is noteworthy when one considers the view that "the most important single factor influencing learning is what the learner already knows" (Ausubel 1968, as quoted by Mintzes et al. 1998: 39). However, in this case, there was very little convergence between the respondents' conceptions of the role and function of the liver and MSS. This means that, if one has to build on what learners already know, there is in this case very little to go by.

Only one response from two respondents marginally fell under this category:

A large organ in the body that keeps the blood clean and helps to digest the food we eat. [M, 11; F, 13]

Although the liver produces bile, which is then stored in the gallbladder, and plays the role of emulsifying fats, it is not clear if one would be right to say that the liver 'helps digest the food we eat', or to say that it 'keeps the blood clean'. These views could lead to some misconceptions, or constitute alternative conceptions.

Pretenders

The responses categorized under this section fell under two types: (a) those which the researcher saw as genuinely reflecting the notions held by the respondents, and (b) those suspected to have either been provided by teachers/parents to the respondents, or the respondents copied them from an external source. The reason for suspecting the second set of responses was that these passages were written in English and contained concepts, which the respondents would not have come across in their formal studies yet.

The following examples illustrate the first sub-category, where everything said is correct but not informative enough with respect to the question being answered.

The liver helps protect the vital parts of the body. The liver takes good care of the body. The liver is important for many things. [F, 12]

The liver has an important role in the body. If you do not have a liver you die. The liver helps in different ways. [F, 12; M, 15]

The second sub-category is represented by the following two examples, which were given in English as presented below.

You also learnt that when this amino acid is carried to the liver by blood vessels, the excess amino acids are broken down to form urea. This process is called deamination. Urea is trans-

ported by the blood to the kidneys. In the kidneys, urea together with other substances, form urine. [F, 15]

At the grade 6 level learners in these rural schools do not ordinarily have this kind of command over the English language. So, it was doubtful that this was the respondents' original formulation of the role and function of the liver in a human body. The following statement was given by three respondents word-for-word, suggesting that it came from the same source. Hence, it was taken to fall under this sub-category.

Proteins are digested into amino acids when it is carried to the liver by blood vessels. Excess amino acids are broken down to form urea. This process is called deamination. Urea is transported by the blood to the kidneys. In kidneys, urea together with other substances, form urine. [F, 11; F, 11; F, 13].

Alternative Conceptions/Misconceptions

Some of the responses revealed some misconceptions/alternative conceptions pertaining to the respondents' home knowledge. In literature, not much is said about the indigenous people's misconceptions/alternative conceptions about their own knowledge systems. The ones revealed in this study included the following.

1. The conflation of the meanings of the terms *sangoma* and *traditional healer*.

Typically, a *sangoma* is a witch finder, commonly identified in South Africa as a bone thrower with regard to diagnosis of illnesses in patients, and/or the causes thereof. On the other hand, a traditional healer typically does not necessarily throw bones to diagnose illnesses, or the causes thereof, but has the knowledge to administer treatment on the basis of the patient's 'case history' or clinical condition. So, traditional healers will typically just listen to your story (equivalent of taking a case history in Western-based medicines) and examine you, and then give you the necessary remedies. In some cases, a *sangoma* will refer a patient to a known traditional healer for certain types of ailments. Admittedly, there are some who render both services.

a) That traditional healers get liver from trees, amongst other places.
b) That *izangoma* (plural of *sangoma*) and traditional healers use the liver *to make herbs*. [Perhaps the term *herb* was used as a generic term for medicine].
c) That *izangoma* and traditional healers make pills/tablets from dried and pounded liver. [However, the researcher wishes to hasten to add that this may be so, although the researcher is personally not aware of any traditional healers who make or manufacture pills/tablets].

Taking MSS as a point of reference, the dominant alternative conceptions/misconceptions were that the liver, (a) pumps blood to other parts of the body, (b) is part of the heart, (c) works hand in hand with the lungs to protect the heart, (d) removes poison from the heart and the brain, (e) makes one's body fatty and soft, (f) completely disappears, and leaves no trace, once a person dies, (g) is used for thinking, (h) the liver controls the urine bladder, (i) is located in the stomach, and a rather subtle suggestion that (j) well-mannered and kind people do not have a liver. The following quotations are examples of the above misconceptions/alternative conceptions.

The function of the liver is to pump blood in your body. The liver also pumps blood in animals. [F, 11]

The liver helps because it pumps blood and the urine and the heart. [F, 12]

Function of the liver is that the heart pumps blood to the liver; that is why the liver is full of blood. The liver pumps blood to the whole body. The liver pumps blood through the veins from the heart. [M, 14]

The liver pumps blood so that it does not get dry. It protects the gall bladder. It also covers the intestines. It also covers the kidneys. It removes poison from the heart and brain. [M, 13]

The liver works hand in hand with the lungs to protect the heart. [M, 14]

The function of the liver in a person is to make the body soft. The liver makes the body fatty and soft. The liver helps in the human body. [F, 12]

The liver controls the urine bladder. [F, 11]

The function of the liver is found like this: the function is to think. [M, 12]

The liver has different functions in the body, but if you die it disappears and no one will know that it ever existed in your body. Not even a little dot shows that the liver was there. [F, 13]

The liver moves inside your stomach. [M, 12]

The person who has a liver likes to shoot other people. Or the person will commit sui-

cide by hanging him/herself from a big tree. People like committing suicide. They eat liver. Many people like to drink alcohol and smoke. [M, 12]

Culturally Imbedded Responses

Under this category of responses are all those statements judged by the researcher to be directly influenced by the respondents' cultural setting.

Bravery/Courage and Healing

The responses falling under this sub-category are best captured in the following quotations.

Function of the liver is to make one brave. [M, 12; M, 12]

Literally translated, 'liver' in isiZulu is '*isibindi*', that is the term, which is also used to refer to someone who is brave/courageous.

The function of the liver is that if you want to do something scary you gather courage, because you want to housebreak and commit robbery. Even if you are ill you may go to the traditional healer who takes the liver and mixes it with the herbs for healing the ill person. There are different types of liver: one that belongs to the goat, cow and human being. I would like to stress on the human liver, because it makes him attack innocent people. You will die or you will get arrested when you have killed people. You steal people's stuff and kill people. [F, 11]

The function of a liver is that a person must not be scared to stab another person or animal. Another person is not scared to be bitten by an animal. Another person who does not have a liver is scared to be bitten by an animal, while another person has the liver. [F, 11]

The function of the liver is to treat sick people. The function of the liver is to make medicine. The traditional/spiritual healers make muti (that is, traditional medicine) with the liver. [M, 12]

The above responses were typical of many others, which fell under this category. They all signified that someone with a liver was someone who was very brave or courageous. Almost invariably, the respondents immediately brought traditional healers into the picture, and described the role of the liver as a vital ingredient in healing sick people.

Perseverance, Strength and Cruelty

The following responses typified the notion that the liver is an instrument of perseverance, strength and even cruelty.

The function of a liver is to give the body hope that you will get hold of something that you have been looking for. The other function of the liver is that it gives a person strength. [F, 13]

The function of the liver is to make the inside of the body strong. The liver does everything that is needed in the human body. [M, 14]

The cow liver is nice. The person who has a liver is a cruel person. [M, 14]

Food

Although the question explicitly emphasized the function of the liver within the living body, there was an overwhelming urge for the respondents to mention that the liver was used for food. It was surprising that so many respondents provided this response when it was stressed during data collection that the question related to the purpose that the liver served inside the living body. Perhaps the intention was to say that as food, the liver was good for the human body. Overall, this was the one single response that carried the highest number of respondents.

The function of the liver is to be eaten, and it is sold in shops, like the chicken livers and the goat livers. Cow liver is nice if you eat it. [11 females and 21 males]

Waffling/Rambling

In this sub-section are responses in which the respondents meandered from one idea to another, and in some cases, saying things, which were totally irrelevant to the question.

Liver is a thing that makes gold. It makes many things for example, earrings and necklaces. Maybe the liver is gold. [F, 11; F, 11]

Monkey liver is not nice. [M, 13]

The liver helps in your body, it organizes food in your stomach. It keeps water in the body. It controls everything in the body to move all over. [M, 13]

If you suffer from liver disease, you indicate that you are not feeling well so that they give you help. They take you to the traditional heal-

er or herbalist. You may eat the liver either grilled or cooked. [F, 13]

A pregnant person craves for liver with chili. Most people eat the human liver. The liver has an important function in the human body. Even the traditional healers should take good care of the liver. The humans also eat the animal liver, like the chicken, goats and cows. [F, 12]

The researcher failed to understand this category of responses, and what the respondents really intended to communicate, given the seemingly simple question that was put to them.

DISCUSSION

From the results of this study reported above, one may say that the school is just one of the many social environments that stimulate the children's intellectual growth. The home environment, as well as the social interactions in which children are engaged in, between school and home, appear to be quite instrumental in shaping the children's understanding and interpretation of what takes place in their lives. Therefore, it is hardly surprising that most responses recorded in this study revolved around matters of tradition and culture. Thus, with regard to the teaching and learning implications of the findings reported in this paper, three possibilities present themselves: (a) ignore and/or obliterate the learners' 'undesirable' home knowledge and replace it with MSS, (b) work on and with, home knowledge with a view to build knowledge and understanding that blends home knowledge with espoused school knowledge and understandings, or (c) embrace the existence of multiple worldviews and treat the learners' home knowledge as an authentic and legitimate knowledge type, which reflects and speaks to a certain world reality, that is the learners' home knowledge should be given space to stand on its own and mature over time, in the same way as MSS, born out of another (different?) world reality, has evolved.

Although the traditional goal of science education has been one of "cultural assimilation of all students into science" (Aikenhead 1996: 2), it is clear that the first option above is unfair and unjustifiable. From the learning theory, constructivists would argue that knowledge is personally and individually constructed and therefore cannot be handed over from one person to another, as one would a loaf of bread (Jonassen 1999; Dede 2008; Wollfolk 2010). Nor is a learner's knowledge like a physical object such that it can be replaced by the teacher's knowledge, as when a person takes a potato out of a basket and replaces it with a tomato. The reason for this is simply that knowledge is individually constructed from one's own personal experiences and prior knowledge. Jonassen (1999: 215) puts this point in the following words:

Constructivist conceptions of learning… assume that knowledge is individually constructed and socially co-constructed by learners based on their interpretations of experiences in the world. Since knowledge cannot be transmitted, instruction should consist of experiences that provide interpretable experiences and facilitate knowledge construction.

Consequently, the notion that learners can meaningfully be assimilated into the MSS subculture by replacing their home knowledge with another knowledge type would not only be unjustified and inappropriate but unworkable. According to McKinley and Gan (2014: 292), cultural assimilation "takes place when the subculture of science is at odds with a student's worldview, and the science instruction causes students to adopt new ways of knowing at the expense of their own indigenous culture and experience." Many learners are reported in literature to resist this and instead, opt to tenaciously hold on to their home knowledge and conceptual frameworks, unwilling to let go of them, throughout their school days (Tsai 2003; Clement 2006; Yangin et al. 2014). In particular, Yangin et al. (2014: 105) aver that misconceptions and/or alternative conceptions "tend to be pervasive (shared by many different individuals), stable, well embedded in an individual's cognitive ecology, often resistant to be changed at least by traditional teaching methods and remain intact throughout the university years and into adult life." Thus, the notion that the learners' 'wrong' knowledge from home can, and must be replaced with the 'correct' school knowledge would not be a good instructional philosophy to adopt.

This approach may be referred to as the 'all or nothing' instructional model of conceptual change, as the learner is compelled to buy into the MSS worldview, at the expense of his/her own cultural beliefs/understanding, or home knowledge. In the minds of the 'all or nothing' conceptual change crusaders, the object of teaching is essentially to obliterate misconcep-

tions and/or alternative conceptions held by the learners. Vitharana (2015: 276) shares this view in her statement that "when students possess misconceptions at any level, a teacher's role is crucial as it needs to eliminate misconceptions of students." The implication of Vitharana's statement is that the 'unwanted' knowledge that learners bring to the classroom is an eyesore that should be gotten rid of and replaced by more authentic school knowledge.

The second option involves accommodating home knowledge within the school curriculum. One of the curriculum objectives of the South African school curriculum (Department of Basic Education, 2012) is to promote home knowledge (otherwise referred to as 'indigenous knowledge systems', abbreviated as IKS). To succeed, this requires developing "culturally sensitive curricula and teaching methods that reduce the foreignness felt by students" when they try to learn science from the school's point of view, and not their point of view (Aikenhead and Jegede 1999: 269). In a similar vein, Meyer and Crawford (2011: 525) argue for the provision of "culturally relevant instruction and instruction toward making the assumptions of science explicit." Thus, a skillful teacher would put the children through learning experiences that give them space to reflect and piece things up for themselves in such a manner that MSS makes sense to them. McKinley and Gan (2014: 292) define this as the cultural transmission approach, or enculturation, and elaborate as follows:

A cultural transmission view suggests that students have to negotiate the cultural borders between their indigenous subcultures and the subculture of science, resulting in differential effects on learning science. Enculturation occurs when the subculture of science harmonizes with a student's everyday culture and science instruction supports the student's view of the world.

This is what McKinley and Gan (2014: 287) refer to as "multicultural science", which they believe draws from the "principles of moral justice as well as antiracism" and is socially and culturally constructed. In the process of going through instruction that is tailored in this manner, both the teacher and learners recognize "the scientific and technological contributions of other cultures." Furthermore, allowing space for both home and school knowledge to come together opens teachers and learners to the possibility of believing in the existence of multiple ways of understanding the natural world, and that "these alternative worldviews may be compatible or incompatible with the scientific worldviews" (McKinley and Gan 2014: 287). For the learner, this may involve outright voluntary rejection of his/her home knowledge, or voluntarily realigning it with the school experience so that *blended or integrated learning* takes place, without causing cognitive constipation. This is what McKinley and Gan (2014: 287) refer to as "cultural hybridity" and "third space", whereby "teachers, students and others in the school settings establish new forms of participation that bring together the first space of school science with the second space of home/culture to create a third space that is inclusive of both in the form of hybrid knowledge." Thus, this perspective takes the view that "the way forward is to create a dialogue space in the science classroom that engages students in constructing an understanding of science that incorporates their cultural knowledge and the way of living within their community" (McKinley and Gan 2014: 287). They sum up this point by stating that "studies that investigate this notion of dialogical inquiry have moved away from the dichotomy between Eurocentric and indigenous knowledge systems and adopted the postcolonial concepts of third space and hybridity" (McKinley and Gan 2014: 287). This approach may be called the 'integrated' or 'blended' instructional model of conceptual change.

However, there is a third option, which derives from the same notion of multicultural science, but takes the angle that some aspects of these various sciences may not necessarily be compatible at every level of the education system. Therefore, even if the teacher and learners operated in the third space, some differences between home science and school science may be irreconcilable. This goes to the core of the debate "between proponents of universal and multicultural views of science" (McKinley and Gan 2014: 287), whereby "universalism conceives science as governed by a single set of rules that is culture free," and "denies difference", while the multicultural view, as already explained above, recognizes differences among worldviews as conceived by different cultures.

According to Taber (2012: 6), one reason why the people's inherent knowledge must be respected is that such knowledge has come to

characterize and define the essence of the people concerned:

Ideas that become "common knowledge" may be adaptive within the society, for all sorts of reasons (relating to social cohesion), as is clear from the widespread occurrence of various superstitions and folk-beliefs. When such beliefs become associated with important cultural rituals, taboos, claims for social status and so forth, there may well be robust mechanisms maintaining them within the culture.

Furthermore, it is important to realize that much of what constitutes knowledge within a given community, whether indigenous or otherwise, is carried in the language used by that particular community. As such, language constitutes "a distinct system for organizing and communicating meanings such that translation inevitably modifies meaning" (Taber 2012: 6). In a similar vein, Hsu and Roth (2014: 729) point out that "learning science interpreted in existing theoretical frameworks often means that students are assimilated, accommodated or enculturated from the entity of the vernacular world to the entity of the scientific world." However, in attempting to integrate indigenous knowledge into MSS, there is a great risk of adulterating the essence of the indigenous knowledge concepts in question. It is with this in mind that the third option advocates for the independent coexistence of home and school knowledge, for as long as the individual can rely on them to make sense of different situations that take place in his/her daily life. The best way to achieve this would be *not* to force the integration of home knowledge into the established school subjects, but rather to find a way of acknowledging IKS as a legitimate worldview that must stand on its own, and be allowed to evolve on its own merits, and in its own time, informed and enriched by other knowledge that the learner comes across.

This view is strengthened by notions of cultural border crossing, whereby learners consciously easily and comfortably move "back and forth between their life's world and the science world, switching language conventions explicitly, switching conceptualizations explicitly, switching values explicitly, switching epistemologies explicitly, but never requiring students to adopt a scientific way of knowing as their personal way" (Aikenhead 1996: 38). The argument being that instead of waging epistemological and ontological wars regarding which worldview is more authentic than the other, teachers and learners embrace the principles of multiple realities and respect for cultural diversity. Indeed, considering that much of culture is carried in the language of the given people, it may be argued that the third space concept has the effect of taking the learner away from his/her original cultural base, especially when seen against the dominance of school knowledge. Certainly, the reality is that the play field is not even when the learners' home knowledge is pitted against the knowledge of the school curriculum. In the final analysis, the learner is compelled by parental pressure, the shame of failure, as well as the political and economic power that fuels the school curriculum, to abandon his/her allegiance to his/her home knowledge for the sake of excelling in schoolwork. Of course, when this happens the learner loses everything, but realizes that this is the price that must be paid in order for him/her to achieve the required school recognition of being labeled an 'intelligent and successful learner'.

In embracing the school and home worldviews, and seeing them as representing and reflecting two world realities of one's life-world, one is freed from the prejudices of the world, and power relations even out. As such, "one's power to raid the subculture of science", for instance, should not necessarily "depend on one's autonomous acculturation into the subculture of science" (Aikenhead 1996: 38). In this regard, Aikenhead (1996: 2) opines that science educators should rather "recognize the inherent border crossings between students' life-world subcultures and the subculture of science, and that they need to develop curriculum and instruction with these border crossings explicitly in mind, before the science curriculum can be accessible to most students." This third option may, therefore, be referred to as the *multicultural instructional model* (MIM) of conceptual change, which Aikenhead (1996: 19) would see as a perspective which "considers students' experiences with school science in terms of students crossing borders from the subcultures associated with peers, family, media, and the school, into the subcultures of science and school science." The MIM sees teachers as playing the role of a 'tour guide' "taking students across the border and directing their use of science in the context of the students' everyday

world." This approach rejects conceptual replacement "in favour of conceptual proliferation dictated by specific social contexts" (Aikenhead 1996: 24). In this regard, the teacher "makes the subculture of science accessible to the 'tourist' students by methods predicated on cross-cultural instructions" and identities (Aikenhead 1996: 27). This way, the "all or nothing" posture of the first option described above becomes unnecessary, as there is no need for one to denounce one's inherited home knowledge in preference of another.

In essence, the MIM of conceptual change best describes the real life world as lived by most learners, and indeed, people in general, as McKinley and Gan (2014: 292) explain.

Students who are capable of negotiating the transitions between their everyday worlds and the subculture of science without having to assimilate or acculturate (a process of intercultural borrowing or adaptation of attractive content or aspects of another culture and incorporating them into one's indigenous culture) science's cultural baggage are seen as more successful learners of science. Those who struggle to negotiate the cultural borders will require explicit instructional support in order to traverse from the sub-cultures of their peers and family into the subcultures of science and school science.

Thus, this third model appears to be the most appropriate way to deal with the students' prior knowledge. In terms of the findings of this study, the centrality of the Zulu cultural knowledge to the learners' understanding of the world around them has been found to be very strong and pervasive. These explanations are the ones that identify them as part of the Zulu culture. Trying to obliterate these interpretations of the learners' life-world will be like trying to change them from being people of Zulu descent and extraction to something else, which they can never be. However, over time, the learners will voluntarily work out how much currency they will place on which interpretations as they accumulate more and more insights into the various worldviews that impact their lives. Otherwise, there appears to be little value in making learners change conceptual allegiances by force. Thus, Seligin et al. (2015: 75) advice, "teachers should be creative, and employ diverse methods of teaching and learning in the classroom to engage and attract students." What is really important is to realize that "the potential conflict between students' cultural experiences and background and what is taught in school science needs to be resolved before a meaningful science learning can take place" (McKinley and Gan 2014: 288). This highlights "the importance of understanding children's varied backgrounds and experiences" as they relate to knowledge growth (Geerdts et al. 2015: 145). In this regard, Vitharana (2015: 276) recommends that in-so-far as student misconceptions are concerned, the role of the science teacher must be one of guiding them "towards better understanding through hands on activities, investigation and interaction with peers and adults." There appears to be some merit in this recommendation.

CONCLUSION

This study has revealed the various notions that learners have about the roles and functions of a liver in a living human body. Many of the views held by the learners are derived directly from their home environment. This in itself was not surprising considering that this topic had not yet been formerly introduced to the learners in school. What is of importance, however, is how education authorities handle the various notions reported here. The school curriculum espouses specific notions about the role and function of a liver. The three options discussed in this paper presuppose that the classroom teacher has flexibility on the end results of his/her teaching with regard to lesson outcomes. In reality, however, it is this lack of flexibility, which makes most teachers adopt the first option. The school curriculum requires that both teachers and learners unequivocally adopt the MSS worldview. This leaves teachers with no choice but to cause their learners to embrace this worldview so that they can pass the ensuing examinations. Inevitably, this leads to shallow learning as teachers stage-manage the learning environment to produce the required results, and learners play along.

RECOMMENDATIONS

From the findings reported in this study, it is hoped that teachers and education officials will find something useful for their respective purposes. The study has shown that the participants interpreted the question put to them entirely within the context and intrigues of their

life-worlds, a world dominated by African traditions, culture and mysteries. So, for both curriculum developers and teachers, it would be important to pay attention to the social context of these learners in planning curriculum materials and lessons. The findings have shown that the worldview espoused by the school curriculum is very distant and foreign to that of the majority of these learners.

School science also has its own traditions, culture and mysteries. Thus, the role of teachers and curriculum planners should be to introduce learners to the MSS culture, traditions and mysteries, while respecting the cultures, traditions and mysteries that define and characterize the life-worlds of the learners. In particular, teachers ought to demonstrate awareness of the inherent contradictions and intrigues that widen and characterize the chasm between the two respective cultures, traditions and mysteries, and honestly assist learners to navigate each of these worldviews, and traverse them with ease and as smoothly as possible. It is not a matter of choosing between the two worldviews, or elevating one over another. Rather, it should be a matter of building bridges that will provide for smooth transitions as one navigates between the two worldviews, and blending those that can be harmonized. This is what will separate good from bad teaching.

LIMITATIONS

The decision to collect data by using a pen-and-pencil task was made so as to allow the respondents free space and time to respond as they wished. An added advantage was that one could also get inputs from home, which would have enriched the data. However, from the responses received, it is possible that follow-up interviews would have allowed the researcher to clarify, as well as deepen, some of the responses. This brings up the issue of how best to conduct follow-up interviews when the first-level data collection was done anonymously.

The second limitation was that the researcher was a non-isiZulu speaker, and relied on translated transcripts for data analysis. There are some words, phrases and terminologies, which are hard to translate between languages and cultures. The issue of translations has an inherent quagmire built in it, in that a person can only be a first language speaker of one language. Since translation is between two languages, it means that one will always be vulnerable in terms of the second language in which one is not a first language speaker. Inevitably, chances are high of something being lost in the translation, or of some misrepresentations creeping in. This was, therefore, a limitation of this study.

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