Integrating indigenous knowledge systems (IKS) in the teaching and learning of science: a case study of Zimbabwean form 3 biology students and South African grade 10 physics students.

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The study sought to establish the knowledge and beliefs learners brought into the teaching and learning of the topics Reproductive Health and Electrostatics; and to determine how students resolved the conflict existing between their Traditional and Scientific World-views. In Zimbabwe, six adult members of the community and 30 Biology students participated while 11 adults and 11 Physics students participated in South Africa. Interviews were held with adults while data were collected from students using focus group discussions, observations, questionnaires and interviews. In Zimbabwe students and adults unanimously agreed about the existence of runyoka, unnatural causes of infertility and unnatural causes of frequent deaths in a family. In South Africa, the participants were unanimous about the existence of two types of lightning, legadima and tladi. Adults and learners believed that people could manufacture and manipulate lightning for personal purposes. In both cases, the scientific knowledge taught did not significantly change the learners’ indigenous beliefs. Students exhibited collateral learning, which explains how students deal with the cognitive conflict between their culture and the subculture of school science. We conclude that although learners acquire modern scientific knowledge from science instruction, if they have to deal with seemingly important matters they cannot explain, they revert to their indigenous knowledge and beliefs. The main implication of the study is, in our view, that teachers should develop culturally sensitive strategies that interface science with local knowledge and beliefs.

Introduction

The 21st century has ushered in new challenges in science teaching and learning especially in non-western classes. By teaching modern science, educators try to develop a scientific world-view in the learners. However, science instruction does not take place in a scientific vacuum, it occurs against the background of an Indigenous World-View (Morris, 1983). This is a theory of reality representing the way reality is experienced, interpreted and perceived (Shumba, 1995). Societies in Southern Africa are dominantly traditional, consequently the majority of the students hold an indigenous world-view characterized by reliance on Indigenous Knowledge Systems (IKS). National Research Foundation (2005) defines IKS as “… a complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographical area.” A typical Indigenous world-view is the notion that supernatural forces, mysteries and superstitions have significant roles to play in people’s daily occurrences. Although not documented, the IKS is the basis for decision-making and survival strategies.

The present study evolved within the context of collaborative research between the University of Limpopo in South Africa and Bindura University of Science Education in Zimbabwe. It was motivated by a need to document the IKS that students in the Limpopo and Mashonaland Central Provinces brought to the science classrooms. The students in the study are inhabitants of nations where the
majority is directly and indirectly influenced by the scientific and the indigenous world-views. The way these world-views interact during learning and how they can be intentionally integrated has aroused a lot of interest among educators. Several studies indicate that inclusion of indigenous ways of knowing would enhance learners’ performance in science (Ashrif, 1998 and Ratsie, 2001 in Emeriole and Maripe, 2003; Fatnowna and Pickett, 2002). However, other researches suggest that getting African students to relate science with indigenous beliefs is a task that raises more problems than it solves (Emeriole and Maripe, 2003).

The study takes the constructivist view that students’ predisposition to the study of school science is greatly influenced by their prior knowledge. It is widely accepted that learners bring some prior knowledge or conceptions in each learning situation (Driver, 1986; Naidoo, 2005). Knowledge is constructed individually, based upon one’s background. Besides what was learnt in preceding levels, prior knowledge includes the traditional cultural one. The new knowledge gained in lessons has to be integrated into the already existing framework in order for it to make sense. Emphasizing the same idea, Ausubel (1968:vi) stated, “… The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.” When views of nature and ways of thinking are un-resolvable, they lead to rejection of science and reversion to one’s indigenous world-view, whereas if conflicts can be resolved, this can lead to accommodation of the scientific world-view (Ogunniyi, 1988). Science is a subculture of Western culture. All students experience a feeling of foreignness towards it, however, non-Western students face greater difficulties in making transition from their own culture into the subculture of science as the border crossing is apparently more hostile for them (Aikenhead, 1996; Jegede and Aikenhead, 1999).

Students experience varying levels of difficulty while making transition between their culture and the subculture of Western science (Costa, 1995 in Aikenhead, 1996). Jegede, (1995) and Jegede and Aikenhead (1999) proposed the construct of collateral learning to explain how students deal with cognitive conflicts between their culture and the subculture of school science. It captures the cognitive experience of border crossing. The success of the transition depends on the degree to which the conflicts are resolved. Students who need to move into the subculture of science require an effective use of collateral learning with a heavy reliance on successful cultural border crossing (RedNova News, 2004).

Indigenous knowledge is a valuable teaching resource. There is a need to preserve, protect, research and promote this cultural heritage (UNESCO, 1999). The current research intended to add onto the experiences of integrating the scientific and traditional world-views. It is imperative for our students to appreciate the existence of diverse views of explaining phenomena so that they make informed decisions in life. It was also envisaged that this study would make learners aware of that their cultural heritage could be legitimately made part of their classroom teaching and learning experiences.

**Purpose of the study**

This study is concerned with eliciting students’ IK and beliefs brought to the science classroom and exploring how they resolve possible conflicts that ensue during their learning process. It investigates the teaching and learning of the topics: ‘Reproductive Health’ by a Form 3 Biology class in Zimbabwe and ‘Electrostatics’ by a Grade 10 Physics class in South Africa. Biology and physics classes were chosen because these students have decided to start specializing in the sciences from middle secondary level, implying that they are potential scientists who need to move into the culture of science. The study sought to answer the research problem: How does the students’ IKS influence their understanding of scientific concepts/ phenomena in Reproductive Health and Electrostatics? In trying to solve the research problem, the study sought to answer the following sub-questions:
1. What indigenous knowledge and beliefs do learners bring to science classrooms?
2. What IK and beliefs on Electrostatics and Reproductive Health do elderly members of the community transmit to students?
3. How does the IK and beliefs of students affect their learning of school science?
4. How do learners resolve the conflict that may exist between their Traditional and Scientific World-Views?

Answers to the research problem could be useful to teachers in ways that might activate them to devise creative instructional strategies engendering in students a feeling of ease into the culture of science.

Methods

A qualitative exploratory approach was adopted, as the integration of IKS in the teaching-learning of science requires a deeper understanding of norms, values and beliefs of the target community (Leininger, 1995 and Chisaka, 2000). Data was collected in the following manner: A self-completion questionnaire that included closed and open-ended items was administered to a class of 30 Form Three Biology students in Zimbabwe. The Biology class also participated in a Focus Group Discussion, which was audio-taped. Six adult members of the community were interviewed in order to obtain information on IK which learners brought to the science lessons.

A class of eleven Grade 10 Physics students, in South Africa was asked to complete a questionnaire and then taught about lightning in the Topic: ‘Electrostatics’ and the lessons were video-recorded. Interviews and a Constructivist Learning Environment Survey (CLES) Instrument were other techniques used. Eleven adults were also interviewed on their perceptions about the whole concept of lightning. In both cases the sampling for the project was purposive as researchers focused on certain attributes within the students.

This paper is based on responses to activities and questions probing knowledge and understanding of sexually transmitted infections, causes of infertility and frequent deaths in a family, on one hand, and understanding and beliefs about lightning production, on the other hand. In order to determine the influence of IKS on the understanding of scientific concepts/phenomena by students in the topics: Reproductive Health and Electrostatics, a thick description, i.e. description of situations as they were presented, was done (Chisaka, 2000). Therefore, responses from both student and adult participants were presented in a descriptive/narrative form, in which common underlying ideas were identified, grouped and synthesized.

Results and discussion

In Electrostatics, responses from elders’ interviews and learners’ questionnaires revealed that most of the respondents had common understanding about lightning. Ten (91%) elders and 9 (82%) learners believed that there were two types of lightning: natural lightning, namely *legadima* in Sepedi (from God) and *tladi* (caused by people/bird/lizard). Only 1 elder and 2 learners believed that there was only one form of lightning, the natural lightning. The interviews and questionnaires revealed that when the respondents were talking about lightning, they were in fact referring to *tladi*, even those who believed that there was only one form of lightning. Table 1 summarises some of the differences between the two types of lightning, as described by the respondents.

After learners were taught about electric discharge using a van de Graff generator, their responses showed that some were able to recognise lightning as an electric discharge, but the majority still believed that people could manipulate lightning. Although a few seemed convinced that it was not possible for people
to control and direct lightning, further probing revealed that they constantly vacillated between explanations proffered by the two world-views. This reflected a high level of uncertainty, with some learners feigning successful movement into the culture of science just to please the teacher.

Table 1. Beliefs about lightning: *Legadima* and *Tladi.*

<table>
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<tr>
<th>ISSUES</th>
<th>LEGADIMA</th>
<th>TLADI</th>
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<tbody>
<tr>
<td>Caused by</td>
<td>God/ nature</td>
<td>People</td>
</tr>
<tr>
<td>Formation</td>
<td>Collision between: hot air and cold air; 2 or more clouds; cloud and mountain/hill.</td>
<td>Witchcraft, magic, bird/lizard</td>
</tr>
<tr>
<td>Occurs when</td>
<td>It’s raining; there are clouds</td>
<td>Anytime; in the presence of legadima</td>
</tr>
<tr>
<td>Self-protection</td>
<td>Prayer- go to church.</td>
<td>Consult traditional doctor or sangoma.</td>
</tr>
<tr>
<td></td>
<td>Ask for priest’s prayer.</td>
<td></td>
</tr>
<tr>
<td>House protection</td>
<td>Place a motorcar tyre on the roof.</td>
<td>Consult traditional doctor or sangoma.</td>
</tr>
<tr>
<td></td>
<td>Use ‘gas’ i.e. lighting conductor.</td>
<td></td>
</tr>
<tr>
<td>Strikes people/ houses</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

In one of the activities, learners were requested to use their understanding of induction to determine whether a motorcar tyre put on the roof of the house could protect the house from lightning. Nine (82%) learners thought that it was actually possible for the motorcar tyre to protect the house from lightning, e.g. 3 said the tyre was an insulator and “it cannot allow lightning to pass through”. Apparently, learners held pseudo-scientific ideas that formed a thin veneer over a deep mass of traditional knowledge (Reiss, 1993).

In Reproductive Health, during the explanation of the types of sexually transmitted infections (STIs), it became clear that students’ prior knowledge about gonorrhea, syphilis, HIV and AIDS was consistent with school science in terms of causes and mode of transmission. Besides using modern medicine, students suggested that all these diseases could be treated using traditional herbs. They further agreed that all the diseases could be cured, except syndrome, AIDS.

Students and adult participants unanimously agreed about the existence of *runyoka/ ulunyoka,* a ‘manmade’ disease that could not be accounted for medically. Students emphasized that it should be referred to as a sexually transmitted disease (STD) and not STI since there was no known causative pathogen (evidence of application of their scientific knowledge in classifying their IK). It was explained as a form of traditional medicine secretly administered to a wife by her husband as a ‘trap’ against infidelity. The husband of the ‘treated’ wife had to ‘take’ the same medicine as a preventive measure against the effects of the *runyoka.* If another man had sexual intercourse with the ‘treated’ woman, he would contract the disease which manifested itself in a variety of forms. The affected man had to quickly seek help from the husband of the unfaithful woman (hence getting caught and fined) or from a traditional healer. Both students and adults suggested 10 types of *runyoka* (see Table 2).

Three out of six adults and 25 out of 30 (83%) students were able to clearly distinguish between *runyoka* and AIDS. However, there was still confusion among some participants who pointed out that some of the signs and symptoms of *runyoka* were similar to those of some AIDS-Related Complexes (ARCs). They gave examples of some types of *runyoka,* i.e. the chameleon, the baobab and *rukawo* types. It is argued that AIDS-related illnesses like the various types of skin diseases, swollen abdomen and general wasting; among others, have been associated with *runyoka.*
Table 2. Types of runyoka and their manifestation.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sign/ symptom</th>
</tr>
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<tbody>
<tr>
<td>Rwembwa/rwebanga (the dog/pocket knife type).</td>
<td>Just like mating dogs that remain ‘locked’ for a while, the infidels are not able to ‘come apart’ until they are freed by the woman’s husband or by a traditional healer.</td>
</tr>
<tr>
<td>Rwenyoka (the black mamba type).</td>
<td>A deadly type of runyoka. During sexual intercourse the man becomes ill, turns black as if a black mamba has bitten him and eventually dies.</td>
</tr>
<tr>
<td>Rwehove (the fish type).</td>
<td>After sexual intercourse, the man has to remain submerged in water otherwise he ‘dries out’ developing a scaly skin, and dies just like fish do when out of water.</td>
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<tr>
<td>Rwemuuyu/ rwedumbu (the baobab/distended abdomen type).</td>
<td>After sexual intercourse the man’s abdomen swells and continues to do so unto death, if not treated. (Similar to an ARC).</td>
</tr>
<tr>
<td>Rweruware (the dwala i.e. the big flat rock).</td>
<td>Intending to start having sex, the traditional medicine visually conceals her genitals, much to the frustration of the sexually aroused infidels.</td>
</tr>
<tr>
<td>Rwerwaivhi (the chameleon type).</td>
<td>After sex the man’s body develops a seriously itchy and painful rash which forms patches of different colours, just like a chameleon does. (Similar to an ARC).</td>
</tr>
<tr>
<td>Rukawo (another name of runyoka)</td>
<td>Characterized by general wasting away. The man gets thinner and thinner, becoming very ill until death. (Like an ARC)</td>
</tr>
<tr>
<td>Rwemajuru/ makonye (the termites/maggots type).</td>
<td>The man feels pain in the genitals as if termites are biting him, or termites/ maggots exit and return into the penis through the urethra, with the man feeling excruciating pain and screaming.</td>
</tr>
<tr>
<td>Rwetsiga (the vein type).</td>
<td>A mere handshake transmits the spell ‘through blood vessels’ into the man’s body. The man contracts the disease, eventually leading to his death.</td>
</tr>
<tr>
<td>Excessive penile enlargement or shortening</td>
<td>After sex the penis elongates so much it hangs down to knee level or shortens, retracting and disappearing into the body painfully.</td>
</tr>
</tbody>
</table>

Decisions on interventions were difficult to make. This issue was further compounded by traditional healers who, when consulted, usually confirm the runyoka condition and assure the family that they were able to treat it. With the high prevalence of AIDS nowadays and the confusion of its symptoms with those of runyoka, some patients neglect seeking medical help for ARCs until it gets too late. As evidenced by the views of the adult participants, indigenous communities explain natural phenomena through their own rational means (MITO meeting, 1996). According to the interviewees, runyoka can only be treated by Traditional healers and any attempt to apply modern medicine was said to result in death.

In terms of causes of infertility among couples, there was a general consensus among adult and student participants. Some of the causes cited were scientifically based, however, the majority were based on indigenous beliefs. The suggested causes were: punishment from ancestors; being bewitched; several abortions; sacrifice of a woman to appease Ngozi (avenging spirits) or zvidhoma (goblins); curse; irregular periods; natural infertility; accidents damaging the reproductive system; incompatibility and excessive alcohol intake and smoking.

When asked who was responsible for lack of children in a family and why, 90% (27) of the learners indicated that the blame for infertility was generally attributed to women. Women were blamed for most of the social ills; e.g. curses in families and witchcraft are blamed on them.
Asked if infertility could be reversed and by who, 93% (28) of the students agreed that it could be reversed. Eighty percent (24) of the students mentioned that Traditional healers (n’angas) and vapostoris (faith healers) were able to reverse the condition. Only 20% (6) of the students said that doctors could reverse infertility. The focus group discussion established that the students would rather go to traditional healers and vapostori first before they give up and turn to medical doctors.

In a focus group discussion, it was revealed that reasons other than those proffered by the medical reports were sought to account for the causes of frequent deaths in a family. This shows that traditionally, it is difficult to accept the death of a family member even if everyone knows about the cause. Even among the highly educated and those who claim to be avowed Christians, indigenous beliefs and practices are known to take over in critical situations.

Evidence from the findings suggests that students bring cultural knowledge to the science classroom. As observed by Ogunniyi (1988), when the two views of nature and ways of thinking were irresolvable, they reverted to their indigenous world-view (e.g. concept of legadima, tladi, runyoka and causes of frequent deaths in a family). However, when their IK was supportive of school science (e.g. knowledge about gonorrhea, syphilis, HIV and AIDS), there was evidence of accommodation of the scientific world-view.

It is also important to highlight that in both cases the mere inclusion of students’ IK and beliefs in science classrooms excited them, making them more active participants than usual. The classroom atmosphere was highly ‘electrified’. Even the laggards who usually did not put up their hands showed a burning eagerness to contribute.

Conclusions

Community elders shared common traditional explanations of phenomena with students. Students brought a lot of IK and beliefs in their learning of Reproductive Health and lightning production in Electrostatics. Some of the IK and beliefs were irreconcilable with science. Apparently, the students relied on collateral learning to resolve the conflict existing between their traditional and scientific world-views. It appears like the irreconcilable IK and beliefs was stored in its own mental compartment where it was retrieved when necessary. Due to the compartmentalization of conflicting schemata, the IK and beliefs students brought to science classrooms seemed not to adversely affect their learning of school science. It is important to point out that although learners are acquiring modern scientific knowledge from their science classes, in seemingly important matters that bother them, they revert to their indigenous knowledge and beliefs on how to solve them. Since success in science depends on how effectively students move between their culture and the culture of science, the onus is on teachers to develop culturally sensitive instructional strategies that interface science with local knowledge and beliefs, bearing in mind to desist from condemning and rejecting the local knowledge nor justifying and idealising it.

References


