Effects of socio-cultural knowledge on Science Education

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Abstract

Science education is of paramount importance to a better socio-economy. The curriculumthat conveys the teaching and learning of science is supposed to reflect on the students.Science education builds on prior existing knowledge of students. However, many African theorists feel that science education is entirely based on "western" ideas. The values and the norms of the "African" or "Non-western" students are basically neglected or come into contradiction with that of science.

Introduction

Although science tends to be very important in the realm of societal development, some African educators delineated that the science that is practised by Africans does not entail an African entity. This paper will briefly view the importance of science education in the African context and will continue portraying the challenges experienced by educators when teaching science. The paper will also define the daily cultural pedagogy of students and delineate what is entailed in a culture of science to that of the daily activities of students. The Borders distinguished between science and students' culture will be scrutinized.

Paramount Importance of science education

In the contemporary world, people depend on science and technology in order to make their lives more doable and comfortable. According to Gaffney (2005), science enables students to have power and control of the environment when they become scientists and other personnel in the society.Scientific skills and knowledge can bring about "step-changes" in areas ranging from health, water supply, sanitation and energy to new challenges of urbanisation and climate change (Dickson, 2005). Additionally, science is needed in each country to overcome economic stagnation, to eradicate poverty and to develop vaccines

and treatments for HIV and AIDS and malaria especially in the African continent. Upon the fundamental importance of science, the science curriculum should play a major role in reinforcing the study of science. It should integrate and link the scientific theories with the daily lives of students so that a meaningful learning and acquisition of scientific values can culminate in high learning order. This is simply because students are not "empty vessels" they acquire some degree of knowledge and values prior to engagement in science education. These values and cultural beliefs of students should be taken into consideration when these learners come to the science classroom (Warren, Ballenger, Ogonowsski, Rosebery & Hudicourt-Barnes, 2001).

Science education as described by a few African educators

Although Science Education seems to be an important catalyst to better life, many science educators and researchers like, Wangola (2002); Aikenhead and Jegede (1999); and Semali and Kincheloe (1999) believe that science when it is practised in the so-called "developing" countries is a form of Western science becausethe values and cultures of Africans are not considered by this type of science. Mwaura (n.d.) suggests that Africans need to develop a science curriculum that integrates both values and cultures of Africans together with Western science. Science educators and students in Africa find many conflicts between their cultural values and that of Western cultures in the science curriculum.

What does the teaching of science mean?

This question can be answered by quoting Stenhouse (1975) he wrote:

> *"Education enhances the freedom of man by inducting him into the knowledge of his culture as a thinking system. The most important characteristic of the knowledge mode is that one can think with it. This is the nature of knowledge-as distinct from information- that it is a structure to sustain creative thought and provide frameworks for judgement. Education as induction into knowledge is successful to the extent that it makes the behavioural outcomes of the students unpredictable."*(p.82)

How does this project into science education? Science teaching or education in general, liberate an individual into a society. Furthermore, the science teaching can be viewed in a way described by Schubert (1986). That a curriculum is an agenda of social reconstruction. In other words, science education is entitled to forge and shape the individual in order to make the society a better living place. Hence science education for sustainable development as it is termed nowadays. This is also solicited by Kristensen (n.d.) who points out that learner-centred educationwhich conveys science education is aimed at harnessing curiosity and promoting democracy and responsibility in lifelong learning, thereby valuing

life experiences and integrating school and life outside school for learners. Analytically, Learning happens only when prior knowledge is thoroughly combined and linked with the observed or acquired knowledge.

Challenges of Teaching and learning Science: The Namibian and African perspectives

Many Namibian teachers are challenged by linking school life to an outside world. For instance, the teaching and rendering of a lesson on the human reproductive system. This causes discomfort in some learners because there is a big gap between learner's out of school life and science teaching in the class. In other words, it is against the cultural background of some learners to talk about 'privates parts' freely. However Namibian cultures are different from one another, for example "Caprivian" Cultures, there would not be a problem because the Caprivans are taught sex education in initiation institutions, which does not really happen among other Namibian cultures like 'Ovambo' people. Additionally, an ultimate challenge is also observed in the theory of human evolution which describes humans and other primates like chimpanzees, monkeys, and gorillas having evolved from a common ancestor; hence these statements are based on the biological, scientific study of human evolution. Most of the population in Namibia are Christians. They believe that God created human being in the form of Adam and Eve. Thus this scenario and human evolution contradict. Scientifically, seeing the rainbow colours in the sky would mean a reflection and refraction of light rays by the tiny droplets of water but culturally, in most African cultures seeing a rainbow depicts that God loves his people.
According to George (2001), there are four distinct categories of a traditional way of knowing (African Culture, the African values and norms) and a scientific way of knowing namely:

- "Category 1: Traditional knowledge and technologies can be explained in conventional science terms. For example, the separation of water from alcohol in making concentrate alcohol which can be explained in terms of distillation both scientifically and traditionally.
- Category 2: Traditional knowledge can likely be explained by conventional science. For example, a brew made from the plant "vervine" *(Strachytarpheta)* is used in the treatment of worms in children. The plant termed by conventional science is believed to have pharmacological properties as studied by scientists. Furthermore, traditionally when one has a cold or flu, eucalyptus tree leaves are boiled and given to the patient. It is also believed that these trees have some pharmaceutical importance in their chlorophyll content.
- Category 3: A conventional science link can be made to traditional knowledge, even though the underlying principles are different. For example, traditional wisdom warns that eating sweet foods causes diabetes. This is related to the conventional

science principle that links diabetes with sugars. However, traditional knowledge states that sugars cause diabetes whereas conventional science claims that when one is diabetic, the ingestion of sugar can cause one's condition to become worse.

- Category 4: Some traditional knowledge cannot be explained in conventional science terms. For example witch crafts and traditional healers." (p. 2)

Basically, the science curriculum is oriented in a Western complexity. In other words, there is a distinct and clear demarcation between science education as a culture on its own and prior school knowledge (traditional knowledge) as described by George (2001). This was also clearly postulated by Verma (2004) as science being an essence to promote Euro-American culture. It neglects non Euro-American personal beliefs, myths, religious values and supernatural forces. Moreover, Jegede and Aikenhead (n.d.) further describe science education based on the following assumptions:

a) Western science is a cultural entity itself, a subculture of Euro-American society

b) People's cultural identities may be at odds with the culture of Western science

c) Science classrooms are subcultures of the school culture

d) Most students experience a change in culture when moving from their life-worlds into the world of school science

e) Students are more successful if they receive help negotiating their cultural border crossings (p10).

Imperative teaching and learning to arouse provocative and pedagogical thoughts in students

Science education and traditional knowledge are two distinct cultures. Literally, culture means a shared way of living which includes knowing, valuing, interaction with others, feeling, and beliefs (Jegede and Aikenheadn.d.). For example, when teaching Human evolution to students this may create some contradictory ideas in the mind of students. Traditionally, by the Christianity (Bible) it is believed that God created Adam as a first human and then one of Adam ribs was used to create Eve as it is well known in most Namibian cultures. However, in science the Human Evolution postulates that origination of human beings and other primates like monkeys; chimpanzees and apes being from the same 'father', which simply means that they have arise from the common ancestor. Biblically, God created humans and animals like monkeys on different days. However, science education has proven that the genetic material of humans and primates like chimpanzees

and apes have a difference that is less than 2%, meaning that there is a possibility of them to be related or to be family members. Thus "hominid" is a scientific name for human and other primates like chimpanzees and apes.
Teaching and learning such a contradictory theories is very difficult. Additionally, Jegede and Aikenhead (n.d.) stipulates that, since science and traditional knowledge are two different cultures. Students need to move from one culture to another, this is referred to as 'cultural border crossing'. Phelan et al. in Jegede and Aikenhead (n.d.) identified four groups of learners when navigating and crossing their cultural values and norms to school science:

1. Potent Scientists whose transitions are smooth because the cultures of family and science are congruent, enculturation or contextualisation tends to be easily achieved by this category. For example if teaching the Africans who attend initiation schools, sex education will not be a taboo.
2. Other Smart Kids whose transitions are manageable because the two cultures are somewhat different. They cross the border from life-world to science world without teachers realizing how foreign science appears to them;
3. "I Don't Know" (named by their typical response to a variety of questions about school and science): Students whose transitions tend to be hazardous when the two cultures are diverse; and
4. Outsiders whose transitions are virtually impossible because the cultures are highly discordant. These tend to withdraw from science practice.

According to Aikenhead and Jegede (1999), for science to be a successful course depends on the degree of cultural difference that students perceive between their life-world and their science classroom; how effectively students move between life-world culture and the culture of science; and the assistance they receive in making the transition. For the successful border crossing, students need to have three characteristics as described by Lugones in Aikenhead and Jegede (1999) these are: *flexibility* in moving between the life-world and science world; *interplay* such as the ability to attain your own cultural identity even upon exposed to another culture. For example, being taught human evolution one can still need to believe in Christianity, as cultural belief and entity; and *feeling at ease* such being a fluent speaker; agreeing with the norms of the new culture; being humanly bonded with the people in that new culture and having sense of shared history.

To meet the needs of students, the science teacher ought to be a 'cultural broke' whereby teaching students how to cross the cultural boundaries either back or forward between science and indigenous knowledge (cultural norms and values). By this students can know where to go upon reflective thinking, such as the ability to scrutinise the usefulness of the scientific culture, without infringing on their traditional way of knowing.

What is the aftermath of cultural border crossing?

This question can be answered by looking at collateral learning as postulated by Aikenhead and Jegede (1999).Collateral learning theory involves two or more conflicting schemata held simultaneously in the long-term memory. There are variations in the degree to which the conflicting ideas interact with each other and the degree to which conflicts are resolved (Aikenhead and Jegede, 1999). A potential scientist or learner, who is of non-Western culture, might have a tendency to have cognitive conflict between facets of their indigenous culture and facets of Western science. Traditionally in Namibia, if a husband had sex with other women whilst his wife is pregnant, it is believed that if this particular man happens to touch his wife their child will have breathing difficulties known as chest breaking "*okulya telela*". Before he even touches his kid when born, traditional healers usually intervene to treat this man. Paradoxically, science discovered that this kind of illness by a child is pneumonia, a lung disease or lung inflammation caused by a common bacteria known as*pneumococcus*. Which one can you believe?

So, collateral learning illuminates how such a potential scientist overcomes and resolves the conflict. As Jegede in Aikenhead and Jegede (1999), pointed out "Other Smart Kids" and "I Don't Know" kids are likely to be the subject of collateral learning, because conflict may arise when they move from the indigenous culture to Western science culture. Therefore science teachers are mandated to know how these students resolve their conflict. For example, I was culturally told that if you happen to seen a rainbow in a particular areas, it simply means that God loves you. In other words, in Namibia seeing a rainbow means that God is showing affection to you. Basically, science has proven that the rainbow is due to the refraction and reflection of sunbeams by raindrops. Which one should I believe?

According to Aikenhead and Jegede (1999), there are four types of collateral learning when students are trying to resolve the two or more conflicts in their schemata.

- Parallel collateral learning: In this case the students may access one of the schemas, depending upon the context. For example the student may use Western science when in the science class only.
- Simultaneous collateral learning: Students may hold both conflicting ideas as long as they make sense to them.
- Dependent collateral learning: the student may produce an amalgamation or well-stirred mixture of two kinds of knowledge (Indigenous and Western knowledge). This might happen when one worldview is challenging to another. The result, is restructuring of the existing world view.For instance the theory of human evolution and biblical creation of Adam and Eve, a student might conclude that although there is evolution, creation has pre-existed prior to evolution.

- Secured collateral learning; the student may develop a commonality theory between the two kinds of knowledge.

Some suggestions

Many non-Western science educators likeVerma, Jegede, Aikenhead and others feel that the contemporary science curriculum needs to be re-addressed and changed to confirm the non Euro-American cultures. By adhering to these sentiments Jegede, Aikenhead and Ogawa in Slay, (2001) note that there is a lot to be done in science education such as:

- To use a "conceptual eco-cultural paradigm" that consists of :
  - generating information about the African environment to explain the natural phenomena
  - identifying and using indigenous scientific and technological principles, theories and concepts within African society
  - teaching the values of typical African human feelings in relation to, and in the practise of, technology as a human enterprise.
- A need of a form of examination within a culture of the conflict between Western science and traditional concepts of science, because science teachers' world views and their traditional beliefs affect their teaching and the students' learning.
- Establishing a "mirror" model in the classroom for comparison of indigenous knowledge and science so that multi-perspective science might be created within the classroom.
- Contextualization of students' daily lives in the science curriculum.
- Employing culturally sensitive instructional strategies and acknowledging the contributions of non-Western scientists (p 29).

Science education and the language

Jegede, Ainkehead and Ogawa in Slay (2001) also proposed the using of native languages in Africa when the teachers are teaching science. However, I am condemning such a notion. English is increasingly becoming an international language, for both business and culture. Based on Stupart (2000), clinging to the vernaculars of the African schools as similar to the developed countries like Japan and Germany will create a huge gap, which could further isolate the developing countries from the rest of the world. On the other hand, Stupart (2000), reckoned that the so-called developing nations are not in the same position as the developed countries. Developing countries do not have the resources to teach science

in the vernaculars. Many African nations do not have one or two indigenous languages; (for example Namibia has 13 indigenous languages) choosing one or two languages could culminate in discriminating against other languages as well.

Conclusion

Although few African educators feel that science presented in Africa is not for Africans because it neglect the African values and norms. Science discourse is still positive, in other words, besides science being western and it does not delineate African pedagogical knowledge. Science still plays a fundamental role in the development of Africa. Science educators need to be alerted to the notion of teaching science to non-western students. However, since there is globalisation and the modernising of most of the African countries to western norms and values, science as a western subject will be an idea of the past.

References

Aikenhead, G. S., & Jegede, O. J. (1999). Cross-Cultural Science Education: A Cognitive Explanation of a Cultural Phenomenon. *Journal of Research in Science Teaching, 36*(3), 269-287.

Crebbin, W. (1998). *Shades, Shadows and Reality*. Retrieved 27 April, 2006, from http://www.aare.edu.au/98pap/cre98365.htm

de la Rosa, C. L. (2000). *Improving Science Literacy and Conservation in Developing Countries*. Retrieved 20 August, 2005, from http:www.actionbioscience.org/newfrontiers/delarosa.html

Dickson, D. (2005). *Science capacity 'imperative' for Africa's development*. Retrieved 21 September, 2005, from http://www.scidev.net/News/index.cfm?fuseaction=pritarticle&itemid=1986&language=1

Ellis, C., & Bochner, A. P. (2000). Autoethnography, Personal Narrative, Reflexivity: Researcher as Subject. In N. Denzin & Y. S. Lincoln (Eds.), *Handbook if Qualitative Research* (Second ed., pp. 733-768). London, New Delhi: SAGE.

Gaffney, J. (2005). *The Importance of Science Literacy in Modern Culture*. Retrieved 03 September, 2005, from http://66.102.7.104/search?q=cache:INDXcroRjJoJ:www.phyast.pitt.edu/~jgaffney/scilit.pdf+Significance+OR+Importance+of+Science+Education+&hl=en

George, J. (2001). *Culture and Science Education: A look from the Developing World*. Retrieved 20 August, 2005, from http://actionbioscience.org/education/george.html

Jegede, O. J., & Aikenhead, G. S. (n.d.). Transcending Cultural Borders: Implications for Science Teaching. *Journal of Science and Technology Education, 17*, 45-66.

Kristensen, J. O. (n.d.). *Reform and/or change? The Namibian Broad Curriculum revisited*. Retrieved 13 April, 2006, from http://www.nied.edu.na/publications/journals/journal%2010%20Article%204.pdf

Mwaura, P. (n.d.). *UNESCO pushes for science in Africa*. Retrieved 03 September, 2005, from http:www.un.org/ecosocdev/geninfo/afrec/vol12no4/unesco.htm

Schubert, W. H. (1986). *Curriculum: Perspective, Paradigm, and Posibility*. New York

London: The University of Illinois.

Semali, L. M., & Kincheloe, J. L. (Eds.). (1999). *What is Indigenous Knowledge?* New York London.

Slay, J. (2001). Research perspectives on culturally sensitive science education. *Intercultural Education, 12*, 173-184.

Stenhouse, L. (1975). *An introduction to curriculum research and development*. London: Heinemann.

Stupart, R. (2000). *African Languages in Africa schools*. Retrieved 27 September, 2005, from http://www.debatabase.org/details.asp?topicID=54

Verma, G. (2004). Perfoming Colonial and Postcolonial Science in India: Reenacting and Replaying Themes in the United States. In K. Mutua & B. B. Swadener (Eds.), *Decolonizing Research in Cross-Cultural Contexts*. Albany, NY: State University of New York Press, Albany.

Wangoola, P. (2002). Mpambo, the African multiversity: A philosophy to rekindle the African spirit. In G. S. Dei, B. Hall & D. Rosemberg (Eds.), *Indigenous knowledge in global contexts* (pp. 265-277). London GB: University of Toronto.

Warren, B., Ballenger, C., Ogonowski, M., Rosebery, A. S., & Hudicourt-Barnes, J. (2001). Rethinking Diversity in Learning Science: The Logic of Everyday Sense-Making. *Journal of Research in Science Teaching, 38*(5), 529-549.