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Culture and Science Education: A Look from the Developing World

By June George

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article highlights

Science education that incorporates indigenous knowledge can:

- *draw upon cultural experience and everyday life*
- *access different ways of thinking about scientific concepts*
- *bridge the gap between the traditional and the conventional*

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Culture and Science Education: A Look from the Developing World

By June George

For many students, science and culture have links.

Until the very recent past, there has been little debate about a likely connection between culture and science education. The scenario is now changing as more and more attention is being paid to the science exposure of students who live in communities in which traditional practices and beliefs guide daily actions.

"Science for all" is science that is meaningful and useful in daily life.

The interest has been fuelled, in part, by the global thrust towards school science programmes that are intended, not for a select few, but for all students. This interest has grown to the extent where an entire issue of *Science Education* has been devoted to the topic.[2] The "science for all" movement is intended to equip all students to use their knowledge of science in their daily lives. "Science for all" and "science for daily living" take on new meaning when the following are considered:

Indigenous knowledge and "common sense" have a place in science education.

- For students in traditional settings (i.e., settings that are mainly non-industrialized), daily living is guided, at least to some extent, by a knowledge system that is different from conventional science as taught in schools. The knowledge is typically passed down orally from one generation to the next.
- Even students who live in Western (Euro-American) settings may sometimes draw on "common sense" knowledge, not school science knowledge, in making some of their decisions.
- If meaningful science programmes are to be devised for such students, then their background experiences must be taken into consideration.

Curriculum development

An epistemological approach that is being experimented with in the effort to provide meaningful science programmes for students in traditional settings is that of contrasting conventional science as taught in schools with the knowledge/beliefs/skills in traditional settings.[1] This approach to science curriculum development is relatively new and there is much scope for further work in this area. This approach:

Western science is not always objective.

- views culture as including the norms, values, beliefs, expectations and practices within a community.
- runs counter to the commonly held view that science as it has developed and is known in the Western world is objective, value free, and context-independent.
- recognises that much of current Western scientific work embraces certain agreed-upon procedures; however, its cultural context influences decisions about which research projects are to be pursued, what questions are to be asked, and so on.

When viewed in this way, science is described as a cultural activity that is a product of Western societies.

The content of conventional science also differs in significant ways from traditional knowledge. Based on previous research, I proposed four categories to consider in planning curriculum content:[3]

There are two ways of knowing; one of them is the traditional way.

- Category 1 Traditional knowledge and technologies can be explained in conventional science terms. For example, the use of lime juice to remove some stains can be explained in terms of acid/oxide reactions.
- Category 2 Traditional knowledge can likely be explained by conventional science. For example, a brew made from the plant "vervine" (*Stachytarpheta*) is used in the treatment of worms in children. This plant is considered in conventional science circles to have pharmacological properties, but appropriate usage has not been verified.
- 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 sugars can cause one's condition to worsen.
- Category 4 Some traditional knowledge cannot be explained in conventional science terms. For example, there is no conventional science explanation for the claim that the ingestion of certain foods can cause "heat" in the body.

Category 1 knowledge is likely to be the easiest to incorporate in the school curriculum. The ready application of Category 1 knowledge is exemplified by the fact that agricultural scientists and botanists have been able to incorporate such knowledge in agricultural extension work with farmers in traditional settings.

Differences between the two ways of knowing exist, not only with respect to content, but also with respect to the interpretative framework that underpins such knowledge. For example, characteristics of health-related traditional knowledge identified by research in Trinidad and Tobago and Jamaica include the following:[4,5]

- Nature is regarded as providing all that is needed for the maintenance of good health. Consequently, efforts must be made to:

Traditional knowledge includes a deep understanding of nature.

  - cooperate with those aspects of nature that are thought to influence the functioning of the human body, for example, the moon.
  - control those aspects of nature that have the potential to impact negatively on the functioning of the human body. For example, the quantity of "heat-containing" foods eaten should be controlled.
  - use to the fullest, those aspects of nature which can result in maximum health benefits, for example, the sea and sea breeze, fresh meat and garden produce, and herbs.
- A high level of importance is attached to the individual. In particular, there is a pre-occupation with taking care of oneself as one interacts with the environment.
- Argument patterns used consist of knowledge claims supported by warrants, with personal experiences forming a high percentage of these warrants.
- A simple cause-effect link is often invoked in reasoning patterns. For example, the admonition that a pregnant woman should eat a lot of ochroes in order to have an easy delivery is, seemingly, based on the belief that the slippery ochroes would make delivery easier.
- Generalisations are made readily with few pieces of evidence.

Curricula should consider life experiences and different ways of thinking.

It is clear from the examples above that children growing up in traditional communities would have gained experiences, knowledge, values, and ways of thinking that might differ in varying degrees with those inherent in or arising from conventional science. Although these examples refer specifically to Caribbean contexts, similar research has been done on children in other contexts, for example, with Maori children in New Zealand and Afro-American and Native American children.[7] These children also had to deal with a new cultural experience when learning conventional science in the classroom.

Bridging the gap

Learning school science requires some students to cross boundaries between the cultural context of their home, family and community and the cultural context of Western science.[1,4] The metaphor of a "bridge" has been used to indicate the mechanism by which this crossing over (back and forth) might take place. This way of thinking is markedly different from the way school science has been presented, i.e., as a totally neutral subject without culture-related difficulties.

Methodology must build bridges between conventional and traditional knowledge.

The new orientation poses several questions for which there are no clear-cut answers as yet. These questions cover several dimensions, ranging from students' learning processes to ethical considerations in the classroom. The questions include the following:

- What cognitive and other processes are involved when students from traditional backgrounds attempt to make sense of conventional science as presented in schools?
- How can appropriate "bridges" be built in conventional science classes to enable students from traditional backgrounds to make sense of, and evaluate what conventional science has to offer?
- What position should a science teacher adopt when dealing with traditional knowledge belonging to Category 3 and Category 4?

O. Jegede described what could happen with students in non-Western settings when they encounter school science concepts and principles that are different from those that they use in their everyday lives.[6] Jegede proposed a theory of a continuum of possibilities with *parallel collateral learning* at one end of the continuum and *secured collateral learning* at the other end:

It is possible for students to make connections between the two types of knowledge.

- With parallel collateral learning, the student is able to hold the two conflicting schemata with minimum interference, and to access at will the schema that best suits the situation at hand.
- With secured collateral learning, the student is able to resolve the conflict. The student may either find good reasons to hold on to both schemata or he/she may decide to incorporate some aspect of one schema into the other.
- Between these two extremes are other positions representing varying degrees of interaction and conflict resolution.

Jegede's scheme holds some promise but there is the need for it to be tested through careful and detailed research work.

The process of bridge building is gaining the attention of researchers in various settings. There are several issues here that need to be unraveled. For example:

- What exactly constitutes a bridge?
- What are the most effective bridge building strategies?
- Are there different types of outcomes for different bridge building strategies?
- Are different types of bridge building strategies needed for the different types of collateral learning?

A balance between the two ways of thinking can strengthen science education.

These and other questions can only be answered by continuing research. In the meantime, teachers will have to confront ethical issues and make decisions about how they deal with Category 3 and Category 4 knowledge in the classroom. To treat traditional knowledge with respect, teachers would need to be careful to portray it as a *different* way of operating. The emphasis could then be on having students examine the strengths and weaknesses of particular aspects of both conventional school science and traditional knowledge.

The way forward

While some attention is now being paid to education in science from a cultural perspective, there is much more that needs to be done.

Conclusion: Science curricula should incorporate traditional knowledge, based on field test results.

- There is the mammoth task of documenting and analysing traditional knowledge in communities before attempts are made to use this knowledge in the classroom.
- Science teachers are not likely to have the time to engage in this preliminary work and, thus, it would need to be done by other agencies.
- Further strategies for bridging the two ways of knowing must be developed and all strategies must be field-tested.
- Teachers may themselves be products of traditional communities (perhaps engaging in some aspect of collateral learning) and so may need considerable help in understanding the conceptual base of traditional practices and beliefs in order that these could be brought to the fore in science classrooms.

Although there is much to be done, the future looks both challenging and exciting.

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Aboriginal science in Australia
Find out how some educators in Australia are incorporating intercultural understandings in the teaching of science.
http://members.ozemail.com.au/~mmichie/handbook.htm

The Third World Academy of Sciences (TWAS)
TWAS represents the sciences in the developing world, and its principal aim is to promote scientific capacity and excellence for sustainable development. A resource for science professionals and teachers alike.
http://www.ictp.trieste.it/~twas/

Traditional science in China
A synopsis of scientist Joseph Needham's research on the history of Chinese science and technology. Information in this article can be used in classroom discussion of traditional science.
http://www.unu.edu/unupress/unupbooks/uu01se/uu01se0u.htm

International comparisons in education
As part of its Congressional mandate, the National Center for Education Statistics provides comparative education data from major international studies. Also find links to additional resources on international education comparisons and related topics.
http://nces.ed.gov/surveys/international/

Read a book
The State of the World's Children: Education by UNICEF and the United Nations (1999) analyzes education in developing countries.

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For teachers: iEARN
The International Education and Resource Network (iEARN) is a global telecommunications community of over 15,000 schools & youth organizations in more than 100 countries. "Participants may join existing structured on-line projects, or work with others internationally to create and facilitate their own projects." This link includes existing science projects; all are focused on "improving the quality of life on the planet."
http://www.iearn.org/projects/project_gateway_science.html

Teacher's web site
A web site just for teachers, with information, activities, and lesson plans.
http://www.teachnet.com/

Free community outreach service
San Diego State University's Indigenous Earth Science Project offers workshops and informal classes about local geology and earth science topics to local Native reservation and urban-Native groups. In addition, the University will help teachers develop an Earth Sciences curriculum, which incorporates traditional knowledge wherever possible and appropriate.
http://www-rohan.sdsu.edu/~eriggs/IESP/Services.html

Adopt a classroom
This non-profit site provides opportunities for individuals and corporations to donate funds or provide other support to teachers who wish to purchase needed classroom supplies in the U.S. Also, teachers can register their class needs online.
http://www.adoptaclassroom.org/

Recycling for school fundraising
Toner Donation, a program of U.S. Recycling, is just an example of how schools can raise funds and help the environment at the same time by recycling inkjet & toner cartridges. "Almost 9 cartridges are discarded every second in the US alone." What other programs are available in your area? Probably many. Try "recycle cartridges" or "recycling cartridges" in a search engine.
http://www.tonerdrive.com/

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