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World View, Culture, and Science Education

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Feature Article

WORLD VIEW, CULTURE, AND SCIENCE EDUCATION

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In the last few years many science education policy documents, including those from Project 2000+, have noted the need for further knowledge and understanding of how people individually and as members of social and cultural groups learn and teach science. To this end science educators have studied cognitive development and mental capacity. They have explored the effectiveness of various instructional strategies. Among other things they have investigated the errors students make. However, what students believe about the physical world, belief rooted and nurtured in students' socio-cultural environments, has received far less attention. In a non-Western economically developing nation one speaks of traditional culture in contrast to the culture of science where educators understand that science is a second culture for students. In Western nations such as the USA science educators have long assumed that scientific explanation is a natural part of student culture. But this is not necessarily a wise assumption. Many Western societies are increasingly pluralistic. Moreover, not only is there widespread disinterest in science among Western students, there are several cultural subgroups traditionally under-represented in science. In the USA these include, for example, women, African-Americans, Hispanics, American Indians, and those who are religious conservatives.

Cultural Studies

Bearing in mind the significant differences between nations east and west, north and south, economically developed and developing, it is perhaps time for science educators to consider the possibility that science is a second culture experience for most students regardless of where they live. What I have set out below is a brief discussion of cultural research in science education based on a world view. The study of culture has typically been the bailiwick of the cultural anthropologist. However, scientists, historians, and literary critics among others, have in recent years joined the study of culture. What unifies these eclectic cultural scholars is that they "take a subject whose working assumptions are considered natural and attempt to demonstrate that they are culture-bound" (Heller, 1989, p. A8).

We live in a rich experiential world brought to us by our senses. But the data of our senses is an amorphous mass of confusion until interpreted by our world view. Sociologist Peter Berger (1979) argued that a people's world view provides a special plausibility structure of ideas, activities and values which allows one to gauge the plausibility of any assertion. This shared world view is a fundamental aspect of any cultural group. In my view, science education has a cultural identity of its own, and teachers typically assume that students operate within the plausibility structure accompanying that identity (Cobern, 1991 & 1993a). The original notion of heretic was someone who decided things for himself instead of employing society's plausibility structure or world view. I suspect that science classrooms are filled with heretics operating within other plausibility structures, and that many can be recognized by their alleged *misconception*.

> Talk of misconceptions . . . carries with it the suggestion that something has been botched or bungled, or that something has gone amiss . . . And there is often the further implication that the student is the culprit: that he or she is the one who has gotten something wrong . . . There is more to error than meets the eye (Hills, 1989, p. 174).

Indeed, there is more than meets the eye. Young children in the classroom are in the process of world view and plausibility structure formation. What was long known about children in cultures outside the West is now being found to equally apply to children in countries like the USA; that is, that school does provide the principal, let alone the sole influence upon this formative process (e.g., Phelan, Davidson, & Cao, 1991).

Moreover, with young children one is not likely able to separate world view development from other aspects of conceptual development. World view theory supports those researchers whose interest is in the contexts of *meaning* in which children construct knowledge. Bloom (1989a) noted that, "children's thinking is guided by an ever-changing variety of knowledge, frameworks of belief, mental processes, and emotions" (also see Bloom, 1989b). In the literature anthropocentrism, anthropomorphism, and zoomorphism have all been given as examples of children's frameworks of belief. Science educators will likely find that these types of belief in children adumbrate world view presuppositions to come. In childhood however, it would be a mistake to see world view as a distinct conceptual development. Older children on the other hand come to class with well developed world views. These students enter the classroom with culturally validated ideas about the world. But again, the principal formative agent is not likely to be the school. Because the school is not the principal agent, educators tend to pejoratively label students' views as *misconceptions*.

As noted by Smolicz and Nunan (1975), Nadeau and Desautels (1984), and Duschl (1985), science education has long been dominated by a scientistic perspective central to which is that science is above culture. Thus, the only concern of science with culture is that culture not hinder science. From this perspective, the first objective of science education is the elimination of all traditional thought that is deemed a hindrance to science, and of course, to replace that traditional thought with scientific thought. In other words, science education is quite imperialistic. The early work done on teaching for conceptual change, though probably unintentional, was based on this view. It was argued that conceptual change would take place when students saw that scientific explanations were superior to the untutored, commonsense beliefs brought by students to the classroom (Posner, Strike, Hewson, & Gertzog, 1982). Researchers quickly discovered that it is not that easy to demonstrate the superiority of scientific explanations. Conceptual change approaches tend to work best with students who already share the plausibility structure of the science teacher and the science textbook. It is ironic then that a frequently stated goal of science education is to develop a scientific outlook or scientific world view, for it seems to me that this goal is tacitly presupposed by much of science instruction.

Of late science education researchers have embraced constructivist ideas (Yager, 1993). Constructivist thought breaks with traditional science education thought in that science and culture are seen as inseparably linked. The constructivist view is that science always exists in a cultural context and that the cultural matrix of science education in which science is embedded may not be one widely shared by students. This does not mean that science is relative. Science content is science content regardless of culture to be sure, but not so with its communication nor the policies that support and direct science. In the jargon of education, there is always hidden curriculum and this raises three issues. The first is the frequently cited concern that traditional culture hinders science education. The second and third issues are much less discussed. While a traditional culture might hinder science education there is as well the potentially adverse influence of an alien hidden curriculum on the integrity of a traditional culture. Moreover, a hidden curriculum may in fact adversely influence science education among those who are alienated by the hidden curriculum.

I understand that culture changes. Any new idea brings change as people in a host environment react and adapt to new ideas. Modern science will influence a non-Western culture as surely as it has influenced and continues to influence Western culture. The concern is not cultural change per se, but unwarranted change. Must African nations, for example, adapt to science and adapt science to African culture exactly as the West had done? This concern arises first because relatively speaking modern science and science education are newly imported phenomenon in the cultures of most developing countries. And, science is indeed a powerful cultural force. Moreover, as educators around the globe adopt the Project 2000+ goal of scientific and technological for all, M. F. D Young's (1976, p. 53) comment of seventeen years ago bears repeating:

> school science separates science from pupils' everyday lives, and in particular their non-school knowledge of the natural world. It is learnt primarily as a laboratory activity, in a room full of special rules, many of which have no real necessity except in terms of the social organization of the school.

And though Young wrote these words in 1976, recent work demonstrating the importance of everyday thinking (e.g., Cole, 1990) shows that the significance remains current. If science educators can come to a better understanding of the different everyday ways that people have of viewing the world and why they have those views, perhaps the structure of science education can be changed so that Young's separation is closed.

To this end the following questions need to be addressed by science educators for the communities and societies in which they live.

1. What do students believe about the world around them, especially the physical world?
2. How do students understand their own place

in the world, especially their relationship to the physical world?

3. What is the cultural milieu in which these student beliefs, values, and relationships are grounded and supported?

4. What is the culture of science and how is that culture interpreted in the school science classroom?

5. What happens when student cultures, teacher culture, and the culture of science meet face to face in the classroom?

6. When science is resisted, is it the science people object to or is it the context of the science?

7. When pupils are influenced by science education, are they influenced solely by science? Or, are they influenced by science plus the context in which it is presented?

In other words, it is important for science educators to understand the fundamental, culturally based beliefs about the world that students bring to class, and how these beliefs are supported by students' cultures; because, science education is successful only to the extent that science can find a niche in the cognitive and socio-cultural milieu of students.

World View Theory

World view, which offers one approach to these questions, is a concept borrowed from cultural anthropology. It refers to the culturally dependent, generally subconscious, fundamental organization of the mind. This conceptual organization manifests itself as a set of presuppositions which predispose one to feel, think, and act in predictable patterns. Kearney (1984, p. 1) referred to world view as:

> culturally organized macrothought: those dynamically inter-related basic assumptions of a people that determine much of their behavior and decision making, as well as organizing much of their body of symbolic creations. . . and ethnophilosophy in general.

To be rational simply means to think and act with reason, to have an explanation or justification for thought and action. Such explanations and justifications ultimately rest upon one's world view. Thus, world view is about epistemological levels antecedent to specific views that students hold about physical phenomena, whether one calls those views commonsense theories, alternative frameworks, misconceptions, or valid science.

In 1984, Brent Kilbourn pioneered the use of world view in empirical science education research by using Pepper's (1940) root metaphor approach. More recently, logico-structuralism was adapted from cultural anthropology for use in science education research (Cobern, 1991). The power of the logico-structural model of world view lies in its composite structure of inter-related, universal categories: Self, Non-self, Classification, Relationship, Causality, Time and Space (Kearney, 1984). Each category is composed of logically related presuppositions. In principle groups of people and even individuals can be identified by world view variations which result from the content variation of categories. This composite nature of the logico-structural model focuses the researcher's attention on the complexity of world view, and yet the categories themselves provide access to that complexity. And while the composite nature of the model makes it less likely that the researcher will oversimplify the notion of world view, one can still speak of world view unity based on salient presuppositions within the seven universal categories. In a recent study based on logico-structural theory, I investigated the contrasting conceptualizations of nature held by college biology professors and women students who were successful in the biology courses but were not science majors (Cobern, 1992 & 1993b). The study is an example of a different way of looking at students and teachers prompted by world view theory. In the study it was found that students and professors can be summed up with the phrase, depth versus breadth. In the research interviews the professors very quickly began to talk about nature in scientific terms and in quite some depth. In contrast, student conversation contained little science but ranged broadly over topics from religion to aesthetics to emotional states. It is not surprising that a biologist without any prompting would voluntarily choose to speak of nature in biological terms. Nevertheless, when laid side by side the difference between the student and professor conceptualizations of nature, one of breadth versus depth, is striking. One cannot help but wonder how such divergent viewpoints interact in the classroom and with what consequences. Of course, this is exactly the direction of future research (Cobern, 1992 & 1993b); and ultimately, the value of logico-structural world view theory in science education will rest on the fruitfulness of the research it precipitates, and the understanding of culture this research provides.

Classroom Application

The first thing for teachers to remember is that the interaction between culture and science education is rarely evident in a single teaching episode. It is an interaction that manifests itself over a period of time. It is not nearly so important to construct a culturally sensitive lesson as it is a culturally sensitive curriculum. Therefore, over the course of a teaching year teachers need to find ways of encouraging their students to grapple with the problem of forming a culturally authentic view of science. My immediate suggestion is that teachers frequently ask of themselves the seven questions listed earlier. In so doing they will prompt themselves first to monitor the cultural appropriateness of their own instructions and second to monitor the opportunities they are affording their students to engage in a cultural dialogue with science.

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FOOD FOR THOUGHT

Science Process Skills

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