CHAPTER 1

THE ROLE OF MORAL REASONING AND THE STATUS OF SOCIOSCIENTIFIC ISSUES IN SCIENCE EDUCATION

PHILOSOPHICAL, PSYCHOLOGICAL AND PEDAGOGICAL CONSIDERATIONS

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INTRODUCTION

In the early part of the 20th century, John Dewey advocated a "progressive" philosophy of science in American education. This view entailed re-evaluating how science was typically taught to children in school as well as adults in college. Dewey's contention was that teaching science as "ready-made knowledge" consisting of facts, principles, and laws divorced from the social activity of science was not sufficient to develop an informed populace capable of using science as a method of inquiry into any subject.

> Science has as yet had next to nothing to do with forming the social and moral ideals for the sake of which she is used... (Science) has remained a servant of ends imposed from alien tradition...science must have something to say about what we do, and not merely about how we may do it most easily and economically...When our schools truly become laboratories of knowledge-making, not mill fitted out with information hoppers, there will no longer be the need to discuss the place of science in education. (Dewey, 1974 / 1910, p.192)

In the latter part of the 20th century, many science educators reaffirmed the importance of envisioning science not as an isolated subject but understanding the role of science in relation to other areas of life (Aikenhead, 1992; Aikenhead, Fleming, & Ryan, 1987; Bybee, Powell, Ellis, Giese, Parisi, & Singleton, 1991;

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Sabar, 1979; Solomon & Aikenhead, 1994; Yager & Lutz, 1995; Zeidler, 1984). The Science-Technology-Society (STS) approach, for example, has been one attempt to emphasize collateral learning by connecting science and the advancement of technology in the student's social world. While those who promote STS approaches clearly support the incorporation of environmental concerns and decisions, advocates of Science, Technology, Society and Environment (STSE) education tend to make more explicit connections with respect to examining science within a larger social, cultural and political context. Proponents of the latter approach also emphasize the importance of contextual decision-making with ethical, individual and social consequences (Pedretti, 2001).

As the 21st century unfolds, professional associations in science recognize the importance of broadly conceptualizing scientific literacy to include informed decision-making, the ability to analyze, synthesize and evaluate information, dealing sensibly with moral reasoning and ethical issues, and understanding connections inherent in socioscientific issues (Zeidler, 2001). To achieve a practical degree of scientific literacy necessarily entails practice and experience in developing habits of mind (i.e. acquiring skepticism, maintaining open-mindedness, evoking critical thinking, recognizing multiple forms of inquiry, accepting ambiguity, searching for data- driven knowledge) advocated in Project 2061 (AAAS, 1989). Habits of mind may suffice when arriving at individual decisions based on an informed analysis of available information. However, it may not be sufficient in a world where collective decision-making is evoked through the joint construction of social knowledge. In the real world of dirty sinks, and messy reasoning, arriving at ideal personal decisions through objective evaluation of neutral evidence is a phantom image.

The focus of this book is to examine factors associated with reasoning about socioscientific issues. Accordingly, socioscientific issues are equated with the consideration of ethical issues and construction of moral judgments about scientific topics via social interaction and discourse. Under this framework, science teaching is viewed as a microcosm of society that must entail, among other kinds of thinking, the following characteristics:

- Processes of Inquiry
- Discourse
- Conflict
- Argumentation
- Negotiation
- Compromise
- Decision-Making
- Commitment

This partial list of features associated with reasoning about socioscientific issues takes on increased importance if teachers understand that the development of meaningful concepts requires (under this framework) the joint construction of scientific knowledge that is at once personally relevant and socially shared.

Consider the high priority various countries have assigned to the moral and ethical dimensions of science education. For example, in the United States, the American Association for the Advancement of Science initiated Project 2061 to set a vision of life-long science literacy. There are five major criteria that *Project 2061: Science for All Americans* recommends in the selection of science content that may provide a "lasting foundation" for all subsequent learning – both in the classroom and in the world. There is an unmistakable emphasis on issues of scientific discourse and reasoning. These criteria are worth repeating here.

- Utility: Will the proposed content knowledge or skills significantly enhance the graduate's long-term employment prospects? Will it be useful in making personal decisions?

- Social Responsibility: Is the proposed content likely to help citizens participate intelligently in making social and political decisions on matters involving science and technology?

- The Intrinsic Value of Knowledge: Does the proposed content present aspects of science, mathematics, and technology that are so important in human history or so pervasive in our culture that a general education would be incomplete without them?

- Philosophical Value: Does the proposed content contribute to the ability of people to ponder the enduring questions of human meaning such as life and death, perception and reality, the individual good versus the collective welfare, certainty and doubt?

- Childhood Enrichment: Will the proposed content enhance childhood (a time that is important in its own right and not solely for what it may lead to in later life)? (AAAS, 1989, p.21)

The importance of not divorcing science from its social function is again strongly reiterated in *Benchmarks for Science Literacy* (AAAS, 1993). Accordingly, cultural issues (i.e. the cultural-embeddedness of science) are a priority of terms of what it means to be scientifically literate. Furthermore, the prominence of cultivating "Habits of Mind" like curiosity, openness to new ideas, skepticism, critical-response skills (e.g., argumentation and discourse issues) is clearly recognizable throughout the document:

> Even today, it is evident that family, religion, peers, books, news and entertainment media, and general life experiences are the chief influences in shaping peoples views of knowledge, learning, and other aspects of life... To the degree that schooling concerns itself with values and attitudes – a matter of great sensitivity in a society that prizes cultural diversity and individuality and is wary of ideology – it must take scientific values and attitudes into account when preparing young people for like beyond school. (AAAS, 1993, p. 285)

In the United States, the National Research Council has extended the seminal work of Science for All Americans and Benchmarks by introducing the National Science Education Standards. At the core of the now familiar eight content standards (Unifying concepts and processes, science as inquiry, Physical science, Life science, Earth and space science, Science and technology, science in personal and social perspective, and History and nature of science) lie four central goals that define scientific literacy. These include the application of scientific processes to derive personal choices and the ability to engage intelligently in public discourse and debate in matters of scientific and technological importance:

> School science reflects the intellectual and cultural traditions that characterize the practice of contemporary science. To develop a rich knowledge of science and the natural world, students must become familiar with modes of scientific inquiry, rules of evidence, ways of formulating questions, and ways of proposing explanations. The relation of science to mathematics and to technology and an understanding of the nature of science should also be part of their education. (National Science Education Standards, NRC, 1996, p. 21)

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