The Nature of Science in Science Education: An Introduction

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ABSTRACT. After providing a definition of the nature of science (NOS) for science education, we argue that a pragmatic consensus exists regarding NOS topics most important for a scientifically literate society. Hence, NOS instruction should take a more prominent role in the science curriculum. While the relationship between a teacher’s NOS knowledge and their pedagogical decision-making is not straightforward, we maintain that a complex interplay does exist. While more science coursework and research experience have been suggested to improve science teachers’ understanding of NOS, neither approach is empirically supported. However, explicit attempts at NOS instruction in science teacher education have been effective. This article, which is an abridged version of one appearing in McComas (1998), concludes with the suggestion of a desired state for NOS instruction.

Below, it is clear that science teachers and their students gain an understanding of the nature of science, a hybrid field blending aspects of various social studies of science such as the history, sociology and philosophy of science with research from the cognitive science into a rich and useful description of what science is and how it functions.

Science has an ever present but often subtle impact on virtually every aspect of modern life – both from the technology that flows from it and the profound philosophical implications arising from its ideas. However, despite this enormous effect, few individuals even have an elementary understanding how the scientific enterprise operates. This lack of understanding is potentially harmful, particularly in societies where citizens have a voice in science funding decisions, evaluating policy matters and weighing scientific evidence provided in legal proceedings. At the foundation of many illogical decisions and unreasonable positions are misunderstandings of the character of science.

CONSENSES VIEWS REGARDING THE NATURE OF SCIENCE

Before embarking on the development of any course or unit of study designed to assist teachers or students in the acquisition of an understanding of the nature of science, one must have some notion of what knowledge is worth possessing for incorporation into curricula and classroom discourse. In spite of significant progress toward characterizing science, much
disagreement remains. Almost thirty years ago, Horrocks (1969) claimed that no sound and precise description exists concerning the nature and structure of science, and more recent voices echo that sentiment. As an example, Laudan states that "... we have no well-confirmed general picture of how science works, no theory of science worthy of general assent" (in Ginev, 1990, p. 64). Duschl (1994) also cites the lack of consensus regarding the appropriate image of scientific inquiry and the growth of scientific knowledge while Lederman (1992) notes that the nature of science is neither universal nor stable. While we agree that particular philosophical issues and even the content of the nature of science will always be somewhat contentious, views regarding topics most important for a scientifically literate society are far less controversial. We concur with Welch’s (1984) view acknowledging a lack of complete agreement regarding what science is and how it works, but maintain that significant consensus exists regarding fundamental issues in the nature of science relevant to science education.

During the past three decades, a number of scholars including Robinson, 1968, 1969; Martin, 1972; Ennis, 1979; Giddins, 1982; Lederman, 1983; Duschl, 1988, and Matthews, 1994 have provided both explicit and implicit suggestions for the characteristics of science to be included in science instruction.

For example, the nature of science recommendations contained in eight international science education standards documents (McComas & Olson, 1998) show significant overlap (Table 1). Of course, the issues included in the following table are complex, but we are making recommendations for K-12 science students and their teachers – not future philosophers of science.

Knowing who the recommendations are for and the degree of sophistication appropriate for that target group is an important consideration when crafting nature of science standards. Moreover, the image of science emerging from the social studies of science is sufficiently robust that science educators can move forward with confidence and provide a more realistic picture of the strengths and limitations of this thing called science (Smith et al., 1997). Where consensus does not exist, science teachers should present a plurality of views. As Matthews (1997) argues, the purpose of nature of science education is not to indoctrinate, but to address reasons for accepting a particular position.

THE NATURE OF SCIENCE IN SCIENCE EDUCATION: HISTORICAL PERSPECTIVE

Advocacy for students’ understanding of science and its nature can be traced back to the early years of this century. Although at that time the phrase ‘understanding the nature of science’ was not clearly stated, some elements and characteristics of science were noted as goals worth pursuing