

## **Inquiry & the Nature of Science: Are these goals in science education reform ones that can be achieved?**

I found this exercise to be quite difficult as I feel that I have limited experience in the field of science education at least in the sense of discussing successes and vexations. One reason that I decided to pursue a career at the Ph.D. level in science education was to be involved with reform efforts in changing the way we teach science in K12 education. My interests range from urban education to engineering education (a huge swing I must admit) yet among these interests I found the philosophical and historical side of science to be the most interesting. With that in mind, my focus and doctoral work in science education lends itself to a more pragmatic approach to teaching and learning of science thus the nature of science (NOS) most naturally evolved for me. My interpretation of success will focus on how research in NOS has evolved over the past several years. Vexations are plentiful so I will stab at what I feel is difficult to address regarding our current reform efforts, e.g. shifting the paradigm of how science is taught in public schools.

### **A Success**

According to reform documents such as *Science for All Americans: Project 2061* (American Association for the Advancement of Science, 1989) and the *National Science Education Standards* (National Research Council, 1996), the nature of science (NOS) has been identified as an important element in science education reform as well as an integral factor that contributes to a student's development of scientific literacy. This claim has opened a line of research that initiates a movement toward discussing how NOS can increase scientific literacy. In my naive opinion, there have been two successes reached in regard to NOS research. One is the defined lines of research that explore NOS and the second is the definition of several tenets of NOS as supported by instruments such as the Views of the Nature of Science (VNOS). This is not, however, to preclude any other instruments that define tenets of NOS but to date it is the most widely recognized instrument available for NOS research.

To address the first claim regarding areas to explore within NOS, Lederman (1992) wrote a seminal article, "*Students' and Teachers' Conceptions of the Nature of Science: A Review of the Research.*" which outlines 4 distinct, yet related lines of research pertaining to NOS: (1) assessment of student conceptions of the NOS; (2) development and assessment of curricula designed to improve an understanding of the NOS for students; (3) assessment and improvement of teachers' conceptions of the NOS; and (4) investigations into the relationship between teachers' conceptions, classroom practice, and students' conceptions of the NOS. Although in 1992, these lines of inquiry were projected to be investigated, in the year 2005, several of these lines of research have been tackled by researchers. Yet, as in any good research agenda, additional questions related to these lines of inquiry have emerged, e.g. how do teachers' incorporate NOS understanding into the classroom using an inquiry approach (yet another reform minded initiative)?

Addressing the second claim as to the tenets of NOS defined by the VNOS, Lederman, Abd-El-Khalick, Bell, Schwartz (2002) developed 7 non-controversial tenets that can be rather easily assessed in K12 education. The article outlines these tenets to describe science knowledge as: (1) tentative; (2) empirical, (3) theory-laden, (4) partly the purpose of human inference, (5) imaginative, (6) creative, and

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(7) socially and culturally embedded. Although some will argue with regard to these descriptors, it establishes a baseline for further instrument development and allows for teachers' and students' to understand what is inferred by NOS.

What's the big deal about NOS research? Since NOS has been identified as an integral component of scientific literacy by several reformed minded groups, we now, as researchers, have a direction in which to pursue, argue and dispute the very nature of science.

**One Vexation**

It has been my observation from teaching pre-service secondary science methods classes as well as instructing Master's students who are experienced science teachers that there appears to be disconnect between how they teach in the classroom and their conceptions of and pedagogy involving inquiry. Upon observation, these preservice and experienced science teachers instruct their students with vigor and enthusiasm demonstrating an excellent knowledge base of facts but from my observations has missed the context in which to teach science as inquiry. When asked if their lesson include an inquiry component, their answers are inevitably, yes. Where was that inquiry component when I observed them? I'd be satisfied with any type of inquiry. This disconnect has been baffling me for several years now. Research has demonstrated that conceptions of NOS do not translated into the classroom so this must also be confirmed about inquiry. How do we break this barrier and disconnect between teachers' conceptions of what they do in the classroom, in particular, inquiry and how they actually teach in the classroom? How do we train them to include inquiry in their lessons? We, science educators, have attempted to instruct and model lessons that are infused with inquiry. We have modeled it, we asked our students to write curriculum that introduces inquiry into the lesson but still it is the rare occasion that we observe it. The entire notion of inquiry and how can teachers include it in their lessons has been discussed at length and again I am interested in this dilemma. So where do we begin as science educators? As inquiry is pivotal as another means of increasing scientific literacy, this issue seems to be pressing. I would like to discuss the issue of inquiry and how it can be introduced into science education particularly at the secondary level. Is this a goal that is unachievable? Some might and do argue, yes it is. In the perfect world, our teachers will be instructing in the context of science inquiry and our students will be scientifically literate. I believe that this is possible but the road will not be smooth. It has been at least 15 years since the first reform initiative in science education was published and we still have the challenge to produce a scientifically literate society. The challenge is there. I am interested in other viewpoints with this regard.