2008 AAAS/Subaru Essay Writing Competition for K-12 Educators, Finalist Essay

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Enhancing the Inquiry Classroom with Historical Science

The Buffalo School System located in Buffalo, New York, is an urban district with approximately 34,000 students. Classrooms in the district represent a wide range of student academic abilities. The Science Department has for more than two decades supported reform initiatives that emphasize development of inquiry skills. The professional organization Buffalo Science Teachers Network (BSTN) also provides professional development for science teachers. BSTN gives science teachers the opportunity to present classroom curriculum, assessment, and instruction ideas.

Given this context, I have been able to enhance the classroom experience for my own students. I use extensive inquiry activities, performance assessments, and essential questions that encourage student critical-thinking skills. Over the last year, I have become interested in the history of science and found myself using a somewhat more historical approach in the classroom. I have developed historically based lesson plans and found good support for this endeavor in some of the documents that began the reform movement. Recommendations in *Science for All Americans* include topics not common in school curricula. Among those topics are the nature of the scientific enterprise and how science, mathematics, and technology relate to one another and to the social system in general. This report calls for understanding something of the history of science and technology.

The traditional science curriculum for middle school truncates science and science understandings in several ways. First, science concepts are treated as if they are independent from one another. The concept of acids and bases is usually treated independently from electricity and these both are usually taught without reference to the structure of the atom. Second, the social context in typical presentations is almost entirely lost. This gives the impression that science proceeds in a vacuum. Students see concepts of science as having arrived in a textbook fashion. This does not allow students to see the sometimes long, arduous thinking and experimentation that is a part of the real science enterprise. Third, besides being socially and conceptually truncated, the current curriculum does not allow for authentic understanding because it relies too heavily on memorization.

Often, the traditional curriculum is supplemented (in some cases supplanted) with inquiry activities. Though the benefits of these hands-on activities are well recognized, the issues remain the same for these approaches. The activities are related to the traditional units and so therefore unfortunately are subject to the same critique as the traditional curriculum.

The approach that I have initiated over the last year takes seriously some of these issues. I have setup a middle-school, physical science curriculum that would be taught within a historical framework. A historical methodology supplies connections

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between disciplines. The rigid disciplinary boundaries of earth science, biology, chemistry, and physics of traditional curriculum are softened and greater emphasis is placed on connections among the sciences and among disciplines generally thought of as outside of school science, such as technology, mathematics, ethics, and social situations. Not unrelated to the implications of research or learning theory is the age-old theme that science teaching should consist of experiences that exemplify the spirit, character, and nature of science and technology. Students should begin study with questions about the natural world (science) and problems about how human beings adapt to their environments (technology).

The historical approach to science curriculum addresses more than just the concepts of science. Curriculum taught within the social and historical context allows students to see the whole of the science enterprise. Achieving the goal of scientific and technological literacy requires more than understanding concepts and processes of science and technology. Indeed, there is some need for citizens to understand science and technology as an integral part of our society. That is, science and technology as enterprises that shape, and are shaped by, human thought and social actions. However, the prevailing approach is to focus on science-related social problems, such as environmental pollution, resource use, and population growth. My tentative curriculum expands these themes to include some understanding of the nature and history of science and technology. Although there is recent and substantial support for this enterprise, there are relatively few curriculum materials. Including the nature and history of science and technology provides opportunities to focus on topics that soften disciplinary boundaries and establish connections between science and other domains such as social studies.

I believe many of the issues that have been articulated in this essay may be addressed by approaches that use the history of science to understand the science enterprise. I have used a series of lesson plans that utilize this approach and begun to outline a full year curriculum. Inquiry skills are in no way being compromised. In fact, doing small, hands-on activities that mimic historical experiments allows students to experience the problems and obstacles of real research. All students can easily respond to historically based science lessons. If they do not take a liking to the content of the curriculum, or to the experimental methodology, they can amuse themselves with the trials and personalities of scientists in writing or oral reports. Lastly, far from being removed from the current desire to address environmental problems, students can trace the line that leads to these problems. This idea was especially gratifying to me in our recent journey into the development of the atom bomb and the subsequent fallout.

Although at this point I have no hard evidence to support this approach to the curriculum, anecdotal stories may be informative. Some student comments collected so far include the following:

> "I like learning about scientists."
> "Scientists have weird families too."
> "I can't believe he wouldn't even talk to women." (Cavendish)
> "So how did they go from neutrons to the atomic bomb?" (Student wanting to investigate further)

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"How did they find out that atoms move around?" (Beginning discussion on Kinetic Theory and Boltzman)
"I thought those old scientists were dumb." (Student coming to see the genius of Robert Boyle)
"I didn't realize there is so much to learn!" (Student reflecting on scientist paper)
"You mean Robert Boyle would have made litmus paper like this?" (Student reflecting on difficulties)
"I still don't get how they came up with the idea of electrons in the first place."

Students, of course, have no basis of comparison but I believe this model is worth pursuing based on general student attitudes. It has made for some interesting conversations as students have presented papers on scientists. It further has allowed an inter-connectedness that has been very interesting to me. Elizabeth the 1st, Galileo, and Shakespeare, who would have thought?