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The Unlearning of Science as Play

My Vexation:

My initial vexation is the difficulty I have encountered with students' understanding and/or acceptance of the concept of student-centered inquiry. I teach a science teaching methods class for prospective secondary teachers and a life science course for prospective elementary education teachers. Over the past few years I have steadily tried to increase the amount of time students practice and reflect upon inquiry; e.g., they practice judging science fair projects, do some guided inquiry research and their own open inquiry project. Nonetheless, when it comes time for the final project, a student-centered inquiry lesson, I continue to get fancy power point presentations, cookbook "hands-on" activities and lessons that expect the children to research answers to a list of teacher generated questions.

I thought I had the solution when I found the article "Simplifying Inquiry Instruction" (Bell et al.) in the October 2005 *Science Teacher*. The verbiage was succinct and good examples were given. What is there not to understand about the statement, "At its heart, inquiry is an active learning process in which students answer research questions through data analysis." While this sets a high standard, I thought it a manageable goal for new teachers. Furthermore, the article described different levels of inquiry and, most importantly to me, examples of the difference between students conducting research by gathering information versus analyzing data to answer their own questions. The most important contribution of this article from my view is that it gives examples of how students might do authentic inquiry (conducting their own analysis of data provided by others) in fields like geology and biology, where traditional experimental manipulations (as in science fair projects) are often impossible or unrealistic.

When I ask my students what inquiry is at the end of the course, some will tell me that "inquiry is learning where students get to find the answers" -- but their lessons indicate that, to them, student-centered inquiry means the students (it is student-centered because the students do the work!!!!) look up the answers (which seems to translate in their minds to researching questions) on their own. My students may have learned the inquiry "talk" but they do not seem to know how to translate this to (admittedly) idealized classroom practice.

As I reflected more on this, I have come to believe that part of the inability of students to implement inquiry as I have tried to help them understand it is that they have absolutely no personal experience with science. Actually I believe they do, but these "authentic" experiences of learning about the world around them, from learning through trial and error which excuses will work for delaying bedtime or not having to clean their room to finding which rocks have cool creatures underneath have nothing to so with science classes and, therefore, are not recognized by students as "science". They have unlearned what E.O. Wilson observed, that "good science consists largely of play disguised as work."

Furthermore, I think this is related to the larger and serious issue of the lack of understanding on the part of the general public as to what science is and is not. The controversies over evolution and other topics might be quite different if the public perceived science as a process not a list of facts.

Is it fair for me to expect students who have rarely (if ever) had inquiry modeled to "get it" in just a few weeks in my class? Even if I have provided them with good models, when they retreat to their computers a few hours before the assignment is due, they oftentimes revert to what they know best: teacher centered instruction and the concept that collecting data is looking up information collected by someone else and using it exactly as they did OR collecting data to verify what you already know (from a book or the teacher) to be true. Have we prepared most K-16 students so poorly with respect to what authentic science is that it is analogous to asking a violin student to play their own multi-part

composition, when their only instruction has been to learn the name of the notes, read histories about famous violin composers and learn to play only a few simple tunes?

My Venture

Closely linked to this vexation of the lack of understanding the nature of science is the question of whether practicing the science fair project format diminishes our student's ability to do inquiry. This perspective was reinforced by a recent conversation I had with a scientist who told me that he was never exposed to the "scientific method" until he was in graduate school. By this time he was totally smitten with his field of study and loved "doing science". He strongly felt that if he had been made to do science following the science fair mode, he would have never have pursued a science career. Unfortunately, I think the science fair model of science reinforces many of the myths that McComas (1996) identified, especially that there is ONE scientific method, that experiments are the principle way to do science, and that good scientists conclusively prove their ideas. It has been ten years since his observation that "instruction in and opportunities to experience the nature of science are vital in preservice and inservice teacher education programs to help unseat the myths of science."

My venture is to bring the play back to science and provide more authentic science experiences to K-12 students and teachers by expanding the Science Olympiad program (which currently only reaches 40 schools primarily grades 6-12) in Utah. Science Olympiad is the only program of its kind to be cited in the NSES standards (NRC, 1995). The Science Olympiad program places an emphasis on problem solving and hands-on, minds-on constructivist learning activities. Additionally, Science Olympiad participants learn to develop teamwork and cooperative learning strategies, since most events are designed for teams of two (a few require three or four). Most importantly, the participants of the state tournament held on campus each year are excited about science -- many experience the thrill of discovering something on their own.

The diverse nature of the types of activities (the main categories are science concepts, inquiry, and application) spread across the physical, chemical and life sciences is one of the strengths of the program as students with different abilities and interests can find success and teachers can incorporate the activities to meet various science core objectives, regardless of whether they compete in a tournament.

Science Olympiad is not without its own problems, including that it is highly competitive and may not always do a good job of making the connection between evidence and explanation explicit. While the popular "experimental design" activity does unfortunately reinforce the "one scientific method" and "doing experiments" myths there are other events that do involve students using data (that students find on the internet, is given to them, or is interpreted from maps) to draw their own conclusions.

The venture plan involves our preservice teachers in a rewrite of certain Olympiad activities to better reflect authentic science endeavors and in an outreach program to schools currently not involved with this program. It also includes establishing summer training camps for students and teachers, practice clinics throughout the year and mini- tournaments throughout the state. As this is no simple endeavor and no small time commitment, I am anxious to hear the advice and ideas of others as I continue to think about how exactly to implement this.