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# ***Technocracizing Science Teaching and Learning:***

## **A Response to Flick and Bell**

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The scene is a "typical" secondary science methods course, and the instructor is in the process of making an assignment for which the students plan and teach a developmentally appropriate lesson incorporating the use of some IBM-based probeware that the university department is piloting. Some students are feeling uncomfortable with the assignment and asking questions, such as

- "Why do I have to design a lesson like this now? It doesn't even fit into the unit I'm teaching."
- "I only have Apple hardware at my school. What am I supposed to do?"
- "I can do a lab on the topic much better without the hassle of the technology."
- "What am I learning by doing this? The school I will work in most likely will not have this equipment anyway."

The instructor for the class responds in a predictably defensive manner, by elaborating on the importance of the preservice teachers' learning about technology and its potential uses. In response to the concerns that most schools will not have access to such technology, the instructor says, "This assignment will give you a good idea of what's out there. So, if you are in a school without good technology, at least you will have some idea of what kinds of things to ask for when money is available. Besides, technology is available and it is here to stay. It is important for your students to become technologically literate."

The situation described should sound familiar. Most of us were educated as teachers at a time when technology was not a major emphasis. Certainly, most of us did not experience much technology beyond microscopes and calculators when we were students, and this has probably been close to what we have experienced during most of our careers as science educators. Regardless of our background experiences, I am fairly confident that any science educator of merit would clearly support whatever is necessary to maximize the teaching and learning of science in our nation's, and the world's, schools. Indeed, although the *National Science Education Standards* and *Benchmarks for Science Literacy* view technology slightly differently (i.e., the latter places a much stronger emphasis on knowledge of technology as an educational outcome), their message is quite consistent with guidelines for the use of technology presented outlined by Flick and Bell. I would like to draw additional attention to several of the five guidelines presented, lest their importance may be lost, as they have in the past.

As pointed out by Flick and Bell, technological advances have become increasingly intertwined

with science and its *progress*. This trend is not likely slow or reverse itself in the near or distant future. What exists is a clearly reciprocal relationship, in which development of scientific knowledge is significantly dependent upon existing technology, while technological advancements often benefit from, or are driven by, the advancement of science. Of particular importance to current reforms in science education is the intimate relationship between scientific inquiry and technology. If students are to experience authentic scientific inquiry during their school years, it is essential that they experience the way scientists do science as closely as is feasible. Naturally, the teachers of these K-12 students will have to have had similar experiences in their science courses and science teacher education courses. How teachers and students experience and learn about technology is often misguided, as portrayed in the methods course scenario presented at the beginning of this paper. Technology is intimately related to how inquiry is done in science, and those interested in the inclusion of technology have much to learn from the mistakes made regarding the inclusion of inquiry as a major theme in science instruction.

As Flick and Bell have so aptly stated, "Technology should be presented as a means, not an end." The same is true of scientific inquiry, although, this fact has not always been acknowledged. In the 1960s, especially within the K-6 science curriculum, scientific inquiry increased its prominence as a component of science teaching and learning. Unfortunately, the focus on inquiry was so strong that it was treated as an end in itself and was often performed in a vacuum. Students learned how to become excellent observers, but knew little about what they were observing. Students investigated solutions to problems—like how to build the tallest free-standing paper tower that could support a raw egg—but learned little science. In short, it was inquiry for inquiry's sake. Students were *doing* science, and it made little more sense than does *doing* technology. Although developing an understanding of science and educational technology, as well as the ability to do science and use educational technology, are important for teachers and students, these artifacts of our culture and humankind are means to an end.

Let us not lose sight of the primary purpose each serves within their respective disciplines. That is, scientific inquiry, in its many forms, is simply the set of approaches and tools scientists use to answer their questions of concern. The scientific technology involved is part of this same purpose. As far as educational technology is concerned, its primary purpose is to improve the teaching and learning of science. If we forget the *raison d'être* of these endeavors during instruction, we are attempting to teach without context, and our efforts are condemned to fail.

In my own laborious way, I am simply confirming the importance of Flick and Bell's first guideline, "Technology should be introduced in the context of science content." The same has clearly been learned from our experiences with the teaching of scientific inquiry. If we remove the context, we also remove meaning and the ability to learn our message in a meaningful way.

Although the idea of teaching skills and knowledge independently with the expectation that the well-intentioned student will apply independently learned skills and knowledge together at a future time may seem sound, it is an intuitive idea with little empirical support. Learning and transfer are both facilitated if students are placed in situations with authentic and relevant contexts.

A few paragraphs ago, I said I wanted to place additional emphasis on several of the guidelines presented by Flick and Bell. Thus far, I have only referred to their first guideline. With little imagination, it should be clear that placing technology within the context of science content quickly leads to, and is necessary for, the subsequent four guidelines. Placing technology within the context of science content, if done effectively, necessitates the use of appropriate pedagogy,

takes advantage of the unique features of technology, makes science more accessible, and sets the stage for the development of students' understandings of the relationship between technology and science. Without the context provided by science content, none of these remaining guidelines can be realized.

In the end, the only context to be avoided is a vacuum. Doing science and doing technology is not inappropriate, as you may have inferred from some of my previous comments. What is inappropriate is doing science or technology without a meaningful context. Without a science context, inquiry is meaningless. Without the context for which technology was created (scientific or educational), technology is meaningless.

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