

Hands-on: A Means to an End

I doubt that there is a more popular term in science education these days than "hands-on." It is overwhelmingly the adjective of choice for labeling science courses, curriculum frameworks, and learning materials. Imagine, for instance, the fate of a proposed new science course that proudly claims that it consists mainly of reading books and listening to lectures.

The term hands-on is so widely used now that it is hard to believe that it is something of a newcomer. It first surfaced in the late 1960s meaning to learn how to use a computer by actually using one—hands-on the keyboard, as it were. Although the computer people coined the term, the idea of learning by doing is an ancient one in the arts and crafts, and it has become a mark of good teaching in science and math.

Defining Hands-On

In science education, for example, hands-on quite literally means having students "manipulate" the things they are studying—plants, rocks, insects, water, magnetic fields—and "handle" scientific instruments—rulers, balances, test tubes, thermometers, microscopes, telescopes, cameras, meters, calculators. In a more general sense, it seems to mean learning by experience. As we put it in *Science for All Americans*:

...students cannot learn to think critically, analyze information, communicate scientific ideas, make logical arguments, work as part of a team, and acquire other desirable skills unless they are permitted and

encouraged to do those things over and over in many contexts.

Hands-on and learning by experience are powerful ideas, and we know that engaging students actively and thoughtfully in their studies pays off in better learning. But before declaring rhetorical victory over the forces of darkness and moving on, let me express a concern. Why is it, given this apparent commitment to hands-on learning, there are so many science classrooms in which textbooks and rote learning are the order of the day?

Could it be that our commitment is not as deep as we would like to believe, or that we mistake the frequent repetition of the catch phrase for the action itself? Possibly. But a more likely possibility, I suspect, is that so few teachers have had the opportunity to develop the needed skills. In their own education, school and university, they did not themselves *experience* hands-on learning, and their teacher training did not make up the difference. Moreover, hands-on learning takes time—and the pressure to get on with the overstuffed curriculum discourages many teachers from taking that time.

Applying Hands-On

The other side of the coin is that there are teachers who feature "hands-on" but use it inappropriately. Because hands-on has so many evident advantages, it has become pretty nearly sanctified, and there is little inclination to question, let alone challenge it. Shouldn't we ask ourselves such questions as: What conditions must exist

for hands-on to work? Considering that time for learning is limited, is hands-on always the best option? What tradeoffs are entailed? When is learning by doing too inefficient? How can we be sure that activity for its own sake does not displace thought?

Part of the trouble we have in answering such questions is the tendency to treat hands-on as an end in itself instead of as a means to an end. In education, we have to make decisions on what we want students to learn and on what methods to employ to bring about that learning. What students learn depends on both kinds of decisions, but they are not interchangeable. Project 2061 has tried to preserve the distinction between ends and means and focus first on ends. The primary purpose of *SFAA* and *Benchmarks* is to specify desired outcomes of schooling.

Both reports also comment, however, on means for achieving the specified outcomes. *SFAA* describes, in Chapter 13, the principles of learning and teaching we believe in, and *Benchmarks* surrounds its specifications of goals with commentary on how to reach them. There is no question that both documents place heavy emphasis on hands-on learning (without, however, much use of that phrase itself). As we develop them, curriculum blocks and models will incorporate the best of hands-on learning to assure optimal achievement of science literacy. ■



F. James Rutherford
Director