

LETTERS

Professional Development Is One Part of Science Education Solution

Much of the wonderful work on K–8 science education reported by Ramon E. Lopez and Ted Schultz (PHYSICS TODAY, September 2001, page 44) will be wasted, I'm afraid, unless greater emphasis is placed on training and supporting teachers.

Not long ago, in an affluent suburb known for its excellent schools, I helped my son's fourth-grade class with a unit on pulleys. The students were to measure the weight required to lift a standard load and the distance the load rose, using one, two, and three pulleys. It sounded straightforward. But the pulleys had a lot of friction and were not light compared to the load. Neither the students nor the teacher realized that the distance needed to be measured from the load's initial height, not from the floor; and no effort was made to keep the strings close to vertical. With attention to these details and judicious use of some oil, we obtained reasonable results, and had a good discussion about what they meant. Apparently that had not happened before. Another teacher who saw the results on the blackboard was astonished to see patterns that actually made sense. I can only imagine the impression of science that this unit had left on previous classes.

In other subjects, these talented and experienced teachers had no trouble improvising, identifying and solving problems on the fly, and helping students understand what they were doing. But in science they were adrift, and the kids could sense it. Teachers need help. At a minimum, every elementary school should have a full-time science specialist. In my son's school, that position had been eliminated to fund a computer room.

ROGER G. TOBIN
(rtobin@tufts.edu)
Tufts University
Medford, Massachusetts

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LOPEZ AND SCHULTZ REPLY: Roger Tobin illustrates quite well what can go wrong in science education. Teachers must have both the scientific and pedagogical content knowledge to teach science effectively. But good professional development is not enough. Tobin also has put his finger on two other essentials.

First, good instructional materials should not suffer the kinds of design problems Tobin indicates, and they should come with a teacher's manual that makes clear the nature of the measurements and the physics underlying them. Good materials should also not be isolated, however good their "gee-whiz" features, but should be part of an extended investigation that will lead to a deep understanding of the science and will enable students to develop increased skill in actually doing science.

Second, to implement such a program, understanding and support must come from both the administration and the community. Tobin's involvement in the classroom seems to have been key to a successful outcome in the case he reports. This is a good example of why scientists must be involved in science education.

As we discussed in our article, not only are ongoing professional development, good instructional materials, and administrative and community support essential, but so are a system for supporting the materials and an assessment program aligned with the curriculum. Only when these five elements are in place has a school system undergone what we believe to be a systemic reform that is likely to mean a good and sustainable science education program.

RAMON E. LOPEZ
(relopez@utep.edu)
University of Texas at El Paso
TED SCHULTZ
(schultz@aps.org)
American Physical Society
College Park, Maryland

In his letter "Educating Students to Appreciate Physics" (PHYSICS TODAY, October 2001, page 11), Stewart Brekke makes excellent points about developing high-school physics courses that are more "user-friendly."

There is no curricular magic bullet for motivating students, but there is a magic gun—high-caliber teachers like Brekke. An enthusiastic and knowledgeable teacher inspires students to go where they've never gone before, leaves them yearning for another trip, and usually manages to avoid being too limited by course materials or administration.

We don't usually remember our textbooks or the flow of a course that we took. We do often remember our teachers, and may strongly identify the subject they taught with that memory. True, some students are inspired entirely from reading texts and find the teacher nearly irrelevant, but those are a small minority, probably well-served by existing resources.

Writing a finely tuned curriculum can be a validating experience for an inspired teacher, but once the product is adopted, it often ends up serving inflexibly as a crutch for poor teachers and a constraint on good ones. We certainly need competent texts and solid curricula. But the greater need—and the greater challenge—is to develop teacher training that requires really learning the technical subject matter and demands good skills, both teaching and interpersonal. Another important requirement is to filter out those without a spark for teaching before they become protected by a tenure system that is the envy of most other professions. Then we can deal with how much teachers get paid and how burnouts should be handled in a tenure system.

STEVEN BITTENS
(sbittenson@odysseyconsortium.com)
Odyssey Consortium
Bedford, Massachusetts

Physical Truth Without the Relatives

Daniel Kleppner writes, in the March 2001 issue of PHYSICS TODAY (page 11), "Nevertheless, essentially all physicists share certain beliefs" and then lists several key articles of faith. I commend Kleppner for pointing these out and
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