More Than Texts Need Reform in Middle Schools

In his PHYSICS TODAY article (May 2003, page 50), John Hubisz discusses the results of a review of middle-school science texts. I read the Hubisz report[1] when it first came out. The basic premise was accurate; opening a random textbook to a random page was about all it took to find several mistakes.

But has Hubisz done recent homework to check for signs of change? In particular, has he looked for improvement in the textbook selection process in large, influential states? In 2000, California made significant strides toward improving texts.

Hubisz writes, "Publishers aim to satisfy the committees that select texts, even though the members of those committees typically have little knowledge of physical science." My husband, an excellent chemistry teacher, chaired the California Curriculum Commission's science subcommittee and oversaw California's last science book adoption. Every submitted textbook was read first by a content review panel composed of three people, each with a terminal degree in science. Texts were then reviewed more thoroughly by committees of teachers and others. Although a few errors remain in the books that survived to adoption, those errors are much fewer than in previous texts. Some errors persist because of time demands on reviewers and the need to provide teachers and students with tools to meet California's demanding content standards. For the review criteria used, see reference 2.

Yes, texts need to be improved, to become more accurate, more interesting, and less disjointed. Yes, well-crafted laboratory activities need to be encouraged. But more has to happen before all children get a good science education. An important step is to make sure that students can read well enough to take meaning from those texts. Many can't now, but research-based reading interventions are being developed and implemented. And then the education system will have to deal with pesky student deficiencies in math. These areas especially need improvement if students are to understand and appreciate science.

Another reform that is badly needed, particularly at the middle-school level, is to improve teachers' science content mastery. Even decent books can be undercut if science-ignorant teachers design their own "innovative" lessons. A couple of years ago, I watched students in an eighth-grade class, with their newly adopted textbooks pushed to the side, do an exercise about molecules. The assignment was to take a chemical formula—for example, Fe_2O_3—and design and color a fanciful molecule based only on the students' artistic vision. One might argue that eighth grade is not the right time to introduce the details of bonding and molecular geometry, but a teacher who knew such things would never have caused students future confusion by assigning this counterproductive exercise.

The problem is multidimensional, and yes, physicists and other scientists should get involved.

References

1. J. L. Hubisz, *Review of Middle School Physical Science Texts*, available online at http://www.psrc-online.org/curriculum/book.html.
2. California State Board of Education, *Science Framework for California Public Schools, Kindergarten Through Grade Twelve*, California Department of Education, Sacramento, Calif. (1990), p. 300. Relevant section is available online at http://www.cde.ca.gov/cdepress/science-framework/science-framework-pt7.pdf.

Martha Schwartz
(mischwar@usc.edu)
San Pedro, California

Letters and opinions are encouraged and should be sent to Letters, PHYSICS TODAY, American Center for Physics, One Physics Ellipse, College Park, MD 20740-3842 or by e-mail to ptletter@aip.org (using your surname as "Subject"). Please include your affiliation, mailing address, and daytime phone number. We reserve the right to edit submissions.

Congratulations to John Hubisz on his fine article and especially for his Herculean efforts to improve an area of our educational system in which our failure has such serious consequences. I am especially dismayed at the preponderance of textbook errors because my twin daughters will be starting middle school in the fall.

The textbook errors Hubisz reports are indeed remarkable. He also emphasizes the importance of precise language, but language adopted by the physics community contains an interesting dilemma: an apparent distinction between law and theory. Is Newton's law of universal gravitation more fundamental than Einstein's theory of general relativity? This is not merely a semantic distinction, as is evident in the debate over evolution: It is, after all, "only a theory."

The call for physicists to take action is quite appropriate. However, one important component in the equation seems conspicuous by its absence from his discussion. Education colleges, by and large, have not been engines for real educational improvement. In our department, we have had to turn away students who were interested in pursuing graduate degrees in K–12 physics education; our college of education provides future teachers with teaching pedagogy but not physics.

It seems that the only long-term solution for the declining interest in and knowledge of science in the public schools lies in reforming teacher education. Physics departments need to play a significant role in that reform.

Kimball A. Milton
(milton@nhn.ou.edu)
University of Oklahoma
Norman

Among the many well-taken points in John Hubisz's article was one less compelling. In box 1 of the article, the answer to the oft-heard lament "Is it too much to ask that middle-school students develop the habit of consulting a dictionary?" should be "yes." Learning science is sufficiently challenging without continual interruptions, and even more difficult is to know what you don't know: Many physics words and names have idiosyncrasies of which young students can hardly be expected to be aware.

Adding pronunciation keys to the difficult words is a practice that might fruitfully be followed by textbook publishers. A few diacritics don't take up much space and don't detract from sentence flow or meaning, but do give the reader a frisson of distinction—that physics words and names are interesting and different! How better to convey the international scope of the physics enterprise than to teach students that "Planck" is pronounced differently from the experimental apparatus for determining mechanical advantage? Pronouncing words and names as if they were English sets students up for embarrassment.

I experienced such discomfort the first time I said "heterodyne" out loud in front of people who were experienced enough to know which syllable got the accent, but were insufficiently genteel to correct me privately. If students are embarrassed whenever they talk physics, they may be driven to philosophy and spend their days pondering So-crātes.

Richard Factor
(rcf@eventide.com)
Eventide Inc
Little Ferry, New Jersey

John Hubisz presents an excellent and important review article. The involvement of physicists as volunteers in K–12 classrooms is only briefly mentioned as a solution to science education problems, but is critical in ensuring that all students receive a quality science education.

Textbook and teacher-training reform are necessary, but such slow processes will only show results in the long term. By volunteering in classrooms, physicists can help children learn science today. In close, continuing collaborations with teachers, physicists can help improve teacher self-confidence and easily dispel misconceptions raised by textbook errors. I've had the experience of visiting the same class for several years; the teacher, students, and I have all benefited enormously.

Douglas L. Ratay
(doug@astro.ufl.edu)
University of Florida
Gainesville

The article by John Hubisz caught my eye. I found the examples of textbook errors and misstatements amazing and frustrating. The example he gave of a textbook's confusing the terms speed, velocity, and acceleration tells me the textbook writer doesn't come close to knowing the subject. Someone might ask if it really even matters outside of science. I'll illustrate with a quick, real-world example.

Several years ago, I was an expert witness in a very lengthy lawsuit about a worker who was severely injured when a truck at a paving site backed over him. I was involved because of my background as an acoustical engineer. I dealt with the audibility of the backup alarm and how the sound field was distorted by the manner in which the alarm was installed.

Toward the end of the many depositions (there were five teams of lawyers), an attorney who was working hard to discredit my conclusions asked if I'd measured the wind speed when I did my testing at the site. I answered yes. He perked up and dug out an old transcript. He asked if I remembered testifying on a particular date, when he had asked me if I had measured the wind velocity and I had said no. He obviously thought he had me on something.

I asked to read the testimony page in question. "What's the problem?" I asked. "Both answers are correct." None of the lawyers understood, so I explained: "Speed is a scalar quantity. Velocity is a vector; it has two parts—magnitude or