THE FEYNMAN EFFECT AND THE BOON DOCS

Albert A. Bartlett

Richard P. Feynman, one of the all-time great teachers of physics, was memorialized by his friends and colleagues in a special issue of PHYSICS TODAY (February 1989). In that issue my attention was drawn to the article by David L. Goodstein (page 70), and in particular to the following:

> In all those years, only twice did he teach courses purely for undergraduates. These were the celebrated occasions in the academic years of 1961–62 and 1962–63 when he lectured ... on the materials that were to become *The Feynman Lectures on Physics*.... As the course wore on, attendance by the kids at the lectures started dropping alarmingly, but at the same time, more and more faculty and graduate students started attending, so the room stayed full, and Feynman may never have known that he was losing his intended audience.... The lessons in physics he prepared, the explanations of physics at the freshman level, weren't really for freshmen, but were for us, his colleagues.... It was more often us, scientists, physicists, professors, who would be the main beneficiaries of his magnificent achievement, which was nothing less than to see all of physics with fresh new eyes.

Let us define the Feynman effect as directing one's teaching toward colleagues when one is supposed to be focusing on freshmen. This situation arises when one allows one's pedagogy to be guided by the perceived standards of one's professional peers rather than by a realistic understanding of the needs of society and the abilities of one's students. A manifestation of the Feynman effect is seen in the texts we choose for our introductory physics courses. The more advanced and modern the text, the better our colleagues will think our course to be. If they think we are teaching a better course, we can reasonably expect that the academic reward system will recognize this. But as our introductory courses become more intensely professional, we lose the interest and attention of those for whom the course is a requirement and we experience a decline in the fraction of those who opt to take these courses. We communicate with fewer students, although they tend to be the better students.

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The 27 February 1989 issue of *Newsweek* arrived a few days after the Feynman issue of PHYSICS TODAY, and one article caught my attention: "Help Wanted: Boon Docs; Some Small Towns Are Desperate for Medical Care." The sad fact recounted in the article is that doctors don't want to practice in rural areas:

> The shortage of health care has been a fact of life in the prairies for decades, but the need is reaching crisis proportions in many rural areas.... Fully one-quarter of the US population and a third of its elderly live in rural America, yet only 12% of the nation's active doctors work there.... A recent study ... predicts that the number of rural practitioners could drop by 25% within the next five years.

The decline of rural medical care is closely parallel to the nationwide decline in science literacy. Both declines seem to be rooted in longstanding attitudes of our faculties of medicine and physics. In physics we feel that our colleagues would frown on us if we were to devote our professional energies—or were to advise our students to prepare to devote their professional energies—to anything as mundane as the battle against science illiteracy. So we advise our students to specialize and to work on the most advanced and exotic enterprises. The Feynman effect is at work, because the words we say to our students are the words we would like to have our colleagues hear us say.

In our classes we fancy that we can teach college freshmen about the forefront of physics—the concepts of quantum mechanics and particle physics—with the elegance and clarity of Feynman. And so the nice Newtonian physics, the exciting elements of electricity and magnetism, and the thrills of thermodynamics are declared to be dull and drab. These concepts are centuries old; they can be skipped. We purge Pascal's principle so that our pupils can ponder the principles of parity. We are sure that whether or not we succeed, our efforts will impress our colleagues. We seem not to care about what students learn in physics. In doing this we may give our students the "illusion of knowledge," which the historian Daniel Boorstin refers to in these words: "The great obstacle to progress is not ignorance but the illusion of knowledge."[1]

Here is the supreme irony. We proclaim our profound concern about the widespread decline of science literacy, while simultaneously we remove from our introductory courses the elements of classical physics that must be regarded as essential in any measure of science literacy.

It seems reasonable to suggest that medical care in the underserved areas of America would be improved significantly if we could bring to those areas the medical care of 60 years ago. In the same way, the science literacy of the public would be enormously improved if we could achieve a widespread understanding of the physics of 60 years ago. Science literacy is not achieved by giving a tiny fraction of our population a passing acquaintance with a litany of facts about quarks and quantum mechanics. It is achieved by giving people an understanding of the science they see and can use in their everyday lives.

If we are to have any success in improving science literacy, we must transform our introductory physics courses so that they obviously relate to the world our students see around them. Theirs is a profoundly classical world, crudely and imperfectly perceived. The starting point for our introductory courses must be student perceptions rather than faculty perceptions. We must not imagine that we can make clear to freshmen in 50 minutes those things it took us a lifetime to learn. We must relate to the world of the average student. This is not the world in which we first learned physics; our aptitudes and interests marked us as very special students.

It is ironic that the Feynman effect and the subsequent escalation of the levels and content of our introductory courses lead inevitably to more reliance on "fact stuffing" and less reliance on understanding. The Feynman effect, as practiced by Feynman, was profoundly constructive because colleagues came to hear him lecture. But we are lesser people. Only our students hear us.

It seems clear that the physics and medical professions have followed similar policies with similar results: We have left a large fraction of Americans without adequate health care and without science literacy. We need to balance our priorities. Every time we ask Congress for a dollar for the Superconducting Super Collider or for the space station, we should ask for a matching dollar to be used to improve science literacy at the grass roots level. Every time the medical community calls for a dollar for mapping the human genome, it should call simultaneously for a dollar to be used to bring better medical care to underserved Americans. Every time we request a dollar for the development of courses for students in the top 0.1% of the ability spectrum, we should request at least $999 for programs for the other 99.9% of the population. We should show as much interest in educating all Americans as we show in educating future Feynmans.

As our lectures become more abstract and advanced, the attendance at our lectures continues its depressing decline. The faces of those present seldom light up with the glow of understanding. No one seems to notice the growing gap between the erudition of our expositions and the abilities of our acolytes. We don't see that in losing a broad audience, we are ultimately eroding our base of support among the American people. And we fail to recognize that we are not all Feynmans.

References

1. D. J. Boorstin, The Key Reporter, Winter 1988–89, p. 6. ■