Because Wisdom Can't Be Told:

Using Case Studies to Teach Science

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Who doesn't like a good story? Teachers and parsons have used them to perk up their students and parishioners from time immemorial. Stories capture our attention, entertain us, stir our emotions, and expand our visions. Preachers use them for moral persuasion, comedians to tickle our funny bone, and teachers as exemplars of good practice.

The formal use of stories, called case studies, was introduced into Harvard University's law and business schools around a hundred years ago. Professor Charles I. Gragg extolled the virtues of the method sixty years ago in an article with an eye-catching title (to which this article's title pays homage), "Because Wisdom Can't Be Told." The title itself emphasizes the truism that simply lecturing students about a subject hardly ensures that they will remember anything at all. The medical profession has known this for a long time. They have always used case studies to instruct their interns and residents with "war stories," but the whole process wasn't formalized until thirty years ago, when McMaster University introduced the storytelling method, Problem Based Learning (PBL), into their medical school curriculum. Today case-based teaching has gone well beyond these graduate programs, especially in science and engineering.

Two groups are arguably responsible for most of the excitement: the University of Delaware and the University at Buffalo-The State University at New York (SUNY). Both institutions have been the grateful recipients of generous grant support from the U.S. Department of Education, the Pew Charitable Trusts, and the National Science Foundation (NSF) for the past decade. The University of Delaware has enthusiastically promulgated the PBL approach across the country and urged its adoption in every undergraduate discipline on campus.

We at the University at Buffalo have been less eclectic. Mindful of the surveys that claim that most U.S. citizens are scientifically illiterate and that there is a disastrous loss of student interest in science throughout the secondary and college years, we have focused our attention on these problems. And we personally know some shocking statistics about introductory science classrooms at large universities. It is not uncommon for 30 to 40 percent of the students to receive Fs, Ds, or withdraw. This statistic seems to be true regardless of the skill of the instructor. Not surprisingly, attendance in these courses is also terrible. Even fine lecturers often end up with less than 50 percent of their class present. Can this situation be completely the result of the immaturity of the students, their lack of motivation, or the fact that many of them work long hours outside of the classroom? Is none of it our fault? Many faculty seem to act as if it is beyond their control. But is that true?

I am especially fond of the sentences uttered by the Swiss developmental psychologist Jean Piaget: *"At one time every teacher ought to have been an animal trainer. When the animal doesn't do the trick, you don't blame the animal. You blame the trainer."* And change the method of training, of course.

Changing the Training

There are lots of ideas about how to change the training. Most of them involve active learning—getting students to *do* something rather than passively receiving wisdom. Our approach at the University at Buffalo has been to capitalize on the inherent interest that is sparked by stories. Not stories simply for entertainment but "stories with an educational message." Of course, the stories can be told in a number of different ways:

through lectures (such as when I give a lecture in the first person as Charles Darwin); as a written story, video, or movie with a discussion following—the method treasured by business and law schools; as a PBL problem, which can be presented to small groups of students; or even through one-on-one discussion, with a professor sitting on one end of the log and the student on the other. All these case-study approaches are important alternatives to the standard lecture. And we vigorously proselytize all who will listen. We have a national Web site supported by NSF where several hundred cases and teaching notes are posted (http://ublib.buffalo.edu/libraries/projects/cases/case.html). We hold workshops and conferences and distribute cases in publications such as the *Journal of College Science Teaching*, which runs a regular column and has an annual issue completely devoted to cases across all fields of science.

Teaching with cases rather than lectures places different sorts of demands on both teachers and students. When you give up significant control of the classroom and actually let the students talk, who knows how the conversation will turn out? And how will you grade the students? Such questions can make anyone anxious. It is understandable if faculty approach the new methodology with some trepidation and skepticism. So, it is important to highlight some of the things that we have learned about this new approach:

- The story of a good case study should be based upon real events, have engaging characters, include dialogue, be short, and have relevance to the students' lives. And it should be a "dilemma case," which means it involves decisions that must be made by the characters and students. Ideally we want a case that engages students in the same way that a detective story does. One that mimics the kind of critical thinking that all scientists must do. Scientists often must reach tentative conclusions on the basis of incomplete information and then be willing to modify those conclusions as more data become available.
- Case method teaching causes attendance to soar. Even in large classes, attendance has approached 100 percent in our experience with this method.
- Students' positive attitudes toward the subject matter increases. Most students report they love learning the material in context, something that the lecture method seldom accomplishes.
- Most students enjoy working in teams, but it is important to establish clear guidelines to ensure there are equal contributions from all students.
- The instructor cannot usually cover the same amount of material as in a lecture, but students retain what is covered better. The lecture method produces students who seem to forget material almost immediately after the final exam. Students who have been taught using cases perform just as well on standardized exams as students who are instructed by the lecture method, but they perform much better on essay exams where higher-level thinking skills are required.

Survival of the Fittest?

Most students indicate that they prefer learning with the case study method; nonetheless, about 15 percent of students still favor the lecture method, even when they have had a positive experience with cases. And those students are in good company—after all, most readers of this article are survivors of the lecture method and may never have experienced anything else in the science classroom. It is a Darwinian educational system that we have produced. Most students do not survive the process of learning science, therefore they go on to other fields. However, even in the face of mounting evidence of its ineffectiveness for masses of students, we survivors of the lecture method are reluctant to abandon our old friend. We seem to be the exception—ones to whom *Wisdom Can Be Told*. But we are few in number, and we have a much greater obligation than to our limited numbers. Transforming the science classroom is not beyond the faculty's control. Through the use of PBL techniques, such as teaching with case studies, we can engage students, provide them with the means to learn how science works, and help them recognize the relevance of science to society. ■

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