

LETTERS

Methods for teaching traditional physics

Enbang Li, in his letter "Teaching traditional physics in a rapidly changing world" (PHYSICS TODAY, February 2016, page 10), has rightly stated that one of the main challenges of teaching electromagnetism (EM) is its heavy mathematical machinery, which many undergraduates find quite abstract. However, in my experience, delivering the main concepts of EM does not require reliance on mathematics.

I have been teaching EM theory for the past four years, and the last time I taught it, I used the Socratic or discussion method, with good results. The students showed an increased interest in reading in general, and they actually tried to understand concepts rather than studying for exams. Many became quite

comfortable with EM, a great achievement since the course is traditionally considered to be difficult. I also found that students were applying the concepts they'd learned to things they experienced every day.

Instead of writing and solving equations, the students engage in a more intuitive discussion of the main concepts and their relevance to natural phenomena and the applications and devices that we use regularly. Here are the main points of how I teach by the Socratic method:¹

- Start the class with an interesting, relatable, and answerable question.
- List all the students' answers and discuss them broadly for a few minutes. If students have missed a crucial answer, give them hints that lead to it.
- From the list of answers, pick those directly related to the particular topic and continue the discussion.
- Gradually introduce concepts by asking thought-provoking but not difficult questions. If necessary, give the students additional clues. If the method is done well, students will pose questions, other students will answer them, and the teacher effectively becomes a moderator in a panel discussion.
- Do not try to finish a set amount of material during each class. Discuss only as much as the students can understand.

The approach also fosters a deep sense of connectivity between scientific concepts and our own perception of reality. I urge all physics teachers to give the method serious consideration.

Reference

1. For further information, see https://docs.google.com/document/d/1eSMp0ul_uhADA_SJw_b3PkkYwQJQdhr_pJemH2SU4/edit?usp=sharing.

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Teaching in a developing country

I had just returned from six months in Rwanda when I read Barry Sanders's Commentary "Asked to speak in a developing country? Say yes!" (PHYSICS TODAY, April 2016, page 10). My experi-

ence is much more limited than that of Sanders, but I fully agree that undertaking a teaching assignment in a country such as Rwanda can provide a unique opportunity for both the students and the lecturer.

I had the fortune to be a Fulbright Scholar at the College of Science and Technology at the University of Rwanda, where I taught undergraduate quantum mechanics. I had a class of 21 third-year students composed of 15 men and 6 women.

The students lack many of the resources that those in the West take for granted. Only four of my students owned computers; in fact, computer access on campus was very limited. That in itself was problematic, but less so than a range of cultural issues that created barriers between student and teacher. Creative thinking, individuality, and class participation do not seem to be elements that are stressed in the Rwandan educational system—although attempts are under way to change that. English comprehension was also an issue. Rwanda changed its official language from French to English in 2008, and my students had about half of their education in each language.

It quickly became clear to me that conventional teaching methods would be less than effective. By proceeding at a much slower pace and allowing students to converse among themselves, I found that they began to gain confidence, ask questions, and even come to see me during office hours. By the end of the semester, the students were proud to have succeeded in a subject as difficult as quantum mechanics. My interactions with them, and all the contacts I made with Rwandans throughout the country, have affected me in ways I could not have imagined. Hopefully, the students were also left with a positive lasting impression of our time together.

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