Teaching Philosophy
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Physics

As a child, I loved collecting coins. While my everyday life now is rather removed from numismatic endeavors, I am often surprised by my enduring knowledge about and interest in the subject. Despite the fact that I had no teacher and completed no formal course of study, I managed to learn a lot about coins and their respective histories based on curiosity alone. I believe that the most important ingredient in learning is the student’s interest and excitement in the subject. Since a student’s passion for a given subject may not be innate, an effective teacher must inculcate his pupils with a genuine sense of enthusiasm for the material. Once the students develop an interest in learning the material, my jobs as a teacher are to clearly and logically present the relevant concepts and information and to get the students actively involved in the subject and culture of the field.

While most people’s minds jump to falling apples or wild hairdos when they think of physicists, I find that many people recall their own experiences with physics in less than flattering terms. This attitude always confused me; how could someone dislike a subject that simply attempts to explain the physical world that we all live in? That is when I realized that what most people took away from their class in physics was a memory of doing math or memorizing equations rather than a realization that the world can be quantitatively understood, and that that understanding can be used in amazing ways. To avoid this error, I take a “punch-line first” approach where I begin lectures with examples of how the forthcoming lesson shows up in ‘real-life’ or how it fits into the bigger, current-day picture. For example, who would not want to learn about dipole radiation patterns when they know it holds the answer to why the sky is blue? I certainly recognize that physics, for many people, is an altogether new beast because it represents a novel combination of mathematics and science; by prioritizing physical results over mathematical derivations, I attempt to drive home the notion that physics is both relevant and ubiquitous.

Once the students’ interests are piqued, it is time to give them what they want: knowledge. I have found that, just like in computer programming, it is more efficient to pre-allocate memory before trying to write data when it comes to teaching. The way that I do this in the classroom is by developing a clear and logically-organized syllabus and course outline so that the students can construct a mental framework on which to store the concepts covered in class. In addition to organizational issues, building a closed-loop course environment with plenty of feedback ensures that instructor, students, and curriculum stay in sync with one another. I typically contact students in my class before the start of the semester to get a sense of their majors, goals, and reasons for taking the course so that the course can be relevant to its audience. Also, I solicit anonymous student feedback and comments throughout the semester as well as regularly invite other instructors to sit in on my classes. The information that I receive through these two channels allows me to alter and improve the course in ‘real-time’ as well as refine my teaching style.

My teaching methodology takes a cue from the wisdom of academia’s tenure-track process; just as aspiring professors must engage in education and scholarship in order to solidify
their positions, so also must students teach and experiment in order to gain purchase in the field. With regard to the role of teaching, I have often heard educators note that they never understood a subject as well as when they had to teach it, but I rarely hear this introspection followed to its logical conclusion: the best way for students to really learn and own a concept is to have them teach it. The two best targets of students’ teaching are themselves and their classmates. I find it useful to assign pre-class online assignments, which forces the students to look at and think about the material ahead of time as well as informs me about their initial misconceptions. This makes the in-class instruction more useful, and helps them mature as independent learners.

Opportunities for peer instruction, on the other hand, can be equally beneficial because the students must reflect on and summarize the concepts in order to communicate them to others. While this can sometimes be accomplished through encouraging small group discussion during classes, I have noticed that a particularly useful forum for peer instruction is in problem solving sessions. As a TA, instead of running ‘standard’ office hours (where students individually show up to ask me questions), I held problem sessions where all students were encouraged to attend and work with one another in small groups on the assigned problem set. Giving the students a chance to think through a concept with others who are grappling with similar problems (rather than always appealing directly to an instructor who has the ‘right answer’) is an invaluable way for them to hone problem-solving techniques.

Beyond simply talking and thinking about physics, students must actually do physics for it to truly mean something to them. In addition to the fact that there are technical skills to learn, realizing that science is an iterative process of hypothesis and verification is crucial to developing the mentality that a physics education attempts to engender. While course-based physics labs serve to illustrate to students the validity of a given theoretical model and allow them to practice scientific writing, I find that the cookbook-like nature of such experiments limits the real usefulness of such an experience. I prefer to assign either individual or group-based research projects that require the students to design, carry out, and interpret an experimental or numerical investigation on a salient subject. Beyond the classroom, having students conduct independent research (whether it is new to the world or simply new to them) is a great way to engage them in the process of science. Through my experience helping to mentor an undergraduate student for a year and a half as she learned about lasers, cooling and trapping atoms, and ultimately built a magneto-optical trapping system from scratch, I realized that forcing students to think about which problems they want to work on and why can be much more useful than simply how to solve them.

Overall, I see my role as teacher as twofold: transferring knowledge to my students, and acting as ambassador for a whole field and culture. In the same way that language classes attempt to introduce students to the beliefs and practices of the language’s speakers, science classes introduce students to the language and customs of science. As I teach my students about one particular topic or another, I hope to demonstrate how and why science is done and, in doing so, open their eyes to the same wonder and excitement with which I view the world.