Teaching Philosophy

Matthew R. Argall

Teaching is an occupation of service; it supplies the public with their need for knowledge. However, not all needs are the same, and universities cannot fashion majors to meet all needs. It is up to the professors, then, to be aware of their students' ambitions and of the job market in order to prepare students for their futures. This service, so far, has led me to teach introductory physics and English as a foreign language. I enjoy the challenge of guiding each student to their potential and adapting lessons to provide tools to benefit them down the road.

Student success depends on how solid the foundation of their education is. Bloom's taxonomy is a set of learning behaviors that students express as they progress from rote learning to creative thinking. . When teaching, I start from the bottom of Bloom's taxonomy and work my way up by first breaking advanced topics down into core principles.Even if a topic is a small extension of previous knowledge, the brain needs to establish synapses between concepts in order for new material to become robust, long-term working knowledge. As an example, in the electronics portion of introductory physics classes, Kirchoff's rules are used to simplify complex circuits. Before challenging students with advanced problems, I have them solve a progression of problems starting with simple series and parallel circuits, followed by combination circuits found in household items, and finally they build a custom circuit using any combination of series and parallel components. In this way, students advance quickly through each stage of learning, thereby creating knowledge networks without skipping crucial steps along the way.

Professors have a lot of liberties when designing their classes. It is unfortunate for students when the classroom is used only to reiterate what is written in the accompanying textbook. In my classes, I extend the textbook material to real-world situations. One example begins with the Lorentz force equation that introductory physics students learn in their second semester. With a little bit of reasoning and the right-hand rule, students work out the equation for the electric drift velocity and the associated particle motions -- a topic typically covered in year three or four. From there, they are introduced to the Electron Drift Instrument, a measurement device onboard the Cluster and Magnetospheric Multiscale satellite missions that uses the electric drift motion to measure the electric field in space. Students visualize and annotate particle motions in electromagnetic fields, reinforcing the theoretical equations offered in the book. When finished, I show EDI data from the satellite missions to provide an interesting take-away point.

Everyday experience and natural instincts can build misconceptions that stand in the way of true comprehension. Newton's second law states that objects in motion will stay in motion unless acted upon by an outside force, yet without being able to see invisible forces like friction, our everyday experience tells us that all motion eventually stops. To make learning gains, misconceptions must be rooted out and addressed. The same is true when teaching a foreign

language. While teaching English in Costa Rica, I was not allowed to use the students' mother tongue. Instead, I was forced to teach new words and phrases to students using vocabulary and grammar structures they did not understand. The only way to connect with them was to elicit answers from the students using gestures, diagrams, and other tricks in a way that turned the students into their own teachers. A major challenge was that the students had spoken Spanish, which has different grammar structures from English, their whole lives. Breaking bad translation-related habits required immediate feedback and correction so that context was not lost. To break physics students of their bad habits, I apply the same strategy: identify preconceptions by eliciting answers, provide immediate feedback when necessary, and accompany mathematical concepts with easy-to-digest diagrams and demonstrations.

We also need to ensure that students are learning skills that will give them an advantage once in the workplace. Physics degree programs require students to take cross-disciplinary classes in, for example, computer science and English. However, the introduction to computer programming they receive is often a far cry from the type of scientific programming skills they need to develop in their own discipline. Furthermore, one semester of writing does not prepare them for the sheer amount of writing in their futures. This is why I incorporated scientific programming and writing assignments into my introductory physics course. I provided program templates that students modified to investigate subtle details of their homework assignments. Students expressed gratitude toward learning MATLAB (a language used in math and engineering), as they knew it was an important workplace skill. For an extra credit writing assignment, students picked a physicist and researched his or her physics family tree. The goal was for them to write a human interest style article and hopefully gain a new perspective on physics. One geology major expressed enthusiasm after discovering that Coulomb studied under a geologist she learned about in another class. By incorporating basic programming and writing tasks at the introductory level, we form building blocks for upper-level classes to incorporate more complex tasks such as machine learning and proposal writing required for data science and scientific research.

The idea of teaching being a service is not possible without compassion and empathy. To meet student needs, their individuality must be recognized and understood. Throughout my courses, I use tools I learned in the Cognate in College Teaching program to ask for feedback, listen to concerns, and take requests. I then incorporate new elements into the class to increase participation. One student said that Physics had become her favorite class despite it not being her best class. Compassion and empathy created an open and diverse classroom in which students felt comfortable expressing their needs.

My career path has been paved with patience, instruction, faith, and hope. Teaching allows me to incorporate service into my daily life as a means of giving back. Through teaching, I have a direct and immediate impact on the community that supported me. It is my aspiration to prepare students for the opportunities they seek and to expose their potential.