Teaching Philosophy

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My teaching philosophy is based on my belief that teaching becomes great when I am able to motivate and stimulate a burning desire to learn in each of my students. 'What motivates them to learn?' is something I always keep in mind as an educator while teaching physics.

What motivates students in a classroom? On my first day of teaching as an assistant professor, I immediately learned how difficult it is to make the classroom interactive, especially when the lecture topic is abstract. I relied on classroom technologies including well-prepared presentation slides, a document camera, video clips of physics demo, and online discussion board. I hoped that technology would assist me to stimulate each student's desire to learn and increase my student's voluntary participation. However, I found that students often pretend to understand concepts when the technology cannot offer enough interactive classroom experience. In the past two years I have adopted the advice of faculty mentors, which are all about how the instructor stimulates in students a practical motivation for deeper learning. There are my teaching plans based on the advice.

First, I will make a physics concept real by sharing my stories. I noticed that many students enjoyed listening and thinking about physics questions related to their own experience in daily life, as well as my experience. For example, in my University Physics class I explained the 'drift speed' of electrons under an applied electric field using my driving experience at the Queen Elizabeth Highway near Toronto during a snow storm. The lateral shift due to the strong side wind is the same concept of drift speed. In Optics class, I often share stories with students about how I deal with beam alignment and focus problems in the research laboratory using basic textbook concepts. The storytelling brings student's attention to the lecture topics and naturally invites students to think for themselves about physics concepts.

Second, I will give students the opportunity to speak. Asking a question and seeking an answer is the quick and easy way to make the classroom experience interactive. However, I observed that this method only invites the same one or two motivated students into the discussion. To enhance student participation, I select an open-ended conceptual question and let students think through step-by-step questions I designed to seek out the answers. I monitored the number of participants, and it grew rapidly during the questioning. For example, in my University Physics class I asked students a question about the charge polarity at each capacitor terminal when connected it to a battery. At first, a few students gave answers which were mostly wrong. Then I showed a picture of a parallel plate capacitor disconnected from the battery and asked students the same question. More students answered 'charge neutral'. Next, I asked students a redirecting question, after showing a picture of the capacitor connected to the battery, about which polarity of charges move to the battery at each capacitor terminal and what the leftover charges are. Finally, more than half of the students responded correctly to the last question. I learned that when more peers participate in the classroom activity, more students pay attention and get involved, which makes the lecture active and alive.

Third, I will provide students with a challenging task. Everyone loves a challenge that gives a great feeling of accomplishment when completed. Challenging questions strongly motivate students in learning, but when the questions are too difficult to solve students get frustrated and eventually give up the task. In my experience, contemporary research topics were the best candidate for a pool of challenging questions, but I needed to redesign the questions to fit the level of the student's understanding. To prevent frustration, I tried to give one challenging problem on each homework assignment and encouraged students to work the problem together with peers. Additionally, I introduced the problem to students in the classroom and showed how to approach it. The tight-binding model of graphene, two-dimensional honeycomb lattice, is one example in the graduate-level Solid State Physics class. Frequency-dependent refractive index of a surface charge oscillation system is an example for an Optics class. When I evaluated the results, about half of my students got the correct answer.

Finally, I will make myself available for students. Since the office hours were determined by myself based on my available time in the semester, I realized that quite a number of students could not visit my office due to their class schedule. I will adjust my office hours based on when students are most likely to be available. I also found that motivated students always emailed me to rearrange the meeting time if the time does not meet their schedule. To invite more students to one-to-one meeting, I stated 'always available by appointment' on the syllabus and encouraged students to visit me by making an email appointment. In addition, I invite students who have not submitted an assignment to meet with me in order to listen to their difficulty and give them advice.

What motivates students in research training? One of my roles as a physics professor is not only to provide knowledge and skills, but also to promote a student's personal growth through advising, mentoring, and research training. When graduate and undergraduate students join my group and start participating in a research project, I immediately find their great passion to learn and so it is easy to engage them to carry out a research project. But, sooner or later the students will face a gap between research in the laboratory and learning in a classroom. There are a few ways I advised students to bridge the gap.

First and foremost is to define student's motivation together. At the first meeting, I used to ask a student his or her future career goal after graduation and what the planning will be. In this meeting, I will be a good listener to catch their motivation, expectations, and interests. Then I discuss with the student how I can help him or her to fulfill their future plan. I help the student to select a research project based on the student's level of interest and knowledge, and we together make a timeline and checklist of research training which will keep the student on the right track. The guidance at this first meeting lets the student adjust his or her motivation which will be the best fit to the future career plan.

Second is to set a deadline for each task. Learning in a classroom follows a well-defined schedule dictated by the course syllabus. There are many deadlines to meet, such as due dates for quizzes, discussion board, homework assignments, mid- and final exams. However, the research training in the laboratory does not have deadlines for setting up an experiment, collecting measurement data, maintaining instruments, running simulations, having a discussion with colleagues or collaborators, or writing a manuscript to publish a research finding. I learned that without a deadline the student does not update his or her progress and report any difficulty to the advisor. As all my advisors did, setting a deadline for each task is very important to move the project forward, guide the student into the research activity step by step, make the student feel accomplished and valued in his or her research tasks, all of which eventually gets students motivated in the laboratory. I also learned that setting the deadline helps me to control the speed of the research training in the laboratory. Since the research is the long-term game, it is required for the student to have patience in conducting the research project. I find that patience can overcome almost any failure or mistake during research.

Third is to make positive use of mistakes. I learned by experience that a mistake gives a beautiful opportunity to make progress in research, although a mistake makes us feel disappointed and frustrated. Trial-and-error is very common in the research laboratory. A mistake allows the student to think differently in approaching the problem. As an example, I traveled with my first Ph.D. student to the nanofabrication facilities at the University of Texas Austin and the University of Houston to teach him how to make nanodevices. It took a long time for him to be an independent user, because nanofabrication has a steep learning curve. Every time he made the mistakes and ruined expensive substrates, I reminded him that failure is a part of the learning process. Now he is an independent user of the nanofabrication facility.

The last is to use a different approach mentoring different students. I helped women students network within the physics community by introducing them to other women physicists. It helps them to choose a role model who will provide momentum to pursue a career in a STEM field. International students can be passive in a group activity or collaborative work. This can be caused by cultural differences or difficulty in communication. I take time to encourage them to participate actively in giving a presentation at a journal club or at a group meeting.

Teaching experience. In my two years at UT Rio Grande Valley I taught different levels of physics courses, including both calculus and non-calculus-based University Physics, Optics, and graduate-level Solid State Physics, in various teaching environments, including conventional lectures, online classes, and ITV (Interactive Television) classes between two campuses. In addition, I have offered research training and mentoring to 4 graduate students through Ph.D./MS physics degree program, 4 undergraduate students through NSF-REU program, and 3 high school students through summer outreach programs.