Teaching Philosophy

I believe a primary goal of a liberal arts educator is to teach critical thinking. A graduate of a liberal arts institution is expected to have the ability to analyze issues in life and society, ranging from starting and growing a new business to contributing solutions to community or global issues. The core of physics is critical thinking. A physicist poses a question, gathers information, and uses a set of skills to sort that information to find an answer. For a physicist, those skills include discarding extraneous information, breaking a problem into tractable pieces, modeling a complex system, and validating or verifying the answer. Often this process involves a number of scientists working collaboratively. Ultimately, physicists make connections between seemingly disjoint phenomena and discover new truths or principles about nature. All of these skills at a physicist's disposal - questioning, discriminating, connecting ideas, and collaborating - are important for all students to master as they learn to be critical thinkers and go on to make a positive impact on society.

I believe learning the tools used for critical thinking requires active, engaged students practicing and doing physics in collaboration with their instructor and their peers. Practicing and doing physics means, for example, working through problems, doing laboratory work, or participating in research. However, not any practice is sufficient to learn. It is typically said that "practice makes perfect". In reality, "perfect practice makes perfect" is a more acurate statement. This means that the students are guided with direct feedback from the instructor and their peers to correct their misconceptins during the learning process. These beliefs are based on my own personal experience as a student, as a scientist, and as an instructor.

As a student, I first learned the importance of perfect practice. As an undergraduate student at Millikin University, a small liberal arts institution, I was the only physics major for two years. Most of my upper level courses were taught as directed study. I worked closely with a professor for two semesters of an electricity and magnetism course and for a semester of statistical mechanics. During these courses, I had the professor's full attention to help me correct mistakes I was making while practicing. As a graduate student at Iowa State University, the importance of practice was apparent during my preparation for the entrance exams to the graduate program. I spent one summer continuously doing physics problems. It was then that mathematical methods and connections between ideas in physics were solidified, never to be unlearned. While such an intensity is difficult to maintain in a classroom, it impressed upon me the importance of practice in learning.

As an instructor, I have strived to build a classroom where practicing physics is central. This was easiest in the laboratory courses that I have

taught at Millikin University and Iowa State University. In the laboratories, the students were already in small groups and I was able to interact with them at that level to alleviate misconceptions that arose. During a summer session at Des Moines Area Community College, I taught the lecture and laboratory for an algebra-based physics course which met four days a week for three hours. I chose to break the three hours into short lecture, problem-solving, and relevant laboratory sessions. During the lecture, I could focus on a single concept or idea and follow it with a problem-solving session and/or laboratory to more fully explore the concept. In these sessions, I was able to work with individuals or small groups of students and correct them as they were practicing physics. During another semester, I used the University of Washington "Tutorials in Introductory Physics" before the lecture session. As the students worked on a section of the workbook, I could interact with small groups of students to help them through the lessons. At Columbia University, I taught the lecture portion of the physics laboratory for engineers. This course had approximately 150 student enrolled. Since it was impossible to break them into smaller groups, the students would work together in small groups on short qualitative or quantitative in-class problems. I would then go through the solutions in detail so students would have the opportunity to see if and where they needed to fix problems they had.

I believe that practicing physics with peers is a valuable source for teaching collaboration. Collaboration is an important skill since none of us ever really work alone. As a scientist in a large collaboration, I have found that conversing with my colleagues is invaluable. They have experiences and strengths that are different from my own. Typically, collaboration is stressed in laboratory settings. Though this is not the only opportunity for students to collaborate, I have found that group tests and exercises are great ways to foster this. In the Des Moines Area Community College courses that I taught, I employed all these techniques. Students learned to communicate new ideas and become part instructor when convincing their peers of their ideas. Peer teaching and collaboration in the physics classroom have a positive impact on both the students' physics education and their future abilities to interact collaboratively in their chosen professions.

I believe a student learns anything best by doing. Typically, physics courses involve a large amount of information to be digested in a semester. Based on my previous experiences as a student, a scientist, and an instructor, I believe a physics classroom with students actively doing physics correctly in a collaborative environment is the best way for students to master that content. As a physics instructor, it is my responsibility to facilitate that activity and to provide the necessary structure and guidance so that the students can learn the essential skill of critical thinking that physics has to offer.