Teaching Philosophy – Materials Science and Engineering

I am often asked the question: "At what point did I decide to become a teacher?" I have always been a teacher; likewise, I will always remain a student. The amazing thing about teaching and learning is that the two go side by side. Along the way in my learning career I have had remarkable teachers and mentors that were able to teach me not only the fundamentals of writing, mathematics, and science, but instill in me the confidence to venture into uncharted scientific territory and tackle new problems with cutting-edge research. In my teaching, I feel that bestowing my students with confidence in their critical thinking abilities, as well as their ability to communicate their knowledge is of utmost importance.

Encouraging confidence in students' abilities does not mean that they should be guided through their courses step by step, or experience some-sort of hand-holding from the professor. Actually, by encouraging confidence in students' abilities, I mean the opposite – challenge students to excel at tasks beyond the basic expectations of a course. In my experience, I learn best when a subject is challenging and I am encouraged to think for myself. For example, one teaching technique that I have found great for getting students to solve problems as a class is what I call "pass the chalk." This involves one student starting a problem by, say, underlining the key phrase in the written problem and passing the chalk to the next student who writes the governing equation(s) for the problem and passes the chalk to the next student who fills in some of the variables in the equation, and so forth until the problem, one that students originally did not understand, is solved.

Classroom diversity includes not only ethnic, racial, gender, and socio-economic diversities, but also diversity in learning styles. In providing a multitude of applicable resources, students are better equipped for an equal learning experience. I have been involved in a pedagogical research project to assess the impact of teaching technologies on student learning. Screencasts, which are audio-visual recordings disseminated via the course management website, were used as an added resource for students in a large (200+ student) introductory materials science and engineering course. The screencasts included lecture recordings, homework solutions, quiz and exam solutions, and mini-lectures on challenging concepts that remained unclear to students after the lecture. We found that students in disciplines (i.e., industrial and operations engineering) that have little content overlap with materials science and engineering used the screencast resources more often than students in disciplines (i.e., chemical engineering) that have overlapping content, indicating that the added resources aided students that assumedly were less confident in the course material. Additionally, students of color used the screencasts more than white students.

I also think that keeping your expectations and course requirements transparent to students is essential to teaching. This may sound obvious, but many professors seem to know their expectations of student learning, yet ineffectually convey them to the students. I had the opportunity to assist with reconstructing the syllabus for an introductory materials science and engineering course. Most notably, the syllabus listed the learning objectives for each chapter. We found that student performance improved, but more factors than just the screencasts were

different from past semesters. The course learning objectives were explicitly stated for each chapter. Quizzes and exams were written to test those objectives. Students found this very useful and were able to focus their learning on the topics that the professor thought were most important. Although this is usually the goal of most courses, I have found that learning objectives are not often explicitly stated, and even if they are, they are not often explicitly tested. It was amazing to me to see that such a simple technique as stating the course learning objectives could impact student learning so significantly.

Finally, I feel that an integral part of science and engineering research is interdisciplinary study. An interdisciplinary approach to teaching inevitably reaches more students in the class because the material discussed is from a broad background. I was able to use an emphasis on interdisciplinary applications for the concepts covered in Introduction to Materials and Manufacturing to reach a broad audience of students. This is a required course for most engineering majors and many of the students do not have an initial interest in taking the course. Therefore, I tried to learn what students were interested in and apply the course to those subjects. One student for example was participating in an engineering design club, and they were having problems with the composite material interfering with the electronics of their system. This student became very interested to apply what he learned in the course to his extra-curricular activity.

Materials science and engineering is a uniquely diverse field with classes ranging from the fundamentals of chemistry and physics of materials, to electives focused on specific material classes, to applied materials courses such as photovoltaics, fuel cells, polymer processing, or nuclear fuels. If my students leave my classroom with one skill it would be their confidence to take on any subject that interests them.