Teaching Philosophy – Industrial and Operations Engineering

Early in my academic training, I made the decision to become a Human Factors engineer when I discovered a fascination with the powerful and unpredictable role of human cognition in engineered systems. Developing methods and tools to effectively support the cognitive processes of humans in these systems has since become a passion of mine. Interestingly, this same passion now drives my decision to pursue a career in academia. The process of imparting knowledge to students is, in a way, "supporting their cognitive processes" in the engineered systems of the classroom or research lab. The joy I derive from finding effective methods and tools to foster student understanding is an extension of my continuing fascination with cognition.

Three major goals motivate my philosophy for teaching engineering students. These are that students acquire a basic understanding of the theories, concepts, and methodological approaches in the subject; that they understand how to apply the subject matter in engineering problem solving and also in their everyday lives; and that through classroom activities they are able to further develop the analytical, communication, and teamwork skills necessary to be successful professional engineers.

In helping students to develop a functional knowledge of course material, I find two approaches to be especially effective: 1) I structure classroom lectures and activities in ways that encourage students to actively participate in the teaching and learning process; and 2) as often as possible, I balance the introduction of formal definitions of new theories and concepts with clearly defined, concrete examples.

I use various methods to encourage active student engagement during class time. Each time a concept from a previous class is reintroduced, I require that students re-explain it to the other members of the class. If a student asks a question during lecture, before answering I first give the other classmates a chance to address it, or to refine or add to it via moderated discussion. One popular activity I have used to help prepare students for exams is to use an entire lecture period for small group concept mapping. For this activity, student groups "map out" a list of class concepts by arranging them on large sheets of paper and denote relationships between the concepts with descriptors written on lines that connect pairs of concepts. When the students discuss amongst themselves the many different ways the concepts can relate to each other and learn from each others' perspectives, they tend to create a more robust understanding of the material which aids them in the upcoming exam. As an added benefit, students are better able to grasp the "big picture" of the course material by reviewing the artifact that they created.

While it is important that students not lock in on one specific example of a concept at the expense of being able to generalize it to other applicable scenarios, I have found that often the best way to foster students' initial understanding of a new idea is to illustrate it in a familiar context. When teaching on issues related to human cognition, it can be especially beneficial if students can experience the cognitive phenomena themselves. For example, cross-modal links in attention have strong implications for multimodal interface design, but can be very difficult to comprehend when students first encounter the concept. By transforming a lecture presentation into a makeshift multimodal display, I can present various multimodal cues so that students can experience and reflect on how the cross-modal links in their own attention affect their ability to process the displayed information.

Students can only benefit from an understanding of course material if they are also able to apply it. One of my teaching goals is that students are able to apply course concepts not only to engineering analysis and problem solving, but also in their everyday lives. To this end, I emphasize that each student formulate their own examples to demonstrate course concepts, and often ask that they elaborate on such examples in exam questions. Classes I have taught and assisted have always involved a group project or case study, for which students are graded on their application of course concepts to real-world design or analysis. For example, in a course on human error in complex system failures, each student group was responsible for presenting how human factors contributed to a specific historical disaster, such as the sinking of the Titanic or the Chernobyl nuclear accident. I have also required students to submit, along with summaries for class readings, questions or comments about how the content of the readings could be applied to previous topics discussed in class or in their own experience, and often introduce interesting responses in lecture. For example, when teaching about heuristics and biases that influence human decision making, students are often willing to share with the class how these influences are manifested in decisions of their everyday lives. It is especially rewarding for me to see how students gain such insight into, and deepen their interest in, their own cognitive processes.

I believe a major part of my role as a teacher of engineering students is to help them prepare to be successful professional engineers. This involves not only imparting knowledge directly related to course material, but also fostering the development of secondary skills which will help them approach real-world problems analytically and work effectively within engineering teams. One way I encourage the development of this skill set is by creating project groups composed of students with diverse backgrounds (e.g., including undergraduate and graduate students with different major areas of study and levels of experience), and giving them a real-world problem to address with the knowledge they have gained from the course material. Since these problems – which are similar to those they may encounter in their careers as engineering professionals – usually do not clearly fit the "textbook example," students are challenged to think outside the box in their analysis. Through this process, it is my hope that students can come to recognize the value of different perspectives in a diverse team, and learn to cooperate and allocate tasks effectively to tackle the problem. Further, these projects provide an opportunity for students to hone their communication skills, which I believe are critical for success in all engineering professions, by requiring both written project reports and oral presentations. In past classes I have met with project teams individually throughout the semester to give them feedback on their developing reports and presentations so that the final products have always been high quality.

A successful student learning experience – one in which the student grasps an understanding of engineering concepts, has an ability to apply them, and develops a skill set to aid them in their professional lives – is the fruit of effective teaching methods. Seeking and employing such methods to successfully support student cognition during the learning process is a passion of mine that mirrors the passion I have for my field.