*"What I cannot create, I do not understand." – Richard P. Feynman*

I believe that the creative process is a critical part of electrical engineering education, which can both motivate students and bring them deeper understanding of the topics of study. Particularly in signal processing, with digital signals pervasive in their lives, students can engage with more general topics by using them as practical tools. While building is never a substitute for basic learning, I believe that it can motivate the study of difficult topics, allow students to test their theoretical understanding, and build confidence in their abilities. The creative process aids their understanding when they use theory to construct proofs, write simulations to test a theoretical result, or learn the signal processing design of the technologies we otherwise take for granted. My experiences in industry research have provided me with both examples of how designing new systems motivates the designer to develop his or her theoretical background, and a broader understanding of the applicability of signal processing theory. I provide my students with opportunities to create and build from the theory, and I expect them to take an active learning role to test and build on their understanding.

Certainly a basic theoretical foundation in signal processing is a critical requirement. Mathematical tools provide a means to analyze and to synthesize the methods of our discipline, and ensuring that all students master these basic mathematical tools is my primary goal. However, I strongly believe that a secondary goal of using the basic theory as tools for creating practical knowledge is complementary to the foundational goals. Where this is possible to achieve, students will feel more motivated, satisfied with and confident in their abilities. Since lack of confidence is often a reason for leaving electrical engineering [MIT, "Final Report of the EECS Women Undergraduate Enrollment Committee," 1995], I believe this is also a strategy for increased retention.

My teaching methods use these active learning methods, both in class, in assignments, and in optional additional resources I offer my students. For example, I've often brought in props into class to help my students visualize a theorem and to help them formulate a proof. I invented a card game I called "relation poker," in which students applied their knowledge of both the properties of relations, and combinatorics, in a competition between students. When teaching random variables, part of my approach is to have students learn how to generate arbitrary distributions within Matlab (or equivalent programming language), as both a practical and theoretical lesson, since it both requires proving that an algorithm works, and allows them to test analysis via simulation.

While such activities can take additional time, they often benefit and are most engaging to students who start the class with less background. Practical and creative exercises can be an equalizing factor, and can build the confidence of students when they demonstrate tangible abilities and understanding. Providing students with interim creative tasks allows them to test their ability, and encourage them to "fill in" missing knowledge in order to finish the tasks.

Creating naturally lends itself to student evaluation. What they cannot create, as Feynman said, they know that they do not understand. Homework exercises and tests should both have students demonstrate their knowledge by requiring them to apply it and synthesize solutions to new questions. Often, results can be obtained from more than one direction, and I ask my students to verify their analysis, for example, by simulation. Such self-testing can be more immediate and thus more motivating than pure after-the-fact external grading. Further, individual and group projects can be very important and memorable. Projects should be flexible to serve different students' interests, but to test each student's ability to apply the basic methods and theory from the course.

Using active, creative methods prepares students for a changing field. For careers in academia or in industry, our students will use their skills to evaluate others' ideas and to create those of their own; such abilities can be taught through experience, which provides students with the necessary mix of skills, intuition, and confidence to be successful. I want my students to understand; and I want them to create, so that they know that they understand.