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Teaching Philosophy

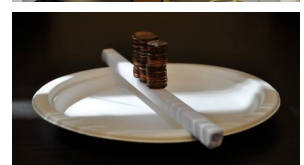
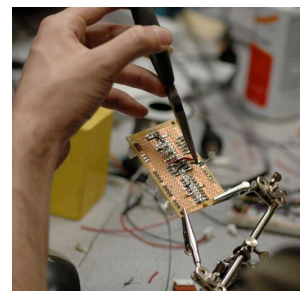
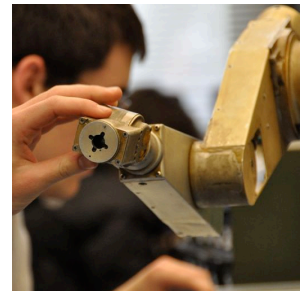
When I came to the University of Pennsylvania in the Fall of 2007, I brought along a lengthy list of ideas, a handful of goals, and some prior teaching experience, yet I knew I had a lot to learn. 3.5 years, 9 different courses, 31 total credit units, and 716 unique students later, I have confirmed that I am deeply passionate about teaching, and I can proudly say that I have learned more than I could have imagined. Looking back, it is clear that my teaching style has evolved tremendously, while certain core elements seem to define who I am and how I teach.

The Practical

I remember sitting in a lecture hall during my junior year of undergrad, listening to a professor try to explain the geometry of helical bevel gears to our mechanical engineering class. I recall being amazed that he was trying to do this with words alone. No images, no videos, no hardware. I considered myself lucky to have previously encountered this type of gear, allowing me to follow what he was saying. It was obvious that most of my peers were painfully befuddled. I quickly promised myself that if I were to ever be in a similar situation, I would remember the power of first-hand experience and physical artifacts in helping students understand complex engineering concepts.

Ten years later, and if there is one thing that typifies my teaching style, it is a dedication to the practical. Though the phrase may be overused, I am a firm believer in the power of *learning by doing*, especially within mechanical engineering. When it comes time to decide how to introduce a new topic, I begin with by first exploring any available hands-on activities that could be integrated into the learning experience. I then determine how I will introduce and explain the underlying principles (lectures, directed lab exercises, individual assignments, group projects, etc.), after which I develop materials, hardware, and resources to support this structure. Such a methodology commonly results in project or laboratory components where the process is less concrete and the results are relatively open-ended compared to traditional assignments. I have seen countless students absolutely thrive in this environment, while some definitely struggle to gain their legs when outside their comfort zone. A cognizant awareness of this diversity has proven critical to managing student expectations and helping the students successfully achieve my pedagogical aims.

Whether I'm introducing the basics of computer-aided design or expounding on the dynamics of robotic manipulators, countless interactions over the years have reinforced my belief that first-hand experience with practical problems results in faster, deeper, and longer-lasting learning for the students. This focus on the practical has had a profound effect on all of my classes, and has led to the publication of two academic papers [1-2].



The Motivational

With only a single sheet of copy paper, suspend as many pennies as possible above the center of an 8-inch diameter hollow cylinder. You have fifteen minutes... It's the first day of labs in MEAM 101, and the students immediately dig into the challenge. The contraptions they design are truly fascinating, but the transformation in the students' attitudes is even more striking.

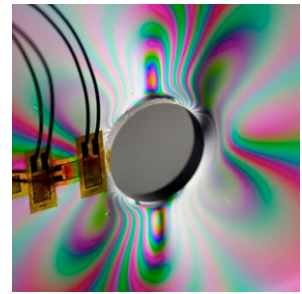
Such design challenges make up only one piece of the motivational puzzle. For instance, I have found that as I put more effort into remembering and using the names of my students, those same students become significantly more apt to open up and share their thoughts and questions with the class.

Yet another motivational tool comes near the end of each semester, as I endeavor to find ways for my students to publicly showcase their work. This might take the form of an open-house or a festival where small groups of students display and demonstrate their hand-built creations, or a double-elimination autonomous robotic hockey tournament [1] with screaming fans and appropriate music. In addition to inspiring and motivating the students to grapple with the technical topics necessary to complete the projects, I've found that such events have a cohesive, community-building effect within each class. I also believe that such events help the students leave the course with a strong sense of accomplishment and an enthusiasm for additional challenges.

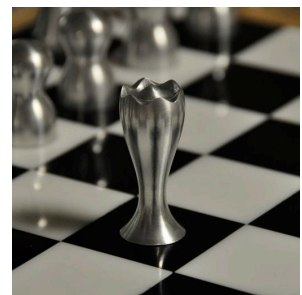


The Beautiful

Attention to the aesthetic, while not usually considered a critical element of engineering education, has become a hallmark of my classes, projects, and my presentation style in general. When it comes to designing the lecture experience, I strive to pull from each communication channel what it affords most naturally, especially give the rich array of tools available in the modern classroom.



I have found the computer projector to be most effective for the presentation of visually-striking imagery that serves to inspire and motive discussion, rather than the more common bevy of text, formulae, and equations. Upon this backdrop I work to combine traditional chalkboard-based instruction with active discourse amongst the students. Indeed, this approach extends well beyond the classroom, as I have used this same philosophy in the design of various assignments and projects, wherein I can make a concerted effort to help students see the natural beauty of our engineered world.

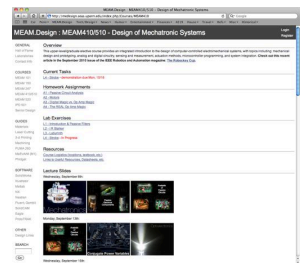


Design is an integral element a large percentage of the courses that I teach, and it is my hope that I can lead by example in inspiring my students to seek out elegant solutions to today's engineering problems. Overall, it is my belief that attention to detail and the establishment and maintenance of a comfortable, aesthetically-pleasing learning environment can have a profound positive influent on the academic experience.



The Useful

Recognizing that the majority of my courses involve project-based components that students must undertake outside of regular class hours, I began work on a collaborative online wiki in the Spring of 2009. Available at medesign.seas.upenn.edu, this publicly-accessible site has grown to include all relevant material for the courses that I teach (including project descriptions, lecture slides, notes, course calendars, etc.), as well as information and guides for the various hardware and software that students encounter in our laboratories. With 660+ pages, nearly 200 contributors, and over 460,000 page views in 15 months, it has become significantly more useful than I could have imagined.



In addition, I have taken up numerous opportunities to develop custom hardware and resources for my classes. Often undertaken when commercially available options were inadequate, such development exercises have helped me keep up with the pace of technology and maintain an intrinsic knowledge of the material that I teach. The most salient example of this work is the custom M1 microcontroller, which I developed in the Fall of 2009 to support the MEAM 410/510 class [3]. The initial run of 300 boards (which I anticipated would last a number of years) is nearly exhausted as students and faculty both in and outside of Penn have adopted this platform for their own work and projects.



In the end, it is truly humbling to recognize the role that I play as an educator, and it is my sincere hope that I can continue to inspire, motivate, and engage my students as they become the leaders of tomorrow.

[1] J. Fiene. *The Robockey Cup: A Look at Mechatronics Education in 2009*. Robotics & Automation Magazine. Volume 17(3). September 2010.

[2] J. Fiene and M. Yim. *Project First: A Case Study in Mechatronics Course Design*. In Proceedings, ASME IDETC. August 2008.

[3] J. Fiene. *The M1: A Custom Mechatronics Platform for Robotics Education*. In Proceedings, ASME IDETC. August 2010.