

Engineering and Art: Putting the EA in STEAM

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EXECUTIVE SUMMARY

This chapter per the author discusses challenges faced by first year pre-engineering students. Also discussed are several topics taught within the curriculum including: the engineering design process, sketching, measurement, the elements and principles of design, and three-dimensional modeling. The chapter proposes a design project for engineering students that would tie all of these concepts together to provide an additional learning opportunity for students and more relevant practice of skills like isometric sketching, creating three-dimensional computer-aided design models, and measurement. Samples of student work from the project are included.

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I became a teacher after working in industry as an engineer. I knew I needed to learn about teaching and choose to enter a teacher education program and become certified through a traditional route. Once I entered the classroom, aspects about my prior life became more known and I was given the opportunity to teach classes such as engineering and energy in the high school. To me, engineering is the application of math and science concepts to solve problems. When I thought through the difference between teaching engineering and chemistry a few aspects appeared. Such as, engineering solutions to problems could be an invention, an innovation, or a more efficient process. Engineers design, build, conduct tests, market, and communicate with others in their pursuit of solutions. Engineering requires creativity

and ingenuity. An important part of the creativity that is integral to engineering is art. Art practices lend a hand to an engineer's process of developing solutions. For example, John Maeda is a former president of the Rhode Island School of Design where he was very involved in adding art to the STEM movement. He holds degrees in Electrical Engineering and Computer Science from MIT as well as a Ph.D. in design from Tsukuba University in Japan. In his piece for Scientific American in 2013, Maeda said that "STEAM and arts integration are crucial in K-12 education, engaging students in the STEM subjects and ensuring that creativity doesn't fall by the wayside as we chase innovation..." (Para. 5).

Integration is also important at the college level. So much so, that multiple colleges and universities have designed courses that tie art and engineering together in one. One of these courses is "Enduring Design: The Art of Engineering" being offered at the Rose-Hulman Institute of Technology in Terre Haute, Indiana. The course was described by Mirth and Findley (2015) as being designed by both humanities and engineering faculty. The faculty members saw that the school's engineering students did not take many liberal arts courses and felt that this caused a "potential handicap in their ability to see opportunities from a broader perspective" (p. 1). While the course was open to all students, a majority of those enrolled in the first offering were engineering students. The course is an art course that incorporates examples of engineering. This course is still new and data is still being collected, but initial data show that the art and engineering connections taught throughout the course helped students to become more creative in their ideas for improving both form and function of objects.

At the University of South Florida in Tampa, an engineering professor created a course that "merges his research world with the world of fine art" (National Science Foundation, 2006, Para. 1). The course teaches concepts like electromagnetism and optics while lab activities incorporate lessons from works of fine art to students creating pinhole cameras and learning how to spot a forgery.

As these schools created courses to open the minds and creativity of engineering students by incorporating art, the project described in this chapter is an attempt to do the same for high school students enrolled in pre-engineering programs, most specifically the Project Lead The Way students that I teach.

Project Lead the Way

Project Lead the Way began at Shenendehowa High School in upstate New York in 1987. There was a decrease in enrollment in engineering programs creating a predicted shortfall of over 600,000 engineers in the United States by the year 2000 and a large amount of engineering undergraduates were changing their goals and dropping out of engineering (Kelley & Wyanski, 1987). Richard Blais, the Director

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