



## Building a Better Engineer: The Importance of Humanities in Engineering Curriculum

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### Prof. John F. Sweigart P.E., Southern Polytechnic State University

John Sweigart is an Associate Professor in and Chair of the Mechanical Engineering Technology Department at southern Polytechnic State University in Marietta, GA. His teaching responsibilities are currently centered on Materials. Prior to his teaching career, John was in the aircraft and composite materials industries. He received his BS degree in ME from Missouri University and his MS in EM from what is now the Missouri University of Science and Technology.

### Dr. Beth Stutzmann, Southern Polytechnic State University

Dr. Beth Stutzmann, is the Director of Bands at Southern Polytechnic State University in Marietta, Georgia where she received the Outstanding Faculty Award in 2011. She is a graduate of The Boston Conservatory of Music (BMEd); earned a master's degree from Oklahoma City University in Horn performance and in 2010 was awarded her Doctor of Musical Arts in Music Education degree from Shenandoah Conservatory, Winchester, VA.

Holding dual music educator certifications (PreK-12) in two states, Dr. Stutzmann is a member of the Research Learning Community (RLC) at her University and is actively involved in presenting and publishing multidisciplinary research studies.

In 2012, Dr. Stutzmann received the Governor's Teaching Fellowship award.

While attending The Boston Conservatory of Music, Beth Stutzmann studied horn with Jonathan Menkis, assistant principal hornist with the Boston Symphony Orchestra. In high school, she studied horn with Robert Ferrante, Brian Morrill, and James Mosher, also a hornist with the Boston Symphony and Boston Pops. In graduate school, Beth studied horn under Martha McQuaid, a former student of Daniel Katzen, second hornist with the Boston Symphony Orchestra. Her conducting studies were with Attilio Poto; Dr. Matthew Mailman; Dr. Scott Nelson. "Taking weekly lessons at Symphony Hall in Boston, where the greatest of musicians throughout time have stood, was awe-inspiring and magical."

### Dr. Wei Zhou

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## **Introduction**

Engineers are thought to be experts in their field of interest and that is often where their expertise ends. Engineers on one hand are good critical thinkers but on the other often lack in communication and interpersonal skills. This lack of interpersonal and communication skills may be attributed to the lack of importance given to these disciplines during their engineering education. In this paper, we analyze the importance of humanities in engineering curriculum. Emphasis on liberal arts and humanities can prepare engineers to fulfill their cultural and civic responsibilities. For an engineering educator, it is vital to inculcate in the engineering students, the importance of studying humanities that can open up their minds to the use of creative ideas from great minds outside of science. Humanists claim that the state-of-the-art scientific knowledge techniques that engineers learn in their college curriculum have a limited shelf life. If they master the humanities, it can provide tools for extending that shelf life. One of the most important aspects of engineering is effective communication, both verbal and written. Humanities study can strengthen the ability of engineers to work and communicate with others.

## **Importance of Humanities**

A number of engineering students take humanities courses thinking that they are wasting their times. Dan Albert, director of eye research institute at the university of Wisconsin-Madison lists several reasons why students pursuing science and engineering careers should augment their education with a strong foundation in the humanities<sup>1</sup>. Humanities courses emphasize on social skills and are rigorous in written and oral communication. These courses prepare students to become better scientists and engineers. They prepare students to fulfill their civic and cultural responsibilities. Studying the humanities allows students to become familiar with and use the creative ideas from great minds outside of their field of study – which can help them generate new ideas and broaden their horizons. Even the state of the art scientific knowledge and techniques that students learn in college can sometimes have a limited shelf-life for example in the evolving disciplines of computer science, bio-medical engineering etc. Mastering the basic communication skills can provide tools for expanding the knowledge. Humanities study can strengthen a student's ability to communicate and work with others. The wall that exists among disciplines has been lowered and students can move across disciplines more freely – the effective writing and oral skills can help facilitate this transition. Students must realize that interdisciplinary learning adds value to one's education. A student is more likely to succeed in an engineering or scientific discipline if they have strong communication and interpersonal skills.

These skills are often not taught in the engineering curricula. There is a need to update the curricula to emphasize the importance of communication skills. Michael Clough, professor in the college of human sciences at Iowa State University argues that teaching is an on-going scholarly practice where existing and new research is organized into a robust framework that produces a total effect greater than the sum of the independent parts<sup>2</sup>.

### **Key Challenges and Recommendations for Engineering Education**

A National Science Board reports three essential challenges for engineering education<sup>3</sup>. They are to respond to the changing needs for engineers, to change the perception of engineering, and to retain top students. Traditional analytical skills are well provided by the current education system. However, industry now needs engineers with passion, systems thinking, an ability to innovate, an ability to work in multicultural environments, an ability to understand the business context of engineering, interdisciplinary skills, communication skills, leadership skills, an ability to adapt to changing conditions, and an eagerness for lifelong learning. This is a different kind of engineer than the norm that is being produced now<sup>3</sup>.

Engineers are often perceived as ‘nerds’ without interpersonal skills, doing narrowly focused jobs. As a result, many students, especially women and minorities cannot see themselves as engineers. Most high school girls believe engineering is just for boys who love math and science. Engineering is also seen as unattractive by many talented and creative people who could excel in engineering but are discouraged by the rigidity of the required studies and perceptions about uncertain career prospects. Attrition is substantial in engineering, particularly in the first year of college. Students have expressed dissatisfaction with teaching and advising in the early years, perhaps for this reason. Some students who leave engineering are among the best students. A large number of these are women and minority students. Engineering schools may be able to learn from business and medical schools both of which have succeeded in transforming their student bodies from predominantly male to a 50:50 male/female ratio, and have succeeded in attracting and retaining more minority students<sup>3</sup>. One of the ways to attract and retain good students is by diversifying the engineering curricula.

Leading engineering schools have had success with a variety of curricular and non-curricular programs to attract and retain engineering students<sup>3</sup>. These include out-of-class experiences, such as undergraduate research, study-abroad programs, internships, and participation in student organizations and professional organizations; assignments to multidisciplinary and even multinational project teams; training for diversity of career paths; hands-on engineering and integrative experiences in first year; emphasis on social relevance, service learning, volunteer leadership, and collaboration. These skills can be taught without significant investment. Introduction and emphasis on more soft skills in engineering classes can help students develop these skills.

In the engineering senior design courses for example, ethics and law (patent and trademark) can be incorporated in the teachings. These could be in the form of assigned reading, case studies, videos, external lecturers, and webinars from professional organizations like ASME, IEEE, and AIAA. Moreover writing should also be much emphasized, assigned and graded. Further oral and technical communication should be part of the training in senior design classes.

### **Current Engineering Curricula**

In the majority of the engineering schools across the U.S., few students experience any humanities, arts, communication, history or culture related classes in their engineering curricula. Those who are required to take such classes see it as unnecessary and irrelevant. Students are subjected to the engineering foundation courses in the first two years and then study their major or concentration courses in the last two years. Little or no importance is given to developing soft skills. Emotional literacy, social skills and interpersonal communication skills are often considered less relevant by the administration. Students therefore turn out to often have little soft skills when they graduate. A reform is needed where more emphasis is given to non-technical skills especially written and oral communication skills.

### **A Complete Education**

The administrators often claim that they have no room for additional courses in the undergraduate engineering curricula. Restructuring of the current courses may provide room for exposing students to soft skills. Some of these skills can be taught in the technical courses and others can be taught in supplemental courses or humanities classes. Public speaking can be made part of almost every engineering class where students are required to present and defend their projects in front of technical and non-technical people. Technical writing can be taught as a separate course or integrated with an existing course. English composition is taught in some programs but should be made part of all engineering programs. Engineering students should also have the opportunity to learn world languages and world cultures. These would help them in the current and future global economy. Having knowledge of international affairs will help students decide what is best not just for their community but also for the entire humanity. Engineering educators need to emphasize the importance of humanities and arts courses in the engineering curricula so the engineering education is complete and the graduates are diverse well rounded, socially conscious individuals that can work effectively with others in teams.

## Soft Skills

Engineering educators often complain that the students who enter the engineering classes already have certain traits that they acquired in their primary and secondary schools. Students can be retrained or even just be trained. Technical writing, public speaking, writing across the curricula, speech and presentations in all classes, and similar types of programs can help engineering students learn to communicate better. Education in arts is a key to creativity, and creativity is an essential component of, and spurs innovation. Innovation is agreed to be necessary to create new industries in the future, and new industries with new jobs are basis of our future economic wellbeing. Arts teach students to take chances and to invent – which is why we need to develop new technologies and to aide in developing a better economy with better living conditions.

By teaching the arts, we can have our cake and eat it, too. In 2008, the DANA Arts and Cognition Consortium, a philanthropic organization that supports brain research, assembled scientists from seven different universities to study whether the arts affect other areas of learning<sup>4</sup>. Several studies from the report correlated training in the arts to improvements in math and reading scores, while others showed that arts boost attention, cognition, working memory, and reading fluency.

Investing in arts education helps Americans compete in the global economy. Kouyate suggests that "Part of what the arts certainly provide is the creativity and innovation, which is really fundamental in how many other countries are looking at success."<sup>5</sup> In the U.S., how we want to measure success is in terms of how to be creative, how to be innovative - the arts bring that specifically into the learning experience. Merging arts with science and engineering will help build a better engineer.

## Improving Engineering Education

Experts in the industry believe that the rigor of the engineering education should not be reduced but at the same time communication skills need to be polished. The technical challenges of the future will require highly skilled engineers, and our educational system needs to train and develop people who can deliver. The changes needed to improve engineering education include<sup>6</sup>:

1. Improve elementary and secondary education
2. Have a wide breadth of education
3. Provide students with the experience of the real world
4. Offer parallel curriculums that are less intense
5. Adjust the curriculum to better prepare students for what they will encounter in their work
6. Teach the value of public relations

## Conclusions

Engineers might be good at solving problems but as the problems become large and more complex, it requires engineers to communicate with each other, customers and other stakeholders. Improvement in written and oral communication is essential for all engineers. This process should start during the engineering education. Students should be trained not only in their technical areas of expertise but also in humanities, arts, literature, history, culture, politics and international affairs. This supplemental education can be incorporated into the current engineering curricula or taught as separate courses. This education will improve the communication and interpersonal skills of engineers and better prepare them to fulfill their cultural and civic responsibilities.

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