Week 9 and 10 notes

Stephanie Betz

Educating the Engineer of 2020

- What will or should engineering education be like to prepare the next generation for effective engagement in the engineering profession in 2020.

Requirements

- Produce technically excellent and innovative graduates.
- How do we enrich and broaden the engineering education so graduates are better prepared to work in an ever changing world?
- Make learning more meaningful to them.
- Research in this field is required for a more efficient engineering program.
- Retension of engineering students is based on if we can keep them energized during previous studies enough to where they want to continue in the field. We should make sure that all areas are well researched and evaluated so students want to continue on the engineering path.

Challenges for Engineering

- The steady integration of technology in public infrastructures will call for more involvement of engineers in those locations.
- Highly enflueced by the global marketplace.
- Rapid growth popukation can enfluence the world stability. Some countries will focus on improving quality of life through advanced technologies while others will focus on more basic problems like access to water and housing.
- Minorties will grow and the traditional majority will decline. We should ensure that there is equitable access to all so that this doesn’t affect engineering field in the future.
- These challenges are paired with exciting opportunities. If the United states is to maintain economic leadership it must embrace these challenegs head on and find ways to continue working in a progressive motion.

- Reinventing engineering education requires the interaction of current engineering in the industry and acdeme. We must consider the entire engineering enterprise to be successful.
- Many engineers work in the industry and do not interact one on one with services this causes a disconnect between the organizations of what is important. As such, students have poorly formed ideas of what engineers truly do on a day to day basis.
- It is not just curricular changes that needs to be addressed but engineering as a whole. How everyone communicates and collaborates with one another is another important topic that needs to be looked at.

Phase 1 revisited

- As technology gains momentum engineering does too. Technological advances have made a lasting imprint on our identiy as a whole.
- Technological advances are growing at an astronomical rate and programs for engineering must keep up with this rate of growth.
- Older technologies are being pushed out as more advanced and more efficient designs become more prominent. It is imperative that we train the next generation to adapt to these changes, learn how to effectively use emerging technologies, and develop the skills needed to thrive in an increasingly digital world.
- “The populations of developed countries will “age” and engineering can be an agent for developing assistive technologies for aging citizens to help them maintain healthy, productive lifestyles well beyond conventional retirement age.”
- Many concerns raised about overpopulation and the potential social, economic, and environmental impacts of people living longer than anticipated.

Professional Context

- Pursue collaboration with Multidisciplinary teams of technical experts.
- Excellence in communication
- Abilty to communication using technology.
- Clear understanding of the complexity associated with global markets and social context.
- Flexibility, receptiveness to change and mutual respect.

The Past as Prologue

- We must continue to adapt to the ongoing changes in engineering and remain open to innovation. Today, the field must evolve even further to meet the growing demands for advanced technologies that often surpass the current knowledge of engineers. Embracing change is essential.

Guiding Strategies

- Reengineer engineering education.
- Asking these questions
    - How can we make our processes more effective more quality conscious, more flexible, simpler and less expensive?
- Quality is measured in terms of product (did we meet our specifications?) and the process (is it simple, integrated, efficient?)
- The desired outcomes should include an enhanced educational experience for engineering students, opportunities to pursue engineering as a liberal education, and, in the systems context, program changes and/or efforts by engineering educators that engage and support K-12 faculty, enhance public understanding of engineering, foster technological literacy of the public, and elevate the stature of the profession.
- Most engineers have only a 4 year bachelor's degree.
- 98% of engineering students who switched from engineering to another major cited poor teaching as a main reason.
- Attention to teaching, to how students learn and to student mentoring is important for enriching the undergraduate experience.
- Engage engineering faculty leaders in consideration of how to reward attention to and excellence in such activities.
- How students learn as well as what they learn should be addressed to ensure that students learning outcomes focus on performance characteristics need for future engineers.
    - Better alignment of engineering curricula and the nature of academic experiences with the challenges and opportunities graduates face .
    - Better alignment of faculty skill set =s with those needed to deliver the desired curriculum in light of the different learning styles of students.
- Engineers and colleagues have found it difficult to evaluate the new approaches to engineering education due to their lack of data.

- An emphasis on how people learn coupled with good resources from engineers can help boost future engineers.
- By focusing on research on learning, we will be able to understand:
    - how to serve students with different learning styles;
    - why specific approaches and pedagogies work, for example, how research as undergraduates serves learning goals such as personal development, knowledge synthesis, development of skills such as data collection and interpretation, design and hypothesizing, information literacy/computer literacy, and teamwork;
    - how to help students clarify, refine, and confirm their career goals and enhance their preparation for career/graduate school, if appropriate;
    - how to help them become responsible lifelong learners;
    - how information technology can support student learning.
    - how they can best learn the specific skills required for the practice of engineering in the twenty-first century.

Communicate

- Communication between engineers and those teaching future engineers is imperative if we plan to create a better understanding of engineering.
- It is important to help the public understand the breadth of engineering as well as its depth. Many consider engineering to involve, among other things, the application of scientific principles to the solution of human challenges. For a long time the scientific principles of interest were those of the physical sciences.
- Fields of information technology and the life sciences have led to increasing exploration of engineering as an application of these separate, yet related, sciences. Engineering education options open to students are thus expanding, and communicating the nature of those options is essential to attracting the most talented students.

Guideposts to the Future

- Collaborations can help us learn about the processes of collective goal setting; of designing, implementing, and assessing curricular and pedagogical approaches; and of using technologies to enhance learning.
- A significant classroom technology is the sharing of ideas, materials and resources relating to the courses or labs.

- STEM Fields all deal with the same trends.
    - Awareness of exposure to S.T.E.M during undergraduate career.
    - Momentum toward integrating research and education so all students have access to discovery- based, problem-solving learning experiences.
    - Student demographics with greater diversity from perspectives of academic preparation. Celebrate diversity as much of the population will continue to guide this way as time goes on.
    - More opportunities afforded by new technologies to transform the learning environment.

Specific Programs and mechanisms

- There have been a few projects over the years that have driven a big push towards engineering but its not enough. Our current engineering curricula is not creating efficient enough engineers.
- There have been a few programs that are rapidly building on the curricular units, like teach engineering. These efforts are showing real progress in changing the public understanding of engineering who are knowledgeable and prepared academically for its rigors.
- Retention in engineering has continued to decline for all engineers.
- One perk is that there can be multiple engineering tracks that serve different end purposes. This can peek interest with multiple different types of people.

Recommendations

- Student must build technical excellence
- They also need team skills, communication, ethical reasoning and societal and global contectual analysis skills.
- The engineer must continue to educate themselves on the ever changing world.
- Engineering schools should use the flexibility of outcomes-based accreditation to try new ideas in undergraduate programs.

- No matter what new approaches are used in the four-year engineering program, the core of engineering: designing, testing, and improving—should be taught from the very beginning, even in the first year.
- Engineering education leaders, such as the Engineering Deans Council, should support and reward research in engineering education. This research helps faculty connect more personally with

students, understand how they learn, and discover teaching methods that inspire them.

- New standards for faculty qualifications and expectations. Create or adapt professional development programs to support the growth of engineering faculty.
- In addition to teaching technical content, engineering schools must help students learn how to learn and promote lifelong learning.
- Engineering schools should include interdisciplinary learning at the undergraduate level instead of limiting it to graduate programs.

- Engineering educators should create case studies of real engineering successes and failures and use them appropriately in both undergraduate and graduate programs
- Four-year engineering schools should take responsibility for working with local community colleges to ensure smooth and effective transfer from two-year programs.
- U.S. engineering schools must develop programs to encourage/ reward domestic engineering students to aspire to the M.S. and/or Ph.D. degree.
- Engineering schools should contribute to a national effort to strengthen math, science, and engineering education in K-12 schools
- The engineering education community should join a national effort to increase public understanding of engineering and technology literacy.
- NSF should gather, or fund the collection of, comprehensive data from engineering departments. This could include retention rates by gender and ethnicity, reasons students leave, graduation rates, time to degree, and post-graduation employment or graduate school placement.

A Brief Summary of Cooperative Education: History, Philosophy and Current Status

By: Thomas M. Atkins

- Experience is required for so many jobs and many employees and employers agree.
- It is important to give everybody the relevant experience needed to get a job in the workforce once finishing their undergraduate.
- Corporative education gives these experiences and enables students to achieve much more than their counterparts who are educated the traditional way.
- Two important components of cooperative educations are the selction of workers and interest in student working habits.
- Corporative Education is
    - Will lead to bachelor’s, masters, or doctoral degree.
    - Students have to option to alternate periods of attendance.
    - Employment is constituted as a regular, continuing and essential element in the educational process.
    - Employment should be related to the branch in which the students field of study is.
    - Diverse employment will result in diverse experience.

    - Work assignments will have an increasing level of responsibility on work teams.
    - Requirements are a minimum numbers of hours and minimum standard of performance.
- Five specific aims of cooperative education
    - Provide direct and practical experience with the implementation of real world projects and developments across career fields.
    - Help students understand and appreciate the perspectives and challenges of working people.
    - Allow students to test their career aptitudes through direct, hands-on experience in industry.
    - Ease students' transition from academics to the demands and conditions of the workplace.
    - To prepare students for higher-level administrative and operational roles.
- The experience of a job is sometime more beneficial than the monetary value of the job.
- In the 1900's they began corperative learning and students alternated between work and school at longer and longer intervals.
- Some Internal and external problems began to arise.
    - Hesitant faculty
    - Schduling and alternating patterns
    - Mandatory verus optional programs
    - Funding
- As time progressed it becam apparent that sharing ideas and concerns benefited the professionals.
    - Advantages of corporative learning to students
        - Enhances classroom learning through practice.
        - Confirms or redirects career decisions
        - Helps cover education costs
        - Expands job opportunities
        - Teaches communication, teamwork, career assessment, writing and interviewing.
        - Encourages students who might not pursue higher education.
    - Advantages of corporative learning to employers
        - Provides a wealth of well- prepared employees.
        - Allows real time performance to guide hiring.
        - Stregthens relationships between businesses and colleges.
        - Make recruitment and train more cot- effective
        - Facilitates technology and knowledge transfer.
    - Advantages of corporative learning to postsecondary institutions
        - Expands educational opportunities by intergrating workplace learning
        - Builds positive connection between school and industry.
        - Allows more students to enroll with out expanding physical facilities.
    - Advantages of corporative learning to society
        - Makes education more relevant by connecting classroom learning to real- world experiences.
        - Promotes respect for work.

    - Prepares the future workforce to compete.
- Over the years cooperative learning programs lost funding and schools could not longer continue to have them. They have declined to under 100 schools but many students still benefit from the programs.

The Global Engineer

By: Linda Katehi

- Having to outsoruce our engineering jobs to those from other countries reminds us that our current education is nor setting our students up for success nor retaining them as they continue.
- History shows us that future in the engineering field follow cultural, social and political changes in the environment.
- Projections say in the future engish will not be the common language and it will be primarily females working in these fields.
- Engineers will face completely different problems then the ones we face today.
- Many US engineers will be based in other parts of the world and will have to travel to meet clients. They will represent a minority culture and will need to be open to diversity.
- They will have to address a variety of problems, from creating means of communication among indigenous groups, reducing or eliminating poverty to providing transportation to addressing environmental problems. The list is diverse and will require a variety of skills.
- US engineers will need to become global engineers. They will need to be self motivated, self intiated learning have to be aware of socioeconomic changes and apprecitate the impact of these changes.
- Curriculum is too narrowed it is focused more on the successes rather than changes of the future. We talk more and more about fewer things. The solutions we have created do not lead to changes but rather pointless.
- Addressing poverty and health care on a global sclae and accepting social responsibility will be a matter of survival for the future.
- The unfortunate part is that engineers must prepare for solving unknown problems and not addressing assumed scenarios. The emphasis should be placed on teaching and understanding more than providing more knowledge about something specific.
- Engineers will need to think analytically more than memorizing facts and equations.
- Currently engineering curricula has focused on creating scenarios pr predicting problems we expect to face. It focuses entirely on the knowledge rather than the skills.
- In a scenario free future, no problems are anticipated and possible opportunities instead skills are developed rather than specific knowledge.
- The end goal is have curricula that is more focused on how to learn rather than what is learned. How to apply the learning given will be more apparent if we expect to make successful engineers.
- We need to work on solving the important problems poverty, connections between member of society and focus on the tools that will improve the quality of life.