



Students' selection of topics for a professional development course

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Introduction

To be successful in their careers, engineers need to be proficient in both technical and nontechnical skills. ABET's student outcomes reflect both of these categories. Five of the eleven a-k student outcomes¹ can be considered predominantly technical: (a) an ability to apply knowledge of mathematics, science, and engineering; (b) an ability to design and conduct experiments, as well as to analyze and interpret data; (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; (e) an ability to identify, formulate, and solve engineering problems; and (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. The other six deal with skills that are more nontechnical involving leadership, management, and interpersonal skills: (d) an ability to function on multidisciplinary teams; (f) an understanding of professional and ethical responsibility; (g) an ability to communicate effectively; (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context; (i) a recognition of the need for, and an ability to engage in life-long learning; and (j) a knowledge of contemporary issues. Often these nontechnical skills do not receive as much emphasis in undergraduate engineering education and instead must be learned on the job, learning "soft skills the hard way"². Opportunities do exist in current engineering curricula to better integrate the development of these nontechnical skills into students' experience. These include team projects in capstone design and freshman design courses, engineering study abroad courses, service learning projects in both formal and informal settings, and those courses with titles such as "Professional development", "Professional aspects", "Ethics and professionalism", "Leading in engineering organizations", "engineering teamwork seminar", etc.

This paper describes an undergraduate professional development course, currently required within the Ohio State University's program for the Bachelor of Science in Food, Agricultural, and Biological Engineering, which has the following goals:

- Prepare students to enter the engineering profession by developing improved personal skills and confidence for interviewing and pursuing professional licensing
- Introduce professional development business topics
- Instill the need for life-long learning after graduation
- Explore ethical expectations within the engineering profession
- Enable students to reflect upon and articulate what they have learned during their engineering education.

The official course description of the course is “Professional development related to food, agricultural, and biological engineering; business communication skills for professional advancement; engineering ethics; health and safety; and the engineer’s responsibilities to society. The course is taught annually and is structured to explore several instructor-determined topics during the first half of the semester, followed by those topics selected by class consensus for the second half of the course. The topics that are included in every offering of the course (i.e., the instructor-determined topics) are the following:

- Professional business communications: Resumes, cover letters, memos, letters, proposals, reports, emails, professional portfolios ^{3,4,5}
- Professional licensing and ABET
- Planning for graduate school
- Job interviews, follow-up letters and calls, and evaluating job offers ^{3,4}
- Engineering ethics ⁶
- Occupational health and safety for engineers

The second half of the course highlights professional skills and business practice topics relevant to the engineering profession and to that particular group of students enrolled in the course. The specific objective of this scholarly study was to examine ten years of data on the students' selections of professional development topics they found most relevant to themselves at this stage of their careers. These selections were made by class vote (on-line and in person) and have shown the changing interests and priorities of students in biological and agricultural engineering over the span of a decade.

Methods

The selection of those topics is made during the course's first and second meetings of the semester. The class is presented with 24 to 28 topics, many of which are industry-identified professional competencies.⁷ Although only seven of these topics can be covered in any given semester course offering, having a long list of candidate topics exposes the students to the breadth of potential topics available for study in this course, and by extension, later in their professional careers. The students are encouraged to add topics to this list, and so the list of candidate topics has expanded over the years. Potential topics are discussed in class, and any student questions are addressed. Students are then encouraged to vote for their top seven choices using an online survey tool. Any ties are broken with an in-class vote the following week.

As part of the learning activities in the course, students complete a weekly worksheet with questions specific to that day's topic. This also allows students to be more active in their learning and serves as a springboard for pair sharing and whole class discussions. The main deliverable for the course is a professional student portfolio⁸ showcasing students' best work over their college careers, organized by ABET a-k outcomes.^{9,10}

Results and Discussion

Table 1 presents the choices that various classes have made over the ten years from 2005 to 2014. This course was offered under quarters during years 2005-2011. The Ohio State University changed to a semester calendar in the summer of 2012, so the last two offerings of this course (2013-2014) have been under semesters.

Table 1. Professional skills and business practice topics from which students choose

TOPIC	NUMBER OF TIMES SELECTED (out of 10 years)
1. Action orientation (being proactive, taking initiative, maintaining energy and drive)	1
2. Compassion / Understanding others (interpersonal skills)	
3. Conflict management	2
4. Conflict-of-interest (minimizing and managing COI)	(new topic option for 2014)
5. Decision-making	2
6. Difficult conversations (dealing with difficult people)	9
7. Dress for Success: Building a professional wardrobe	(new topic option for 2014)
8. Engineering contracts and documents (Plans & specifications, cost estimates, and bid documents)	6
9. Intellectual property and patent protection	1 (new topic option for 2014)
10. Law and engineering (Reducing professional litigation risks, engineering errors & omissions insurance, expert witnessing)	7
11. Leadership	2
12. Listening	
13. Managing change and innovation	
14. Managing diversity	
15. Negotiation	6
16. Organizational skills	
17. Personality types	1
18. Perspective / thinking globally	
19. Planning	
20. Process / systems management	
21. Professional social networking	1 (new topic option for 2014)
22. Results orientation (Focusing on the bottom line)	

23. Self-knowledge / Self-development	
24. Sizing up people	4
25. Strategic agility	
26. Teamwork and team meeting dynamics	2
27. Time management and priority setting	
28. Work / Life balance	6

As indicated by Table 1, some topics are predictable selections most years. Nonetheless, in any given year there is always at least one topic chosen that is new to the instructor. Sometimes a guest lecturer can be invited, but more often, it becomes an opportunity for learning, growth, and modeling what it is to be a life-long learner. It is also helpful under those circumstances to have a good network of professional contacts in the human resources and executive coaching professions.

The most popular topics over time have been, in order of popularity: (1.) Difficult conversations, (2.) Engineering and the law, (3a.) Engineering contracts and documents, (3b.) Negotiation skills, and (3c.) Work-life balance. Although "Difficult conversations"¹¹ continues to be the perennial favorite, it is interesting to note those topics which were not chosen in earlier offerings of the course but are now becoming as predictable a selection as "Difficult Conversations," the top choice in 9 out of 10 years. "Work/ life balance" is an example of this kind of topic, which was of little interest to earlier generations of students but is now of vital interest to today's students of both genders.

Inviting students to design half of their own course has led to increasing buy-in and student engagement. In course feedback questionnaires, students say they would have liked the course to have more contact hours and more time to discuss these topics that are rarely touched upon in their engineering education and yet are very important to their professional success.

Conclusions

An undergraduate course in engineering professional development can be mutual learning experiences for students and teachers alike. The selections students have made, when given the opportunity to design their own course tended to emphasize interpersonal challenges (difficult conversations and work/life balance), business topics (negotiation, contracts), and legal issues for the engineering professional. It has been important for the instructor also to be actively engaged in their own professional development, as student interest in specific topics can and do shift over time, reflecting the different individual experiences represented in each year's class, and also changing cultural trends and sensitivities.

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