A SEMINAR COURSE ON PROFESSIONAL DEVELOPMENT

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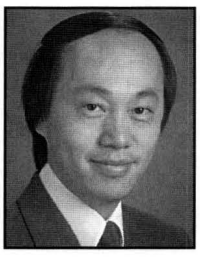
Practicing engineers have long known that it takes more than just technical competence to succeed and advance in a career. This fact was most recently acknowledged by the Accreditation Board for Engineering and Technology (ABET) in its Engineering Criteria 2000. Besides reaffirming the importance of mathematics, science, engineering, and design in an engineering curriculum, ABET explicitly lists other educational objectives such as the ability to function on multidisciplinary teams, an understanding of professional and ethical responsibilities, the ability to communicate effectively, a knowledge of contemporary issues, and the acquisition of a broad enough education to enable the student to understand the impact of engineering solutions in a global/societal context.

One of the challenges that engineering educators face is how to achieve these desired outcomes within the constraints of a four-year curriculum. One possible solution is to break the problem into two parts: first, we must make our students aware of the importance of non-technical skills, and second, we need to help them develop these skills through meaningful exercises that are integrated into their technical courses.

In order to raise the students' awareness of professional skills and to provide them with some context of an engineering education, in 1997 we introduced a 2-unit (equivalent to 1-credit) course that juniors are required to take in the fall semester. In this article, I will share my experiences in teaching this course for the first time.



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ORGANIZATION OF THE COURSE

Course Objectives

The class meets once a week for fifty minutes. Through a series of 11 discussions, I expect my students to

- *Articulate what they would like to get out of a college education and what kinds of careers they would like to pursue*
- *Identify their strengths and weaknesses*
- *Develop skills that will make them better students in the near term and better workers in the long term*
- *Become more confident in finding their first jobs*
- *Be in a better position to make the transition from the college to the next phase in their lives*

Simply put, the course is about professionalism and about the skills that are essential to having a productive career.

Textbook

I adopted *The Career Tool Kit: Skills for Success*[1] as the textbook for the course. As stated on its back cover, the book "develops the practical and interpersonal skills essential in modern business settings." The course schedule (see below) roughly follows the flow of the ten chapters in the book. We only had time to cover selected sections of each chapter in class, but I asked the students to read through the entire book. I also told the students about several other books that cover similar topics.[2-5]

Schedule

We spent each week discussing a particular topic. The key word here is *discussing*. In each class meeting I gave the students a handout listing several items for discussion. After

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providing some background for the chosen topic, I became more like a moderator than a lecturer, encouraging the students to express their viewpoints and sometimes even encouraging them to argue with each other. The topics and selected discussion items are shown in Table 1.

The order of these topics follows the chapters in the book, but there is some flexibility in moving the topics around. Certain topics follow each other naturally; for example, time management and money management fall into the grouping of "resource management." In the two weeks that I was out of town, I arranged for two guest lecturers to speak with the students. One was a writing consultant who talked about writing as an intellectual exercise, and the other was a career consultant who did a workshop on internships.

Because of time constraints, I chose not to repeat certain topics that students had already been exposed to elsewhere in our curriculum. For example, professional ethics and resume writing, two topics that would normally belong to a course on professionalism, are covered in our first-year introductory course and our sophomore seminar course, respectively. Together, these three courses provide a firm foundation for the professional development of our students early in their college careers.

TABLE 1
Items for Discussion

Universal Work Skills
- Skills needed by the American work force
- ABET Engineering Criteria 2000
- Life-long learning

Self-Image and Motivation
- Self-esteem
- Self-confidence
- Commitment
- Integrity

Diversity in the Workplace
- Being adaptable
- Being tolerant
- Being thoughtful
- Being unprejudiced
- Being empathetic

Setting Priorities and Managing Time
- Setting goals
- Taking inventory
- Identifying time wasters

Budgeting and Investing
- Gross vs. net income
- Fixed vs. discretionary expenses
- Savings vs. investment

Concentration and Memory
- Staying focused
- Avoiding distractions
- Making associations
- Using mnemonic devices

Communication
- Communication in building and maintaining relationships
- Nonverbal communication
- Getting along with people

Staying Focused and Managing Stress
- Keeping promises
- Avoiding procrastination
- Taking care of yourself

Networking and Tracking Down Career Leads
- Establishing contacts
- Finding mentors
- Talking with people
- Job searches

Interviews
- Things to do before, during, and after an interview

Making the Transition to and Moving Up in the Workplace
- Striving for excellence
- Taking the initiative
- Being adaptable
- Continuing to grow
- Looking at the big picture

Grading Criteria

I designed the grading system in such a way that students don't have to compete with each other. Instead, everyone was given 100 points at the beginning of the course and lost points only when they displayed "unprofessional behavior," defined as

- *Missing a class (minus 5 points)*
- *Showing up late for a class (minus 3 points)*
- *Turning in homework late (minus 3 points)*
- *Turning in homework that is unsatisfactory or missing one (minus 5 points).*

The penalty was not imposed if the student provided me with a valid excuse (*e.g.,* medical reason) in writing.

I told the students that I would hold myself to the same professional standard, *i.e.,* that they each would get 5 points if I missed a class without prior notice or a valid excuse, showed up late for class, or did not return their homework in the following class meeting.

At the end of the semester, a student who lost less than 11 points received an A; less than 21 points, a B; 31 points, a C.

Homework

Students were required to submit an essay after each class meeting. The essays were graded satisfactory/unsatisfactory; the guidelines for a satisfactory essay were

- *It should be no more than one page long*
- *It should be professionally formatted and presented*
- *It should be well written (at least free of typographical and grammatical errors).*

Other than giving students ample opportunity to write, the essay assignments were intended to encourage them to be reflective, a point that is best demonstrated by the following examples:

- *"Describe two accomplishments that you are most proud of and explain briefly why. These accomplishments can be things you did at home, at school, in a job, or in a hobby."*
- *"State two of your short-term and two of your long-term goals. Describe the extent to which these goals have been influenced by others (your family, friends, or teachers)."*
- *"Identify two items in our discussion on savings and investment from which you gained the most. For each of them, indicate how you plan to use this information to shape your behavior when you start your career."*
- *"Think of an instance in your life when miscommunication has cost you time, money, or peace of mind. Analyze the situation and describe the cause for miscommunication and how it could have been avoided."*
- *"Identify an idea that meant the most to you from our discussion in class. Give an example of how you will use that idea in order to achieve success in your career. Indicate specific changes you plan to make as well as how you will continue, or reinforce, existing behavior."*

Time Commitment

Students spent, on average, less than two hours a week outside of class on the reading and writing assignments. For myself, the time spent on developing the course was comparable to that needed for a typical technical course on a per-credit basis, but it actually took less time to teach the course than it does a technical course because there were no problem sets or exams.

EVALUATION OF THE COURSE

Essays

Reading the students' essays each week was one of the most enjoyable grading experiences I have had as a teacher. First of all, it was clear from the essays that most of the students paid attention and followed the discussion in class. More importantly, students were uniformly open and honest in expressing their views and sharing their life experiences. In fact, I came to know many students in the class very well by reading their reflective essays—quite an accomplishment in a course where I met with the fifty-two students only one contact hour a week. Throughout and after the course, many students asked me to write letters of recommendation for them—another indication that the format of the course promoted student-faculty interaction.

Grades

At the end of the course, 47 out of the 52 students received A's. Although a student could miss one class and one assignment and still get an A, 21 of them did not lose a single point! I found this to be encouraging because it showed that students could and would meet high expectations that were clearly articulated to them.

Students' Comments

I conducted a mid-semester evaluation and found that at seven weeks into the semester, most of the students felt that they understood the goals of the course and what was expected of them. They also found continuity among the lectures, the reading assignments, and the homework. At the formal end-of-semester course evaluation, the students gave an overall course rating of 4.5 out of 5 (for comparison, the department average is 4.0 and the university average is 4.1). Perhaps more telling are the students' (voluntary) comments, some of which are reproduced below.

> *"The course really prepared me for the professional life. I really believe the material from the course is worth keeping for life."*
>
> *"I felt that this course has helped me grow as a person and has significantly aided me in learning how to be successful in my job search and in my career."*
>
> *"This course must definitely stay since it really helped in getting to know what the real world is like."*
>
> *"I liked this course because we discussed things that we never learn in other classes. I definitely think I benefited from this class."*
>
> *"I thought this class was a really good use of our time. This has been my most beneficial class so far in college."*

Students also made specific recommendations for areas that they felt needed improvement. For example, many of them found the textbook not to be very useful. In retrospect, I could have chosen a book intended for an audience closer to chemical engineering juniors at Carnegie Mellon (for example, reference 4). And despite my conscious attempt not to lecture in class, many students felt that there should be more time spent on discussion, especially among the students themselves. I later realized that most of the discussion did take place between students and myself.

Pre-Test and Post-Test

The critical question, of course, is whether the course helped students to learn. For that purpose, I conducted a pre-test and post-test by asking the students to answer the following questions both at the beginning and at the end of the semester.

- *What are the essential skills necessary for a successful career in engineering?*
- *What personal qualities can enhance or detract one's success?*
- *How do you set goals and prioritize?*
- *What time management strategies do you use, if any?*
- *What communication strategies can enhance relation-*

ships? Hinder relationships?

- *What is networking (in the human sense) and how can you best accomplish it?*
- *What should you do before, during, and after an interview?*

Note that these questions were designed to test only for increased student awareness of the important skills (which, after all, was the course's main goal) and not for actual mastery of these skills. Furthermore, these questions do not provide a direct correlation to all the course objectives stated earlier. Despite these caveats, an analysis of students' answers (done by an independent, objective assessor[6]) showed that the course was most effective in increasing student awareness of issues related to the interview process, goal setting and prioritization, and effective communication; it was less effective in helping students to identify the skills and qualities that would most help them to be successful in their careers, and in teaching them networking skills; and it was least effective in conveying information regarding time management strategies.

In most cases there is a correlation between a course's effectiveness and students' prior knowledge (as shown in the pre-test). In other words, if students have good prior knowledge about a particular topic (such as time management), then the course was less likely to enhance their knowledge in that area. This finding may be simple common sense, but it highlights the importance of assessing prior knowledge in the planning stage of such a course. Overall, the course did add some value, even though many of the students had at least *some* good prior knowledge on every pre-/post-test question.

SUMMARY

I must admit that I approached the teaching of this course with some trepidation, not knowing how well chemical engineering students would react to a "non-technical" course offered by their home departmant, let alone a course that involved numerous writing assignments. The fear turned out to be unfounded. Students reacted very positively to the discussion of issues that are relevant to their study, their lives, and their careers. They participated actively in class discussion, wrote openly about their aspirations and fears, and were delighted to have the opportunity to place their education in context. I encourage other departments to consider offering such a course to their students. My course syllabus can be found at

http://www.andrew.cmu.edu/course/06-208

REFERENCES

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2. Harris, C., *Hired! The Job-Hunting/Life-Planning Guide,* Prentice-Hall (1996).
3. Wilkes-Hull, M., and C. B. Grosswait, *Professional Development: The Dynamics of Success,* Fifth Edition, Wadsworth (1996).
4. Goldberg, D.E., *Life Skills and Leadership for Engineers,* McGraw-Hill (1995).
5. Kravetz, S.,*Welcome to the Real World: You've Got an Education, Now Get a Life!* Norton (1997).
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BOOK REVIEW: *Thermodynamics*

Continued from page 223

and Bridgman relations are very concisely and logically developed in Chapter 7, together with an excellent discussion of the Clapeyron equation. Chapter 8 uses the derivations of the previous chapter to develop relations for properties of real fluids using each of the PvT relations of Chapter 3 to derive departure functions for both gases and liquids. Graphical and equation representations are given. Property tables and diagrams are briefly discussed.

Chapters 9 through 13 deal with phase equilibria. The first chapter defines and calculates partial molar properties, chemical potentials, and fugacity coefficients, the latter by applying the definition to the various equations of state. Mixing rules and calculations of both thermal and equilibrium properties for real fluid mixtures follow. Chapter 10 discusses stability of equilibrium systems as well as pure fluid phase transitions, vapor pressure, and the phase rule.

Properties of solutions from ideal to very nonideal, simple phase equilibria predictions, and the full Gibbs-Duhem equation and its use, including derivation of excess free energy models for activity coefficient correlation, are given in Chapter 11, together with activity coefficient prediction methods.

Chapter 12 discusses vapor-liquid equilibrium in a methodical and logical way and is a high point of the book. Basic relations used to equate fugacity for both low-pressure and high-pressure systems are detailed with many examples. Tests for VLE thermodynamic consistency are discussed. Qualitative discussions of both vapor-liquid and vapor-liquid-liquid equilibria are discussed and illustrated. A short treatment of dilute solution laws and liquid-vapor-solid solubilities is contained in Chapter 13.

Chemical reaction equilibrium is the subject of Chapter 14, which discusses basic free energy-equilibrium constant reactions, homogeneous gas reactions and the effects of variables, adiabatic reactions, and phase-rule analysis of and calculation of equilibrium for simultaneous equilibrium reactions. A short discussion of simple liquid phase and heterogeneous reactions concludes the chapter. This chapter could be improved by including more material on solid-gas reactions and a discussion of solution of simultaneous reaction equilibria by free-energy minimization.

Appendices include pure component data properties from various sources as well as thermodynamic data for steam and common refrigerants. The pure component data section should be updated to the data now accepted as the most accurate.

In summary, the book is a credit to the author and to his profession. In my opinion, it is definitely competitive with the leading first textbooks in chemical engineering thermodynamics. Faculty, students, and practitioners will all find material of value. The only negative is that the book is softbound and poorly glued; my copy split after very little use. ❐