ChE curriculum

JUST A COMMUNICATIONS COURSE?

Or Training for Life after the University

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Today, many chemical engineering curricula include courses in strength of materials, electronics, heat and mass transfer, reactor engineering, plant design, economics, communication skills, etc. Competence and technical expertise alone, however, will not guarantee graduates (or, as a matter of fact, anyone) a job in today's economy. We should not only teach our students the necessary tools to enable them to survive in a work environment but we should also assist them in their transition from the university to industry. While there are career placement services on almost every university, their success in helping students find suitable employment after graduation is usually limited.

Having noted these difficulties in the past, I felt a need to become more actively involved in assisting students to find employment. Our students are now being given an early opportunity, as part of a two-credit-hour course in "Communications and Information Systems,"[1] to learn more about technical report writing, oral presentation skills, computer applications, and life after the university.

Many publications have been written on the subject of developing good communication skills.[2,3] This paper discusses the techniques used to teach students the principles of critical thinking, communication skills, and up-to-date com-

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TABLE 1
Course Objectives (Short Version)

You will bring your own interests and we shall discuss how they may be incorporated into the ChE 1014 course. We have an academic responsibility also to ensure that we aim for certain learning objectives and, for this course, those objectives are as follows:

1. Development of communication skills through oral and written presentations.
2. Familiarization with current information technologies.

Learning Objectives

Learning at this stage of your education means the development of critical skills. In this course, therefore, you will be

- ► articulating facts, concepts, principles, and rules;
- ►problem solving in real life situations;
- ►using effective communication skills;
- ►interacting productively in small and large group settings; and
- ►enjoying yourself too!

The Tools

We shall select practical examples to illustrate the principles of critical thinking, communication skills, and up-to-date computer technologies. The main part of the course shall be centered around the area of "Job Hunting." The following steps will not only describe the course structure in more detail but also present a possible application of the material studied to a real-life situation.

- ► *Career Assessment - the most critical phase in the whole process*

  We shall discuss the various aspects in the area of Critical Thinking Skills and how we can make good use of it at home, in school or in a work environment.

- ► *Decision Making - all about choices*

  In order to make educated decisions one must have access to pertinent information. We shall explore different ways of obtaining the necessary information, e.g. libraries, databases and the Internet.

- ► *The Résumé—a very effective marketing tool*

  The development of a great résumé requires of computer technology. We shall familiarize ourselves with the use of various computer applications such as word processors, databases, etc.

- ► *The Job Market*

  You will present in a 10-minute oral presentation some detailed information on the industry of your interest. We shall explore the use of overhead transparencies and computer-based presentation techniques. In addition, you will be given an opportunity to summarize your findings in the form of a technical report.

- ► *The Cover Letter*

  The writing of cover letters, i.e., letters of transmittal, is an important part in an engineer's working life. We shall learn about the various styles of cover letters.

- ► *The Interview*

  We shall reinforce our critical thinking skills, learn about active listening, observe and diagnose verbal and nonverbal messages, and, most importantly, learn how to handle problem (stress) situations. Practice interviews will assist in refining these skills.

- ► *The Tale of a Success Story*

  At this stage, the course is coming to an end. You have not only learned about various computer applications, literature searches, oral and written presentations, and critical thinking skills but, more importantly, you have had an opportunity to apply of these techniques to different situations in your daily life.

TABLE 2
Six Thinking Hats (Reference: Edward deBono[6])

Color of Hat	*Characteristics*	*Questions*
White	Facts, figures, objective material, . . .	What information do I need to make a decision? How can this information be obtained?
Red	Feelings, emotions, intuition, . . .	How do I feel about it? What does my "inner voice" say about this?
Black	Logical negative arguments, . . .	What are the risks? What does "Murphy's Law" say about this?
Yellow	Possibilities, opportunities, . . .	What are the advantages? What is the best-case scenario?
Green	Creative new ideas, . . .	Can I come up with a more innovative approach?
Blue	Master control for the thinking process	Summarize results Review of results

Name:_____ Date:___/___/___

TABLE 3
Suggested Career-Related Topics to Think About

Topic	*Results from the Six Thinking Hats*
Intellectual challenge	
Meaningful work	
Opportunity to learn new things	
Sense of achievement	
Creativity	
Interpersonal relationships	
Salary	
Benefits	
Job Security	
Social Status	
Promotions	
Opportunity to travel	
Personal growth	
Independence	
Fast-paced	
Future power	
Variety of tasks	
Exciting, stimulating	

1. Study the ten most important value items; do you notice any specific patterns?

2. Develop an "I can do" list by identifying some actions that will integrate your expectations in educational strategy.

Name _____ Date _____

puter technologies based on real-world applications such as "finding the right job." The course objectives are outlined in Table 1. The following steps highlight the techniques used to achieve these goals:

► *Critical Thinking Skills*

S. R. Covey[4] discusses the four unique human endowments of imagination, conscience, independent will, and self-awareness. Imagination, as defined by Covey, is "the ability to envision, to see the potential, to create with our minds what we cannot see at the present with our eyes." This ability does not come naturally, but it can be learned. The Critical Thinking Skills segment of this course provides the students with insight in the decision-making process. Some of the techniques discussed in detail are ones described by Covey,[4] deBono,[6] and Butler and Hope.[5] These techniques aid students in discovering more about themselves.

In one exercise, based on deBono's approach, each class participant is asked to imagine six colored hats. Each hat represents a role one's mind plays in the critical thinking process. By switching from one hat to another as one thinks about a topic, the learner is forced to look at the topic from a variety of perspectives.[5] For the exercise, the students start with six sheets of paper—one for each hat. They select a topic or problem that they would like to think about or work on. Each participant decides which of the hats would be good to start with and then works his/her way through all six, writing down notes on the thoughts that come to them with each hat. Table 2 identifies the six hats, their characteristics and some of the questions one should ask with each one.[5] The students may think of other questions as well.

If the learner has worked a problem through all six hats and has written down at least three points for each, he/she will know that all the major points in the critical thinking process were covered. Table 3 presents some sug-

gested career-related headings that may be used to explore the critical thinking process.

This and similar exercises will not only help the students learn more about themselves but they can also aid the students in identifying their long-term career objectives. A significant increase in self-awareness can be observed over the course of the term.

► *Computer Applications*

In this part of the course various computer applications, such as word processors, spreadsheets, databases, e-mail and Internet tools, are introduced to the students. Guidance is provided through the use of slides, handouts, and extensive hands-on exercises.

► *Obtaining Information*

Information Technology is the buzzword of the 90s, and in that vein, an in-depth summary called "The Retrieval of Information" is presented to the students. Among the topics discussed in class are library and CD ROM searches, organization of database systems, and "how to surf" the Internet.

Assignments in this section focus on topics such as "Retrieve information about injection molding of polymeric materials," or "Retrieve the latest information in the area of pulp bleaching." The search results are then reported, as discussed below, both orally and in the form of a written report. The added benefit of these exercises is that the students are, at the same time, also broadening their knowledge in the general area of chemical engineering.

► *Technical Writing*

In this section of the course, topics such as technical writing and document layout are introduced to the students. The assignment topics (technical reports) are based on information retrieved in the Obtaining Information section, and in addition, the students are introduced to different types of résumés.

One approach that has proven to be successful (but by no means the only appropriate model) can be found in "The Job Hunting Guide."[7] Excerpts of this document are shown in Table 4. Guidance is provided in the résumé development process through slides, handouts, and hands-on exercises. The most important part of this document is the Objective section. Here the writer addresses the very important issues of "What skill do I bring to this position?" and "What can I do for the Company?" The insight obtained in the section on Critical Thinking Skills will guide the participants in the development of this subsection.

TABLE 4
The Résumé
A Very Effective Marketing Tool

The next step, after having successfully completed the career-planning phase, is the development of a résumé. If developed properly, it can be a highly effective marketing tool. Its two main purposes are to advertise your availability and to supply information to the recruiter.

How should a résumé be prepared? Perhaps the most important thing to remember is that the format must capture the recruiter. It should enable the recruiter to quickly find the key points. Clear headings, off-white paper, and point format are desirable. Remember that you will have less than ten minutes to prove to the person that you are an exceptional candidate. Effective use of language, emphasis on achievements, and quantified experience are thus important aspects of a résumé.

There are three basic formats being used today. The most widely used and accepted format, the chronological style, lists your experiences in reverse chronological order. This style emphasizes your most recent achievements. The functional format lists the duties performed by category. With this style, it is harder for the recruiter to get an instant picture of the candidate. The third type, which is not widely used, is a hybrid of the chronological and the functional format styles.

What key information should a résumé contain? The following eleven categories should be included:

Personal Data • The only data required are your name, addres, and phone number. Your fax number and e-mail address are optional. One would not want to supply information such as religion, marital status, or citizenship. These are 'knock-out' factors that may or may not be used against you. You do not want to limit your chances right from the beginning.

Career Objective • There is some debate on whether or not this section should be included in a résumé. Unless the objective is written carefully, do not include it. This section should show what you can do for the company and NOT what the company can do for you. A sample objective for a person who has participated in a Co-Op Professional Experience Program could read: *"To provide leadership in industrial research and development activities, where strength in superior analysis of data, problem solving, innovation, and excellent communication skills will: design and develop new technologies, provide opportunity for technology transfer, train and motivate staff, and generate results consistent with organizational initiatives.*

Professional Profile • This summarizes your professional experience in a few short sentences. The following could be used as a guideline: *"Engineering experience relating to injection molding, process automation, and the modeling of PET resin drying processes."*

Education • List your education in reverse chronological order. Do not include your high school education if you have a college or university degree.

Work Experience • Describe all the relevant work experiences here. Use action verbs such as *directed, developed, implemented, designed,* and *presented* to describe your accomplishments. Do not forget to include your job titles, times of employment, and the names of your employers.

Selected Achievements • This section should list a maximum of three work/education-related accomplishments in more detail.

Professional Development • This category should include all professional development activities that you have undertaken ouside of the standard engineering curriculum.

Scholarships • List all your scholarships.

Professional Affiliations • Are you a member of a profesion organization? List it here.

Languages • Indicate the languages you know and your level of competence. If you are fluent in English and can "get by" in Spanish, you should write *"Fluent in English and functional in Spanish."*

References • "Available upon request." Do not include the names of your (three) references in your résumé. Prepare the list of references on a separate sheet to be used as a handout during the interview.

TABLE 5
Oral Presentation Evaluation Form

	Comments/Mark
Opening Statements	
• Did the speak state her/his name?	_____
• Did the presenter state the topic?	_____
• Did the presenter state the purpose?	_____
• Did the presenter outline the presentation?	_____
Organization	
• Is there a logical flow or a rambling monologue?	_____
• Does the presentation target the audience?	_____
• Is the presentation informing or merely trying to impress?	_____
Presentation	
• Is presenter enthusiastic about the topic?	_____
• Is the speaking clear or mumbled?	_____
• Is the presentation delivered in a professional manner?	_____
• Was eye contact made?	_____
• Is the talk too long (past target time)?	_____
• Were the gestures distracting?	_____
• Is the speaker still or walking nervously?	_____
• Is the dress code appropriate?	_____
• Is the presentation natural and not read?	_____
Visual Aids	
• Is the layout of the visuals appropriate?	_____
• Do they contain a reasonable amount of information?	_____
• Are they referred to rather than read from?	_____
• Is the grammar correct?	_____
• Are they shown for less than one minute?	_____
Subject Knowledge	
• Does the presenter master the subject?	_____
Closing Remarks	
• Is the objective statement repeated?	_____
• Is the presentation summarized?	_____
• Are proper acknowledgments made?	_____
• Were the questions answered concisely?	_____

TABLE 6
Discussion and Listening Skills

Interviewer: _____
Interviewee: _____
Question: _____
Or question number from list _____

Evaluation of Interviewer	*Needs Improvement*	*Good*	*Short Comments*
Eye contact			
Body language			
Oral communication			
Self-confidence: "Think on your feet."			

Evaluation of Interviewee	*Needs Improvement*	*Good*	*Short Comments*
Eye contact			
Body language			
Oral communication			
Self-confidence: "Think on your feet."			

More detailed comments from the observer should be submitted on a separate sheet.

Name _____ Date _____

A significant amount of effort by the students is voluntarily directed toward the development of this document. This high degree of motivation may be attributed to the fact that they are doing something for their own benefit, *i.e.* they can apply these skills during their studies as well as in their life after university.

► *Presentation Skills*

An emphasis on the development of presentation skills in universities has significantly increased over the past decade.[2,8] In our course, each student is given the opportunity to make a formal presentation to the entire class twice during the term. In a short, three-minute presentation, topics such as "The use of NaCl in the pulp and paper industry" or "Recent developments in the area of power generation" are presented to the whole class. Also, a ten-minute presentation summarizes the results obtained in the "Obtaining Information" section. A detailed discussion on the presenter's performance is scheduled on a one-to-one basis. The Oral Presentation Evaluation Form (Table 5) serves as an aid in this process.

In addition to these "formal" presentations, the students participate actively in short exercises throughout the term. At the beginning of each lecture, one student, selected at random by the instructor, must summarize the previous class in about three minutes. This exercise serves two purposes: everybody comes to class prepared and it gives the students yet another opportunity to hone their presentation skills. In addition to the above described exercises, students enjoy frequently-held "one-minute" impromptu talks.

► *Discussion and Listening Skills*

The way a person asks and answers questions impacts significantly on the working environment. Questioning is a valuable tool and is critical to the oral communication process. Many successful approaches have been described in the literature.[9, 10] The students learn about and practice how to ask, as well as how to answer, two basic types of questions: open-ended and closed-ended.

As the communication process suggests, for communication to be congruent, one has to clearly understand the other's frame of reference. The students gain this understanding by asking questions that will clarify and confirm the messages others are sending to them. After the students were encouraged to engage in discussions, they observe and diagnose the other's verbal and nonverbal messages. Through group exercises and continuous feedback (see Table 6), one observes significant improvements in

the students' performance.

▶ *Real Life Situations*

Employers emphasize that interpersonal and communications skills are as important as technical knowledge. Through group exercises, the students are given several opportunities to practice different interviewing situations. Learning how to ask questions, and learning how to answer difficult ones, does not come quickly. Practice makes perfect. The skills and knowledge obtained in this course help the students to overcome interview anxiety.

DISCUSSION

The purpose of this course is to help students hone their communication skills. In addition, the students will learn more about themselves and their goals. These techniques, tested and refined over many years, work well in both university and non-university environments. When the concept was first being introduced, there were comments from our students such as:

> *We should not only teach our students the necessary tools to enable them to survive in a work environment but we should also assist them in their transition from the university to industry.*

- ▷ *"This instructor is crazy. He is trying to teach us communication skills and at the same time he is asking us to learn more about ourselves!"*
- ▷ *"I am just a second year student. I can't use this concept to go after technical summer jobs!"*

After a few students tried the approach, the following comments were made:

- ▷ *"I got a job using the communication skills and job hunting techniques that I learned in your class."*
- ▷ *"Thank you for your efforts. My communication skills improved significantly."*

Initially, the students have to learn how to overcome their fears. Active support by the instructor is the key in this process. Support begins with the instructor's in-depth understanding of the course material and its adaptation to the specific learning environment.

This course, unlike ordinary lecture courses, requires a significant amount of student/instructor interaction outside the scheduled class time. During the course of the term, the instructor should have several private review meetings with each student. The focus of these meeting should be on working together to achieve the goals that were set out in the course outline. By answering questions, resolving problems, and emphasizing good communication skills, these meetings can help foster an understanding and a strong commitment of the learner to her/his chosen profession. The instructor's responses during the meetings should be positive and supportive. This will help ensure that the established goals are successful and are harmonious with those of the rest of the class.

By the end of the course, the students have not only significantly enhanced their communication skills, which of course is our main objective, but they should have also gained an enhanced self-awareness that will help them along their chosen career path.

CONCLUSIONS

A course such as "Communications and Information Systems" can be taught through the application of real life situations. Although there are currently many discussions being held about the university's role in today's society, the author strongly believes that, if one strikes the proper balance between the economically driven goals (*i.e.,* the education of marketable students) and the more traditional goals of the university (*i.e.,* let's educate great thinkers), this approach will serve the students well in the future. "Let us not lose sight of the results we seek to achieve as we focus of the process of providing relevant chemical engineering education for the 21st century."[10]

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