Introducing Engineering Technology Students to Industry

Ray Bachnak
Texas A&M University-Corpus Christi

Abstract

At Texas A&M University-Corpus Christi (TAMU-CC) we are in the early phases of implementing two B.S. degree programs in Control Systems Engineering Technology and Mechanical Engineering Technology. In spring semester 1999, we developed and taught Introduction to the Process Industry, a new course that covers the process industry terminology and operations. The main goal of this introductory course is to introduce students to the operations, equipment, and organization of industrial facilities. Another goal is to familiarize students with the responsibilities of technicians, technologists, and engineers working in various technical positions. Delivery of the course involved three mechanisms: lectures, laboratory lessons, and field trips. This paper describes how lectures, laboratory lessons, and field trips contributed to accomplishing the course objectives. The paper also presents the results of a survey where students showed satisfaction with their learning experiences but made some important suggestions for improving the course.

Introduction

Engineering and engineering technology programs have recognized the importance of involving industry in the educational process[1-6]. Similarly, the engineering technology curriculum at TAMU-CC includes a two credit-hour introductory course designed to introduce students to the operations, equipment, and organization of industrial facilities and familiarize them with the responsibilities of technicians, technologists, and engineers working in various technical positions. This paper describes the implementation of the course and shows how lectures, laboratory sessions, and field trips contributed to accomplishing the course objectives. The course is offered for a one-hour lecture and a three-hour laboratory per week. The laboratory is mainly devoted to field trips and a safety training seminar, Basic Plus Safety Training, that is taught to our students on campus by the Contractors Safety Council (CSC) of the Coastal Bend.

The course, which was offered for the first time in spring semester 1999, differs from other courses in that it relies heavily on field trips. In addition to contributing to achieving the course objectives, the field trips have other benefits that make them an invaluable component of the course. They, for example, help faculty gain knowledge about current industry tools, practices, and operations and increase exposure of the engineering technology program. This paper describes how lectures, laboratory lessons, and field trips contributed to accomplishing the course objectives. The paper also presents the results of a survey where students showed satisfaction with their learning experiences but made some important suggestions for improving the course.

Role of Lectures and Laboratory Lessons

The lectures and laboratory lessons cover the process industry terminology and operations including basic process principles, plant instruments and equipment, quality control, environmental issues, health and safety issues, and plant organization. Lectures are used to offer an overview of the chapter and to describe in detail the operation of the equipment using schematics and diagrams. Students are expected to read each chapter before coming to class so that they are prepared to participate in the discussions. They are also expected to be ready to describe the operation and design of the equipment.

In the laboratory, students use the Distillation Expert Trainer (DEXTER), an integrated computer-based training system, which consists of lessons, quizzes, drills, a simulator, and help resources. The lessons are comprehensive interactive sessions that cover various aspects of process technology. Each lesson has an associated quiz of 10 to 40 questions. The program keeps records for each student and the instructor has access to reports that show, among other things, the scores on the quizzes and lessons that have been completed. The simulator provides a means to practice process operation skills in a realistic operational environment by allowing the operator to control the four process variables: flow, level, pressure, and temperature. The drills are designed to test the student's knowledge of the distillation process. All laboratory lessons and quizzes are completed during non-class time.

As Table 1 shows, the weekly schedule lists both the topics covered in the lecture and the associated laboratory lessons. Students normally complete the laboratory lessons after the corresponding chapters have been discussed in class. The advantage of this approach is that students are at this point able to go through the lessons without major difficulties. It is estimated that an average of two hours is required to complete each lesson and its corresponding quiz. The following is an overview of the weekly schedule.

The first two weeks of the course explain the roles and responsibilities of technicians, technologists, and engineers and introduce basic process principles. Students, for example, learn how temperature and pressure affect each other. They also learn the names and molecular structures of some key hydrocarbons. The third week is devoted to safety and environmental issues. Students learn about unsafe acts and conditions, common safety procedures, the material safety data sheets (MSDS), safety signs and labels, and fire extinguisher types. In the fourth and fifth week, students learn the basics of process chemistry and are familiarized with the distillation column, its function, and auxiliary equipment.

The next eight weeks provide students with essential information on many of the equipment used in processing and manufacturing facilities. These include valves, pumps, steam systems, reactors, and heat exchangers. They also learn about Piping and Instrument Diagrams (PI&Ds) and how maintenance personnel use them. Other topics include start-up procedures, failure of equipment, and troubleshooting the process to locate and eliminate sources of problems. They learn, for example, how important it is to determine the root cause of a problem and correct it before it has a major impact on safety, quality, reliability, or profitability.

Week	Textbook Readings	Laboratory Lessons
1	Ch. 1 Process technicians	Introduction to DEXTER
2	Ch. 2 Basic process principles	1. Basic fundamentals
3	Chs. 18 &19 Environmental & safety issues	9 & 14. Safety & emergency
4	Ch. 13 Process chemistry	2. Physical properties
5	Ch. 14 Distillation	3. Distillation principles I
6	Ch. 3 Valves	4. Distillation principles II
7	Chs. 4 & 5 Pumps and compressors	5. Unit equipment I
8	Ch. 6 Steam turbines	6. Unit equipment II
9	Ch. 8 Instruments	7. Control equipment
10	Ch. 9 Heat exchangers	8. P&ID symbols
11	Chs. 10 & 11 Heating and cooling systems	10. Normal operations
12	Chs. 15 & 16 Steam systems and boilers	11. Start-ups
13	Ch. 12 Reactors	12. Shutdowns
14	Ch. 17 Extruder operations	13. & 15 Equipment failure
15	Ch. 7 Quality control	16. Profitability

Table 1 Weekly Schedule

Finally, the last two weeks of the semester introduce extruder operations and cover quality control principles.

One of the laboratory sessions is devoted to a safety training course, Basic Plus Safety Training, that is taught on campus by the Contractors Safety Council (CSC) of the Coastal Bend (Fig. 1). In addition, in Fall 1999 an engineer from Koch Industries, Mr. John Williamson, visited the class and described the use of electronic instruments in refineries (Fig. 2).

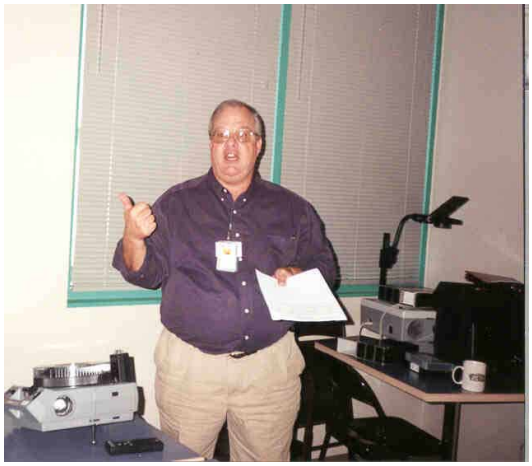

Fig. 1 An instructor from Ccontractors Safety Council teaching the safety training course.

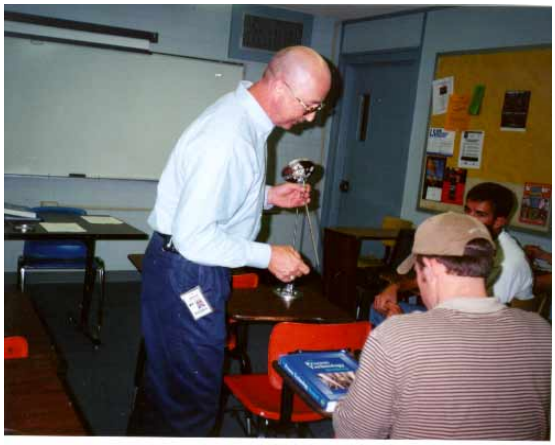

Fig. 2 Mr. Williamson explains to students how a bimetallic temperature sensor is designed and constructed.

Role of Field Trips

The course requirements include participation in field trips. A major objective of the field trips is to familiarize students with the responsibilities of technicians, technologists, and engineers working in various technical positions. Another goal is to give students the opportunity to expand their vision of their chosen careers by observing the operations and organization of industrial facilities.

A great deal of preparation is needed to ensure that field trips are successful. Here are the steps that the author normally follows to arrange them.

- Identify a company appropriate for the type of tour desired. This includes finding background information about the company.
- Establish communication with the company (normally the Human Resources office) to identify a person who can organize or help in conducting the field trip. This task is normally done at least one month before the desired date of the tour.
- Contact (phone or e-mail) the person identified in the previous step to discuss the details of the tour.
- Send a letter (or e-mail) to confirm in writing the date and time and to provide information about the course, number of students, desired outcomes, and other pertaining details.
- Verify that everything is as scheduled about one week before the date of the tour. This can be particularly important since it is always possible that a tour may be canceled.
- Send a thank you letter about one week after the tour. The letter includes a copy of one of the reports turned in by students.

From the students' perspective, the field trips are the most time consuming part of the course. A typical field trip consists of watching a 15-minute video, a short technical presentation, and a plant tour. Students are instructed to listen and take notes, observe what they see, ask questions, and turn in a two-page report one week after the date of the tour. The report includes a tour evaluation section that consists of answering the following questions.

a. The most important thing I learned from participating in this tour was . . . . . .
b. This tour can be improved if . . . . . .
c. Did this tour increase your understanding of the responsibilities of technicians, engineers, or technologists? ___Yes ___No
d. Did this tour increase your understanding of the operations, equipment, and facilities of industrial facilities? ___Yes ___No
e. I recommend that this tour be taken by future classes. ___Yes ___No
f. Overall, this tour was ___Excellent ___Good ___Fair ___Poor
g. Other comments . . . . . .

As shown in Table 2, in spring 1999 semester a total of ten tours were arranged to various types of businesses.

Company	Type of Business
Bradley's, Inc.	Motor repairs
Berry Fabricators	Fabrication
Corpus Christi Army Depot	Overhaul of aircrafts
Celanese Technical Center	Petrochemical
Reynolds Metal Co.	Processing (Alumina)
OxyChem	Petrochemical
Koch Refining Co.	Refinery
DuPont	Petrochemical
Central Power and Light	Power generation
GPM Engineering	Consulting

Table 2 Field trips conducted in spring 1999

We were very pleased with the support we received from local industries in arranging the field trips and the high level of professionalism at which they made their technical presentations. Figure 3 shows students during two of the field trips.

(a) (b)

Fig. 3 Students touring (a) Koch Refinery and (b) GPM Engineering

Student Survey Results

At the end of spring 1999 semester, a survey of students in the course revealed that the course achieved its objectives. Given below are five of the questions, along with responses and their averaged percentages.

- To what extent do you feel the objectives of the tours (field trips) were achieved? Write your answer as a percentage. 85.33%

- Do you recommend that the "Safety Course", offered by the "Contractors Safety Council", be a part of the course schedule? Yes (9 students), No (0 students)
- How many tours do you think should be taken in a semester? Number of tours: 8.6
- To what extent do you feel that the course objectives were achieved? Write your answer as a percentage. 93.22%
- How did the lectures (including tests and homework assignments), lab exercises (including lessons and quizzes), and tours (including reports) contribute to your learning the course material? The total must be 100%. Lectures (46.8%), lab exercises (28.4%), tours (24.8%).

Overall, student satisfaction with the course seems to be high, with the majority feeling that the course achieved its intended goals and was a positive learning experience.

Conclusion

This paper describes an introductory course designed to introduce students to the operations, equipment, and organization of industrial facilities. Another goal of the course is to familiarize students with the responsibilities of technicians, technologists, and engineers working in various technical positions. The paper shows how lectures, laboratory, and field trips contributed to accomplishing the course objectives. The benefits of involving industry through conducting field trips and technical presentations include contributing to marketing the engineering technology program and strengthening our relationship with industry. Student satisfaction with the course is high, with the majority feeling that the course is a positive learning experience.

Bibliography

1. Donald J. Fournier, Jr. and Cyndi Gaudet, "Creating Relationships with Industry to Advance New Programs," 1999 ASEE Annual Conference Proceedings, Session 2548, 6 pages.
2. Jeffrey J. Fetterman, "Partnership with industry to teach automation and process control," 1999 Frontier in Education Conference Proceedings, 4 pages.
3. Jeffrey A. Griffin and Rick Homkes, "Faculty Internships," 1999 ASEE Annual Conference Proceedings, Session 1375, 6 pages.
4. Mark R. Tufenkjian, "A new engineering educator's guide for creating a summer engineering internship program," 1999 ASEE Annual Conference Proceedings, Session 1375, 6 pages.
5. Saleh M. Sbenaty, "Industrial Partnership for the Enhancement of Engineering Technology Education," 1999 ASEE Annual Conference Proceedings, Session 2547, 7 pages.
6. Peg B. Single, Carol B. Muller, and Keiko Inoue, "Industry Professionals as Mentors: A Model to Guide Mentor Training," 1999 Frontier in Education Conference Proceedings, 3 pages.

Biography

RAFIC BACHNAK

Rafic (Ray) Bachnak is an Associate Professor of Engineering Technology at Texas A&M University-Corpus Christi. He received his B.S., M.S., and Ph.D. degrees in Electrical and Computer Engineering from Ohio University in 1983, 1984, and 1989, respectively. Dr. Bachnak was previously on the faculty of Franklin University and Northwestern State University.