INDUSTRY INPUT INTO CURRICULM CHANGE

BY

DERAN HANESIAN

ANGELO J. PERNA

NEW JERSEY INSTITUTE OF TECHNOLOGY

NEWARK, NJ 07102

ABSTRACT

Historically, academics have jealously guarded the prerogatives associated with curricula content and educational teaching methods. However, as of late, a change has occurred and industrial feedback regarding enhancing graduates' capabilities has been received more favorably. The industry point of view is that engineering students are extremely capable in their technical expertise but lack equivalent level skills in communications and teamwork. During the same period students and institutional administrators were also raising concerns. Students were questioning why they weren't exposed to "real engineering" earlier in their studies and administrators became concerned about retention rates for students in engineering.

At New Jersey Institute of Technology these concerns were addressed starting in 1991 with changes in the freshman engineering year. The development of Freshman Engineering Design (FED) and Freshman Engineering (FE) modules coupled with humanities, computing and computer aided design courses was undertaken. The initial FED courses were in the areas of chemical, mechanical, civil and electrical engineering and in the main were lecture/laboratory formats. The FE courses, developed later, were interdisciplinary in content and were combinations of chemical/environmental, electrical/mechanical. Electrical/biomedical, and mechanical/industrial engineering. These courses were mixed with some continuing to be laboratory/lecture while others were more lecture/design in nature (1).

The rationale behind integrating course content among these offerings was to provide "real engineering" up front, integrate engineering problems with required computing skills and improving written and oral abilities. Over the past seven years the discipline oriented Freshman Engineering Design Modules of seven weeks duration have added interdisciplinary fourteen-week Freshman Engineering courses in a two semester sequence. However, their coupling with computer aided design and humanities courses remain. Student response to these approaches has been, "that the engineering courses are very time demanding, but they are a worthwhile experience."

INTRODUCTION

At one time or another engineering faculty have been questioned by their former students, now alumni, on why in courses they were not exposed to certain materials. These materials in general were specific areas, usually hardware oriented, such as pumps, thermocouples, motors to name a few. The authors response has always been that we teach engineering principles which can be directed to broad problem areas and in the other areas students should be able to develop expertise on their own. Overall alumni and industrial feedback has found little fault in the technical abilities of graduates. However, repeatedly a continuing complaint has been the communication skills of students needs upgrading (2). This statement is not a new one but a continuing refrain that the authors have heard for the past fifty plus years as can be seen by the following quotes which Professor Fred H. Rhodes of Cornell expressed in his book entitled "Technical Report Writing" written in 1941 (3):

> "One of the most outstanding faults, if one is looking for faults in the young men, is their inability to use ably the English language. The writing of simple reports and the expressing of themselves verbally seem to be two things in which they are notably deficient." (V.L. King, Technical-Director, Calco Chemical Co.)
>
> "The most striking defect in the training of practically every man we employ is the lack of knowledge of English composition." – (Allan F. Odell deceased, formerly chemical director, Plastics Department, E.I. du Pont de Nemours and Co.)

However of late as globalization emerged a new complaint from the industrial sector was that engineers needed to understand the role of teaming

and be exposed to these interactions during their college years. Interesting to note at the same time a cry of student's dissatisfaction with the freshman year, began to be heard. This discontent was mainly with the students impatience to be exposed to "engineering studies" in the freshman year and having to take all that other "stuff" such as chemistry, math and physics. One is reminded of a slogan some time ago which said "Where's the Beef". Along with this university administrators became concerned with not only the low numbers of students entering engineering but more importantly retention rates. As a result, the old engineering standby of assembling entering engineering students and saying "look to your left and then to your right only one of you will graduate in engineering" was no longer acceptable.

Faculty were also aware that the old ways of teaching, chalk and blackboard, were not motivating students but that the new technologies and methods had to be incorporated into the classroom presentations. All these factors were stirring the mix especially the concerns of the industrial sector and their belief in the need for change to meet the challenge of globalization of the market place.

As many of us know, engineering educators had long been aware of the need for students being good communicators, work in teams (however, this was disciplinary and not interdisciplinary) and have a "real" engineering experience (this was either in a capstone laboratory or a design course).

NJIT APPROACH TO THE PROBLEM

As an example we give you the following abstract of the aims of the senior laboratory experience from our laboratory manual (4):
"The purpose of any chemical engineering laboratory is to serve several important functions in a student's program of development. Among the more important are:

(1) To teach students to communicate results obtained from experimentation through a written document in a clear and concise fashion;
(2) To put theory into practice in a realistic sense, through a set of instructions, which will require independent logical thinking; (the intent here is to compare the idealistic (theoretical) teachings in the classroom with the real-world operations (experimental equipment) and to realize the limitations of each);
(3) To acquaint the student with the availability and use of published data and the various sources for obtaining these references;
(4) To illustrate the difficulties associated with leadership and group effort approaches in solving particular problems. In essence, the complexities of people working together and contributing to a common goal;
(5) To teach students how to prepare and present an industrial seminar. WRITTEN AND ORAL COMMUNICATION WILL LARGELY DETERMINE IN AN INDUSTRIAL ENVIRONMENT WHAT MANAGEMENT THINKS ABOUT YOUR EFFORTS AND WILL THEREFORE BE THE PRIMARY INFLUENCE IN YOUR PROMOTION, ADVANVEMENT, AND CONSEQUENTLY YOUR EARINGS."

However, on reflection these experiences were in general only reserved for the senior year rather than building from the first year up. In the early nineties NSF sponsored educational initiatives began with the goal of change in engineering education through the funding of coalitions. This initiative was a catalyst for moving engineering experience and communication skills into the freshman year. NJIT, a member of the Gateway Coalition, initiated freshman engineering design modules in mechanical, civil, electrical and chemical engineering (5). These modules were seven weeks in length and were coupled with fourteen week courses in the humanities and computer aided design. The humanities course along with the engineering modules had strong oral and written communications components as well as teaming concepts.

This initial effort has been followed by follow up "interdisciplinary" second semester freshman fourteen week engineering courses with a continued interrelationship with a humanities course emphasizing communication skills. This second semester course is a scaled downed capstone type design experience that freshman students could handle with minimum faculty guidance.

These interdisciplinary efforts were combinations of electrical-mechanical, industrial-mechanical, biomedical-electrical and chemical-environmental engineering. While it is still too early to judge how industry will respond to these efforts to meet their concerns retention has been increased, and students have been uniformly satisfied with the changes. These results are evident from their responses on course/faculty assessment surveys of the courses.

ACKNOLOEDGEMENTS

The authors wish to express their appreciation to the many undergraduate and graduate students that assisted them over the years in the programs as well as the following:

NSF-Gateway Coalition
The State of New Jersey
New Jersey Institute of Technology

REFERENCES

1. Hanesian, D., and Perna, A.J., "The New Jersey Institute of Technology Experience in Fundamentals of Engineering Design (FED) and Freshman Engineering Courses, 1994-1997", Manual prepared for the Summer School for Chemical Engineering Faculty, Chemical Engineering Division, American Society of Engineering Education, Snowbird, Utah, August 11, 1997.

2. Hanesian D., and Perna, A.J., "Communications in the Chemical Engineering Laboratory – Then and Now ", Proceedings, 1994 Annual Conference, ASEE, Vol. 1, 1224-1228, June 26-29, 1994, Edmonton, Alberta, Canada.

3. Rhodes, F.H., "Technical Report Writing", 1st Edition, McGraw-Hill Book Co. Inc., New York, New York. (1941)

4. Hanesian, Deran, (Editor), "Chemical Engineering Laboratory Manual", Fall 1984, New Jersey Institute of Technology (Revision and 2nd Printing)

5. Hanesian, Deran and Perna, Angelo J., "A Laboratory Manual For Fundamentals of Engineering Design", 1st and 2nd Editions, Copyright 1995 and 1997, New Jersey Institute of Technology, August 8, 1997.

BIOGRAPHIES

DERAN HANESIAN served as Chairman of the Dept. of Chem. Eng., Chem., and Env. Sci. from 1975-1998 and is Professor of Chem. Eng.. He came to NJIT in 1963. He received a bachelor of Chem. Eng. In 1952 and a Ph.D. in Chem. Eng. 1961, both from Cornell University. Dr. Hanesian worked for Du Pont from 1952-1957 and 1960-1963. He taught at the Algerian Petroleum Institute, Yerevan Poly. Inst., Armenia as a Fulbright Scholar, the Univ. of Edinburgh, Scotland, and Rutgerts, the State Univ. of NJ. He was the recipient of the Robert Van Houten award for Teaching Excellence in 1977 at NJIT, the ASE, Midlantic AT&T Foundation Award for Excellence in Instruction in Eng. In 1986, the John Fluke Award, ASEE, 1994, the Outstanding Tenured Faculty Award, NJIT, 1994, and Distinguished Teaching Award, Middle Atlantic Section, ASEE in 1997, the Armenian Students Association of America (ASA), the Dickran H. Kabakjian Award for Outstanding Contributions in the Field of Science, June 13, 1998, the Excellence in Teaching Award for Lower Division, Undergraduate Instruction, October 1998, New Jersey Institute of Technology, and the Centennial Certificate Award, American Society of Engineering Education, June 1993. He is a Fellow and Emeritus Member of the American Institute f Chemical Engineers and a Fellow and Life Member of the American Society of Engineering Education.

ANGELO J. PERNA received his B.S. ChE degree from Clemson University in 1957 and his M.S. degree from there in 1962. He received his Ph.D. from the University of Connecticut in 1967. He worked as a production and development engineer with Union Carbide Nuclear Company in Oak Ridge, TN, and taught at VIP, and the University of Connecticut. He is currently Professor of Chemical Engineering, Chemistry and Environmental Engineering at New Jersey Institute of Technology. In 1997, he received the NJIT Alumni Award for Teaching Excellence. He is Fellow in both American Institute of Chemical Engineers and the American Society of Engineers Education.