

THE DU PONT TEACHING FELLOWSHIP PROGRAM

1991 Teaching Experiences

Editorial Note:

The DuPont Teaching Fellows Program was initiated in 1990 to complement the objectives of the DuPont Fellowship Program in chemical, mechanical, and electrical engineering. The Teaching Fellows Program was initiated to encourage high-quality students to obtain PhD degrees and enter academia.

There were six DuPont Teaching Fellowships awarded in chemical engineering in 1991: Linda J. Broadbelt, Gregory S. Fisher, Walter M. Hart, Michael L. Luyben, Steven A. McCluney, and Ronald D. Shaver. DuPont teaching fellows were required to have responsibility for one undergraduate course. The following article describes the teaching experience of five of these students, written by the students themselves.

We thank Professor TW Fraser Russell, who provided the inspiration, advice, and compilation of the material for this presentation.

NAME: **Steven A. McCluney**

DEPARTMENT: Chemical Engineering UNIVERSITY: Texas A&M University
COURSE TAUGHT: "Chemical Engineering Reactor Design/Kinetics" NUMBER OF STUDENTS: 24
TEXT USED: *Fundamentals of Chemical Reaction Engineering*, by Charles D. Holland
and Rayford G. Anthony; Prentice Hall Book Company, Publisher
FACULTY MENTOR: Dr. Rayford Anthony
NUMBER OF YEARS OF GRADUATE EDUCATION COMPLETED: 6
THESIS TOPIC: Modeling AC Impedance Behavior of Coated Electrodes
THESIS ADVISOR: Dr. Ralph White

Teaching an undergraduate course was an extremely valuable and enjoyable experience for me. I feel that in many ways I learned as much as I taught, and I was surprised to find that I still remembered a lot of the material that I had not used for several years. I also discovered that teaching a subject is the best way to become thoroughly familiar with it, both through preparing lessons and through trying to answer students' often in-depth questions. Finally, I learned that teaching involves dedication and patience. In order to teach well, one must be willing to put in the necessary time to carefully prepare a lesson and to try to anticipate any questions which may be raised. One must also be willing to take the time to explain a concept clearly and at the students' level.

I was given almost complete freedom in teaching the course; I discussed my teaching plans with my

faculty mentor several times during the semester, but, in general, I was solely responsible for preparing each lecture, and my lectures were not monitored. Since my mentor coauthored the course textbook, I had a clear guideline of the material I was expected to cover. I was also given examples of exams and course notes from previous semesters. On an average, I spent one to two hours preparing each lecture, depending on its content. I also worked each homework assignment so I would be able to explain the concepts as clearly as possible to the students.

In summary, teaching an undergraduate course was a rewarding experience. I now have a greater respect for professors who work hard to be good teachers in addition to researchers. I hope to eventually have a career which will allow me to teach college-level courses—either as a college professor or as a guest instructor from industry. □

NAME: **Ronald D. Shaver**

DEPARTMENT: Chemical Engineering UNIVERSITY: Oklahoma State University
COURSE TAUGHT: "Introduction to Chemical Process Engineering" NUMBER OF STUDENTS: 24
TEXT USED: *Elementary Principles of Chemical Processes*, 2nd ed.;
by Richard M. Felder and Ronald W. Rousseau; John Wiley & Sons, Inc., Publisher
FACULTY MENTOR: Dr. Ruth Erbar
NUMBER OF YEARS OF GRADUATE EDUCATION COMPLETED: 3.5
THESIS TOPIC: Equation of State Development for Equilibrium Predictions
THESIS ADVISOR: Dr. K.A.M. Gasem

Having the opportunity to serve as a 1991-92 DuPont Teaching Fellow gave me some valuable insights into teaching at the college level. The course I taught was the sophomore-level "Introduction to Chemical Process Engineering."

Traditionally, chemical engineering attracts only the best students, and this course represents the first challenging course that most of them take. This teaching experience taught me how to properly organize a fast-paced engineering course and how to recognize when students properly understand the necessary concepts, as well as when they do not.

Daily preparation for the course required much more time than I had originally thought it would. I found that not only must the lectures be presented in an organized, logical manner, but also that every possible question that may be asked by someone being exposed to the material for the first time must be anticipated.

Throughout the semester I had the privilege of being able to consult the late Dr. Ruth Erbar about details of course organization and how to structure some special projects to ensure that the students

obtained the maximum benefit and preparation for later courses. We often talked about the students' reactions to various situations; for example, we both felt that in order for students to best learn the covered topics, they should be pushed to the limit of their abilities. Although many students were initially intimidated by exams that challenged even the best students in the class, several of them commented at the end of the course that the material they best understood was the material they initially had the most trouble comprehending.

Throughout the course I maintained an open-door policy and encouraged the students to come discuss any problems they might be having with the course material. There is a wonderful satisfaction in seeing students' eyes light up when they first truly understand a concept that they've been struggling with, and even more joy in seeing students become excited about a topic and excelling beyond that which is required or expected of them.

Being a DuPont Teaching Fellow was a wonderful experience, and I fully intend to pursue university teaching at some future point in my career. □

NAME: **Greg Fisher**

DEPARTMENT: Chemical Engineering UNIVERSITY: Michigan State University
COURSE TAUGHT: "Material and Energy Balances" NUMBER OF STUDENTS: 52
TEXT USED: *Elementary Principles of Chemical Processes*, 2nd edition; by Richard M. Felder
and Ronald W. Rousseau; John Wiley & Sons, Inc., Publisher
FACULTY MENTOR: Dr. Alec Scranton
NUMBER OF YEARS OF GRADUATE EDUCATION COMPLETED: 5
THESIS TOPIC: The Effect of Interphase Composition on Adhesion in Polyphenylene Sulfide/Carbon Fiber Composites
THESIS ADVISOR: Dr. Lawrence T. Drzal

The time I spent as a DuPont Teaching Fellow was time well spent. The experience was overwhelmingly positive, both as an introduction to college-level lecturing and in organizing familiar material into a package that beginners could understand.

I actually received instruction from my faculty mentor the term before I taught the course when I served

as his teaching assistant. This enabled me to be completely on my own during the time I taught the course, heightening the experience even more for me. Teaching the course required approximately ten to fifteen hours a week. The help of a teaching assistant and two homework graders allowed me to concentrate on writing and giving lectures, on writ-

ing exams, and on assigning grades.

It was disappointing to discover that some students expected a 3.0/4.0 grade "just for showing up," and that often the students who needed extra help the most were the very ones to request it too late. On the other hand, I was delighted to find that many students were eager to learn the material, that some of the students who struggled in the beginning worked hard and did well in the end, and that establishing a good rapport with most of the students was relatively easy.

The most difficult part of teaching the course was designing a fair grading scale, and keeping as many

of the students as possible involved in lectures provided another challenge. Working with the students to help them learn was the most rewarding aspect of teaching the course.

I enjoyed the teaching experience a great deal and would like to pursue a career in teaching after gaining some industrial experience. Since chemical engineering is such an applied field, I believe students appreciate instructors who have actually worked in industry.

I believe the DuPont Teaching Fellows program is a worthwhile program and truly appreciate the opportunity I had to participate in it. □

NAME: *Michael Luyben*

DEPARTMENT: Chemical Engineering UNIVERSITY: Princeton University

COURSE TAUGHT: "Introduction to Chemical Engineering" NUMBER OF STUDENTS: 45

TEXT USED: *Elementary Principles of Chemical Processes*, 2nd ed., by Richard M. Felder and Ronald W. Rousseau; John Wiley & Sons, Inc., Publisher

FACULTY MENTOR: Dr. S. Sundaresan

NUMBER OF YEARS OF GRADUATE EDUCATION COMPLETED: 4

THESIS TOPIC: A Multi-Objective Optimization Approach for Analyzing the Interaction of Design and Control

THESIS ADVISOR: Dr. C.A. Floudas

My service as a DuPont Teaching Fellow in 1991 at Princeton University provided a valuable opportunity for me to learn about teaching. The course I taught, "Introduction to Chemical Engineering," contained material with some approaches, terminology, and jargon which were unfamiliar to the first- and second-year undergraduates, and it was important to remember and consider this when I was planning classes and answering questions.

The course challenged me to communicate ideas as clearly and enthusiastically as possible, since success in this respect usually engaged the students' intellectual curiosity and challenged them to think clearly and independently. Teaching involves not so much an imparting of information as it does training students' minds to think critically and teaching them to approach problems both systematically and creatively. Such a goal demands a lot of practical experience, and this opportunity to teach gave me that experience.

The course culminated in a case-study project which required the students to work in groups and to tie together all of the material they had learned in the course. This gave them a better perspective on the type of analysis used in chemical engineering and demanded more sophistication in applying general principles to a problem that was larger than the weekly homework assignments to which they were

accustomed. The students seemed to think this was a helpful survey of the course material and it proved to be a valuable educational tool.

I cannot make generalizations about how students learn since each of them is an individual. Some of them understand the subject quickly just by reading the book, while some learn from doing the homework assignments and still others have to come by the office and ask questions to clarify the material. The real teaching challenge lies in finding an appropriate balance of difficulty in the course material. Many students have a lot of pressure on them with their coursework load, and it compounds the problem when universities place so much emphasis on research rather than on teaching. The DuPont Teaching Fellows Program contributes significantly to support teaching ability and works to counteract this trend.

The course required three to four hours a week of lecture preparation; I also spent quite a bit of additional time with the individual students, answering questions. The faculty mentor for the course occasionally attended class while I taught, and at least once a week we discussed teaching, course material, and overall plans.

I would like to again thank DuPont for providing this opportunity for me to gain undergraduate teaching experience. I found that I greatly enjoy teaching

and want to pursue it as a career. I feel it will be a challenging and rewarding occupation. DuPont has generously provided the support and encouragement

for me and for other graduate students in chemical engineering to consider careers in teaching through their Teaching Fellows Program. □

NAME: **Linda J. Broadbelt**

DEPARTMENT: Chemical Engineering UNIVERSITY: University of Delaware

COURSE TAUGHT: "Chemical Engineering Kinetics" NUMBER OF STUDENTS: 20

TEXT USED: *Chemical Reaction Engineering*, 2nd ed., by Octave Levenspiel; John Wiley & Sons, Publisher

FACULTY MENTOR: Dr. TW Fraser Russell

NUMBER OF YEARS OF GRADUATE EDUCATION COMPLETED: 3

THESIS TOPIC: Thermal Degradation of High Performance Polymers and Integration of Structure, Reactivity, and Property

THESIS ADVISOR: Dr. Michael T. Klein

The experience I had as a DuPont Teaching Fellow was extremely positive and reinforced my desire to pursue a teaching career. It also forced me to increase my knowledge of reaction engineering and kinetics. Most importantly, it revealed to me that it is quite different to be up in front of the class teaching a course than it is to sit at a desk and listen!

Teaching style is directly related to an individual's personality. I found I was most comfortable when I did not try to adopt someone else's style and just acted naturally. I learned a great deal, however, from watching and listening to Drs. Russell and Orbey when they taught.

I found that in-class problem sessions were invaluable. The problems generated excellent class discussion and dramatically reinforced learning while at the same time providing ample opportunity for student-teacher interaction. It also prevented a monotonous, long-winded monologue at the blackboard.

I had the benefit of sitting in Dr. Orbey's lecture in advance of mine. The course was taught in two 20-student sections. This allowed me to improve my own grasp of the material, and more importantly, to assess the students' responses to the various facets of the lecture. Dr. Russell sat in on most of my lectures and gave me excellent feedback about my style and the students' reactions. He was also an invaluable resource during a lecture, providing knowledge and insight from his years of experience. Having such an active and interested mentor was the most crucial element in making my teaching experience so rewarding and successful.

I also received invaluable feedback from the students. It was not hard to determine when a certain approach was successful—the students were not afraid to participate in discussions or to voice their frustrations when they had them. They enjoyed the in-class problems and felt they were beneficial to

learning the material. They also voiced appreciation of any extra effort I expended, such as long office hours, help sessions, etc., and took advantage of any help I offered. I found that one of the most important elements of establishing good rapport with the students was knowing and calling them by name.

A more negative facet was that teaching reminded me what it was like to be an undergraduate student, when the end goal was not necessarily the learning or the acquired knowledge, but the grade received. Students frustratingly begged for additional points, asked for extensions on their homework, complained about unfair or difficult exams, or lamented the poor choice of a textbook. I had to remind myself that only hard work earns a high grade and that learning is always the ultimate goal. I found assigning grades at the end of the course to be the most difficult part of teaching. It was hard not to let an element of subjectivity to creep into the grade of a student with whom I had significant personal interaction. While there is room in the grading system for effort expended and class participation to be considered along with reliance on numerical analysis of exams and homework, I tried not to let personal feelings cloud my judgment.

The time commitment involved was immense and involved preparing lectures, exams, and interesting homework in addition to student-teacher interaction outside of class. I had the benefit of two excellent mentors who made all the tasks much easier and less time consuming. I estimate that we spent two or three hours a week discussing lecture preparation, class material, exam preparation and grading, and teaching style.

I feel very fortunate to have been a part of the DuPont Teaching Fellows program. My mentors were exceptional and contributed greatly to making the experience so rewarding. □