

This column provides examples of cases in which students have gained knowledge, insight, and experience in the practice of chemical engineering while in an industrial setting. Summer internships and co-op assignments typify such experiences; however, reports of more unusual cases are also welcome. Description of analytical tools used and the skills developed during the project should be emphasized. These examples should stimulate innovative approaches to bring real world tools and experiences back to campus for integration into the curriculum. Please submit manuscripts to Professor W. J. Koros, Chemical Engineering Department, University of Texas, Austin, Texas 78712.

WHAT IS INSIDE THAT BLACK BOX *And How Does It Work?*

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I think this article should be read by every instructor of introductory chemical engineering courses. The author, a just-graduated BSChE, provides a view from the trenches of what it is like for a "practical learner" to translate the theoretical information we provide into meaningful knowledge. The student, Shanaya Godiwalla, was more assertive than most and took responsibility for finding the missing "hands-on" component to her education that she found necessary for understanding. As Rich Felder has pointed out, student learning styles are diverse, and accommodating them will tend to maximize the efficiency of learning. As Shanaya notes, sometimes the accommodation can be quite simple.

Bill Koros

It all began in the first chemical engineering class "Mass and Energy Balances." We had just learned to size pumps, calculate the heat duty required for heat exchangers, and draw process flow diagrams. I questioned exactly what a pump looked like. How does it actually move fluid? What are its internal components, and how would changing its internal components modify its capabilities? What does a heat-exchanger really look like? And process flow diagrams—does a chemical plant really look like that?

This class brought up an infinite number of questions for

me. My usual method of solving problems by memorizing a fixed procedure began to breakdown. I was blindly completing calculations on complicated problems by memorizing the methods. I felt it would help to have a physical picture and understanding of the basic equipment before attempting these calculations.

Hoping to get some answers, I proceeded to one of the chilling stations on campus. The plant manager gave me a tour so I could actually see these mysterious pumps and heat-exchangers. I became slightly frustrated when he showed me a metal box and said, "This is a heat-exchanger," then proceeded to a smaller metal box, and said, "This is a pump." What does it look like inside? We sat down in the control room with the owner's manual for the heat-exchanger and he explained the components of the diagram, how they work individually, and how they work as a unit. Things finally began to come into perspective!

I wanted and needed to know what I was calculating and how these calculations would be useful to me at a later date.



Shanaya Godiwalla is currently a chemical engineering and dance major at The University of Texas at Austin. She has two years of industrial experience and has accepted a full-time position in process engineering at The Dow Chemical Company.

I have always been a "practical" learner. To learn something effectively, the first few questions that need to be answered consist of, "Will I need to do this someday? When, where, and why?" Once these questions have been answered, my interest and motivation develop because I have an understanding of the big picture. Then the "how" can be put into perspective.

Classroom learning usually skips straight to the "how." There are many different types of learning styles, and my learning ability is not maximized in a classroom. Touring the chilling station allowed me to see the practical uses of heat-exchangers, pumps, and process flow diagrams. This simple experience allowed me to understand that these calculations would become some of the basic building blocks in my education ahead. As I continued through the chemical engineering curriculum, the same problem began to reemerge. I found myself at a higher level, but again resorting to memorization rather than understanding and analysis. Since I couldn't place where the memorized techniques fit into a chemical engineer's job, I again began to think I was learning useless information.

I decided co-oping was the answer to my frustration. My thought was that the pieces would fall into place by my being in a plant environment, getting practical experience, and developing a basic knowledge of process equipment. As it turned out, the benefits of co-oping greatly outweighed graduating a bit later. I researched several companies and chose Dow Chemical because of their high standards of safety, intense training opportunities, and esprit de corps of the employees.

CO-OPING

My first term at Dow Chemical was in manufacturing. I was given a list of projects, which varied from installing and automating pumps and valves to demolishing old process units. The experience provided hands-on opportunities and vast exposure to basic process equipment. In addition, I learned further how to work with people and how to "get work" from people.

My second term at Dow Chemical was in Epoxy Process Research. My primary project was to develop a neural network model for a gas phase reactor. This process model would ultimately be used as an on-line sensor for process control. The assignment gave me an opportunity to gain a thorough understanding of Process Insights, a neural network software. I also became more familiar with the VAX and DEC term systems and completed a research and development report that detailed the entire project. I also acquired

a taste of the world of research and the unlimited opportunities of discovery it has to offer.

Engineering Sciences and Market Development represented my third term at Dow Chemical. My project entailed running co-polymerization experiments to better define the reaction kinetics of a free radical initiated suspension polymerization. This information helped to optimize the process, thereby increasing production. My project used a reaction calorimeter to measure the heat flow released in combination with an on-line mass spectrometer and Fourier transform infrared spectrometer. The experimental data yielded conversion and concentration versus time data to improve mathematical reaction models. The project was completed successfully, and I drafted a research and development report prior to returning to campus for my senior year.

REAPING THE BENEFITS

Co-oping has been an essential part of my education. I am a hands-on type of student who learns best and thrives in the work environment rather than in the academic one. The co-op program has allowed me to look at chemical engineering in a different light. Initially, it was very difficult to imagine how I could apply some of the things I was learning in school to the outside world. Before co-oping, I learned the academic material for the moment, never planning on using it again. Now I have a better understanding of which material is useful background information and which will actually be useful in the workplace. This experience was ideal for me because it forced me to use the information I learned in school and to apply it immediately in the workplace. For example, after completing thermodynamics, I worked on a reaction calorimetry project at Dow.

Co-oping also promoted my personal growth. I finally had the opportunity to experience living on my own outside of a university environment and having a job, just like a real adult. It led me to thinking about what it would be like in the future to have that particular eight-to-five job. I began to consider whether I would be happy completing those types of tasks, working with those types of people, and for that kind of company, day in and day out.

Working full-time and living on my own forced me to learn more about myself and to establish some sort of career path to prevent future misery. Co-oping helped me realize what tools I need to learn to be successful in the workplace and to understand what the "real world" would be like. I would highly recommend the co-op program to anyone! □

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