Bringing LITEE to the Classroom

Cheryl Cobb
Auburn University

In the spring of 2002, engineering faculty from across the nation gathered at the Auburn University Hotel and Conference Center to focus on effective ways to prepare students for the workplace. The three-day workshop, sponsored by the Laboratory for Innovative Technology and Engineering Education (LITEE), Auburn University, and the National Science Foundation, provided participants with the opportunity to discuss ways to bring theory, design, and practice into the classroom.

LITEE is a cooperative effort designed to develop and disseminate innovative instructional materials, using multi-media information technologies and cross-disciplinary teams. These materials seek to bring the real world into the classroom. The effort includes faculty and staff from the Colleges of Engineering, Business and Education.

According to Thomas Walter Professor of Mechanical Engineering and Laboratory Director, P.K. Raju, the businesses and agencies that hire engineering graduates have made it clear that current engineering teaching methods are inadequate for today's complex and fast-changing workplace.

"American industry has been outspoken on this issue," explains Thomas Walter Professor of Management Chetan S. Sankar, one of LITEE's principal investigators. "They tell us that in addition to strong technical capabilities, a successful engineer must understand the non-technical forces that affect engineering decisions. LITEE was formed to address this need."

Early LITEE efforts involved a review of commonly used instructional methodologies coupled with a study of alternative teaching methods. These efforts identified the case study method of instruction as the most promising learning tool.

To date, a collaborative team of faculty and students from engineering and management disciplines, working in partnership with industry, has

Cheryl Cobb is a communications administrator with the Samuel Ginn College of Engineering, Auburn University. Before coming to Auburn University, she worked as a researcher for Weyerhaeuser and Crown Zellerbach Corporations, and ran CobbWrite — a small technical communications company serving the agricultural and biotech industries. She received her BS from Pennsylvania State University in 1974 and her MS degree from Oregon State University in 1976.

A Call for Engineering Education Reform

According to Wm. A. Wulf, it is well past time to change the way engineers are educated. Wulf, President of the National Academy of Engineering, spoke before a packed auditorium at the 2002 LITEE Workshop.

Wulf's career has been long and varied. After many years as a Professor of Computer Science at Carnegie Mellon University, he founded Tartan Laboratories, serving as Chairman and Chief Executive Officer. He is currently on leave from the University of Virginia.

Welcoming Dr. Wulf to Auburn, Dr. Larry Benefield, Dean of the Samuel Ginn College of Engineering, discussed the ongoing efforts at the college to improve undergraduate engineering education. A video presentation developed by LITEE showcased its activities.

Wulf pointed out that the end of World War II marks the last major curriculum change in engineering. Still in use today, this 20th century curriculum with its emphasis on continuous mathematics and physics, ignores the cascade of changes that have occurred over the past century. New fundamentals such as biological materials and processes, and information technology (and the discrete mathematics that underpins it) are lacking from many curriculum.

In addition, today's engineer designs under a complex variety of constraints. Cost, safety, reliability and global social and environmental impacts are just a few of the things that must be considered. Given the disconnect between what goes on in the classroom and what goes on in the real world, it's not surprising that industry leaders have been increasingly vocal about their discontent with engineering graduates.

"This is not a quick fix," says Wulf. "We can't just add all of these new elements to a curriculum that is already bursting at the seams and already provides far

too little exposure to the humanities. We have to step back and look critically at cherished fundamentals and be willing to make tough changes."

In Wulf's opinion, we need to begin by reevaluating how we define an engineer. According to Wulf, engineering is the only highly creative field where the bachelor's degree is the professional degree. Other professions, including medicine and law, view the bachelor's as a foundation upon which the professional degree program is built.

According to Wulf, the engineering profession must also embrace the notion of life-long learning. Continuing education should be as much a part of engineering colleges as it is of business colleges where the best faculty are involved in executive training."

"The time in which half of what an engineer knows become obsolete varies by field, but is estimated to be in the range of 2.5 to 7.5 years," says Wulf. "Change is here to stay, and as engineers we have to keep up with this change."

In addition to acknowledging change, the new degree program has to recognize the importance of diversity in our lives – not because it is politically correct, but because it is essential to this country's ability to compete in the diverse global marketplace. A lineup of automobiles designed to fit the 50th percentile of U.S. males does not work in this marketplace.

Finally, Wulf suggests that it is well past time to acknowledge the profound advances in information technology that have occurred over the past decade. Simulation and virtual reality offer a cost-effect means of providing students with "hands-on" experience. These tools should be used to teach smarter and faster.

In closing, Wulf stressed that the time for action is now.

"We have studied engineering education reform to death," he says. "The need for change is urgent. Let's get on with it!"

prepared seven engineering case studies along with associated competency materials, instructor manuals, and videos.

These materials have been tested in a mechanical engineering sophomore-level course at Auburn; and in freshman classes at the University of Virginia, Illinois Institute of Technology, Purdue and Alabama A&M University.

"The tests show that these materials enhance the learning factors of students, particularly self-reported learning and challenging learning from peers," says Raju. "Students tell us that these case studies increase their interest in the engineering field. This is important because it may help us retain some of the students that currently drop out mid-curriculum."

In addition to bringing theory and practice together in the classroom and allowing students to develop higher-level cognitive skills, the case studies should also help engineering schools meet the Accreditation Board for Engineering and Technology 2000 criteria. The ABET accreditation process is a voluntary system of accreditation that assures that graduates of a program are adequately prepared to enter and continue the practice of engineering. The process is designed to stimulate the improvement of engineering education by encouraging new and innovative approaches and by educating the public about the importance of engineering education.

"The recent ABET updates, have created a system that relies less on bean counting and more on outcomes," says P.K. Raju. "So far, the data on these case studies tells us that they can have a positive impact on student learning. We hope to see case studies become an integral part of engineering curriculum."

At the recent workshop, participants learned how easy it is to integrate case studies into the curriculum to enhance student learning through direct participation in the decision making process. A network of on-site computers allowed participants to work with a number of the case studies. These case studies were developed in partnership with industries ranging from Chick-fil-A to the Southern Company. A number of the students who helped develop these modules were present to lead participants through the process. The case studies integrate fundamental engineering principals with design constraints such as safety, cost, manpower and politics.

Workshop participants also had a chance to listen to a distinguished lineup of speakers that included Wm. A. Wulf, President of the National Academy of Sciences; Russell Pimmel, Program Director, Division of Undergraduate Education at the National Science Foundation; Richard, Felder, Heochst Celanse Professor Emeritus of Chemical Engineering, North Carolina State University; and Dayne Aldridge, Dean of the College of Engineering at Mercer Univerisity.

"The feedback on the meeting was excellent," says Raju. "It was very much an interactive learning experience. Participants learned about the case studies. We received valuable feedback on different ways to incorporate the materials into curriculum. This year, we were particularly pleased with the number of students who showed up to hear our speakers. Dr. Wulf presented to a full house. We're planning to host another seminar February 24-25, 2003."

The photographs included here were taken at the LITEE Workshop, "Bringing Theory and Practice Together in Engineering Classrooms," held March 21-23, 2002 at Auburn University Hotel and Dixon Conference Center.