Mobile Computing through the Curriculum in the Department of Chemical Engineering at the University of Texas at Austin, Texas

Thomas F. Edgar

With the assistance of a grant from AMD, the Department of Chemical Engineering at the University of Texas at Austin has created a mobile computing facility to enhance its instruction in the following seven courses that span freshman through senior years.

(1) ChE 210 (Introduction to Computing)
(2) ChE 348 (Numerical Methods)
(3) ChE 253K (Statistics in Chemical Engineering)
(4) ChE 354 (Fluid Flow and Heat Transfer)
(5) ChE 372 (Reactor Design)
(6) ChE 360 (Process Control)
(7) ChE 473K (Process Design and Operations)
(8) ChE 333T (Technical Communication)

All of these courses make heavy use of computing which is presented in an integrated fashion so that the student's capabilities grow during their four years in the Department. The software used includes Excel, MATLAB, JMP (statistics), Fluent's Flowlab (computational fluid dynamics), and Aspen, which is the commercial package for flowsheet simulation of chemical plants. Class sizes in these courses range from 20 to 90. The use of laptops with wireless connectivity in the chemical and petroleum engineering building was pursued because available computer classrooms were constrained by schedules and by size. In addition, few students carry laptops on campus because there is no requirement in the College of Engineering that students own a laptop and bring it to class. The 40 laptops are kept in two carts and handed out in each class when computer-based materials were covered.

Having laptops available in a given class enables a new form of teaching and learning in which pure lecturing to passive students can be replaced by an integrated lecture/laboratory situation. In this mode the instructional material is presented on the computer with the conceptual elements explained and supplemented by the instructor's lecture. During the presentation, a laboratory exercise is executed on the computer under the supervision of the instructor to give experience in application of the concepts or processes.

The purchase of 40 laptops allows a ratio of 2 students per computer (team problem-solving) in large classes. The system specs were met by Hewlett-Packard 1.8 GHz, 14.1 in SXGA, wireless card included). Rather than operate with a thin client model, we have installed appropriate software in each machine. The portable cart with the equipment is

wheeled to a specific classroom in CPE as needed. The wireless connectivity in CPE is utilized, because the Aspen License Manager on the ChE server needs to be accessed.

The faculty believe that this approach will make lectures about computing tools much more effective and will also help us integrate a continuous thread of computing throughout the curriculum, which is one of our goals in the ABET educational outcomes. Professor Tom Edgar, coordinator of the project, indicates that the use of the laptops during the past fall has been received positively by students in the classes as well as teaching assistants who have given tutorials in recitation sections.

About half of the courses listed earlier used the laptops in the fall of 2003, startup of the project, but with more lead time we expect six classes to use the equipment during the Spring semester of 2004.

According to Dale Simpson, Teaching Assistant in Process Design and Operations (ChE 473K), the laptops were very helpful in the Aspen tutorials for the class. During three sessions, he gave a tutorial on the large screen projected at the front of the classroom while the class worked through it on their laptops. The laptops allowed them to work through the tutorial at their own pace and it allowed Dale to be able to navigate them through the more complicated points in the software usage.

John Hedengren, graduate student and TA for the process control class said, "The laptops were a valuable asset. Most of the students were able to get a quick working knowledge of MATLAB/Simulink in less than an hour of in-class demonstration. The drawback to using the laptops was that some of them had network problems, but we were able to replace those laptops with others in the cart, although some class time was wasted while the students tried to fix the problem, and then boot up another machine. There was good problem reporting to the department computer technician so hopefully some of the technical issues will be ironed out by next semester."

Jonathan Richter, who graduated with his B.S. Ch.E. degree in December, 2003, provided the following comments:

"I have had experience taking classes which used other computer labs as well as experience with the new laptop computers for in-class tutorials. The laptops are far superior. First, with the laptops everyone is facing the front of the class with a clear view of a projection of the TA's screen. In the computer lab, the students may or may not be able to see what the TA is doing, a huge impediment to the ease of learning. Second, other computer labs require a new log-in account, which I know from personal experience is not always reliable.

Third, the number of computers in available computer labs are small; desktops take up a fair amount of space limiting the number a normal size room can hold. Generally, there were one to two students per computer, and even with the doubling up the TAs were still required to hold one or two sessions per class to accommodate everyone. While the number of laptops is not unlimited, in theory there are enough for each student to have

his or her own. I think that the laptops are a great step for the chemical engineering department to take in the process of positioning itself on the cutting edge of the information age of education. What I see for this department is the eventual elimination of computer labs. Eventually, all students will own one computer, a laptop, which they will use on or off campus. Printing will be available to on-campus printers over the wireless web, and special software packages will be available to in-coming students so that they have access to Aspen, MATLAB, etc."

Another December graduate, Julia Campbell, reports: "The advent of the in-classroom use of laptops has been exciting, even though it is a program that has not yet met its full potential. My experience has been using the laptops in the process and Plant classes, and it easily surpasses the typical computer tutorials experienced in other labs. Rather than dedicating an entire class or discussion to spending time over in a dedicated lab in a different building, it has been possible to use the in-class laptops for a portion of a class, as needed.

One issue that should be considered is preserving the life of the laptop batteries. The normal practice is that the computer is issued, used for twenty minute to an hour and a half, and then is plugged back in on the cart. A plan needs to be put in place to drain those batteries regularly, to avoid developing the dreaded battery memory that is the bane of most laptop users.