

A Revolution in Education Clicks Into Place

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By JODI WILGOREN

WINSTON-SALEM, N.C. -- During his economics seminar the other day, Sean Leary, a freshman at Wake Forest University, scanned stock prices, browsed basketball updates from ESPN, checked his e-mail, and perused pictures of "beautiful girls" on [www.acewallpapers.com](#) in search of a new backdrop for his laptop computer screen.

It seems Mr. Leary, who had already taken one economics course in the fall, was bored by the discussion of marginal benefit and cost. But no matter. This is a laptop classroom, where each student sits behind an open machine, sometimes posting answers to the professor's queries on a virtual chalkboard, sometimes, well, doing something else.

"I haven't skipped this class once," noted Mr. Leary, 18. "Even if there's something in class that's boring, there's other stuff you can do."

Wake Forest is one of more than [100](#) colleges and universities across the country where a computer is now required to matriculate. (Some, like Wake Forest, have raised tuition and mail the laptops shortly after acceptance letters.) Not only has this created new forms of in-class distraction and revolutionized campus communication -- [e-mail is used to plan Saturday night outings](#) as well as to write responses to required readings -- but it has begun to transform teaching itself.

For example, [Gordon McCray](#), a Wake Forest business professor, turned all of his lectures into a [streaming video CD-ROM](#), essentially doubling his class time by forcing students to watch the lectures (or read a transcript) on their own. He thereby freed class time for group exercises. Others have students do Web research in class to supplement discussion or use software for homework and quizzes that help tailor syllabuses to individuals. Professors say this way they are now serving a broader spectrum of learning styles.

The very hours of learning have also been extended beyond the classroom through online discussion groups -- often including experts in the field or alumni. Where only a handful of students typically take advantage of once-a-week office hours, instructors are now in constant contact with their students by e-mail, even in the wee hours.

"It's not just added on to the old curriculum -- it's a whole new curriculum," said Bill Moss, a professor of mathematics at Clemson University in South Carolina, where he started a laptop project for 250 engineering majors this year. "You've got old guys like me who've been teaching for 30 years who've got to throw out stacks of yellow notes and start a whole new pedagogy."

Arguing that computer literacy is now an [essential part of a liberal arts education](#), small colleges and professional schools now scratch for spots on Yahoo's annual ranking of America's "most wired" colleges.

The first colleges to require computers were the [military academies](#), which started putting a desktop in every cadet's room in 1983. But the current wave began a decade later at the University of Minnesota-Crookston, an outpost of 2,464 students on the western edge of the state, and has erupted over the last five years, from Seton Hall in New Jersey to Sonoma State in California, from the University of Virginia's business school to the tiny Shepard



Gerry Broome/Associated Press

David G. Brown, dean of the [International Center for Computer Enhanced Education](#) at Wake Forest University, teaches with laptops. Students type answers into a chat room instead of raising their hands.

Universities are also spending millions of dollars to upgrade classrooms so there are plugs and Internet connections at every seat -- though some are experimenting with wireless technology -- as well as laser disc players and video screens up front. There are added costs for expanded computer help desks, work-study jobs for students who provide emergency technical assistance in dormitories, and training for reluctant, old-fashioned faculty.

"The students believe we've given them an edge as they go out into the marketplace," said Joseph D. Harbaugh, dean of the Nova law school, where students use legal case-management software to file their assignments and mock-bill their time. "This has set us apart as we go out into the market for students and for faculty."

At Clemson, English classes keep their compositions in electronic portfolios posted on the Web. At Western Carolina University in the foothills of the Smoky Mountains, literature professors are able to use primary source documents in their lectures, displaying Web images of the handwritten notes of a minor British poet from an archive hundreds of miles away at Princeton University. In Jonathan Zittrain's class on Internet and Society at Harvard Law School, students respond each week to a question posted on the Web, and the answers are automatically routed to another student -- or, perhaps, the author of the pertinent article -- for comments.

At Oberlin College in Ohio, a class on the industrial revolution is using university-owned laptops kept locked in a newly wired classroom. One day they browse an online archive of correspondence between spouses in 19th-century Pennsylvania, another they analyze data from the 1870 census in Cleveland.

"We're experiencing something of the same sense of upheaval," said Gary Kornblith, the professor, aware of the irony of his technique and his topic. "I see a lot of parallels, and I hope my students will see parallels."

Here at Wake Forest, where the class of 2000 was the first to receive laptops, only a handful of professors regularly use computers in the classroom, but nearly all of them incorporate technology into their teaching.

Students in Patricia Dixon's Musical Protest in the Americas class consulted Pete Seeger himself in an online chat (and later corrected the professor by supplying Mr. Seeger's eyewitness view of events).

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Rick Matthews, chairman of the physics department, said a circuit-maker program has elevated his electronics class. Before, students would draw a circuit, he would find a couple of mistakes -- probably miss one or two -- and give the paper, say, an 82. Now, students can test the circuit to see whether current would actually flow; everyone gets a zero or 100, because no one turns the assignment in until it works.

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"The homework before wasn't teaching them anything -- it was merely documenting what they knew and didn't know," he said. "Now, they're putting four times as much time in as they did before, they're enjoying the homework more, learning 50 percent more electronics."

David G. Brown spearheaded Wake Forest's computer initiative while he was provost, and now is dean of the university's International Center for Computer Enhanced Learning. Dr. Brown, an economist, is a surprising spokesman for e-education: his computer experience five years ago was limited to typing on a word processor. Now, his syllabus is an interactive document featuring color photographs of his students, his "textbook" is electronic, and he grades essays online.

"The computer is like the library," said Dr. Brown, who uses laptops every day in class, having students type answers into a chat room rather than raise hands, or prepare an instant presentation doing Web research. "It's an intellectual resource. If you don't have it, you've got to dumb down your course, you've got to dumb down your research."

There are, of course, potential pitfalls.

There is the astronomy professor at Wake Forest who posted his lectures on the Web -- so most people stopped showing up for class. And there are the students at Columbia University School of Business who spend their time in class trading stocks -- occasionally interrupting the lecture with whoops of joy or sighs of pain over their trades. And there is the incessant clicking on campuses everywhere as students take notes on their machines or use



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