NOW ... New teaching models look to technology. For intro physics, M.I.T. students work at laptops as faculty circulate. But nothing casual here: nine to a table, three to a computer. Ideal table diameter: seven feet.

101 Redefined

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SEMICIRCULAR rows of benches face the front of the room. A raised platform faces the benches. Anyone who has ever attended college will recognize the setting at once: a lecture hall.

That's what archeologists figured they found last year when they unearthed room after identical room -- 13 in all -- at a site that appears to have been part of the ancient University of Alexandria in Egypt. What's more, those 13 classrooms adjoin a theater uncovered 25 years ago. The auditorium, they now realize, must have functioned as one of the biggest lecture halls of them all. If so, then the large-enrollment lecture course has endured as the heart of higher education not simply since the founding of Harvard nearly four centuries ago, as scholars previously thought, but for a couple of millenniums.

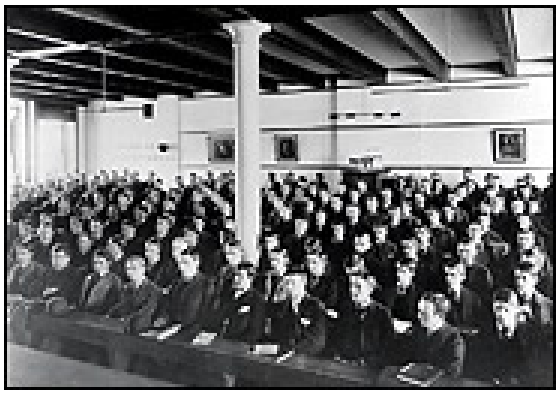
If some educators have their way, however, the lecture course will soon occupy the same dustbin of history as the chariot race. "I don't think the solely lecture-based course will survive," says Carol A. Twigg, director of the Center for Academic Transformation at Rensselaer Polytechnic Institute in upstate New York. "And," she adds, "it shouldn't."

The freshman lecture course has always made economic sense: a student-teacher ratio of 700 to 1 helps underwrite all those small seminars for juniors and seniors. Now Ms. Twigg intends to convince institutions of higher learning that they can save even more money while improving the quality of education. Since 1999, the center has awarded $6 million in grants to 30 institutions of higher learning to reimagine the large-enrollment introductory course by introducing technological elements. Beginning this academic year, the most successful course redesigns are being passed on to 20 new institutions, which two or three years from now, if all goes according to plan, will pass their own refinements on to other institutions, and so on, until each course model is factory-ready to ship to any college that wants it. The hope is that these alternative approaches will redefine the freshman experience once and for all.

THIS challenge to the introductory lecture course is hardly the first. For decades, progressive educators have been critical of what they call a push technology. It's all information, no interaction. It's unidirectional: lecturer-active, student-passive. It's indiscriminate; the same lessons reach each student regardless of individual interest, skill or intellect.

"We have a fundamental mismatch between how students learn and the lecture method," says Arthur Levine, president of Teachers College at Columbia University. Students, he says, generally think in concrete terms: "Show me the pieces. Show me how they work." By contrast, he says, teachers tend to think in abstractions, and assume that their students do, too, that they're sitting out there in their lecture hall seats, bolted to the floor, saying, "Tell me the theory."

Large lectures survive, in part, because they're an efficient way to deliver the mass of facts necessary to build foundational knowledge in a discipline.



... THEN Lecture classes like this one at Harvard, circa 1894, are being phased out at many campuses.

"That doesn't mean we can't do them better, though," says Diana Oblinger, a vice president of the EduCause Center for Applied Research, a nonprofit organization that promotes technology in higher education. "People need to do more than just learn facts. They need context. They need to have not just rote memorization but a way to transfer one situation to another.

"The real key," Ms. Oblinger says, "is interactivity," which has become a dominant concept in higher education today, and one that encompasses interaction with the teacher, with other students, and with the material itself, often through the use of information technology.

The Massachusetts Institute of Technology, for one, is rethinking the prevailing model on its own. It is converting its infamously daunting introductory physics lecture courses to what it calls Technology Enabled Active Learning, or TEAL. The principal coordinator of the effort, John Belcher, used to teach the university's introductory physics courses and, he says, "I wouldn't go back." The failure rate in the classes was typically 10 to 12 percent, he explains, but "most notable was that only 40 percent of the students were coming to class by the end of the term." And it wasn't just his classes that suffered attendance drop-off; other M.I.T. professors working within the large lecture format reported that attendance at the end of the semester would rarely rise above 50 percent. "Whatever you think of the pedagogy of large lectures," Mr. Belcher says, "if students aren't coming, it's a problem."

His opportunity to address the situation came when Alex d'Arbeloff, an alumnus and former M.I.T. Corporation chairman, established a $10 million Fund for Excellence in M.I.T. Education. Mr. Belcher's solution has been a "flat classroom." Students are divided into groups of nine at round tables, and teams of three share one laptop, where they can follow the instructor's Power Point presentation or even monitor results from real (not virtual) desktop experiments through sensors that feed into the computer. Instructors circulate, intervening where necessary, answering questions, asking questions and, yes, delivering the occasional lecture. In this case, though, lectures are brief and in an intimate setting.

So far, M.I.T. has instituted the new format in the course on electromagnetism, and it seems to be working. In a study that tested students on concepts before and after a semester, TEAL students demonstrated a comprehension nearly double that of the large-lecture students. For that reason, M.I.T. is going to apply the model to the other half of the introductory physics curriculum, a course on mechanics, by next fall.

TEAL is only one of many acronyms out there. In designing it, Mr. Belcher borrowed heavily from the Student-Centered Activities for Large Enrollment Undergraduate Programs, or Scale-Up, at North Carolina State University. But Mr. Belcher had to adapt it to M.I.T.'s specific needs, incorporating visualizations of electricity and magnetism, for instance. On the whole, though, TEAL follows Scale-Up's example right down to the round tables' supposedly ideal diameter, as determined by North Carolina State designers after testing several other sizes on students: seven feet.

If Mr. Belcher had to go hunting for a model for TEAL, Ms. Twigg's goal is to create a one-stop clearinghouse. For a modest fee to cover administrative and consulting costs, an institution could buy both a new pedagogical model and the know-how to implement it. For that reason, some of the alternatives that the Center for Academic Transformation is now producing might well be the ones that stick.

"You do unto students what was done unto you," Ms. Twigg says. "If you don't see alternatives that work as well as or better than what you know, then you won't think about change. I can say with great confidence that once people become familiar with alternative, more effective ways of structuring the student learning experience, the solely large-lecture course will disappear.

"But it's been around for how many hundreds of years? So you can't expect it to change in two years."

The center's Program in Course Redesign began when the Pew Charitable Trusts approached Ms. Twigg about rethinking higher education. As a vice president of EduCause, she had advocated the potential for technology in academia. "In other areas," she says, "technology reduces costs and improves the quality of service." So, she wondered, why not in higher education? "It seems obvious, but not to a lot of people."

Pew's donation paid for the initial phase, in which 30 institutions developed pedagogical models in any number of disciplines. For this second phase, 20 new institutions have agreed to underwrite the costs of implementing the most successful models and refining them further. For now, the models are being applied to precalculus, psychology, Spanish and statistics; eventually humanities, biology and chemistry will be the focus.

So far, five distinct pedagogical models have emerged. One simply supplements the lecture with online quizes (as was the case in the University of New Mexico's general psychology course) or small problem-solving groups (as in the University of Massachusetts-Amherst's introductory biology). Another model substitutes online sessions for one or two of the weekly lectures, either in a scheduled computer lab (as in Pennsylvania State University's introductory statistics course) or anywhere anytime (University of Tennessee-Knoxville's introductory Spanish).

A third model offers a smorgasbord of options; in fact, it's called the "Buffet" model. Instructors at Ohio State University, the institution that created this model, work with the 3,250 students taking introductory chemistry to match individual backgrounds, skills and goals with an appropriate combination of laboratories, projects, videos, study sessions, good old-fashioned homework and large lectures.

Nearly all the institutions using these three models reported a rise in student test scores that ranged up to 10 percentage points and increases in attendance of, in some cases, more than 20 percent. At the same time, they also report decreased costs of an average of 37 percent. "By using technology for those aspects of the course where it would be more effective, and by engaging faculty only in tasks that require faculty expertise," Ms. Twigg explains, "an institution can decrease costs per student even though the number of students enrolled in the course remains unchanged."

The other two new pedagogical models take place outside the classroom, and that's where results become more ambiguous, at least academically. The Emporium model eliminates all class meetings in mathematics in favor of a "learning resource center" -- a lab that (as at Virginia Tech) houses banks of computer workstations and provides access to personalized assistance 24 hours a day. And the fully online model (as in the University of Dayton's intro psychology course) is just that.

Yet you don't have to be a knee-jerk naysayer, only a parent paying tuition, to ask: $27,000 a year to sit in front of a computer? Ms. Twigg laughs at the question. "It's one course," she says, "not their entire baccalaureate experience." Still, that course might well leave some students who say "show me the pieces; show me how they work" showing themselves.

In fact, Dayton reported problems with students dropping or withdrawing from intro psychology -- over two semesters, 8 and 10 percent more students from the online courses than from the traditional course. And for those students who stayed, exams and collaborative exercises indicated "no significant differences" between the traditional and online formats.

Among the Emporium institutions, Virginia Tech and Northern Arizona University saw changes that were not statistically significant, a result that, as Virginia Tech reported, "bears out course personnel's general observation that the new system appears to work less well for conceptually difficult material." What was statistically significant about the off-classroom models were the decreases in per-student costs: from $139 to $84 at Dayton, $91 to $21 at Virginia Tech, and $138 to $82 at Northern Arizona.

Ms. Twigg is not worried. She points out that the program is being gradually rolled out to figure out which models to pursue as well as to refine them.

The large lecture is not without advocates. Kenneth Elzinga, a professor of economics at the University of Virginia, says that when he learned he would be teaching a course of 700 students, "I was just shocked. I thought, 'This can't work. I don't even believe in this.' It took me a long time to come to peace with it." Today, every Tuesday and Thursday, he teaches 1,000 students. First he delivers one lecture to more than 500 students at 11 a.m., then he repeats the lecture at 12:30 p.m. word for word.

What changed his mind was the realization that for students, being part of such an enormous gathering fosters "a certain bonding experience." The reason is "what economists call 'economies of scope': a shared experience that allows students to discuss topics at mealtime and in dorms with classmates who encountered the same ideas that same day."

"I'm not a Luddite," he adds. But with online communication or videotaped lectures, Mr. Elzinga feels the talks wouldn't have the same impact: "What's lost is this camaraderie of the classroom that somehow seems to be a positive experience for a lot of students here."

Ms. Oblinger offers another defense: "Some faculty are wonderful performers."

An example from the Program in Course Redesign itself reinforces this observation. The University of New Mexico's report on its experiences says that the decision of the school to eliminate two of three weekly lectures by a popular associate professor in psychology was met with "considerable, sustained student protest." The university relented, reinstating one of the lectures.

It's an example that speaks to a reason beyond the pedagogic or the economic -- beyond reason, even. The lecture format might lend itself to a flat classroom and a fleet of laptops. But what about the lecturer -- that eminent presence planted at the front of the room, dispensing depths of knowledge in the very voice of authority, commanding attention with a display of erudition that is nothing if not theater? It would be difficult to imagine a Vladimir Nabokov pacing among a bunch of seven-foot-diameter tables, occasionally consenting to interrupt his literary discourse long enough to lean forward and offer interactivity. As far as Mr. Elzinga and even Ms. Oblinger are concerned, we shouldn't have to.

A Socrates practicing his method, however, might be a different story. In the idle moments between grant applications, this is what Ms. Twigg envisions: a contemporary version of the ancient Greek navigating a sea of laptops, soliciting questions, and perhaps, even from freshmen, eliciting wisdom.

Oh, yes: and saving money.