Focus
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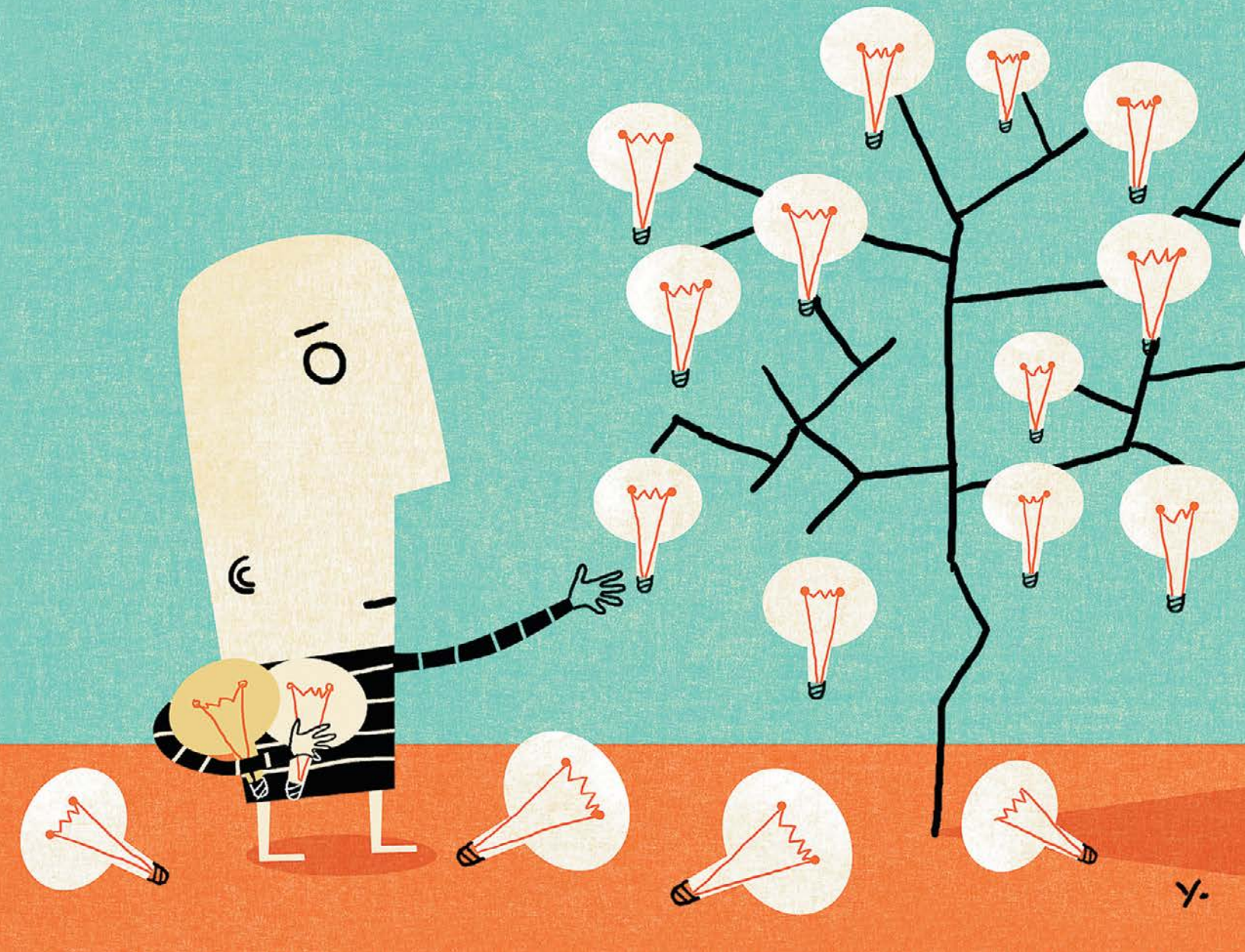

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A MEAL OF FRIED WORMS, paper snowballs, pop quizzes: Professors are using whatever it takes to liven up the classroom and help students master and remember material. This collection describes innovative teaching strategies — not just high-tech ones, like webcast introductory courses, but low-tech ones, like peer instruction, faculty learning communities, and reconsideration of the canon.

Cover illustration by James Yang for *The Chronicle*

MAURA FRIEDMAN FOR THE CHRONICLE

Students toss "snowballs" — crumpled wads of paper containing summaries of Gary Green's primary lecture points — in his forestry and natural-resources class at the U. of Georgia.

How One University Encourages Innovation in Teaching

By KATHERINE MANGAN

When wadded-up papers start flying across the University of Georgia lecture hall where Gary T. Green is teaching, it may look as if he's lost control of the class. But these are the times, he says, when his students are most engaged.

Each time a "snowball" lands on a desk and a student unfolds it, the recipient writes down three points that he took away from a potentially confusing part of the lecture. He in turn balls up the paper and throws it to a classmate, who smoothes it out and adds three more points.

By the time the snowballs have been crumpled and uncrumpled twice, each one lists nine bullets to help students summarize the main ideas of the lecture.

Mr. Green, a professor of natural resources, recreation, and tourism, is always on the lookout for ways to energize his students and encourage the shy ones to speak up.

Sometimes the students' notes fly around the classroom on paper airplanes or bounce from row to row on Post-it notes stuck to beach balls. A typical comment in his teaching evaluations, he says, is that the class was fun and "we never knew what he was going to do."

Mr. Green shares his ideas about teaching a large class, and borrows others, in faculty learning communities organized by the university's Center for Teaching & Learning.

These committees, made up of five to 15 participants, meet about once every three weeks throughout the year. Members are encouraged to share their strategies with the broader faculty through workshops, short summaries, or journal articles.

At a time when budget cuts are causing student-to-faculty ratios to climb on many campuses, the pressure to make students feel like more than a roster number has intensified.

A national study published in 2014 found that grades improved and failure rates decreased when active learning was incorporated into large science, technology, engineering, or math classes. That's not always easy to do in classes with hundreds of students.

A proliferation of high-tech tools, from handheld clickers to interactive programs, promises to transform the "sage on the stage" to the "guide on the side."

But active learning takes place in many forms, as Georgia's efforts illustrate. Faculty members who have been teaching the same way for decades are more likely to buy in to new ways of teaching if the ideas are coming from their peers, and not from administrators.

"One-off workshops don't necessarily bring about the significant changes in faculty practice we're looking for," says the director of the Georgia center, C. Edward Watson.

Because the faculty learning communities meet every three weeks, participants are more likely to try out and report back on the strategies, he says.

When it comes to generating ideas, Mr. Green is never at a loss. Once he plunked his brown-bag lunch on the lectern and a student asked what it contained. The professor grabbed a marker, scrawled a question mark on the bag, and told the class that the first person to ask a particularly insightful question could reach into the bag and help herself. The tuna sandwich he had intended to eat for lunch was a hit, as were the packs of gum in later classes and the Spider-Man toy his son had tired of.

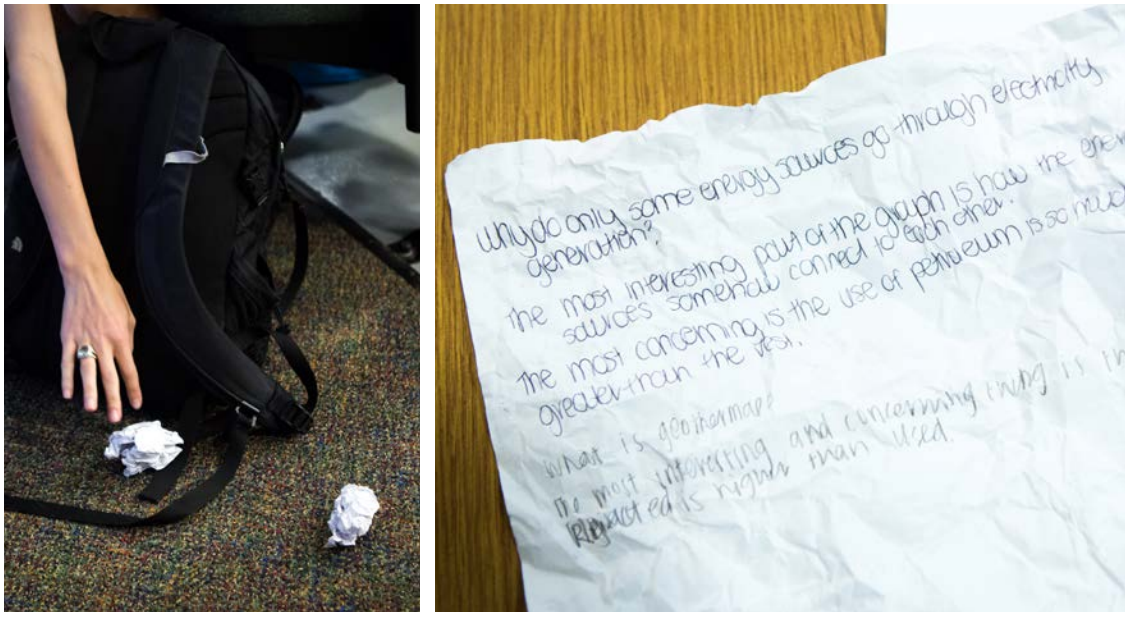
During such times, "the energy in the room goes way up," Mr. Green says.

Translating one professor's brainstorm into a strategy that others can use is one of the goals of teaching and learning centers like the one at the University of Georgia.

To encourage more faculty members to jazz up their large classes, Georgia selected 25 of them to be part of a new fellowship for innovative teaching. All but two had classes of 100 or more students, some teaching as many as 900 students per semester.

Their focus last year was on flipping the classroom, a technique that involves having students read lessons and watch videos beforehand so that the class can focus on exercises, projects, and discussions.

This year's cohort is focused on a technique called Scale-Up, Student-Centered Active Learning Environment with Upside-down Pedagogies.



MAURA FRIEDMAN FOR THE CHRONICLE

Each time a "snowball" lands, the recipient unfolds it, writes down three points from Mr. Green's lecture, then balls up the paper and throws it to a classmate, who adds three more points. By the time the snowballs have been crumpled and uncrumpled twice, each paper lists nine of the main ideas from the lecture.

The strategy, which was championed by a North Carolina State University physics professor and since adopted by more than 200 colleges, involves breaking large classes into small teams. Students sit in three groups of three at round tables where they share computers and work on exercises while instructors circulate.

The technique has been credited with improving pass rates among students who typically struggle in large introductory classes.

At Georgia, faculty members looking for ways to improve their teaching can also sign up for midsemester evaluations by a team from the teaching center.

The evaluators excuse the professor and ask the students three questions: What aspects of the class are going well, which need improvement, and what changes in the course would help them learn?

After a discussion, the suggestions are written on the board and students vote for their top two.

Within a week, an evaluator meets with the professor to discuss the weighted results and consider strategies for improvement.

Peggy Brickman, a professor of plant biology at Georgia, says she started offering more-frequent practice questions after students said they were getting "blown away" by her exams.

"One of the best things about these evaluations is the discussion you have with students afterwards," she says. "Sometimes it's like, 'No, I'm not changing that. I'd love to watch movies and sit around and talk about it, but we're going to have tests and other things.'" But when she does take them up on their suggestions, "they feel like you're really listening to them."

In a survey that Ms. Brickman helped administer to about 450 science-faculty members nationwide, most said they were dissatisfied with the feedback they were getting about their teaching. The input they wanted most, she says, was from their peers.

At Georgia, peer consultants help faculty members focus on areas where they need to improve. The consultants gather and assess data from student ratings, course materials, classroom observations, student interviews, and teaching portfolios. The evaluations and resulting plans for innovation are confidential and not part of the tenure-and-promotion process.

Ms. Brickman has been a mentor to a graduate student, showing him how it's possible, even in a class of 330, to break students into small groups to work on a project about genetic testing.

The biggest fear some professors have about encouraging group discussions in their large lecture classes is that they'll never be able to rein the students back in.

"If we have 300 students and we whip them up into a roar, how do we regain control?" says Mr. Watson. Some professors add timers and microphones to their teaching tool kits.

"One-off workshops don't necessarily bring about the significant changes in faculty practice we're looking for."

Something as simple as giving everyone a two-minute break partway through a lecture to read through their notes and fill in the blanks can make a big difference to students who sometimes feel as if they're drinking from a fire hose, some professors say. Research has shown that students perform better when they're given a break to catch up.

Ms. Brickman would like to see the university expand peer mentoring, in which two faculty members at about the same level critique each other's teaching styles.

"It's kind of like getting undressed in front of someone else," she says. "It feels awkward and strange, but if we're all doing it, you get used to it."

Originally published on December 4, 2016

The Personal Lecture

How to make big classes feel small

By KATHERINE MANGAN

ILANA PANICH-LINSMAN FOR THE CHRONICLE

Cynthia LaBrake, a lecturer in chemistry at the U. of Texas, often has her 400 students break into small discussion groups. Her 1970s-era classroom, which is scheduled for an overhaul next year, has desks bolted into the floor, posing a challenge. "We crawl over the space to reach them," she says. "It's not ideal, but we make it work."

AUSTIN, TEX.

Introduction to psychology is about to begin. A student in the front row of the studio audience cues her 23 classmates to give her professors a rousing cheer. Cameras are rolling as the rest of the class — all 910 of them — tune in from their dorm rooms, coffee shops, and study rooms at the University of Texas flagship campus.

Over the next 75 minutes, they'll watch a "weather report" that maps personal stereotypes by regions of the country (red zones splashed across parts of the Northeast mark areas of high neuroticism), and listen to an expert flown in from Stanford University discuss what someone's Facebook "likes" reveal about her personality.

They'll participate in a lab exercise that matches students from the studio audience with their taste in music and groan when the burly guy who looks like a country music fan actually favors Lady Gaga. They'll take a pop quiz and watch a video clip of their professor snooping around someone's office for keys to his personality.

Welcome to a version of the giant intro class that's almost guaranteed to keep students awake.

For generations, students have complained about feeling like nameless specks in a cavernous lecture hall. Faculty members often dread a sea of blank faces, or worse yet, those absorbed by online shopping or video games.

As budget cuts intensify pressure to pack more students into these classes, universities are experimenting with ways to liven them up. The approaches can be high-tech, like the webcast psychology class, or they can be more rudimentary, like breaking big classes into small brainstorming groups or interspersing lectures with snippets about students' backgrounds gleaned from surveys. Regardless, the goals are similar: Make classes feel smaller and more personal.

Given economic pressures, "the large classroom is not going away," says Kathryne McConnell, senior director for research and assessment at the Association of American Colleges & Universities. "You can look at it from a deficit perspective and say, Here's everything that's wrong with it. But what if we flip that and look at what the scope and scale of this class could allow us to do?"

"Anyone who's been to a good lecture knows how you can be carried along by a gifted lecturer as they unspool a story and interpret it for the class."

Three years ago, two professors of psychology, James W. Pennebaker and Samuel D. Gosling team-taught what they termed the first "synchronous massive online course," or SMOC, the precursor of the introductory psychology class Mr. Gosling now teaches with Paige Harden, an associate professor of psychology.

These intro classes, with their short, snappy segments, may be bigger, Mr. Pennebaker says, "but they're psychologically smaller."

Teaching a small class of students while simultaneously beaming in hundreds of others gives the classroom a more dynamic and personal feeling than students would get from a MOOC, or massive open online class, he says. More than 20 faculty members are now offering SMOCs.

"We want faculty to appreciate that our students are using online technologies most of the day," he says. "That's part of who they are."

Mr. Pennebaker is leading a universitywide effort, Project 2021, to redesign undergraduate courses at UT-Austin.

Part of the project's goal is to get instructors to rethink the traditional large lecture course with its emphasis on a single wise professor holding court in front of hundreds of students. Lectures can be effective teaching tools, says Mr. Pennebaker, but their impact is sometimes overrated.

"Faculty members are often bamboozled into thinking that students are going to remember all these pearls of wisdom we've tossed at them," he says.

Because the program just began in January, it's too soon to measure success, but the factors administrators will look at include the number of departments redesigning their curricula, the changes that result in higher grades in subsequent courses, and increases or decreases in students' satisfaction with the quality of their education.

Much of the experimentation taking place at Texas is coordinated through its Faculty Innovation Center.

"The problem with lectures of over 50 has been that it's hard to know how students are doing and very difficult to have a discussion," says Hillary Hart, a senior lecturer of civil, architectural, and environmental engineering who directs the center.

Sareena Contractor, a freshman who is enrolled in the psychology class, says the pop quizzes and interactive exercises keep her focused, even when she's working from home and surrounded by distractions. "I thought it was going to be like watching a TV show and I'd be getting up and doing stuff," she says. "They keep you engaged."

The start-up costs of setting up a studio like the one at Texas could run between $750,000 and

$1 million, according to university officials. Once in place, the classes cost about the same to run as other large classes, Mr. Pennebaker says. The psychology class is being rerun in the spring to another 1,000 students and to several hundred more in the summer. The same studio space broadcasts to some 8,000 to 12,000 students who are enrolled in about a dozen other courses throughout the semester.

Not all the solutions to the impersonal lecture are as tech-heavy as the psychology class. Cynthia LaBrake, a senior lecturer in chemistry at Texas, has her 400 students break into groups of two to four to work on problems while a dozen undergraduate and graduate teaching and learning assistants circulate through the room. Her 1970s-era classroom, which is scheduled for an overhaul next year, has small desks bolted into the floor, making group work a challenge. "We crawl over the space to reach them," she says. "It's not ideal, but we make it work."

At the University of California at Berkeley, Martha L. Olney, an adjunct professor of economics, uses a similar approach in some of her courses. She breaks classes of 150 students into groups of three or four to discuss portions of her lecture — a technique she says takes getting used to. "If you're going to have 50 conversations going on at the same time," Ms. Olney says, "you have to be very comfortable with noise."

For larger classes, like her principles of economics class that typically enrolls more than 700 students, she manages to incorporate active learning, even if it's just using hand-held clickers to quiz students and be sure they understand the material.

That way, she says, students are getting feedback a half-dozen times a day, and not just when they get a D on the economics midterm. If she throws out a question and gets a lot of blank stares, she might ask students to brainstorm for a few minutes with someone in the same row.

She tries to set the right tone from the start. When students walk in, she gives them a set of three to five questions they should be able to answer by the end of the hour. "That encourages them to listen for those things during the class," Ms. Olney says. "They have to show their TA that they tried to answer, and they grade their own quizzes the next day."

One of the most popular trends in recent years has been the flipped classroom, which usually involves having students watch videos and read course materials outside the classroom so that class time is used for hands-on experiences and discussions.

But students don't always do the work before class, says Peter E. Doolittle, assistant provost for teaching and learning at Virginia Tech. Quizzes and short writing assignments can help hold students accountable, he says.

During the summer, Mr. Doolittle helped lead a national conference on teaching large classes, where faculty members critiqued various strategies.

In addition to clickers, some faculty members use programs that allow them to create interactive lectures.

Conference participants also described plenty of low-tech ways of engaging students.

Poster presentations, the staples of faculty conferences, are becoming increasingly popular assignments in large undergraduate classes. Groups of four or five students present their research findings at a public exhibition, and peers evaluate one another.

Another increasingly popular way to make the class feel smaller is to bring in undergraduate teaching assistants to supplement the work of graduate TAs. Undergraduates who have done well in a course can lead small-group discussions in exchange for course credit or pay.

"Undergraduate TAs provide extra eyes and voices," says Mr. Doolittle. "They're sources of energy, working with groups and helping keep discussions on track."

The layout of the classroom can also make a difference in student engagement. At Virginia Tech, as in many other universities, new classrooms are being built with interactive and technology-driven large classes in mind. Seats can be turned around and multiple screens project shared and student work.

Yet for some lecturers, these extra technological bells and whistles aren't the key.

For Gabriel K. Harris, an associate professor of food science at North Carolina State University, creating a memorable experience in his 200-person class that he refers back to throughout the semester is what works.

Once, he fried mealworms and served them to willing students over rice with vegetables, then took the same insects, dry roasted them, and ground them into powder to add to oatmeal raisin cookie batter. What better way to make the point that insects can be a sustainable, high-quality form of protein that people will eat "if you don't see six legs." It's the kind of experience they might go back and tell their roommate about.

"Humans are fundamentally hard-wired to remember stories," he says, "and when they do, the scientific principles associated with them will be retained."

Few people would disagree that getting students more engaged in their education is a worthy goal. But with so much focus today on active learning, some faculty members feel like they're expected to jump through too many hoops to keep their students entertained. There's something to be said, they argue, for getting multitasking, hyperconnected students to sustain attention on a full-

length, well-crafted lecture.

Molly Worthen, an assistant professor of history at the University of North Carolina at Chapel Hill, says teaching centers are often biased against the traditional lecture.

"There are loads of resources for flipping classrooms and experimenting with other forms of active learning, but if you just want to become a better speaker, that isn't something that's advertised," she says. "It isn't perceived of as trendy."

Students sometimes tell her they feel shortchanged if the faculty members who are experts in their fields turn too much of the teaching over to peer discussions. There's nothing passive, she says, about listening to a lecture, synthesizing the key points, and taking effective notes.

"Part of what I'm doing when I'm on stage is modeling the act of analytical thinking," Ms. Worthen says. "Anyone who's been to a good lecture knows how you can be carried along by a gifted lecturer as they unspool a story and interpret it for the class."

Ms. Worthen believes that a good lecture lays the groundwork for a richer, more informed discussion session than she would get if students watched videos to prepare for the class. Her introductory history classes, which typically enroll about 100 students, meet three times a week. Two of the sessions are lectures and the third is a discussion session for groups of 15 to 18 students with a teaching assistant.

Advocates for revamping the traditional lecture concede that persuading some faculty members to change traditional lectures can be a challenge, in part because there isn't a lot of data showing what works.

Faculty members who flip their classrooms or try other techniques to get students involved risk flopping in their end-of-semester assessments, say Mr. Pennebaker and Ms. Hart at UT-Austin. Students are sometimes most comfortable with a class that rewards them for memorizing facts for a few exams per semester. Daily quizzes and graded group work make it harder to skate through a class.

Even though they're key to keeping students engaged, daily quizzes haven't caught on with UT-Austin faculty, though, "because it's too damn much work," Mr. Pennebaker says.

Yet it can pay off in better attendance. In a typical course he teaches, about 60 percent of students were still showing up two-thirds of the way through the semester. After an overhaul that included daily quizzes, it was more like 95 percent, and students were scoring a full grade higher on their tests.

Moving some of his course work online also gave students greater flexibility and allowed him to expand his class sizes, especially for introductory courses. Big introductory courses allowed the university to offer smaller upper-division courses, he says.

"Humans are fundamentally hard-wired to remember stories, and when they do, the scientific principles associated with them will be retained."

Faculty members, Ms. Hart says, are given incentives to try new techniques and not have to worry that they'll be punished if students don't immediately warm to the changes. Those incentives include pay bonuses for professors to prepare new courses or for departments to experiment with new curricula.

But elsewhere, changes can also be as simple as making an extra effort to connect with students on a personal level. When that happens, students tend to be more engaged in a class, and less likely to skip, says Windi D. Turner, an assistant professor of family and consumer sciences education at Utah State University.

She has each of the 180 students in her "Dress and Humanity" class fill out an index card at the start of the semester with personal information, including something interesting about themselves.

When a student confided that she was an avid participant in "cosplay" — in which participants wear costumes to represent a specific character — Ms. Turner tracked down the student and asked if she'd mind explaining her hobby during a session devoted to how people play out different roles through dress.

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5 Ways to Shake Up the Lecture

By KATHERINE MANGAN

Transforming a large lecture class into a more personal, engaging experience doesn't have to involve high-tech gadgets and a team of production assistants. Plenty of other strategies work. Here are a few of the approaches that have gained traction.

FLIPPED CLASS

Instructors seem to either love or loathe this approach, which reverses traditional teaching by giving students recorded lectures and lessons to access in the dorm or at home and using class time for hands-on assignments or projects.

Many students like being able to stop, start, and rewind a recorded lecture until they understand it. In class, students learn from one another while the instructor circulates through the classroom, acting as a facilitator or coach.

In order for this to go smoothly, students have to prepare extensively before they come to class. Faculty members who have struggled with the approach say that doesn't always happen, and some have responded by giving graded daily quizzes.

Variations of the flipped class abound. Many instructors flip only a portion of the class, or a few sessions a month. The most successful often take place in classrooms that have been redesigned to create collaborative work spaces.

SCALE-UP

One of the most ambitious efforts is the Scale-Up approach, which is being used at more than 250 campuses, according to Robert J. Beichner, the professor of physics at North Carolina State University who is perhaps its biggest champion.

Nine students sit at a round table in three groups of three, each with a laptop and whiteboard. The instructor gives them something interesting to investigate, and while they tackle the challenge, the instructor and assistant roam around the classroom, asking questions and sending teams to help one another. Depending on the enrollment, a classroom might have a dozen of these tables.

The acronym stands for Student-Centered Active Learning Environment with Upside-down Pedagogies.

The Massachusetts Institute of Technology's version, known as Technology Enabled Active Learning, intersperses 20-minute lectures in physics with discussion questions, animations, and pencil-and-paper exercises.

SMALL-GROUP EXERCISES

A more traditional lecture class can still be split up intermittently into groups so that lectures are delivered in 15-minute bursts rather than 50-minute orations.

Professors might check in with students from time to time using hand-held classroom response devices, or clickers. When the answers (or silence) indicate the students are confused, the professor might ask them to brainstorm with someone sitting nearby.

Some faculty members create working groups at the start of the semester, aiming for a diverse mix of class years, majors, and demographics. The same groups meet throughout the year, so members are encouraged to sit near one another.

Other faculty members rely on ad hoc groups that change each class. Students are often graded on group assignments, which creates peer pressure for them to come to class prepared.

Collaborative learning works much better when seats swivel and desks aren't fixed. On a growing number of campuses, classrooms are being built with this in mind. Existing ones are being reconfigured to eliminate the long desks and bolted-down chairs that are typical of lecture halls.

UNDERGRADUATE ASSISTANTS

Group work requires more assistants to roam the classroom and help keep discussions on track. There usually aren't enough graduate students to go around, so universities are hiring undergraduate students who have done well in a class to help out for class credit or pay.

Having more teaching and learning assistants allows instructors to offer frequent short quizzes and writing assignments. This lets them engage students more deeply and assess them more regularly.

A 400-seat chemistry class at the University of Texas at Austin relies on a dozen undergraduate and graduate TAs circulating through the room to help students during group work. The instructor has developed a "peer learning assistants" course to train undergraduate chemistry majors to serve as learning coaches in large classes that use active learning. The goal is to give a small-seminar feel to a class that could seem large and impersonal.

Originally published on December 4, 2016

THE PERSONAL TOUCH

Even when it's impossible in a class of 300 to remember students' names, professors can personalize their lectures by referring to details that show they're interested in their students as individuals. Faculty members sometimes start by asking students to fill out a card listing personal tidbits like favorite songs, hobbies, or hometowns.

One professor asked students what songs they listened to when they were stressed; he then played a couple of selections before a test by a class favorite — Ed Sheeran, the English singer-songwriter. Another professor makes a point of asking students their names when she calls on them and then refers to them by name in her response.

And one asks two students to help him take notes when a guest lecturer is speaking. He then combines the three sets of notes to give to the class and takes the two student note-takers to lunch.

DUSTIN THOMAS CHAMBERS FOR THE CHRONICLE

Evidence means different things in different disciplines. In Sally Radell's "Connecting the Mind to the Moving Body," primary evidence is collected through physical sensations.

If Skills Are the New Canon, Are Colleges Teaching Them?

Most people agree that students should learn skills like critical thinking. But courses aren't set up that way.

By DAN BERRETT

ATLANTA

The essence of a university education used to fit across a five-foot shelf.

That was the space required for the 51 volumes of the *Harvard Classics* compiled by the university's president, Charles William Eliot, and published in 1909.

Plato, Machiavelli, Milton, Darwin: Each volume, Eliot explained, was vital. The compendium presented "the stream of the world's thought," he wrote, such that "the observant reader's mind shall be enriched, refined, and fertilized by it."

Spending 15 minutes a day reading the texts was tantamount, Eliot argued, to a liberal education. Many of the works made up the core curriculum at the nation's leading universities.

Over time, though, the canon unraveled, pulled apart by disparate forces. By the latter half of the 20th century, students chafed at a core curriculum and demanded more control over their education. "Buffet style" distribution requirements became the norm.

Meanwhile, knowledge was proliferating, from Darwin to DNA. In the 1980s, scholarly consensus fractured as humanists fought the canon wars over what qualified as seminal works, and whether the dead white men whose words filled Eliot's volumes still reigned.

Agreeing on an essential body of knowledge came to seem impossible, but over the past decade or two a new consensus has emerged: that colleges ought to develop in students a set of skills.

Today just about everyone — administrators, students, parents, employers, policy makers, and most professors — has accepted the notion that broad, transferrable skills are the desired product of college. Courses reflect that: An introductory survey of American history, for example, might be supplanted by a niche offering like "Baseball in the 1950s," because either one can supposedly teach students how to think critically and write well. And so course content becomes little more than a delivery device for skills.

To be sure, colleges still care about specific areas of knowledge: Most institutions have learning outcomes for the sciences, mathematics, and the humanities, according to the Association of American Colleges & Universities. But learning outcomes for writing, critical-thinking, analytical-reasoning, and quantitative-reasoning skills are now even more common, almost universal.

In short, skills have become the new canon.

The structure of higher education and the training and motivations of most faculty members, however, tend to operate under the old assumptions. Content and disciplines are still mainstays. Students still take courses from the mathematics faculty, not the quantitative-reasoning department. And course material has a depth and allure that skills don't. Analytical reasoning doesn't pulse with the mind-expanding genius of Einstein. Lovers swoon to poetry, not oral-communication proficiency.

If skills are the new canon, curricula as they're now configured often fall short of instilling them. Educators and associations have called for change. Nicholas Lemann, dean emeritus of Columbia University's Graduate School of Journalism, advocated in a recent essay in *The Chronicle Review* for "a canon of methods," like the interpretation of meaning, numeracy, visual and spatial grammar and logic, and information literacy (see Page 38).

Unless they're explicitly designed to teach such methods, most courses may not do the trick. Mr. Lemann argued for "developing courses that are specifically aimed at creating those capabilities, rather than declaring that existing courses that are notionally about something else will confer them."

Many academic leaders are reaching a similar conclusion. On a broad scale, national faculty-led efforts like the Lumina Foundation-supported Tuning project define disciplines' core elements in terms of skills, knowledge, and habits of mind. Individual campuses are talking about that, too. At Nebraska Wesleyan University, students take courses focused on verbally representing quantitative thought, for example, and the fundamentals of communication. At Emory University, faculty members and administrators have chosen to focus on developing one skill: using and evaluating evidence.

How well are colleges teaching this new canon? Does it require wholesale reimagining of courses, or do subtle tweaks suffice? And what is lost when some content gets left out?

One wednesday this semester, students here at Emory stared up at a projected photograph of an animal's paw print in mud. Anthony J. Martin, a professor of practice in environmental sciences, had snapped it that morning in nearby Lullwater Park, a 185-acre preserve. Dirt still clung to his mocs.

His course "How to Interpret Behavior You Did Not See" is on ichnology, the study of animal traces. Evidence carries a particular meaning in that field: It's making inferences about animal behavior using indirect evidence like tracks and scat. Mr. Martin rarely misses an opportunity to highlight the reasoning process.

The image on the screen included the professor's yellow, pocket-size spiral-bound notebook. He handed it to a student in the front row and asked him to measure it, so the class could judge the size of the print.

Mr. Martin then followed with a series of questions about the mark: its shape, the placement of the heel pad, the track pattern. What did those things say about the animal? Could it have been agitated, running, based on how far apart its tracks were?

A few of his students thumbed through their copies of the *Falcon Guide to Scats and Tracks of the Southeast*. They reasoned that the track's size and oval shape strongly suggested a coyote.

"That's our hypothesis," Mr. Martin said, citing the first step in the scientific method. But what else could it be?

The track was too big to be a fox's. He pushed his students to consider other sources of data, like the preserve's topography, soil, vegetation, and hydrology. The prints appeared by the side of the road, so maybe a dog had made them. Water was pooled in the impressions. How recently had it rained? Was the creature nocturnal or diurnal? "You want to be

DUSTIN THOMAS CHAMBERS FOR THE CHRONICLE

Students at Emory U. learn the skill of evaluating evidence in various ways, including through physical sensation.

careful," he said, "about confirmation bias."

Mr. Martin has taught this course for more than a decade. His original goal was to get students outdoors and paying careful attention to the natural world.

Then Emory started its campuswide skills-teaching effort, the Nature of Evidence. Mr. Martin, intrigued, volunteered to retool the course. His is one of 27 freshman seminars across 22 departments now offered in the effort's first year. Each one puts evidence at the forefront, exploring how a discipline defines, uses, and evaluates it. The courses make teaching and learning evidence the explicit goal.

Instructors receive a $3,000 stipend to redesign a course, participate in workshops, and submit graded assignments for assessment. Emory is also surveying students and faculty, analyzing assignments, and administering the Watson-Glaser test of critical thinking to students before and after the course to chart their growth relative to a control group of other freshmen at the university.

Mr. Martin tries to foster skills like careful observation and evidence-based reasoning, and the habits of taking in new information and revising assumptions. "We constantly ask students, How would you evaluate this evidence?" he says. "What would you need to support this interpretation — and how can it be wrong?"

Emory's focus on evidence grew out of what could have been an exercise in bureaucratic box-checking. The university had to develop a quality-enhancement plan for reaccreditation by the Southern Association of Colleges and Schools.

The faculty committee developing the plan widely solicited ideas for how to improve student learning, winnowing 170 responses. After brainstorming with a fellow art historian, Bonna Daix Wescoat proposed emphasizing "primary evidence and original thought." Evidence is foundational to every discipline, she said. "Not a single person would be left out."

A few faculty members balked, arguing that primary evidence was too narrow a topic or irrelevant to their discipline. The idea became "The Nature of Evidence: How Do You Know?"

Students can now watch short videos on the subject, attend a town-hall event, take part in debates, even wear a T-shirt. At the center of the effort, first-year students can choose an evidence-themed course as their required freshman seminar.

One reason evidence gained traction is that faculty members across disciplines seemed to quickly grasp its importance to their teaching and research, says Tracy L. Scott, a senior lecturer in sociology and director of the university's quality-enhancement plan. "It's something they're thinking about all the time."

But on many campuses, that thinking doesn't necessarily make its way into instruction. The problem is that aspiring professors spend years in graduate school homing in on a discrete area of knowledge, says Terrel L. Rhodes, vice president of the Office of Quality, Curriculum, and Assessment for AAC&U.

"It's all about becoming a content expert," he says. Over time, scholars absorb their discipline's ways of knowing, including how to use and judge evidence. Finding and vetting evidence becomes "second nature to us," he says. "It isn't for our students."

By the time professors find themselves in front of a class, they've forgotten what it was like all those years ago, before the skill became a reflex.

For many Emory students, evidence had little broad significance, according to a survey by the university. Most students said the term referred to legal proceedings.

"With the mushrooming of information on the Internet, students aren't very savvy about figuring out how they know anything," says Ms. Scott. Is what they see online true or false? Where does it come from?

"This generation of students is faced with this overload of information," she says. "They don't know how to distinguish good evidence from bad."

Yet undergraduates may assume they can already judge evidence. DeVonnae' Woodson-Heard, a senior sociology and psychology major, found Emory's whole endeavor unnecessary when she first heard about it as a member of the campus advisory committee. "What do you mean?" she remembered thinking to herself. "We do this all day."

The more she thought about it, the more she realized that using evidence was just an assumption in courses, not often explicitly taught. This year she has noticed a ripple effect: Even professors who aren't teaching the freshman seminars are more deliberately discussing evidence.

The topic has spilled out farther, which is especially handy during a presidential campaign. "We didn't want it to just be this thing in the sky that you philosophize about," says Ms. Woodson-Heard, "and then leave in the classroom."

For the effort to work, Ms. Scott has found that flexibility matters, with faculty members defining what evidence means in their own disciplines. In the humanities, that's often supporting an argument through textual analysis. In economics, evidence might be tested by microeconomic theories — or challenge them. "Maybe we didn't do the model correctly, or maybe the model isn't the right one," says Christina M. DePasquale, an assistant professor of economics. "Real life has all of these confounding factors."

As different as disciplinary definitions of evidence may be, faculty members here say the effort has given them a curricular focus and shared vocabulary, allowing them to discuss teaching and learning in new ways.

The new focus has also revealed shortcomings. Several Emory professors said they've come to realize they weren't teaching how to analyze evidence as explicitly as they thought they were.

"One of the things we're doing is losing common cultural reference points."

Robert Goddard used to focus on teaching the content of his course "Tourist Meets Native," which examines tourism as both an economic and a cultural experience. If students developed skills along the way, it was through osmosis. And if they didn't, Mr. Goddard, a senior lecturer in Latin American and Caribbean studies, would tell himself that "sometimes you get kids who get it, and sometimes you don't."

This semester, emphasizing the skill of using and evaluating evidence has made it plainer to see when students are struggling. Mr. Goddard set out to teach two methods of understanding evidence, quantitative (analyzing hotel bookings and growth rates) and symbolic (grounded in cultural criticism).

Few of his students could pull off symbolic analysis, he says. And the new approach has reframed his thinking. "Maybe I'm not presenting it successfully," he says.

In a recent class, he discussed how some Caribbean states had shifted their economies from mining bauxite to harvesting sugar to serving tourists, and cited gross-domestic product as a barometer of economic health.

Is GDP really the best measure of a nation's economic health? a student asked, referring to the human-development index, which measures average life span, health, standard of living, and years of schooling. Mr. Goddard thought for a moment but dismissed GDP as less transparent, then moved on.

Reflecting on the question a month later, he wondered if the class should have lingered more on

COURTESY OF SUBHA XAVIER

In a cultural-studies course on race in France, students examined the changing portrayal of African soldiers in ads for Banania, a breakfast mix, from (left to right) 1915, 1936, and 2000. They used that evidence to analyze the poem "To Senegalese Sharpshooters Who Died for France," by Léopold Sédar Senghor.

moments like that one. He realized he was teaching too broadly, a mile wide and an inch deep.

As the semester has unfolded, he has changed direction. Instead of asking students to study some aspect of tourism in the Caribbean, he narrowed the focus considerably. Inspired by a chance meeting with a marine biologist here, Mr. Goddard assigned a research project on the impact of tourism on coral reefs. The tighter focus, he thinks, will give students a better opportunity to engage more deeply with evidence.

At the same time, he is ambivalent about what happens when skills take precedence. "I wonder if we are doing a disservice to the students by not having a more coherent, uniform body of content to deliver," he says. "One of the things we're doing is losing common cultural reference points."

Like many professors at Emory, Subha Xavier says basing a course on evidence hasn't required wholesale changes as much as tweaks. Her focus is still on constructing and defending an argument. She just uses the word "evidence" more than she used to.

During a recent meeting of "Paris: City of Lights or Darkness?," a cultural-studies course on race, Ms. Xavier guided her students through a poem, "To Senegalese Sharpshooters Who Died for France," by Léopold Sédar Senghor, a soldier and cultural theorist who was the first president of Senegal.

To make sense of the poem, Ms. Xavier, an assistant professor of French, offered an overview of the sharpshooters, who fought on behalf of France against other Africans resisting colonization. She described their recruitment, equipment, and mortality rates. She also brought in other texts, including a stanza from Senghor's anticolonialist "Liminary Poem": "I will tear off the Banania grins from all the walls of France."

The Banania grin, an illustration of a soldier's smiling face that's used to sell a drink by that name, was an important piece of evidence to understand Senghor's elegy to the sharpshooters. It brought to the surface decades of Senegalese rage and frustration that lurked beneath the surface of his ode.

Ms. Xavier showed her students more primary sources: recruitment posters from the turn of the last century that depicted a white French soldier, in boots and a helmet, next to a Senegalese one, with no shoes and a simple red hat.

That red hat became iconic in marketing Banania, a breakfast mix of banana and chocolate popular in France and its colonies for more than a century. Students examined an advertisement from 1915, when the product started using an image of a Senegalese soldier, smiling with a bowl of Banania in a lush field. A student said it made the soldier appear heroic but childlike.

Ms. Xavier projected another ad from 20 years later. This time, the image was more cartoonish. One more, from 2000, still with the red hat, was a full-blown caricature.

The students split into groups. Use what we've learned about the advertisement to analyze the text of the poem, Ms. Xavier told them.

"Putting one text over another," she said, like a magnifying glass, "can make things evident that you wouldn't have seen before."

Ms. Xavier has no love for the traditional canon. Her course features the kinds of material left out of Eliot's volumes: African poetry, films, and music, and ephemera like posters and ads.

But her goals aren't far from Eliot's either. The point is to produce college graduates who can think, analyze, and write — whether their subject is Beowulf or Banania.

If Ms. Xavier doesn't simply lead her students to the works Eliot described as inevitably educational, it means she does something at least as important: teach.

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The Making of a Teaching Evangelist

By DAN BERRETT

ELIZA GRINNELL, HARVARD JOHN A. PAULSON SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Eric Mazur photographs a car that students created in an active-learning lab. Designing and carrying out experiments, not sitting through lectures, was how Mr. Mazur came to understand and appreciate science. "I learned physics through apprenticeship rather than through courses," he says. "That's when I discovered the joy of science."

CAMBRIDGE, MASS.

ERIC MAZUR could barely contain his excitement. His teaching evaluations had just come in, and they were glowing.

He was still untenured, an associate professor of physics and applied physics at Harvard University. Eager to share his good news, he phoned his friend and mentor, Albert Altman, then a professor of physics at the University of Massachusetts at Lowell.

His students, Mr. Mazur crowed, had rated him about as highly as they could.

An uncomfortable silence hung between them.

"Eric," Mr. Altman finally said. "This is the kiss of death."

That conversation, some 25 years ago, was a clarifying moment for the Har-

vard professor. Conventional wisdom for a young, early-career faculty member is that good teaching won't get you very far. The incentives, particularly at research-oriented institutions, favor scholarship, and tooting your horn about how good you are in the classroom won't exactly burnish your tenure bid.

Mr. Mazur's career since then has defied those truisms. He's become an academic celebrity, crisscrossing the world as an evangelist for improving teaching, mostly by lecturing about the need to end the lecture.

His most popular speech is a story of personal awakening: how he once thought he was an excellent teacher, became aware of his failures in the classroom and, by researching how his students learned, reinvented his courses. By framing his story as a confession, he gives voice to the anxieties that many of his fellow professors feel about their own teaching. He has been a key player in the effort to transform how science is taught, which is part of a broader debate about the flaws and virtues of the lecture, one of higher education's most beloved, reviled, and enduring institutions. That argument, in turn, elicits deeper questions about professorial expertise, academic rigor, and who, in the end, is responsible for student learning.

Mr. Altman, as it turns out, didn't have to worry about how his friend's devotion to teaching would hurt his career. But his advice carried a second warning that Mr. Mazur didn't grasp at the time. Teachers who think they've figured everything out risk becoming intellectually complacent. And that surely is the kiss of death.

"I'd been fooling myself for many years thinking I was an effective professor. But it was a house of cards."

The signals Mr. Mazur received as a young professor pointed to one conclusion: He rocked.

His lectures were clear and well received. His students could solve complex problems about rotational dynamics by calculating triple integrals.

His serene confidence was shaken by an unusual source: the Force Concept Inventory, a test of basic understanding of Newtonian physics, which was then making the rounds among physicists.

Mr. Mazur had heard about the test's results at other colleges. Students generally showed a poor grasp of underlying scientific principles, whether they took seminars or large lectures, were taught by award-winning instructors or by graduate students, or attended elite institutions or less-selective ones.

Mr. Mazur was sure his students were different. This was Harvard. And he was a terrific teacher, after all.

Then he tested them.

What he found out unsettled him. The results showed that the majority didn't understand the fundamentals of Newtonian physics, a subject they'd covered in the second week of the semester.

He retested them at the end of the course and they didn't fare much better. The class average went up eight points, from 70 to 78, on a 100-point scale.

Struggling to understand the results, Mr. Mazur devised an experiment. On a midterm, he included two questions about circuitry. One was traditional and came from a textbook; it tested students' ability to identify and carry out the appropriate calculation. The other was word-based and conceptual.

He thought the conceptual one would be simple, taking about 30 seconds to answer. Instead, he says, his students panicked. One of them filled six pages with everything he knew about circuits and currents in the hopes of stumbling across the right answer.

The students fared better on the calculation-based question. Mr. Mazur realized what he had really been teaching them: to memorize formulas.

Suddenly, other warning signs came into focus. He thought back to the people who told him they'd aced physics in school but never really understood it. He remembered the despairing comments scribbled on his otherwise stellar teaching evaluations. The subject is boring, some students wrote. Physics sucks.

Mr. Mazur reflected on how he had come to learn physics. It wasn't during lectures, when his professors would turn their backs to the students and solve problems on the board. That was how he taught, too.

No, it was in his third year, when he worked in a lab, designing and carrying out experiments, that he came to understand and appreciate the subject. "I learned physics through apprenticeship rather than through courses," he says. "That's when I discovered the joy of science."

Joy is not a word that often describes the lecture. But this method of teaching has come to arouse passions in an increasingly pitched and moralistic debate.

Critics, like Mr. Mazur, favor approaches that demand more classroom participation from students. In their view, students need to do more than listen during class; they must actively grapple with the subject matter, whether in small groups, by responding to questions using clickers, or through other exercises.

One scholar likened lectures to bloodletting, antiquated and not terribly effective. Another described lectures as "toxic" to student learning. When he was asked once about a large-scale analysis that showed greater gains in student learning from participatory strategies compared with lectures, Mr. Mazur wondered whether lecturing was an ethical teaching choice.

Defenders of the lecture counter that it has endured for hundreds of years for good reason: It works. To discard it, they say, is to acquiesce to the erosion of educational standards and let students off the hook for their own learning.

One humanities professor wrote last year that lectures work because they demand that students pay close attention, connect ideas, and understand how to build an argument.

For Alex Small, an associate professor of physics at California State Polytechnic University at Pomona, a lecture is only as passive as the listener. Students learn when they think about what they're hearing and organize it into salient points. "This places the responsibility for learning on the student," he wrote on his blog, "whereas the modern zeitgeist places the responsibility on the instructor."

Lecturing, he says, serves another important purpose. It reaffirms the importance of expertise and allows students to see how an expert role-models the process of working through a problem.

In truth, though, the distinctions between lecturing and active learning aren't always clear cut. Mr. Small, who has defended the lecture in *The Chronicle,* says that in his own courses he frequently stops to ask and answer questions.

"Should students do problem solving? Well, of course," he said in an interview. "If you're only delivering information, you're doing it wrong."

For his part, Mr. Mazur appreciates the lecture's value. Some can be inspiring, and many are effective at dispensing information. But if students are supposed to learn, he says, they need to do more than simply listen. "Learning is not a spectator sport," he says.

After all, it's not like you'd expect to pick up a dance step by watching a trained dancer, or learn to drive by observing someone else do it. You have to do something.

ELIZA GRINNELL, HARVARD JOHN A. PAULSON SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Eric Mazur listens in as his students discuss the concept of momentum. "If you're only delivering information, you're doing it wrong," he says.

Why, then, does the lecture endure? Money is one reason. Lectures are inexpensive for institutions, allowing hundreds of students to be assigned to one faculty member.

Custom is another. Professors and students can each walk away from a lecture convinced they've gotten something out of the exchange, even if they haven't. Mr. Mazur often likes to cite education research suggesting that students overestimate how much they learn from a smoothly delivered lecture.

"The lecture creates the perfect illusion," he says.

"I'd taken something broken, the lecture, and tried to make it better."

"As the primary vehicle for teaching, it's completely outmoded."

Confronted with his classroom failures, Mr. Mazur needed an alternative way to teach. It came to him by accident.

He was explaining a question on the Force Concept Inventory that about half of his students had gotten right. It asked them to compare forces that a car and truck exert on each other when they collide. He scribbled equations on the board but could tell from their faces that his students were lost. To him, the answer was simple. According to Newton's third law, the forces were equal. He tried to explain again. No luck.

His despair mounting, Mr. Mazur told them to discuss their answer with a neighbor.

The tenor of the room changed. The students grew animated and the staid lecture hall began buzzing.

Mr. Mazur has developed an entire method around that experience. At its core, peer instruction requires students to learn, typically from a brief lecture, about core concepts, which they apply to problems and explain to their fellow students. It's a simple way to get them to participate actively within the construct of a large lecture.

He has studied the effect on his students. Three years after switching to peer instruction, their learning gains on the Force Concept Inventory over the semester had doubled, from eight points, when he lectured, to 16. Four years after that, his students' increase in conceptual understanding had tripled over the original group's gain.

"I'd been fooling myself for many years thinking I was an effective professor," he said in a lecture at the University of Maryland-Baltimore County that he gave in 2009 and that has been viewed online more than 145,000 times. "But it was a house of cards."

His narrative of discovery has struck a nerve.

It is a staple of his lecture, "Confessions of a Converted Lecturer," that has helped turn him into an academic celebrity. His message, that professors must move away from the lecture, is one that some faculty members are reluctant to embrace. But he's been asked to deliver more than 1,100 talks about teaching since 1990.

Mr. Mazur tailors his pitch carefully. People don't like to feel pushed or told that what they're doing is wrong, so he grounds his talk in his own experience. "I essentially make a fool of myself," he says.

The demand for his speeches also reflects a hunger for advice about teaching. "Deep down," he says, "everybody realizes that there are huge failures in the system."

Harvard, too, enhances his influence. It is supportive of teaching in general and of his work in particular, he says. The institution also provides him with a perch to spread his message and bypass his audiences' resistance. If students as well prepared as Harvard's aren't learning through traditional methods like the lecture, his story suggests, then the same thing must be happening elsewhere.

A key moment in his talks is a demonstration of an exercise he does with his students. One of his standbys involves a basic concept about how molecules behave when they are heated. He explains it, then asks those in his audience to apply the idea to a new context, make a prediction, and persuade someone nearby that their answer is right.

The effect can be galvanizing. Lynda A. Murphy, director of the Office of Teaching and Learning with Technology at Texas Woman's University, recently brought Mr. Mazur to her campus in Denton after a year and a half of effort. She had been encouraging her colleagues to use techniques that prompt students to apply what they learn. Mr. Mazur, she says, had the scholarly gravitas to get instructors to see these methods' value and try them.

"Everyone in the room was buzzing," she recalls. People were pounding on desks, trying to persuade one another that their answer to the thermodynamics question was correct, she says. "It was hysterical."

Mr. Mazur has visited more than 40 countries delivering presentations like this, and awareness of the kinds of strategies he advocates is growing in his field.

Close to 90 percent of physics faculty members said they had heard of research-based teaching strategies like Mr. Mazur's, according to a 2012 study. A similar percentage had used these practices, and, among those, nearly two-thirds stuck with them.

Peer instruction is regularly cited in grant proposals and papers, both in physics and beyond. Over a recent lunch, Mr. Mazur unholstered his iPhone to run a search of scholarly citations of the term. The last time he checked, there were about 1,000 references to peer instruction, he said. His expressive eyebrows rose. "Wow," he said. Today there are more than 9,000.

Even now, Mr. Mazur remains keenly aware of the academic hierarchy that separates researchers and educators. He is adamant about maintaining his productivity as a researcher. Next year, he will serve as president of the Optical Society, a disciplinary group. His lab employs some two dozen researchers, most of whom work on projects involving short laser pulses and black silicon (he maintains a separate, and smaller, project on education research).

Still, being a teaching evangelist has proved lucrative. He and two partners developed software called Learning Catalytics, a cloud-based assessment system, which they sold to Pearson in 2013 for a reported $10 million. And in 2014, Mr. Mazur won the inaugural $500,000 Minerva Prize, a no-strings-attached grant recognizing his work in the classroom.

But every evangelist needs an audience of doubters to convert. Mr. Mazur estimates that the vast majority of faculty members are still content to lecture, and he likens changing the habit to moving a mountain. His gut feeling, he says, is that the share of professors who still lecture is somewhere around 95 percent. "Maybe I'm underestimating," he says.

Mr. Small, of Cal Poly, disagrees. It has become almost obligatory, he says, for physics professors to talk up the importance of active learning instead of lecturing. Even though a method like Mr. Mazur's has become widely accepted, says Mr. Small, "people will often respond as though it's revolutionary."

Even as peer instruction became widely adopted, Mr. Mazur was restless for change. In studying data on his students, one point bothered him. Although peer instruction produced gains in conceptual understanding, his students' sense of competence, or self-efficacy, dipped. It wasn't as bad as in traditional courses, he says, but it was still a decrease.

"I felt crushed," says Mr. Mazur. He thought back to how he once felt as a 5-year-old in the Netherlands, where he grew up. His grandfather gave him a book about astronomy that captivated his imagination. When he entered Leiden University, he declared his major in that subject but dropped it six weeks later. The big questions that once animated him had been replaced by the

ELIZA GRINNELL

The Harvard physicist and education innovator Eric Mazur discusses momentum and potential energy with students as they demonstrate their Rube Goldberg machine. "Learning," he says, "is not a spectator sport."

How to Remake a Course From the Ground Up

Eric Mazur has crusaded for decades against the lecture, favoring an alternative method called peer instruction. Three years ago, he went back to basics and designed a new physics course for nonmajors. It emphasizes team-based projects, uses positive peer pressure to motivate students, encourages cognitive growth and risk taking, and harnesses the social aspects of learning. Here are how three familiar features of a typical course get a makeover:

Readings

Students read material before class on an online platform called Perusall, which Mr. Mazur and his colleagues developed. Students post comments on the reading and respond to one another's annotations, and these comments drive the next class.

Homework

To answer each problem, students do four things: articulate the problem in their own words, devise a plan to answer it, execute it, and evaluate how well it worked. They complete the problem sets alone before class and work in teams during it to correct errors. They are not graded on how correct their answers are but on their effort and their accuracy in judging how well they understood the problem.

Exams

There are none, but students do complete five hourlong "Readiness Assurance Activities" during the semester. In the first half-hour they solve the problems alone; they can consult the internet but not one another. In the second, they go over the problems again, this time with their teams. Their scores reflect individual mastery and collective contribution.

drudgery of equations about star positions.

He wanted to help his students regain that sense of wonder. Peer instruction did little more than make the best of an inherently flawed model, he realized. "I'd taken something broken, the lecture," he says, "and tried to make it better."

He decided to build a course from scratch. After persuading his dean to let him take time off to rethink his teaching, he dug into education research and took a tour of other campuses to study what they were doing. He concluded that two things needed emphasis: students' motivation and the social dimensions of education.

The result is Applied Physics 50, a yearlong course designed to fulfill physics requirements for majors in other science disciplines. A few universities are adopting the model on their own campuses.

Project-based learning is the center of the new course. Students work in teams. Many projects have low-stakes competitions attached to them, like constructing the most secure safe by using magnets as locks. Other projects have an explicit social benefit, like building musical instruments for an orchestra for poor children in Venezuela.

If peer instruction forced students to participate in class, the new course makes them take it over. Professors are often urged to place more onus for learning on students; the advice is that they should be a guide on the side instead of a sage on stage. In his new course, Mr. Mazur has moved himself far offstage; he missed about 40 percent of the meetings this past semester. Class just rolls on without him.

During a recent visit, students huddled around tables near whiteboards. They designed spectrometers, figuring out which lenses had the right focal length. They chose materials and argued over dimensions. Teaching assistants walked through the room, dispensing advice here and there. "Don't just go off and build," one said. "Draw up a plan."

Mr. Mazur reconceived homework for the course, too. Students aren't scored strictly on the accuracy of their answers but on their effort and how well they evaluate their work. If one of them skips a problem set, the score for the entire group suffers. Peers, Mr. Mazur says, are a far greater source of motivation than a professor.

His syllabus dedicates two paragraphs to the virtues of failure. Students are warned that some of their scores may be lower than what they're used to. They should see failures, he writes, as "learning opportunities, not negatives, as steppingstones to success."

Repeated failure, as he has learned, is necessary for success.

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How One Professor Is Trying to Paint a Richer Portrait of Effective Teaching

By EMMA PETTIT

In his research, Philip B. Stark pinpointed something that he believed professors already suspected to be true: that student evaluations of their teaching are biased.

Mr. Stark and several other researchers recently examined student evaluations in online courses and found that implicit gender bias had seeped into end-of-semester evaluations. The students routinely rated professors higher when they thought they were male, even though the classroom experiences were standardized and students and professors never interacted in person.

The scores also did not correlate with how much students actually learned, as measured by the final examination.

"Whatever it is the students are responding to, it's certainly not what they're learning," said Mr. Stark, who is associate dean of the division of mathematical and physical sciences at the University of California at Berkeley.

Mr. Stark's research built on existing studies that suggest a professor's race, age, accent, and even physical attractiveness could alter evaluation scores.

When he was chair of the statistics department, Mr. Stark analyzed those studies and eventually published a paper concluding that student-evaluation surveys were a poor measure of effective teaching. He was also aware of Berkeley's reliance on survey feedback during the faculty-review process.

Every semester students ranked their professors' teaching effectiveness on a scale of one to seven. Department and university committees used an average of that score — and sometimes little else — to inform their decisions. (At Berkeley, professors undergo assessments every two to three years at the start of their careers, then less frequently as they progress.)

As chair, Mr. Stark revamped the process. He had professors submit portfolios of materials they had created for their classes, including syllabi, exams, and lecture notes, as well as examples of student work. He sent other professors into classrooms to observe their peers before major reviews and write up assessments that those being evaluated could read and respond to. Student evaluations were not eliminated, and their input was still valued, said Mr. Stark. He just aimed to widen the lens through which to view a professor's teaching.

Deandra Little, director of the Center for the Advancement of Teaching and Learning at Elon University, said many colleges are bolstering their assessment process with metrics other than student-evaluation scores. Mr. Stark's system is unique because many departments are not recommending peer evaluations so frequently, said Ms. Little.

COURTESY OF PHILIP STARK

Philip B. Stark, associate dean of the division of mathematical and physical sciences at the U. of California at Berkeley

Now, armed with statistical evidence of bias in student evaluations, Mr. Stark wants to graft a similar approach onto the entire mathematical- and physical-sciences division, which encompasses five departments, for next fall. He and others in the division agree that the evaluations are flawed. But how to mitigate those flaws is still up for debate.

OUT WITH THE OLD

Elizabeth Purdom, an assistant professor in the statistics department, started teaching at Berkeley in 2009. She re-

members that her first evaluations were fairly negative. The class was not smooth sailing, she said.

But even as Ms. Purdom gained experience, the numbers on her evaluations stayed low. And the written portion and numerical rating often did not align, making it difficult to establish any trend. Once a student wrote that the course was the best stats class she'd ever taken. But then she gave Ms. Purdom a five out of seven on the teaching-effectiveness question.

"Well, that number is not really useful," Ms. Purdom thought at the time.

The departmental committee that reviews professors brought up those low scores even after her ratings had improved, Ms. Purdom said. The people who conducted her reviews also typically relied on her average score instead of the median, which meant one low rating could tank — or at least drag down — a large pool of high marks.

Ms. Purdom was eager to receive any feedback that might be more useful, so in 2013 she agreed to act as a guinea pig for Mr. Stark's new evaluation system.

A professor in another department observed one of her classes and wrote up a synopsis. Ms. Purdom said that professor gave her a wealth of positive feedback and several concrete suggestions, which gave her confidence in her teaching for the first time.

"Up until that time I was sort of like, OK, maybe I'm not one of these people who is good at teaching," Ms. Purdom said.

The written observation, along with a teaching portfolio she had constructed, went into her dossier for her midcareer review. Those materials were a stronger foundation than just her student-evaluation scores and a brief teaching statement — the documents typically used to judge a professor at that time, Ms. Purdom said.

The statistics department still uses peer evaluations, as well as teaching portfolios, in tandem with the student scores to evaluate professors for their major career reviews. L. Craig Evans, interim chair of the mathematics department, said that process would have benefited him last fall.

As chair, he reviewed multiple professors' promotion cases with little more than "a single number and raw teaching comments from the students," Mr. Evans said. He wished he had had a fuller perspective.

"When students evaluate how a course went, they have a view. I don't think it's an entire view," Mr. Evans said.

IN WITH THE NEW

Though Berkeley has cautioned for several years against relying too heavily on student evaluations, the practice still happens, and the university has struggled to avoid it, said Frances Hellman, dean of the division of mathematical and physical sciences.

"All of us cling to this hope that it will be a reasonable metric," Ms. Hellman said.

Ms. Hellman knows firsthand that student evaluations can be unreasonable, or occasionally "kind of merciless," she said. (She remembers one student's remark on her hair, which said she looked as if she stuck her finger in a light socket every morning.)

The Committee on Teaching for Berkeley's Academic Senate reviewed the universitywide policy for evaluating teaching and, in 2015, published its findings. The committee concluded that "student course evaluations alone do not portray a complete picture on which to conduct an evaluation." The group recommended requiring a teaching dossier that would include peer observation as part of a professor's merit and promotion materials.

Juan M. Pestana, a professor in the department of civil and environmental engineering and chair of the Academic Senate's teaching panel, said it was too early to tell if departments were heeding the panel's suggestions. But there is an active conversation on the campus about the best ways to measure effective teaching, he said.

Ms. Hellman said she supports drafting and circulating new suggestions on how to evaluate teaching to the five departments in her division for the fall. But she said she's not convinced that peer evaluations would be less influenced by implicit biases than student evaluations are. And she's skeptical that asking faculty members to watch one of their peers' lectures would do much to strengthen the observed professor's teaching.

Mr. Stark also understands the potential shortcomings of peer evaluations, but for a different reason. Asking faculty members to sacrifice time and energy to perform additional duties is "a hard sell," he said. But he added that such work is key to actually improving teaching, not just assessing it.

Department chairs in Ms. Hellman's division will talk with Mr. Stark throughout the summer to hammer out the specifics of how a department might put peer-assessment and teaching-portfolio requirements into practice. What teaching criteria to examine, how often to prescribe evaluations, and which professors are qualified to do the assessing are all potential points of discussion. She foresees a process that blends all options — student, peer, and self evaluations — to paint a richer portrait of a professor. She hopes it will measure how hard professors are trying to be effective instructors.

"Effort, by and large, will lead to better teaching," said Ms. Hellman. "Just like it leads to better everything else."

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LAUREN SCHNEIDERMAN FOR THE CHRONICLE

Central Connecticut State U. professors (left to right) Abigail Adams, Jacob Werblow, and Catherine R. Baratta are part of a broad, standardized effort to analyze the real stuff of college — students' work.

The Next Great Hope for Measuring Learning

By DAN BERRETT

SIMSBURY, CONN.

The long search for an answer to one of higher education's most pressing questions led here, to the basement of a bistro outside Hartford.

What do students really learn in college?

To find answers, about 20 faculty members from Central Connecticut State University came to spend the waning days of summer break analyzing hundreds of samples of students' work.

Carl R. Lovitt, their provost, gave them a pep talk over bagels and coffee: "You are engaged in work of meaningful national significance."

Academe has been pilloried for decades, he said, for its lack of accountability. This project could remedy that. It's the kind of acronym-heavy, jargon-laced endeavor that's easily overlooked. But by measuring students' intellectual skills,

it might turn out to provide telling insight into one of higher education's central functions.

Accountability is often equated with standardized tests, which have attracted support from policy makers and researchers but have failed to catch on with many faculty members. Most tests aren't connected to the curriculum, and students have little motivation to take them seriously. Other measures, like students' self-reported attitudes or study habits, are widely used but tend to give institutions few clues for how to improve. So the quest for a faculty-endorsed, broadly useful measure of student learning has continued.

The professors at Central Connecticut State are part of a large-scale project, involving 900 faculty members at 80 public two- and four-year institutions in 13 states, called the Multi-State Collaborative to Advance Quality Student Learning. It's being led by the State Higher Education Executive Officers Association and the Association of American Colleges & Universities. The project's scale, novel approach, and strong faculty support have many assessment experts hopeful that it will make a big impact.

Perhaps, they say, this collaboration will help establish common understandings and measurements of some of the most important outcomes of a college education. Though the project is still young — it's getting ready to publish its second year of results — its leaders hope that by 2019-20 it will have enough data, including from similar efforts at private colleges, to paint an accurate picture of learning nationwide and, in turn, to spark continuing improvement.

What makes the effort notable is its subject of analysis: the authentic stuff of college — the homework, problem sets, and papers that students regularly produce. From those, evaluators like the ones being trained at Central Connecticut State can produce generalizable and comparable findings across disciplines, institutions, and states about students' critical-thinking, writing, and quantitative-reasoning skills.

To do so, they're using tools called "Value" rubrics (it's an acronym for Valid Assessment of Learning in Undergraduate Education). Developed nine years ago by faculty members at more than 100 institutions, under the guidance of AAC&U, the rubrics have a 0-to-4 scale on which evaluators rate how well students demonstrate various components of each skill.

The project is sure to face challenges. Longstanding tensions in assessment aren't easily resolved. The tradition of faculty control over education makes it difficult for any effort to take root widely. Feeding useful data back to professors to help them improve their teaching is a perennial problem.

But the rubrics' fundamental connection to the daily work of education, says George D. Kuh, a leading expert on assessment, means this attempt may succeed where others have foundered.

"In terms of trying to assess authentic student learning," he says, "it's the most ambitious effort ever."

Assessment often gets caught in a tug of war between accountability and improvement. Those who embrace improvement see assessment as the domain of the faculty. Quizzes, tests, essays, and the informal back-and-forth of class discussion reveal what students have learned in a course, allowing professors to take stock and adjust instruction accordingly. The end product is a grade.

But some say that's not reliable. Maybe grade-point averages used to mean something, before grade inflation. As the price of college continues to rise, assuming without any verifiable proof that students have learned something is unacceptable, the argument goes. Accountability requires some external measure of learning, like a standardized test.

The tensions have produced a stalemate, and educational quality has remained opaque.

"You are engaged in work of meaningful national significance."

"We know less about what our students know and are able to do than just about virtually any other aspect of the enterprise," says Mr. Kuh, who is evaluating the 13-state effort for the Bill & Melinda Gates Foundation, which is also supporting the project. "It's a national embarrassment."

Tensions between accountability and improvement characterized the No Child Left Behind Act, the unpopular federal law that set targets and measured progress in reading and mathematics for elementary- and secondary-school students. Replaced late last year, it has served as a bogeyman for many college educators. They feel they must develop a broadly applicable measure of learning themselves, or something like No Child will be imposed on them.

It hasn't been easy to come up with one. Standardized tests of core skills, like the Collegiate Learning Assessment, ETS Proficiency Profile, and ACT's Collegiate Assessment of Academic Proficiency, have attracted widespread interest. But many faculty members have chafed, seeing the

tests as disconnected from their courses. The tests may present one way to hold colleges accountable, but on their own they do little to drive improvement. Another measure of the value of college is graduates' first-year earnings, which figure controversially in the Obama administration's College Scorecard.

Looking more closely at the existing byproducts of college — the assignments students already do and supposedly learn from — and drawing conclusions from them may be a better way forward, says Robert M. Shireman, a former deputy under secretary at the U.S. Department of Education who is now a senior fellow at the Century Foundation, a think tank.

"The evidence of excellent or inadequate student engagement is student work," he wrote this year in a report for the foundation. Making students' work more widely available for inspection would provide a clear indication of what they're learning.

"What we want," Mr. Shireman said in an interview, "is faculty members to be creative and push students to their potential."

Assignments are pivotal to a college education, but professors get little guidance on how to create them. A common approach is to gauge students' content knowledge. Helping them develop skills like oral communication or creative thinking — and judging those skills — can be more difficult.

In the basement of the bistro, Central Connecticut State's professors saw that analyzing those underlying skills can get messy. They split into three groups to examine students' work in quantitative reasoning, writing, and critical thinking.

The last group was led by Cassandra Broadus-Garcia, an associate professor of art. She outlined the ground rules. Start your evaluation by looking at each subcategory of critical thinking in the rubric, beginning at the top of the scale. Assume that the student's work is a 4 until you can't justify it. Then move to a 3. Look for evidence of the proper score. Don't make inferences; stick to what the student actually wrote.

"Take off your professor hat," Ms. Broadus-Garcia told them. "You're not grading."

The distinction between grading and scoring is an essential one for this effort. Grading is second nature to faculty members and reflects their disciplinary judgment about how well students understand the course material. Scoring gauges the intellectual skills and habits that should characterize an educated person from any discipline, and that's what this project wants to capture.

The shift sometimes proved difficult for the

LAUREN SCHNEIDERMAN FOR THE CHRONICLE

Cassandra Broadus-Garcia, an art professor (center), led a group scoring students' critical-thinking skills. The goal is to capture the intellectual skills and habits that should characterize an educated person from any discipline.

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Faculty members, like Marianne Fallon (left) of Central Connecticut State U., are part of a broad effort to understand what students learn, based on their completed assignments.

group, even though the process was designed to discourage grading. For one, the professors didn't know the discipline or the purpose of the two-page homework assignment they were evaluating. All the group had were five prompts and one student's answers. Knowing the goal of an assignment tends to focus attention on how well students meet expectations. And that leads back to grading.

The first prompt was to choose a health treatment to study. This student opted for the "liberation procedure" for multiple sclerosis, based on the idea that poor blood drainage from the brain causes the disease's main symptoms.

The next prompt was to evaluate the credibility of two websites describing the treatment. The student chose WebMD and a page published by Singularity University. The latter's reliability had raised questions for the student because it linked to Wikipedia, and the author seemed to have few relevant credentials.

"The article seems like more of a blog posting," the student wrote. WebMD, in contrast, was written by people with expertise in medicine, health communications, and journalism.

The five professors — a biologist, two from business, and another two from political science — quickly found themselves drifting toward grading, especially as they debated one category of critical thinking, "influence of context and assumptions." Were the students supposed to analyze a controversial health treatment? Or was this exercise about information literacy?

"This goes back to the problem of not having the assignment," said Robbin Smith, an associate professor of political science, with some frustration.

Grading crept into the conversation in other ways. Several professors wondered about Singularity University, which the student identified as a university (it's a think tank that promotes technological solutions to social problems). Would choosing such a site matter if the point of the exercise was to evaluate sources of health information?

If that was the assignment, then the student, by choosing unequal sources, seemed to be constructing a straw man, said Jason Snyder, an associate professor of business. It was a form of selection bias, he said, as the biologist next to him nodded vigorously. After all, how difficult is it to weigh competing claims when one source is WebMD and the other's author profile features, the student noted, "a picture of a cartoon"?

But regardless of the assignment, the professors weren't impressed by the student's handling of context and assumptions. Four of the scorers rated the sample a 2 out of 4. The student had questioned a few assumptions, but not necessarily his or her own.

Professors using these rubrics have long been able to score individual pieces of student work like the group at Central Connecticut State did. What's different now is that hundreds of faculty members in 13 states are being trained to do the same thing, allowing researchers to aggregate the numbers and look for patterns.

That's part of what worries John D. Hathcoat. The assistant professor of graduate psychology at James Madison University will be leading the

Multi-State Collaborative to Advance Quality Student Learning there. He counts himself as a supportive skeptic.

Should the numbers be used to hold colleges accountable? If one state's average score on written communication is 2.3, and another's is 2.5, does that mean the latter's public colleges are 0.2 points better at developing that skill?

"It's worth doing and we need to do it," Mr. Hathcoat says of the project, but "it could get misused."

He also has methodological concerns. The nature and rigor of assignments vary widely, and oversampling very easy or difficult ones, he argues, could produce misleading results. And his research suggests that critical thinking and writing are fuzzy things to assess, often bleeding into each other. "If my thoughts are jumbled," he said, "it's going to show up in my writing."

Terrel L. Rhodes, executive director of the Value project for AAC&U, shares some of those concerns. He worries that the rubrics' scores will be rolled up into an average and used for the wrong purpose. "None of this is intended for rankings," he says. "It is about, What are you doing on your campus to improve?"

And he agrees that, on some level, categories like critical thinking or writing are artificial. But the more important point, he says, is that this effort has provoked sustained thought and attention among faculty members to intellectual skills, teaching, and assignments. It has served to focus professors' attention on different aspects of learning, he says, "by naming them and trying to take them on."

Analyzing student work seems to have energized many professors: 94 percent of participants in an earlier stage of the project said they enjoyed having cross-disciplinary discussions. The forums gave them an opportunity to think deeply about skills they all see as valuable and discuss how to teach and assess them in their own fields.

"When was the last time," asks Mr. Rhodes, "you had people enthusiastic about assessment?"

Rubrics work best for improving teaching, says Roger Benjamin, president of the Council for Aid to Education, which oversees the Collegiate Learning Assessment. But they're not as reliable for accountability purposes, he says, as standardized tests like his.

More than two-thirds of institutions use some type of rubric, while fewer than half give standardized tests like the CLA. Colleges tend to see many forms of assessment as a way to satisfy accreditors, according to a 2014 study by the National Institute for Learning Outcomes Assessment. Using such tools for institutional improvement or curricular change ranked far lower.

But attitudes seem to be shifting, says Natasha A. Jankowski, director of the institute, which is

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Central Connecticut State U. professors score student work using a widely shared rubric. They are among 900 faculty members nationwide who are learning a standardized method to measure students' skills.

updating the study. The Value rubrics and the state collaboration, she says, have changed faculty behavior, chiefly because the approach is directly related to their daily work.

"It's been maybe the best leverage point we've had to help faculty think about improvement," says Ms. Jankowksi. "It hits them where they live."

Still, results don't always make their way back to the classroom. A standard complaint about assessment efforts is not "closing the loop."

Yvonne Kochera Kirby, Central Connecticut State's director of institutional research and assessment, wants to avoid that. She provides data to the professors whose assignments are scored, and that has sparked changes. One professor realized she'd focused on the arcana of her discipline, mistaking that for critical thinking. Another saw that, in one assignment, she had unintentionally repeated the same prompt three different ways.

Absent such feedback, professors often assume their assignments achieve what they're supposed to, says Ms. Kirby. "A lot of faculty members probably say, 'This assignment aligns,'" she says, "but it really doesn't."

Improving teaching can seem like a huge task. It may sound like it requires wholesale changes or a radical rethinking of the professor's role in the classroom.

The changes driven by the rubrics tend to be comparatively modest. But a small adjustment can still be powerful. It might mean drawing a clearer connection between an assignment and the goals of the course, or giving more-explicit directions. "Those minor modifications have huge impacts on students," says Ms. Jankowski.

Professors have described how the rubric scores have helped them look with fresh eyes at what they assign students. Bonnie L. Orcutt is one of them.

For a microeconomics assignment, the professor at Worcester State University often asked students to analyze an article from *The New York Times* on the use of a tobacco tax to balance state budgets. She would have students summarize the states' position and predict what would happen if they increased taxes.

When that work was analyzed using the quantitative-literacy rubric, her students scored low in one category, evaluating assumptions. It wasn't because they couldn't, she realized. She just hadn't asked them to evaluate assumptions, no small matter to an economist like Ms. Orcutt. "Assumptions," she says, "inform the models you choose and how you interpret them."

Ms. Orcutt revised the assignment, making explicit the steps she wanted students to take. She added a prompt: "Indicate any assumptions that underlie your analysis." She also brought up assumptions during class discussions. They were simple modifications, but since then, Ms. Orcutt has noticed her students demonstrating that skill more consistently.

Focusing on little things has had a big effect on her teaching. She got into assessment almost by happenstance eight years ago, when she was enlisted to help with a general-education revision at Worcester State. She recently finished a three-year term as director of learning-outcomes assessment for the Massachusetts Department of Higher Education.

Ms. Orcutt is an unlikely convert. Early in her career, she thought of assessment as one more hoop to jump through. Teaching well was a matter of how "on" she was during her lectures, she says, and how much course content her students absorbed. She still cares about whether they know their stuff, of course, but now she thinks about how to help them apply it.

Creating the right conditions for that kind of learning is an intellectual challenge, like research, that is both invigorating and aggravating. The work of teaching well is a continuing process, she says, of creating assignments, analyzing the results, and making more changes. It's work that's never finished.

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Small Changes in Teaching: The First 5 Minutes of Class

4 quick ways to shift students' attention from life's distractions to your course content

By JAMES M. LANG

"MANY YEARS LATER, as he faced the firing squad, Colonel Aureliano Buendía was to remember that distant afternoon when his father took him to discover ice."

In a conversation I had with Ken Bain, my longtime mentor and favorite education writer, he cited that quote — the first sentence of Gabriel García Márquez's novel *One Hundred Years of Solitude* — as one of the great openings in literary history. It's hard to disagree: The sentence plunges us immediately into a drama, acquaints us with a character on the brink of death, and yet intrigues us with the reference to his long-forgotten (and curiosity-inducing) memory. That sentence makes us want to keep reading.

When I teach my writing course on creative nonfiction, we spend a lot of time analyzing the opening lines of great writers. I work frequently with students on their opening words, sentences, and paragraphs. In that very short space, I explain to them, most readers will decide whether or not to continue reading the rest of your essay. If you can't grab and hold their attention with your opening, you are likely to lose them before they get to your hard-won insights 10 paragraphs later.

The same principle, I would argue, holds true in teaching a college course. The opening five minutes offer us a rich opportunity to capture the attention of students and prepare them for

learning. They walk into our classes trailing all of the distractions of their complex lives — the many wonders of their smartphones, the arguments with roommates, the question of what to have for lunch. Their bodies may be stuck in a room with us for the required time period, but their minds may be somewhere else entirely.

It seems clear, then, that we should start class with a deliberate effort to bring students' focus to the subject at hand. Unfortunately, based on my many observations of faculty members in action, the first five minutes of a college class often get frittered away with logistical tasks (taking attendance or setting up our technology), gathering our thoughts as we discuss homework or upcoming tests, or writing on the board.

Logistics and organization certainly matter, and may be unavoidable on some days. But on most days, we should be able to do better. In this column, the second in a series on small changes we can make to improve teaching and learning in higher education, I offer four quick suggestions for the first few minutes of class to focus the attention of students and prepare their brains for learning.

Open with a question or two. Another favorite education writer of mine, the cognitive psychologist Daniel Willingham, argues that teachers should focus more on the use of questions. "The material I want students to learn," he writes in his book *Why Don't Students Like School?,* "is actually the answer to a question. *On its own, the answer is almost never interesting.* But if you know the question, the answer may be quite interesting."

My colleague Greg Weiner, an associate professor of political science, puts those ideas into practice. At the beginning of class, he shows four or five questions on a slide for students to consider. Class then proceeds in the usual fashion. At the end, he returns to the questions so that students can both see some potential answers and understand that they have learned something that day.

For example, in a session of his "American Government" course that focused on the separation of powers, the first question of the day might be: "What problem is the separation of powers designed to address?" And the last: "What forces have eroded the separation of powers?" Those questions are also available to the students in advance of class, to help guide their reading and homework. But having the questions visible at the start of class, and returning to them at the end, reminds students that each session has a clear purpose.

So consider opening class with one or more questions that qualify as important and fascinating. You might even let students give preliminary answers for a few moments, and then again in the closing minutes, to help them recognize how their understanding has deepened over the course period.

What did we learn last time? A favorite activity of many instructors is to spend a few minutes at the opening of class reviewing what happened in the previous session. That makes perfect sense, and is supported by the idea that we don't learn from single exposure to material — we need to return frequently to whatever we are attempting to master.

But instead of offering a capsule review to students, why not ask *them* to offer one back to you?

In the teaching-and-learning world, the phenomenon known as the "testing effect" has received much ink. Put very simply, if we want to remember something, we have to practice remembering it. To that end, learning researchers have demonstrated over and over again that quizzes and tests not only measure student learning, but can actually help promote it. The more times that students have to draw information, ideas, or skills from memory, the better they learn it.

Instead of "testing effect," I prefer to use the more technical term, "retrieval practice," because testing is not required to help students practice retrieving material from their memories. Any effort they make to remember course content — without the help of notes or texts — will benefit their learning.

Take advantage of that fact in the opening few minutes of class by asking students to "remind" you of the key points from the last session. Write them on the board — editing as you go and providing feedback to ensure the responses are accurate — to set up the day's new material. Five minutes of that at the start of every class will prepare students to succeed on the memory retrieval they will need on quizzes and exams throughout the semester.

One important caveat: Students should do all of this without notebooks, texts, or laptops. Retrieval practice only works when they are retrieving the material from memory — not when they are retrieving it from their screens or pages.

Reactivate what they learned in previous courses. Plenty of excellent evidence suggests that whatever knowledge students bring into a course has a major influence on what they take away from it. So a sure-fire technique to improve student learning is to begin class by revisiting, not just what they learned in the previous session, but what they already knew about the subject matter.

"The accuracy of students' prior content knowledge is critical to teaching and learning," write Susan A. Ambrose and Marsha C. Lovett in an essay on the subject in a free ebook, because "it is the foundation on which new knowledge is

built. If students' prior knowledge is faulty (e.g., inaccurate facts, ideas, models, or theories), subsequent learning tends to be hindered because they ignore, discount, or resist important new evidence that conflicts with existing knowledge."

Asking students to tell you what they already know (or think they know) has two important benefits. First, it lights up the parts of their brains that connect to your course material, so when they encounter new material, they will process it in a richer knowledge context. Second, it lets you know what preconceptions students have about your course material. That way, your lecture, discussion, or whatever you plan for class that day can specifically deal with and improve upon the knowledge actually in the room, rather than the knowledge you imagine to be in the room.

Here, too, try posing simple questions at the beginning of class followed by a few minutes of discussion: "Today we are going to focus on X. What do you know about X already? What have you heard about it in the media, or learned in a previous class?" You might be surprised at the misconceptions you hear, or heartened by the state of knowledge in the room. Either way, you'll be better prepared to shape what follows in a productive way.

Write it down. All three of the previous activities would benefit from having students spend a few minutes writing down their responses. That way, every student has the opportunity to answer the question, practice memory retrieval from the previous session, or surface their prior knowledge — and not just the students most likely to raise their hands in class.

Frequent, low-stakes writing assignments constitute one of the best methods you can use to solicit engagement and thinking in class. You don't have to grade the responses very carefully — or at all. Count them for participation, or make them worth a tiny fraction of a student's grade. If you don't want to collect the papers, have students write in their notebooks or on laptops and walk around the classroom just to keep everyone honest and ensure they are doing the work. Limit writing time to three to five minutes and ask everyone to write until you call time — at which point discussion begins.

In my 15 years of full-time teaching, the only thing I have done consistently in every class is use the first few minutes for writing exercises, and I will continue to do that for as long as I am teaching. I love them not only for the learning benefits they offer, but because they have both a symbolic value and a focusing function. Starting with five minutes of writing helps students make the transition from the outside world to the classroom.

So don't limit student-writing time to papers or exams. Let a writing exercise help you bring focus and engagement to the opening of every class session. Build it into your routine. Class has begun: time to write, time to think.

In writing, as in learning, openings matter. Don't fritter them away.

James M. Lang is a professor of English and director of the Center for Teaching Excellence at Assumption College, in Worcester, Mass. His new book, Small Teaching: Everyday Lessons From the Science of Learning, *will be published in March 2016. Follow him on Twitter at @LangOnCourse.*

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Small Changes in Teaching: The Last 5 Minutes of Class

Don't waste them trying to cram in eight more points or call out as many reminders as possible

By JAMES M. LANG

I REMEMBER sitting in a movie theater with my children in December of 2003, watching the final minutes of the third film in *The Lord of the Rings* trilogy, and feeling a deep sense of closure as Gollum and the ring toppled into Mount Doom, and Frodo and Sam were rescued by the eagles. What a glorious finish to an epic film series, based on a book series that I loved as well.

Only it wasn't the finish. Once the ring melted we got to see the members of the original fellowship united again in the land of the elves. OK, I get that. Feel-good closure. I prepared to get up and leave. Oh, wait, another scene: The hobbits receive public recognition for their heroism. That's nice. Time to go. Not yet. Now we have to follow the hobbits back home. Finished now? Nope. Sam gets married.

And on and on it seemed to go. I believe I prepared to get up out of my seat five times before that film finally ended. A series that could have finished with a nice dramatic punch instead lurched along wrapping up every possible thread that had loosened over the past nine hours of film.

All of which reminds me

of nothing more than your typical college classroom.

In my experience — having observed many dozens of college courses over the past two decades — most faculty members eye the final minutes of class as an opportunity to cram in eight more points before students exit, or to say three more things that just occurred to us about the day's material, or to call out as many reminders as possible about upcoming deadlines, next week's exam, or tomorrow's homework.

At the same time, we complain when students start to pack their bags before class ends. But why should we be surprised by that reaction when our class slides messily to a conclusion? We're still trying to teach while students' minds — and sometimes their bodies — are headed out the door. We make little or no effort to put a clear stamp on the final minutes of class, which leads to students eyeing the clock and leaving according to the dictates of the minute hand rather than the logic of the class period.

When it comes to the deliberate construction of our course periods, we can do better. As I have been arguing in this series, small changes to our teaching — such as the way we approach the closing minutes of class — can make a big difference. Like most of my fellow professors, I know I could be doing many things better in my teaching. But the prospect of change can be overwhelming. Fortunately, a substantial body of research on learning in higher education offers us strategies for improving our teaching in ways that don't require a major overhaul, and yet that have the power to boost the learning, motivation, and mind-set of our students in substantive ways.

In a series of essays for *The Chronicle* — which draw from my book, *Small Teaching: Everyday Lessons From the Science of Learning* — I have argued for the power of small changes in the minutes before class starts, in the first five minutes of class, and in the connections we can help students make between the course material and the world around them. In this column, let us turn to ways we can make better use of the final five minutes of class.

The minute paper. You can't wade very far into the literature of teaching and learning in higher education without encountering some version of the Minute Paper, a technique made justly famous by Thomas A. Angelo and K. Patricia Cross in their book *Classroom Assessment Techniques: A Handbook for College Teachers*. The Minute Paper comes in many variations, but the simplest one involves wrapping up the formal class period a few minutes early and posing two questions to your students:

- What was the most important thing you learned today?
- What question still remains in your mind?

Taken together, those two questions accomplish multiple objectives. The first one not only requires students to remember something from class and articulate it in their own words (more about that in a moment), but it also requires them to do some quick thinking. They have to reflect on the material and make a judgment about the main point of that day's class.

The second question encourages them to probe their own minds and consider what they haven't truly understood. Most of us are infected by what learning theorists sometimes call "illusions of fluency," which means that we believe we have obtained mastery over something when we truly have not. To answer the second question, students have to decide where confusion or weaknesses remain in their own comprehension of the day's material.

On my campus, most students do not bring laptops to class, so I might ask them to answer those two questions on a half-sheet of paper. Reading their responses, even if I don't grade them, will give me a quick picture of how well the class went. If everyone writes down as the most important point of the day a throwaway example I gave, I know I have some work to do. Likewise if everyone expresses the same question in the second part of their answer, I know how I have to start the next class. But even if I don't collect what they write, and simply stroll around and ensure pens are moving on paper, students will still benefit from some retrieval and reflection at the end of class.

If students in your classes are on various electronic devices, you might create a discussion thread in your course-management system and ask them to post their responses to these questions at the end of every class period. In this model students can read each other's responses, and you can throw the thread onto the screen at the beginning of the next class period to highlight answers that either nicely captured the main point of the previous class or raised questions that need answering.

Closing connections. If we want students to obtain mastery and expertise in our subjects, they need to be capable of making their own connections between what they are learning and the world around them — current events, campus debates, personal experiences. The last five minutes of class represent an ideal opportunity for students to use the course material from that day and brainstorm some new connections.

Most faculty members seed such connections throughout our lectures. The other day, for instance, I used a Taylor Swift song to introduce students to the dramatic monologues of Robert Browning. In offering such examples, we can model the sorts of connections we expect of students.

Finish the last class of the week five minutes early, and tell students that they can leave when they have identified five ways in which the day's material appears in contexts outside of the classroom. You'll be amazed at how quickly they can

come up with examples when this activity stands between them and the dining hall.

In my class period on Browning's monologues, for example, I might ask students to list five popular songs in which the "speaker" clearly does not represent the voice of the singer. In a marketing class on the role of packaging you might ask students to give you five examples of distinctive product packaging that spring to mind. You can write them on the board or have students post the examples to a course website. Make it three items instead. Or take 10 minutes instead of five. Vary according to your taste and classroom.

The metacognitive five. We have increasing evidence from the learning sciences that students engage in poor study strategies. Likewise, research shows that most people are plagued by the illusions of fluency. The solution on both fronts is better metacognition — that is, a clearer understanding of our own learning. What if all of us worked together deliberately to achieve that?

For example, we have excellent evidence that students remember material better when they test themselves and try to retrieve information from their own minds. And yet most students still study by reviewing their notes over and over again — probably the least-effective study strategy they can employ. The final five minutes of class can provide a quick opportunity to let students know how best to prepare for their next assessment, based on the science of learning and on your experience as an expert learner.

Before the midterm, I asked students to take two minutes and write down for me how they studied for the test. When I compared what they said with the exam scores, the evidence couldn't have been clearer: Low-performing students used phrases like "reviewed my notes" and "reread the poems"; the students who aced the exam said things like "wrote an outline," "rewrote my notes," "organized a timeline," "tested myself," and "created flashcards." I made a slide with a side-by-side comparison of the two columns, and spent five minutes of class showing students the differences. They'll see that slide again in the last five minutes of class just before the next exam.

Imagine what a difference we could make if we all took five minutes — even just a few times during the semester — to offer students the opportunity to reflect on their learning habits. We could inform their choices with some simple research, and inspire them to make a change. One five-minute session in one course might not mean much, but dozens of such sessions across a student's college education would add up.

Close the loop. Finally, go back to any of the strategies I introduced in my recent column on the first five minutes of class and see if the suggestions can help you formulate a strategy for those final five minutes. If you began class with a few questions, put them back up on screen and have students use what they have learned that day to formulate their own answers. If you opened by asking students to tell you what they learned in the previous class, close by having them tell you what they learned in *this* class. Or if you started by soliciting their prior knowledge on the subject, close by having them explain how today's class confirmed, enhanced, or contradicted what they knew before.

We have such a limited amount of time with students — sometimes just a few hours a week for 12 or 15 weeks. Within that narrow window, five minutes well-spent at the end of class can make a difference.

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ILLUSTRATION BY KEN VAN AELST FOR THE CHRONICLE

What Should Graduates Know?

By NICHOLAS LEMANN

Ten years ago, I was teaching the first cohort of students in a newly designed professional master's-degree program at the Columbia University Graduate School of Journalism. From the earliest days of journalism education in universities, a never-ending debate has pitted an approach that emphasizes skills associated with various formats for presenting the news against one that stresses understanding of the complex subjects about which journalists are supposed to inform the public. Our program was meant to represent a pendulum swing in the latter direction.

We left in place our established master's-of-science program, which focuses on skills. In stages, we reworked its curriculum to introduce the new skills associated with the digital revolution in journalism. Both of our main degree programs are based on courses that all students are required to take, but our master's of arts offers no courses on the various ways of presenting news. It focuses on a "journalistic method" of on-the-fly epistemology; on teaching students to understand and write about complicated and important subjects for a general public; and on a thesis project that entails substantial original research, often done through reporting abroad. We teach statistical literacy and state formation, monetary policy and ethnography, literature reviews and public health.

If you're reading this, you probably don't have to be persuaded that those studies should be part of the equipment that journalists take into the world. But that would still be a minority position within journalism itself. And it isn't just in journalism education where arguments pitting employment-related skills against understanding and complex thinking take place, but, also increasingly, throughout universities.

Professional schools are naturally contested ground, because by definition they are not purely academic institutions. But the argument about what should be taught is now also taking place in undergraduate education — at least in the liberal arts, the part of undergraduate education that wasn't always mainly devoted to skills instruction. What to teach and how to teach it are likely to become central issues for colleges in a way that they haven't been for a long time.

Professional schools first. Each of them has had to find a way not only to feel like part of the larger enterprise of the university, but also to demonstrate a tangible career value to prospective students and to employers. At schools that train people for fields that require licensing, like law and medicine, what's taught tends to be bound up in legal requirements and is therefore not overly fluid. Journalism schools are more like business or public-policy schools in being able to change quickly and substantially, if that seems to be required, and in having to justify their utility to students who are free to enter the field without taking a degree.

Professional education usually migrated into universities from apprenticeship systems in the workplace. In the early going, the apprenticeship model seemed appropriate: Hire veteran practitioners as faculty members; try to replicate a practice environment as much as possible; focus on conferring the skills that students would most likely be using in their first jobs. Employers often like that model because, in effect, it puts them in charge of what happens in professional schools: The schools' mission is to emulate what employers are doing.

In most cases, forces within universities, like the requirement that faculty members produce academic research, have over the years moved professional schools away from the apprenticeship model. Such forces, however, have had remarkably little effect on journalism schools. A hundred years ago, when journalism education was just beginning, state press associations relentlessly and effectively lobbied for a focus on basic news reporting and writing, with little or no intellectual or analytic content.

Today the argument that journalism schools have to embrace the digital revolution has led to a

new, innovative-sounding version of the venerable call for more practical skills and less of anything that can be caricatured as "academic." The most recent major report on the future of journalism education, from the John S. and James L. Knight Foundation, imagines an ideal professional program that privileges "currency" far more than the intellectual and research orientation of its home university and, in that spirit, sharply reduces its commitment to permanent faculty. It's a program that would focus primarily on "the capacity to identify and master emerging market trends and media technologies and to integrate them quickly into journalistic work" and would strive for "a startup, digital-first program with all new systems, structures, and operating assumptions." It's hard to imagine that kind of rhetoric being applied to professional education in, say, law, medicine, or architecture.

Columbia's journalism school opened, in 1912, firmly in the academic camp, which was in accordance with the wishes of its founding donor, Joseph Pulitzer, who in 1904 wrote an essay, "The College of Journalism," exhorting it to scour disciplines like law, statistics, economics, sociology, history, and the physical sciences and to "divert, deflect, extract, concentrate, specialize them for the journalist as a specialist." The most influential figure on the committee that devised Columbia's curriculum was the historian Charles A. Beard, who at first personally taught journalists-in-training how to cover politics. But within a few years, Beard had quit Columbia over its trustees' interference with academic freedom, and the journalism school had abandoned this approach. Instead it set up a large newsroom where the students would arrive and sit at their desks only until they were dispatched by their teachers to go out and cover news stories around New York City.

All in all, setting up the master's-of-arts program has been a happy adventure, beginning with the year or two we spent inventing a curriculum and then planning the courses, one by one, with the help of colleagues elsewhere at Columbia and outside the university. We have graduated hundreds of students from all over the world, whose work has appeared in *The Washington Post, Slate, The New Yorker, The Wall Street Journal,* the *Financial Times,* the *PBS NewsHour, The New York Times, The Guardian, Time, Frontline, Fortune,* and many other places (including *The Chronicle*). They have written acclaimed books, made documentary films, and have helped start such ventures as the reborn The Caravan, the first English-language magazine of long-form journalism in India, and the Tehran Bureau, the leading dedicated source for independent news about Iran. We are demonstrably not impractically academic.

Our experience obviously has something in common with that of other professional schools. Almost all of them require some kind of set curriculum for entering students. Business students must take accounting and finance; medical students, anatomy and biochemistry; law students, contracts and civil procedure. The lineup varies from institution to institution, but every school, in every professional realm, has to propose a set of materials that it considers essential for people entering the profession. Usually these required courses are not simply a map of the way professional practice is organized; instead of having been conceived by reasoning backward from the categories the profession uses to organize its work, they are reasoned forward from capabilities, ways of thinking, and a body of knowledge that the school believes are foundational for professionals who will be practicing under many conditions over a long time. A big law firm, for example, will almost certainly have a mergers-and-acquisitions department, but a law student won't be able to take a mergers-and-acquisitions course until after having completed a less practice-specific, more conceptual first-year curriculum.

Colleges have something to learn from professional schools about better defining themselves academically.

I don't mean to make it sound as if questions about what to teach in professional schools have been settled. Every dean knows that they are a matter of contention, course by course and in the broader sense of striking the proper balance between more academic and more practice-oriented material. Politically it is a challenge to create consensus among groups with often quite different visions of what the school should be: faculty, students, alumni, employers, and the outside bodies that accredit and rate the schools. Should medical schools teach family medicine? Business schools entrepreneurship or more technical material? Should law schools hire faculty members who

have Ph.D.s in other fields? You wouldn't want professional schools to stop having those kinds of arguments.

That these remain openly contentious issues is a contrast with the situation in undergraduate education, where the conversation about the content of education is much less developed. Colleges, which are increasingly regarded by the people paying for them as proto-professional schools, have something to learn from professional schools about better defining themselves academically.

The great majority of college students in the United States are taking mainly skills courses, which are aimed at getting them jobs in white-collar fields that are not the "ancient and honorable professions" that college graduates once looked to. They are studying to be providers of human-resource services, bookkeepers, computer programmers, early-childhood educators, and so on, and much of their coursework pertains to their career aspirations.

In the better-resourced, more-selective colleges that a lucky minority of students attend, the curriculum is usually both less practical and less prescribed. A few, like Columbia, the University of Chicago, and St. John's College, have a core curriculum required of all students; a few, like Amherst College and Brown University, have no specific curriculum requirements; most have a fairly light-duty distribution requirement, asking students to take a small number of courses in whichever of the humanities, social sciences, and natural sciences aren't their major field of study. As a result, most selective institutions, private and public, that emphasize an undergraduate liberal-arts education have gotten themselves off the hook of having to do what professional schools do: decide what all degree recipients must have learned.

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One reason that more-structured undergraduate education is so rare is that it doesn't have an organized constituency. Students generally like having the freedom to choose to study whatever they want, from a large menu of options. Faculty members, especially in research universities, are rarely eager to take time away from their own research to engage in the intensive work of developing core courses; they often don't see direct involvement in undergraduate education as a crucial element in their work. Administrators are increasingly caught up in the management of "student life," work that rests on an understanding of college as a community, a site of maturation, where purely academic questions are secondary. Significantly, the most spirited discussion of what's taught in college is about getting more topics about diversity into courses, and adding more courses about diversity. In other words, it's occurring in response to a student movement that began in another realm, not because what's taught is the obvious main topic of discussion.

Harvard University provides an interesting example of the difficulty of establishing an undergraduate curriculum, even in a supremely established and well-off institution that strongly feels it needs one. Charles William Eliot, Harvard's president from 1869 to 1909, established an elective system, which freed undergraduates to take courses in any field, in the 1880s, as one element in a great institutional transition to the research-university model. After the Second World War, the college established a General Education program out of a felt need to give more definition to what it meant to have a Harvard education, so that a student's learning could not be limited to one field of study. Over the years, that system became so diffuse that, by the late 1970s, the university replaced it with a core curriculum. But by the turn of the 21st century, that was thought to be so loosely defined that the university began a long, elaborate effort to replace the core with a new system, known by the old name of General Education, which was meant to connect academic study more vividly to the real world. It began in 2007. Last spring a faculty committee's highly critical review

of Gen Ed reported that it "is failing on a variety of fronts," including allowing students to fulfill the requirements by choosing from a list so extensive — 574 courses! — that maintaining the overall aims of the program was impossible. So another major revision of the undergraduate curriculum is in the offing.

For colleges less fortunate than Harvard, the impulse to avoid taking on the difficult task of establishing a more-structured undergraduate curriculum can impose real costs over the long term. Despite the nearly ubiquitous rhetoric about skyrocketing tuition, the evidence seems to indicate that colleges' pricing power is eroding significantly. The National Association of Independent Colleges and Universities' annual tuition survey shows that the size of the annual increases in stated tuition peaked in the early 1980s and has been declining ever since; the most recent survey showed an average annual increase of 3.9 percent, the lowest in 40 years. And that's the stated price, not what students actually pay. The latest annual survey conducted by the National Association of College and University Business Officers, released in August, shows that at the 411 participating colleges, the average tuition-discount rate for first-year students was 48 percent, up from 38 percent 10 years ago. Discounting is rising more rapidly than published tuition, so tuition revenue at many private institutions may be falling. Public colleges have their own financial woes because of budget cuts and tuition caps imposed by state legislatures.

If a college is presenting itself as an institution offering a wide variety of options from which students can select, it has to maintain a large, expensive set of departments and courses.

If a college is presenting itself to prospective students and their families as a living environment, as much as or more than an academic experience, it has to try to take on the implied cost: pleasant dormitories, athletics facilities, counseling services. And if it is presenting itself as an institution offering a wide variety of options from which students can select, it has to maintain a large, expensive set of departments and courses. At many colleges, those pressures set off a dynamic of relentless competition for students with peer institutions that are not obviously very different; that, in turn, has increased the importance of ratings systems and tuition discounting. The harder it is to state your intellectual mission, the more your customers must choose on the basis of generic price and quality comparisons.

If colleges can't or don't want to clearly define what they're about academically, they are left unarmed against what has become the intense pressure to define undergraduate education in terms of acquiring only those skills that have an obvious, immediate, practical applicability and will enhance a graduate's chances of employment. Students, parents, many employers, and state governments tend to push colleges in this direction. Recently the Obama administration added to the pressure by publishing the College Scorecard, which provides data on institutions and majors according to future earnings potential. It's true that some majors are associated with higher incomes than others, but the evidence we have about what accounts for the substantial overall economic value of a college degree over a lifetime indicates that it is a payoff for the development of "cognitive skills" rather than for specific job skills or credentials — a payoff that manifests itself regardless of what a student learned.

Confidence that a college education will pay off no matter what it provides academically seems misplaced. Against the felt need of students and their families to get something intellectually specific out of college, heartfelt commencement speeches about how important a broad humanistic education is to good citizenship and a meaningful life make for a pretty weak countervailing force.

It would be disingenuous for me to argue that what I believe colleges should do — move in the direction of a more defined curriculum, with a concomitant greater emphasis on teaching as a primary faculty responsibility — is merely an unavoidable necessity. But I do believe that colleges will find it more and more difficult to stay the pres-

ent course, which drive costs ever higher and revenues ever lower. Far better to go through a considered, openhearted process of deciding what you stand for academically and where you want to be strongest, ensure that every student's experience encompasses that, and use it as the way you present yourself to the world.

Spending 10 years as a professional-school dean preoccupied with the question of what the suite of requirements should be for students habituated me to thinking about curriculum, and I have been noodling around with ideas about undergraduate education. What would produce a version of what it means to be a college graduate, regardless of one's major, that would be as clear and strong as stipulating what it means to be a professional-school graduate? My own preference is to create a canon of methods rather than a canon of specific knowledge or of great books — that is, to define, develop, and require instruction around a set of master skills that together would make one an educated, intellectually empowered, morally aware person.

Here is a quick list of possibilities: Rigorous interpretation of meaning, taught mainly through close reading of texts. Numeracy, including basic statistical literacy. Pattern and context recognition. Developing and stating an argument, in spoken and written form. Visual and spatial grammar and logic. Understanding how information is produced, how to locate it, and how much faith to put in it. Empathetic understanding of other people and other cultures. Learning to explore rigorously the relationship between cause and effect and to draw plausible inferences. I should emphasize that I am advocating developing courses that are specifically aimed at creating those capabilities, rather than declaring that existing courses that are notionally about something else will confer them.

As a journalist, as a teacher, and as an administrator, I've had a sometimes overwhelming past 10 or 15 years as I've watched my original profession being subjected to changes more rapid and more pervasive than I would have thought possible. Can that happen to colleges and universities? I don't think so — universities offer a far more varied suite of experiences, which they provide mainly in person rather than as pure transmitted information — but the lesson of my experience in journalism is that anticipating change leaves you in much better shape than betting that it won't ever come and then having to react under duress. In undergraduate education, the best way to anticipate change would be to define, state, and put in effect a clear academic mission.

Confidence that a college education will pay off no matter what it provides academically seems misplaced.

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