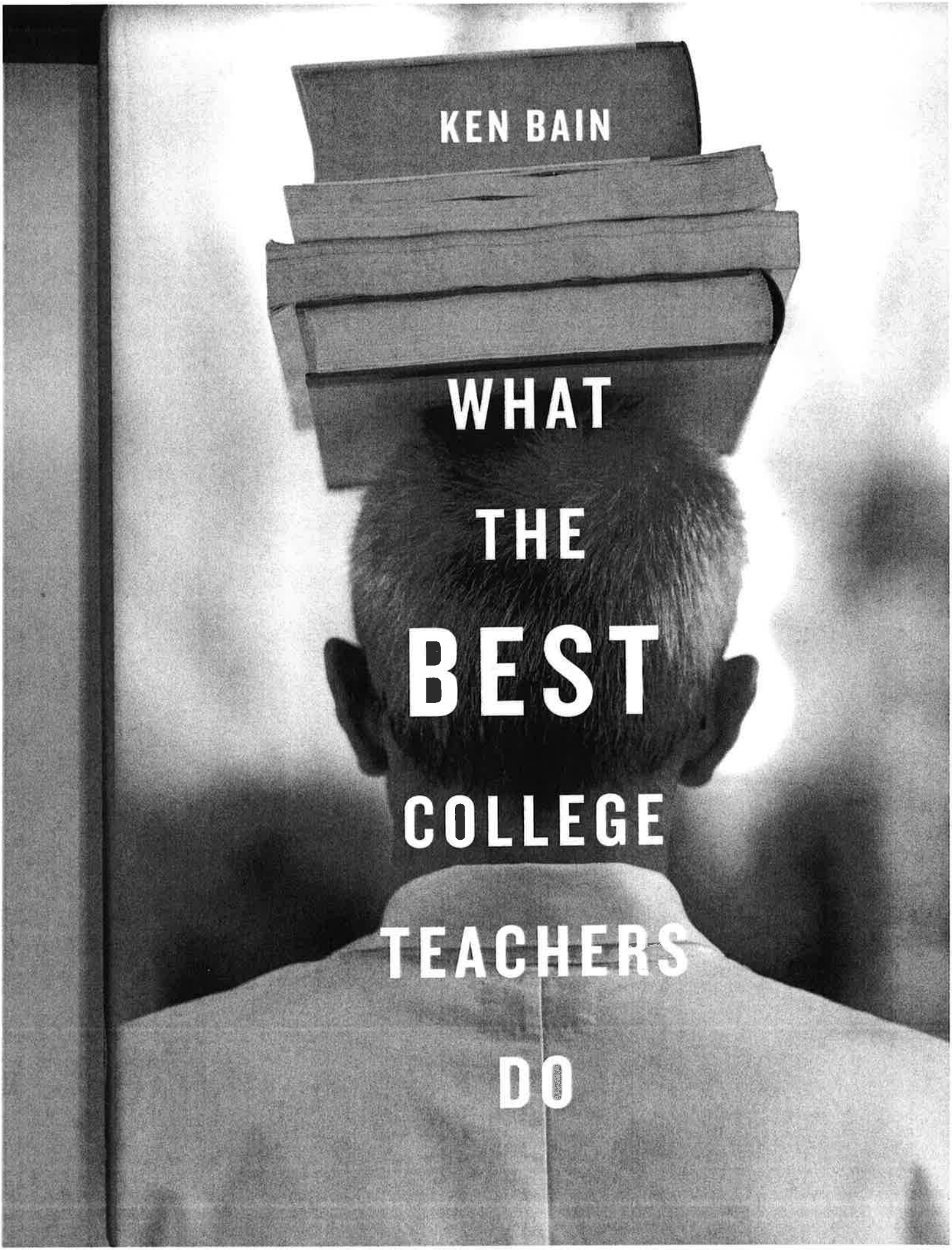
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WHAT
THE
BEST
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DO

# HOW DO THEY CONDUCT CLASS?

A few years ago, one of my colleagues at Northwestern gave a talk on teaching that she called "Are Lectures Useless?" It was actually a vigorous defense of lectures, but the question mark in the title sent another professor on campus into intellectual apoplexy. Armed with the flyer that announced the event, he strolled into class one day ready to tilt at the windmills in his mind, those evil forces raising doubts about the wisdom of his favorite pedagogical weapon. "I want you to know," he told a slightly bewildered student audience while waving the flyer before them, "the teaching center at this university wants us to believe that lectures are no good, but I'm going to continue to lecture whether they like it or not."

More recently, a professor attended one of our summer institutes, fortified with what she believed to be incontrovertible evidence that no one could learn from something called lectures. As part of the program, we featured a demonstration of what students consider to be an outstanding lecture. Our visitor was horrified that anyone would even consider teaching by telling, and later took the opportunity of an elevator ride with the speaker to deliver a fierce tongue-lashing.

These two episodes are part of a growing national debate about lecturing in class. One side in that squabble is convinced that research has proven that lectures never work; the other is often passionately devoted to using the ancient pedagogical device. While this debate has no doubt opened some minds to the possibilities of using tools other than a formal lecture, it has just as often produced rigid positions that shed little light on good teaching, each side convinced that they know a simple truth. Our study of outstanding



teachers revealed, however, that some people can engage their students with good lectures, helping and encouraging them to learn on the highest level; others can do so with case studies, problem-based learning, powerful assignments, playing guide by the side, conducting discussions, or creating stimulating field work. Yet any of these methods can also fail miserably.

So what distinguishes the successful from the unsuccessful? First, some underlying principles cut across practices and shape the learning environment, whether a teacher lectures or not. Second, a few key techniques propel the application of those principles. To understand what makes teaching successful, we must explore both principles and techniques.

## UNIFYING PRINCIPLES

Seven fairly common principles emerged in the practices of the teachers we studied.

### *1. Create a Natural Critical Learning Environment*

More than anything else, the best teachers try to create a natural critical learning environment: "natural" because students encounter the skills, habits, attitudes, and information they are trying to learn embedded in questions and tasks they find fascinating—authentic tasks that arouse curiosity and become intrinsically interesting; "critical" because students learn to think critically, to reason from evidence, to examine the quality of their reasoning using a variety of intellectual standards, to make improvements while thinking, and to ask probing and insightful questions about the thinking of other people.

Some teachers create this environment within lectures; others, with discussions; and still others, with case studies, role playing, field work, or a variety of other techniques. A few create it with a central project that students take on, often working collaboratively

with other members of the class. Sometimes students tackle the problems silently while hearing them raised in provocative lectures designed to offer them ideas and evidence that challenge their previous ways of thinking. Other times, they address the problems in small groups or in larger class discussions. Indeed, the method of choice varies considerably depending on a variety of factors, including the learning objectives, the personality and cultures of teachers and students, and the learning habits of both. But the method matters far less than do the challenge and permission for students to tackle authentic and intriguing questions and tasks, to make decisions, to defend their choices, to come up short, to receive feedback on their efforts, and to try again. The best teaching creates a sense that everyone is working together, whether that means working on a problem silently while listening to the professor or reasoning aloud with other students and the professor. Moreover, the questions, issues, and problems are authentic: they seem important to students and are similar to those that professionals in the field might undertake.[1]

An intriguing question or problem is the first of five essential elements that make up the natural critical learning environment. The second crucial element is guidance in helping the students understand the significance of the question. Some teachers accomplish this by framing the question in such a way that its implications are clear, giving it power and provocation. Several years ago, we asked Robert Solomon, a philosophy professor from the University of Texas, to talk about his teaching to a group of faculty members. Solomon called his talk "Who Killed Socrates?" and in that title captured much of the intellectual energy of his inquiry into Socratic pedagogy and why it isn't used much anymore. When we watched Solomon conduct an introductory philosophy class on epistemology, he simply stood before the group of freshmen and sophomores, looked them in the eye, and asked, "Does anyone here know *anything* for sure?" The way he asked the question gave it



meaning. Because people learn most effectively when they are trying to answer their own questions, Solomon's effort helped his students accept his inquiries as their own. As students cast about for a positive answer, reeling in one solution and then another, they began to grasp the purpose of this modern inquiry. Once that happened, their learning could begin.

Many teachers never raise questions; they simply give students answers. If they do tackle intellectual problems, they often focus only on their subject and the issues that animate the most sophisticated scholarship in the field. In contrast, the best teachers tend to embed the discipline's issues in broader concerns, often taking an interdisciplinary approach to problems. When Dudley Herschbach teaches chemistry at Harvard, he does so with a combination of science, history, and poetry, telling stories about human quests to understand the mysteries of nature. Because he regards science as a journey rather than a set of facts, he takes his students into the historical struggle to fathom the universe. The lesson on polymers becomes the story of how the development of nylons influenced the outcome of World War II. He invokes the arts, using them to capture the emotional power and beauty with which the poet or the painter stirs the imagination and wonder. He even asks his chemistry students to write poetry while they struggle to comprehend the concepts and ideas that scientists have developed.

Often the most successful questions are highly provocative, what one person outside the study derisively called "come-on" questions. What would you do if you came home from college and found your father dead and your mother married to your uncle, and the ghost of your father appeared saying that he had been murdered? Why did some societies get in boats and go bother other people while others stayed at home and tended to their own affairs? Why are human beings occasionally willing to leave home and hearth and march off into the wilderness, desert, or jungle and kill each other in large numbers? Why are some people poor and other people rich?

How does your brain work? What is the chemistry of life? Can people improve their basic intelligence?

Sometimes teachers tell a story or remind students how the current question relates to some larger issue that already interests them. When Solomon taught an advanced undergraduate course in existentialism, he began with a story about life under Nazi rule in occupied France in the early 1940s, reminding students that even ordinary activities like whispering to a friend could have dire consequences in that police state. He used that account both to help students understand the political and social conditions that shaped Sartre's thinking and to raise questions about the origins and meaning of existentialism.

Third, the natural critical learning environment also engages students in some higher-order intellectual activity: encouraging them to compare, apply, evaluate, analyze, and synthesize, but never only to listen and remember. Often that means asking students to make and defend judgments and then providing them with some basis for making the decision. They might judge the argument they encounter on some important question, decide when and how to use a certain method, determine the implications of what they encounter, or make choices between different methods of solving a problem. Or do all of these. Robert Divine raises an important question about U.S. history, helps students see that question in the context of larger issues, shares with them briefly some of the ways that other scholars have attempted to answer that question, then challenges the class to evaluate the argument he would make. Donald Saari uses a combination of stories and questions to challenge students to think critically about calculus. "When I finish this process," he explained, "I want the students to feel like they have invented calculus and that only some accident of birth kept them from beating Newton to the punch." In essence, he provokes them into inventing ways to find the area under the curve, breaking the process into the smallest concepts (not steps) and raising the questions that will Socratically pull them through the most difficult moments. Unlike so many in his discipline, he does not simply perform calculus in front of the students; rather, he raises the questions that will help them reason through the process, to see the nature of the questions and to think about how to answer them. "I want my students to construct their own understanding," he explains, "so they can tell a story about how to solve the problem."



Fourth, that environment also helps students answer the question. Some of the professors we studied raised important inquires but challenged students to develop their own explanations and understanding—and defend them. "My greatest success comes," Saari said about his calculus classes, "when I get students to answer the questions for themselves." Others advanced arguments and explanations to aid that process, even sometimes using a "lecture" to do so.

Fifth, the natural critical learning environment leaves students with a question: "What's the next question?" "What can we ask now?" Some instructors respond to questions with a question: "What do *you* think?" "If this is true, then why (how, what, where, etc.) . . .?" "What do you mean by that?" A few of the teachers we studied used a technique that we first encountered in the 1960s, but that has probably been around much longer than that. At the end of class, they would often ask students two questions: "What major conclusions did you draw?" "What questions remain in your mind?" (In the 1980s a few educators discovered this routine, gave it various names—one-minute paper, immediate feedback, and so forth—and claimed it as their own.) Sometimes they would ask students why they drew the conclusions they did. They might raise this question in open discussions or ask students to provide a written response. With the advent of the Internet, some instructors ask for responses on-line after class.

Depending on the teacher, these five elements appeared in interactive lectures or emerged in discussions or problem-based sessions.

In the 1990s, the Institute for the Learning Sciences at Northwestern worked with several professors to develop highly interactive multimedia programs that tried to create the natural critical learning environment. Larry Silver, a professor of art history at the University of Pennsylvania, for example, developed software called "Is It a Rembrandt?" In that program, a museum curator confronts students with this problem: A prestigious exhibit of Rembrandt's work is about to open, but some questions have emerged about the authenticity of three of the paintings. Each student becomes the museum's top art investigator to look into the suspicions. To do so, the students must examine the paintings and build a case to support their conclusions. They can inspect each piece of art, compare it to similar works, view the curator's files, or go to the conservation lab. At each turn, they encounter questions, but they decide which ones to pursue, picking their own path through the material. If they decide to inspect a painting, for example, they can select an area to view in detail, asking about brushwork and composition. They can ask questions about other works and their relationship to the art they are investigating. An art expert pops up on the screen to provide a short answer, and each answer produces more questions. When, for example, the students have been drawn into a close examination of the brushwork on the face of the painting *Old Man with a Gorgat,* they can ask whether Rembrandt's students also mixed brushwork styles in their paintings. If they do ask, Professor Silver appears to tell them about "bravura display," and the students can then ask, "What is bravura brush stroke?" something that would never have been asked except in this context.

Slowly, the students build their understanding of art history, the important questions that the discipline pursues, and what constitutes evidence to answer those inquiries. They develop an understanding of the art world in which Rembrandt worked and of the community of critics, connoisseurs, collectors, scholars, and controversies that have emerged over the years around the work of the



Dutch master, his students, and his imitators. They build a vocabulary for thinking about various issues, a knowledge and understanding of technical details and procedures, and an ability both to remember and to use a vast array of historical facts. In short, they learn to think like a good art historian, to understand and appreciate the questions that the discipline pursues, to frame important questions of their own, and to understand the kinds of evidence that might help resolve controversies and how to use that evidence to do so. And they do all that while building their case about how to attribute certain paintings rather than simply trying to commit facts to memory.

When the students think they can make a case for a particular conclusion, they marshal their evidence and present it to the museum curator. If the argument is weak, she responds with constructive criticism, sending the students back to the investigation. Even if the case is strong, new questions always remain. Any conclusion simply opens other areas of possible investigation.

Gerald Mead developed a similar program for his course on the history of modern France called "Invitation to a Revolution," which invites students to travel to the late eighteenth century to see if they can avoid the excesses of the French Revolution. In Deborah Brown's physics course, students can use a program that challenges them to build an elevator. In Jean Goodwin's course on free speech, students can act as Supreme Court justices to decide a tricky but actual case that asks whether people can be held legally responsible for the long-range consequences of their speech. In still another program called "Emerging Economies," management students can advise the CEO of a fictitious company on how to do business in an emerging economy.

The power of these programs lies not in their sophisticated computer programming (indeed, one might even argue that they would work more effectively outside the "box") but in the creation of natural critical learning environments in which students can learn by

doing, by confronting tasks, intellectual or otherwise, that they want to do.

Fascinating? Yes, but enormously expensive to create. Yet we saw the same kind of natural critical learning environments created in classes that used simulations, case studies, problems, field work, and even lectures. We saw them when Chad Richardson's students did ethnographic research on their own cultures, and when Charlie Cannon's students struggled with how to treat pollution in New York Harbor. Ed Muir, a professor of Italian Renaissance history, recreates trials from that era to help students develop both an understanding of the period and how to use evidence to draw historical conclusions. Donald Saari takes a roll of toilet paper into class, asks students how they will calculate its volume, then nudges them toward breaking that problem into its simplest components. Jeanette Norden confronts her students with actual people who have suffered some malady and challenges the future physicians to think through real clinical cases. Some instructors use case studies. In a history class, for example, students might work in groups to represent various historic interests. In an international relations class, they might formulate policy for Richard Nixon when Salvador Allende, a Marxist, was elected president of Chile in 1970, and later in that same hour, advise Allende—from the perspective of 1972—on how to respond to the economic warfare that the Nixon administration had waged over the previous two years. To prepare for any of these cases, students must work in groups to research the events and the factions they represent, reading a variety of historical accounts and documents. In the process, they learn to recognize the nature of historical questions and how to use evidence to help resolve them. They explore conflicting interpretations and how they might begin to evaluate them, using the evidence, concepts, and reasoning of the discipline.

I have stressed in this chapter that the natural critical learning



environment is not dependent on whether or not teachers lecture. But lectures from highly effective teachers nearly always have the same five elements of natural critical learning noted above. They begin with a question (sometimes embedded in a story), continue with some attempt to help students understand the significance of the question (connecting it to larger questions, raising it in provocative ways, noting its implications), stimulate students to engage the question critically, make an argument about how to answer that question (complete with evidence, reasoning, and conclusion), and end with questions. The only exception? Sometimes the best teachers leave out their own answers whereas less successful lecturers often include only that element, an answer to a question that no one has raised.

In the hands of the most effective instructors, the lecture then becomes a way to clarify and simplify complex material while engaging important and challenging questions, or to inspire attention to important matters, to provoke, to focus. It is not used as an encyclopedic coverage of some subject, or as a way to impress students with how much the teacher knows. We found no great teachers who relied solely on lectures, not even highly gifted ones like Jeanette Norden, but we did find people whose lectures helped students learn deeply and extensively because they raised questions and won students' attention to those issues. The students became engaged in thinking through the problems, in confronting them, in looking at evidence, and in reasoning rather than memorizing. Most important, the lecture was part of a larger quest, one element of a learning environment rather than the entire experience.

Some people use highly interactive lectures in which they might occasionally stop and ask students to talk about a topic, to discuss their understanding, or to consider when and how some concept or procedure might be applied. Many of them organize the class into small groups and carefully craft assignments to charge those groups

with working collaboratively outside of class to confront the intellectual problems and questions of the course. With some topics they might give students a written "lecture" to read in class, asking them to identify its central arguments and conclusions. Because students can read in fifteen minutes what it takes fifty minutes to say in a lecture, they could then gather in their groups to discuss for another fifteen minutes the meaning, application, implications, and so forth of the material in the "lecture." In the final twenty minutes the instructor can entertain questions, clarify misunderstandings, suggest how students can learn more, ask additional questions, summarize, and finally ask students to write their major conclusions and why they drew those conclusions. In some disciplines, the instruction might begin the last twenty minutes when the teacher asks one or more groups to offer a brief summary of the central argument and major conclusion of the "lecture" or, in other fields, to go to the board and work a problem by applying the methods covered in the written material.[2]

One teacher often asks students to play the devil's advocate and submit every argument they can imagine against the conclusions he draws in class. In recent years he has asked them to submit their responses on-line. Another instructor asks students to list assumptions that she and other scholars are making in reaching certain conclusions. Still another occasionally asks students to discuss the implications of central conclusions or principles.

In all these examples of natural critical learning environments, students encounter safe yet challenging conditions in which they can try, fail, receive feedback, and try again without facing a summative evaluation. They learn by doing and even by failing. They gain specific reasoning skills while the experience itself tells them and their teacher if they have learned to reason in the discipline.

A simple yet profound perception guides the natural critical learning experience: People tend to learn most effectively (in ways



that make a sustained, substantial, and positive influence on the way they act, think, or feel) when (1) they are trying to solve problems (intellectual, physical, artistic, practical, or abstract) that they find intriguing, beautiful, or important; (2) they are able to do so in a challenging yet supportive environment in which they can feel a sense of control over their own education; (3) they can work collaboratively with other learners to grapple with the problems; (4) they believe that their work will be considered fairly and honestly; and (5) they can try, fail, and receive feedback from expert learners in advance of and separate from any judgment of their efforts.

### *2. Get Their Attention and Keep It*

Whereas the ideas of natural critical learning serve as a robust organizing rationale around which the best teaching takes place, some more specific principles guide the actions of the people we studied. They consciously try to get students' attention with some provocative act, question, or statement. "The human mind must first focus on the problem of how to understand, apply, analyze, synthesize, or evaluate something," one of the professors told us in an argument we heard frequently, "and a teacher can help stimulate that focus." Teaching is "above all," Michael Sandel, a Harvard political theorist, argued, "about commanding attention and holding it." That means not just generally motivating students' interest in the subject but capturing and keeping their attention for each class. "Our task," Sandel contended, "is not unlike that of a commercial for a soft drink or any other product." The only difference, he went on to argue, is what professors might do with that attention once they catch it. "For the most part," he said, "we want to hold the attention of students for the sake of changing the things they are likely to pay attention to most of the time. We want to grasp students and direct their attention some place else."

Teachers succeed in grabbing students' attention by beginning a

lecture with a provocative question or problem that raises issues in ways that students had never thought about before, or by using stimulating case studies or goal-based scenarios.

### *3. Start with the Students Rather Than the Discipline*

To gain students' attention and hold it for some higher purpose, the best teachers start with something that, as Sandel put it, "students care about, know, or think they know, rather than just lay out a blueprint or an outline or tale or theory or account of our own." Several ideas rest at the heart of this approach. For Sandel and many others, the method is grounded in Socratic dialogues. "Socrates began," Sandel explains, "by attending to what people thought they knew, and then he tried gradually and systematically to wrench them from their familiar place." Such an approach often means asking students to begin struggling with an issue from their own perspective even before they know much about it, getting them to articulate a position. Donald Saari does some of that when he gets students to break a calculus problem into smaller pieces. Using Socratic questioning, he begins with what "common sense" might suggest to the students; then, through additional probing, he helps them add the "muscle" that disciplinary discoveries can give them. Sandel compares this method of teaching to ways that he might teach one of his children to play baseball: "I could give them detailed instructions on how to hold the bat, where to stand, how to look for the ball from the pitcher, and how to swing, never letting them hold a bat until they had heard several lectures on the subject. Or, I could give them a bat and allow them to take a few swings, after which I might find one thing that the kid is doing, which if adjusted, would make him a better hitter." The second approach seems eminently more sensible than the first for teaching someone baseball, and it is the method Sandel and others use to teach students to think.

Every year more than seven hundred students crowd into Sandel's classroom at Harvard to take his course on justice. To help



them become good political philosophers, he introduces on the first day of class an intriguing puzzle that raises many of the questions with which he wants students to grapple. He asks them to imagine the following scenario: You are the driver of a runaway trolley car that is approaching five men who are working on the track. You cannot stop the train, and it seems destined to run over the men and kill them. As you speed down the track toward this waiting tragedy, you notice a side track where you can steer the trolley car if you choose to do so. The only problem is that one man is working on that track and the train will undoubtedly kill him if it goes that way. What would you choose to do, he asks the students? Do you turn the car onto the side track, killing one person but saving five others? What would be most just and why? Often the students have no difficulty deciding that they would take out the one life to save the five others.

Sandel then introduces a wrinkle to the story. Suppose, he says, that you are not on the train but standing on an overpass watching it speed toward the five workers. As you watch this disaster in the making, you notice a large man standing next to you, also peering over the railing of the overpass. You quickly calculate that if you push this person over the railing, he will land on the track in front of the train. He will die, but his body will stop the train, saving five lives. Would it be just to give that person a shove?

In that exercise Sandel hopes to provoke students to think about fundamental issues of justice and understand their own thinking in relationship to that of some of the major philosophers. When they start, they may be no more prepared for their task than his sandlot kids are to play in the big leagues, but they learn by doing and receiving feedback on their efforts. Throughout the course, Sandel then embeds all the major philosophical schools and writers he wishes to consider in contemporary ideological battles intended to excite the students. His knowledge of the history of ideas helps him select the proper passage from Mills or Kant; his knowledge of and

concern for the students helps him select the political, social, and moral debates that will engage them. Equally important, he constantly changes the issues to fit new generations of students.

Many of the best teachers make a deliberate and carefully measured effort to confront some paradigm or mental model that students are likely to bring with them to class. That practice too breaks with convention. Most customary instruction follows an organization that stems wholly from the discipline, a set of topics and subjects that need to be taught—or covered. The approach we encountered in our study takes into consideration both the discipline and student learning, asking what important troublesome (from the discipline's perspective) notions students are likely to hold and then designing instruction that challenges each one progressively, picking the order that will best help students to develop an integrated understanding of the whole. We saw entire classes organized around a series of mental models that the students were likely to bring with them that the course wished to challenge. Such courses were powerful models of what can be called "student-centered" rather than "discipline-" or "teacher-centered" education.

This idea of beginning where the students are rather than where disciplinary traditions might dictate has another influence on practices in the classroom: It leads to explanations that start with the simple and move toward the more complex. "If students have an understanding that is down here," Jeanette Norden explained, putting her hand close to the floor, "you don't start with something up here. Some medical students come in not even knowing what a neuron is—a neuron is a cell in the brain—so you have to begin with that simple notion and then you can build from there quickly."[3]

### *4. Seek Commitments*

Exceptional teachers ask their students for a commitment to the class and the learning. Some people do so in first-day exercises that



lay out the promises and plans of the course. They ask students to decide if they really want to pursue the learning objectives in the manner described. Others spell out specific obligations they see as part of the decision to join the class. "I tell my students the first day of class that the decision to take the class is the decision to attend the class every time it meets," one professor explained. "I also tell them that my decision to teach the class includes the commitment to offer sessions worth attending, and I ask them to let me know if they think I'm not doing that." Donald Saari, the math professor, and Richard Leuptow, an award-winning engineer, exact such dedications from their students. That's what Charlie Cannon is doing when he lays out the project and the collaborative responsibilities the first day of his innovation studio. With a firm but friendly request, Leuptow asks his students for a show of hands that they are willing to be on time for every class and participate intellectually in the deliberation of each day. "The decision to take the course is yours," we heard more than one person say, "but once you make that decision, you have responsibilities to everyone else in this community of learners."

There is a subtle but extremely important difference between this approach and that of professors who try to rule like drill sergeants. The teachers in the study never tried to command students; instead, they asked for their commitment *if* they planned to take the class. "I want my students to decide whether they really want to take this class, to pursue these goals," a professor told us, "and to realize what is entailed in that pursuit within this class. I ask them to think about it and decide." Even without any formal and public ceremonies of commitment, highly effective teachers approach each class as if they expect students to listen, think, and respond. That expectation appears in scores of little habits: the eye contact they make, the enthusiasm in their voice, the willingness to call on students. It contrasts sharply with professors who seldom if ever

look at their students, who continue on in some set piece almost as if they do not expect students to listen, and who never try to generate a discussion or ask for a response because they don't expect anyone to have any.

### *5. Help Students Learn outside of Class*

The professors do in class what they think will best help and encourage their students to learn outside of class, between one meeting and the next. That approach is fundamentally different from simply deciding to do something because it is traditional or because it "deals with" or "covers" some subject, but it might lead to a variety of orthodox approaches: an explanation that helps to clarify and simplify, enabling students to read or study more complex material; a discussion that gives students a chance to confront new questions and explore their own thinking with others before tackling a project; a demonstration that both confronts existing notions and provokes confrontation with new ones; a debate that enables students to practice critical thinking and to realize gaps in their own understanding and reasoning abilities; group work that asks students to grapple together and helps build a sense of community. The difference comes in the planning and in why teachers make their choices. Because the best teachers plan their courses backward, deciding what students should be able to do by the end of the semester, they map a series of intellectual developments through the course, with the goal of encouraging students to learn on their own, engaging them in deep thinking. In ordinary classes, instructors might create assignments for students, but they rarely use the class to help students do the work.

### *6. Engage Students in Disciplinary Thinking*

The most effective teachers use class time to help students think about information and ideas the way scholars in the discipline do.



They think about their own thinking and make students explicitly aware of that process, constantly prodding them to do the same. They do not think only in terms of teaching their discipline; they think about teaching *students* to understand, apply, analyze, synthesize, and evaluate evidence and conclusions. Some use a Socratic method; others accomplish much the same end with a combination of explanations and questions. "We cannot learn to reason without something to reason about," one teacher told us, "but knowledge comes not through rote memorization of isolated facts, but from the ability to reason, that is, the ability to draw conclusions from reason." We saw instructors call attention to specific reasoning as they made explanations or conducted a discussion. We saw professors constantly asking students to analyze the arguments they encounter in lectures, readings, and from each other. On examinations, they asked students to use their clinical or scientific or historical reasoning skills, reinforcing the centrality of those abilities in the educational goals for the course.

Through such an approach teachers help students build an understanding of concepts rather than simply perform their discipline in front of them. Unlike many mathematicians, chemists, and economists who spend most of the class time working problems on the board, exceptional teachers from those disciplines offer explanations, analogies, and questions that will help students understand fundamental concepts and consequently solve their own problems. While others argue that students must learn (memorize?) information first and use reasoning only later, the professors we studied assume that learning facts can occur only when students are simultaneously engaged in reasoning about those facts.

In class, they might engage students in a highly interactive "lecture" in which they present a problem and coax students into identifying the kinds of evidence they would need to consider to solve that problem and how that evidence might be gathered: "Here's the

evidence we've encountered thus far; what do you make of it? What problems do you see? What questions would you ask about this evidence? What evidence do we need to answer those questions, and how will we find or collect that evidence? Here are some results of doing what you suggested. Now, what are the questions, the kind of evidence, and tentative conclusions (hypotheses)?" Others might ask students to work in groups to identify central arguments, the kinds of evidence (observed or inferred) contained in the argument, the types of agreements and disagreements that exist between two arguments (belief and attitude), the assumptions and implications of the arguments, and the appropriate lines of additional inquiry.

*7. Create Diverse Learning Experiences*

"The brain loves diversity," Jeanette Norden told us repeatedly. To feed that appetite, she and other outstanding teachers conducted class in a multitude of ways. Sometimes they offered visual information (pictures, diagrams, flow charts, time lines, films, or demonstrations); other times, auditory input (speech or visual symbols of auditory information—written words and mathematical notations). They allowed students to talk things out, to interact with each other; but they also gave them a chance to reflect independently or to hear someone else's explanations. Some material was organized inductively, from facts, data, and experimentation to the general principles and theories; other things, deductively, by applying principles to specific situations. The teachers gave students an opportunity to learn sequentially, a piece at a time; they also gave them space to learn globally, through sudden insights. Some of the learning involved repetition and familiar methods; some, innovation and surprises. The very best teachers offered a balance of the systematic and the messy.

"The great contribution of the learning-styles stuff," one teacher told us, "is that it called attention to the need to diversify. I don't think there's much evidence that most people have exclusive learning styles and can't learn in any way but one, but I do think that we all benefit from variety."



## EMPLOYING THE CRAFT OF TEACHING IN THE CLASSROOM

As potent as these seven principles may be, they can still fall flat if the professor doesn't act on them well. Performance in front of students affects how well they learn, and it involves a kind of craft of teaching, techniques, and even physical abilities. Such skills cannot transform teaching that has more fundamental weaknesses, but honing these skills can make good teachers even better. This kind of attention to performance is still "student centered," a focus on details for the sake of student learning.

Let's look at two elements of this craft of teaching: the ability to talk and the ability to get students to talk.

*Good Talk*

Perhaps the most significant skill the teachers in our study displayed in the classroom, laboratory, studio, or wherever they met with students was the ability to communicate orally in ways that stimulated thought. No scholar would deny the importance of writing well, and certainly good writing involves primarily the capacity to think, but it also entails a certain craft and even considerable attention to small details and rules. In academia, the ability to write well has a special status that oral communication no longer enjoys. For our subjects, however, the capacity to talk well—in brief instructions or in long explanations—remains important, a skill as much worth refining as their own writing.

All the best teachers talked to their students, and the quality of those talks made a significant difference in the success of the teaching. Generally the most accomplished of the teachers had the best ways of explaining things, but all our subjects noticed that

improving their oral skills resulted in more positive learning responses from their students. Here I concentrate on the practices and insights of the very best communicators, those whose students raved about their stimulating talk, clear directions, and thorough explanations.

More than anything else, the most successful communicators treated anything they said to their students—whether in fifty-minute lectures or in two-minute explanations—as a conversation rather than a performance. They interacted with students and encouraged and allowed them to interact with one another and with the material. They pulled each person in the room into a dialogue, offering gestures and body language that conveyed their desire to reach out to each student. Because they wanted their students to think and understand, to confront the problems, to learn the intellectual skills, and to engage in a conversation with themselves and each other, they checked on their students' comprehension as they talked and made sure that everyone in the room was included in the discussion.

The most effective teachers might begin a point by looking at one student then move their eyes from one person to another before finishing the explanation with someone across the room. In a large room, they might occasionally talk specifically to people in distant corners of the room ("Can you hear [or see this] from up there?"). Most of the teachers we studied frequently used rhetorical questions, even if it was no more than to ask, "Does this make sense?" They watched their students' reactions, read their eyes and other body language, and adjusted what they said to the enlightened, confused, bewildered, or even bored looks they saw in the classroom. They learned students' names and called on them. They moved from behind the podium, or avoided artificial obstructions altogether. They asked for feedback from students, stopped to ask for questions, and paused for ten seconds at a time, looking at students. Some teachers often visibly struggled with understanding an idea



or how best to explain it, creating a sense of spontaneous exchange and prompting students to feel a part of that same struggle and a part of the conversation. Others engaged in constant banter with their students, allowing them to ask questions, make comments, and remain active in the dialogue. According to Susan Wiltshire, this kind of teaching was not unlike inviting students into exchanges around the dinner table.

To achieve that sense of conversation, however, the teachers paradoxically paid some attention to the quality of their performances, mindful of the number of students and the size and shape of the room. They did not put on a show like some film or television program that played a fixed script regardless of the reactions it sparked, but neither did they ignore the demands of communicating with all their students in one place. Two hundred students required different levels of energy and projection than did six students sitting around a seminar table—or two people sitting in a living room.

The most effective speakers used conversational tones but projected their voices to include everyone present. They spoke clearly and carefully. They would pause to let important points land. They would not start walking in the middle of an important point, or if they were walking, they would not stop until the point had been made. In a large lecture hall, they made gestures larger than life, even to achieve a small effect; in a seminar, they used small actions to achieve large results. Regardless of the size of the room, they spoke as if they knew and wanted to engage every student, including those in the back row.[4]

Many of the people we studied said they had, at sometime in their careers, practiced enunciating clearly—getting the words out of their mouths—or rehearsed an explanation before a mirror. Others told us they had made conscious efforts to keep themselves from pacing or talking to the board, to eliminate some nervous and distracting tic—perhaps discovered after watching a videotape of themselves teaching—or to look at students in the back row, to

gesture toward them, and sometimes to ask them questions. Some teachers told us they had worked on the timbre of their voices, on appropriate gestures, or even on their tendency to slouch and mumble through class.

There was within this conversation/performance a sense of the dramatic, a sense of when to stop talking and let a key idea land. That slight change of pace became the exclamation behind a key point, a trigger for thought, for calculation, or for construction of understanding.[5] Robert Divine knew how to ask a good question in a seminar and then how to wait patiently, even through several minutes of silence, while his students thought about their answers. Sometimes highly effective lecturers will pause ever so slightly following a key point and stand perfectly still; their body language will suggest suspended animation as they work to keep their students' attention focused on the point and to give them time to contemplate it. They know how to make silence loud.

They also know when to change pace. Every ten to twelve minutes, they change the rhythm and content of their delivery, shifting direction or focus, altering activities or subject, punctuating an explanation with stories or questions, ending or beginning an exercise. Some teachers sprinkle in humor; others move from the concrete to the abstract. If they are talking, they stop; if they are silent, they say something.

Yet no catalogue of such abilities and preparations can capture fully the ingredient that made these teachers so effective in reaching their students: a strong intention to help them learn.

This old-fashioned notion of intention, so prominent in the theater, played a powerful role in driving the highly effective to say the right thing in the right way. The best teaching occurred when people came into their classes filled with intentions to stimulate every student's interests, to communicate clearly and effectively, to help everybody understand, to provoke responses, to foster deep thinking, to engage, and to entertain multiple perspectives. Those



aims and the feeling that went with them influenced everything the teachers did and how they did it. "When I go into the classroom wanting only to get through the hour or to impress my students with my knowledge," one professor told us, "it affects the class. That's when my teaching fails. I can't explain how or why it makes a difference, but it does."

Many professors told us that in the few minutes before they enter a class, they often sit quietly in their offices trying to capture what they want to help and encourage their students to do that day—and in the days to come. Jeanette Norden told us that before she begins the first class in any semester, she thinks about the awe and excitement she felt the first time anyone explained the brain to her, and she considers how she can help her students achieve that same feeling. Ann Woodworth often talks about a ball of power she imagines coming out of the ground and filling her body and soul with an energy that she carries into the classroom or rehearsal hall. Her descriptions sound like a form of self-hypnosis.

Some people may dismiss such practices as so many shenanigans that get in the way of more important preparation, but we need look no further than the ancient practices and insights of the theater to find the power of understanding and using intentions to affect other people. Teaching is not acting, yet good teachers do expect to affect their audience when they talk: to capture their attention, to inspire, to provoke thoughts and questions. The most effective teachers understand that, and they often consciously investigate their own intentions, slowly defining and molding their ambitions in a process that is both rational and emotional. This practice has all the power of careful analysis, but it also entails the energy of feelings and attitudes that no induction and deduction can achieve. Students feel it and respond accordingly. Many of the students we interviewed talked about "something she does" and told us they "can't explain it," but that certain teaching inspired their efforts. When we compared the people they were talking about with their

less successful colleagues, we sometimes found nothing in content or structure that could explain the difference either. But we did find that the most effective teachers generally thought more carefully and extensively about their intentions with students and let those aspirations and attitudes guide them in their teaching.[6]

### *Warm Language*

As powerful as these ideas may be, something else marked the communication of the most effective teachers. For years, we struggled with how to think about those additional qualities until Paul Heinrich of the University of Sydney introduced us to the idea of "warm" and "cool" language. Sometimes when we explain something we talk about it rather than talk through it. We dance around the edge, almost afraid to begin with an explanation. "We could do something like this," Heinrich explained: "There was this story about this little girl and three bears and how she went to their house when they were gone and tasted and tried everything and then they came home and discovered her." That language is cool. It doesn't tell the story and assumes that the listener has either already heard the story or would be bored at its telling. It is, Heinrich argues, "detached, less emotional, less descriptive." In contrast, he goes on to say, we could just tell the story: "Once upon a time, there were three bears and a little girl named Goldilocks." That language is warm. It's involved; it tells the whole story rather than just referring to it. Warm language is "essentially story telling," Heinrich explains. "You begin at the beginning and work your way forward to the conclusion. The conclusion remains unknown, even if anticipated, until the end." Warm language tends to be in the present tense, but "even if the past tense is used, the intent is always to take the listener into the moment and work slowly through it 'from the inside.'"

The best professors tended to use warm language, to be explicit, to be complete, and to tell the story and make the explanation. They would raise powerfully worded questions. They would bring their



listeners inside the material. Less accomplished professors, in contrast, often used cool language. They would refer to information as if they were afraid to tell the story, skipping important steps in an explanation almost as if they thought that because they had heard it before they need not tell it again.

This is not to say that good teachers never use cool language. They do, but generally only after their warm language has brought students inside the subject, has involved them intellectually and emotionally. They use cool language to remind, to summarize, and warm language to invite, to stimulate.

### *Making Explanations*

Conversational tones, good intentions, and warm language are all important elements of the craft of good talking, but something else distinguishes the most effective communicators. The best teachers simply know how to make good explanations.[7] It goes without saying that they are clear and thorough and stimulate learning, but how do they achieve those results? To gain some insights into this part of their craft, let's concentrate on explanations of concepts or information, the sort of explaining that often goes into lectures but could also appear in answers to students' questions. In general, exceptional teachers begin with simple generalizations and then move toward both complexity and specificity. They use familiar language before trying to introduce specialized vocabulary.

Someone once videotaped Richard Feynman sitting in a big easy chair, telling a story about going swimming. Imagine, the physicist offered, that you are sitting next to a swimming pool and someone dives in, creating waves in the water. "It is possible," he explained, "that in those waves there's a clue as to what's happening in that pool." It is also possible, Feynman continued, "that some sort of insect . . . with sufficient cleverness could sit in a corner of the pool and could be disturbed by the waves and by the nature of the irregularities and bumping of the waves [and] . . . figure out who jumped

in where and when and what's happening all over the pool." In fact, he explained, "that's what we do when we are looking at something. We have this hole in our head called an eye and waves called light enter that opening, sloshing about to give us information."

As Feynman told the story with an almost childlike giddiness, he gradually added more complexity to the tale. Light waves are like the waves in the water but in three dimensions rather than two. It's all "kind of incredible," Feynman exploded, "because when I'm looking at you someone standing to my left can see somebody who's standing at my right." How could that be? "It's easy to think of them as arrows passing each other. But that's not the way it is. Because all it is, is something shaking. It's called the electric field, but we don't have to bother with what it is. It's just like the water height going up and down. And so there's some quantity that is shaking about here, and in a combination of motions that's so elaborate and complicated that the net result is to produce an influence that makes me see you." Feynman gradually wove x-rays, cosmic rays, and infrared and radio waves into his account.[8]

Several factors made this telling such a good example of the kind of approach we found among highly effective teachers. At each level, he emphasized concepts and understanding basic principles, using his "bug in the pool" story to illustrate and provoke. He stressed broad understanding of basic concepts before adding more complexities and even before bothering to name those ideas. We found that other highly effective teachers follow much the same pattern and may even oversimplify initially with some metaphor, analogy, or explanation that helps the novice begin to understand. Later, as the explanations, examples, and evidence continue to grow, the teacher introduces more complexity that may even challenge those early metaphors, analogies, or explanations. "I often begin with an explanation," one of the teachers told us, "that will help students begin to grasp something, to build their conceptions. Later, as we add more information and ideas, they begin to realize



that our initial way of thinking was too simplistic and even misleading. But if I started with the more complex way of explaining something, they would never understand it." Notice that her intention is to help students understand, not to impress them with the sophistication of her knowledge.

When I interviewed one of the mathematicians in the study, he asked me if I knew how to define a function. I confessed that my knowledge was a little rusty, and that the definition I remembered memorizing in college didn't spring immediately to mind, something about variables being related to the values of other variables. "But can you explain the basic concept in your own words?" he persisted. I stammered and began looking for the nearest exit. At that point, he tossed a pen in my direction, which I instinctively reached out to catch. "How did you catch that?" he asked. "I opened my hand and then closed it around the pen at the right moment." "But how did you know when to open your hand and when to close it?" he pressed. After a little struggling, and some additional questioning from the mathematician, I stumbled to the conclusion that I predicted where the pen would be by observing its flight. "That's a function," he exploded. "You took information about where it was at this point, this point, and this point, and predicted when it would arrive in your hand." He then turned to the board and wrote a formula. "I could have explained it this way, and that's the way it's ordinarily done. But when we do it that way, students just memorize formulas or definitions and really don't grasp what's involved in the concept." We found history professors, chemists, sociologists, economists, biologists, and others who followed much the same approach as the mathematician, stimulating students to understand an idea in their own words before bothering with its name or some set language that might define it.

Good explanations start with ways to help the learner begin to construct a good understanding; they are not necessarily the most accurate and detailed way of putting something. They start with

simplicity, with the familiar, and gradually add more complexity and the unknown. They might begin with a metaphor or generalization. Jeanette Norden called the method her "sandwich approach." She would begin with the bread, a good general account of some basic and fairly broad ideas. Over time, she would gradually add the mayonnaise, meat, lettuce and tomatoes, until the students had developed a more sophisticated understanding, and perhaps could even look back at their first understanding and realize its inadequacies. Good explanations come from people who realize that learners must construct knowledge rather than simply absorb it.

### *Getting Students to Talk*

Good teachers know how to talk well, but they also can get students talking. Indeed, we often heard classes buzzing with lively conversations as questions and ideas darted around the room. Yet talk can be cheap, bull sessions that produce little understanding or debates that encourage students to "win an argument" rather than find the truth. The exceptional teachers did not just want to get students speaking; they wanted them to think and learn how to engage in an exchange of ideas. "Let's think about why we conduct class discussions," one of them told us. "Surely, we want more than to fill time or allow students to work out their nervous tensions so they will more likely listen to us."

According to Erwin Hargrove, a professor of politics at Vanderbilt, class discussions have a broader purpose. "Remember when you first started teaching," he reminded a group of his colleagues several years ago. "If you are typical, you most likely told yourself, 'I'm learning more now than ever before.' We conduct class discussions to give our students a little taste of that experience. We ask them to struggle with their own thinking and understanding on a subject, to express their ideas to others, and to have their ideas challenged." The teachers we studied thought a good class discussion



could help students focus on important questions, stimulate them to grapple with key issues, help them acquire intellectual excitement, and give them the opportunity to construct their understanding. We came to judge discussions in much the same way. It didn't matter to us how much students talked; we wanted to hear them grappling with important issues, struggling toward a better understanding of key issues, raising critical and original questions.

What produced that kind of conversation? Most important, there was something to discuss that the students regarded as important and that required them to solve problems. The teacher raised questions that the students had come to regard as significant; or, better yet, the students raised those inquiries, often because the teacher had said something or asked them to read or view something that had puzzled, stirred, provoked, intrigued, disturbed, surprised, or even outraged them. Many teachers used stories to stimulate discussion. Often we heard instructors ask for evaluations and recommendations—even in science and math classes. Donald Saari used his sense of humor, love of puzzles, and trust in the students' ability to think to spark an intense conversation about how to calculate the area under the curve. Michael Sandel posed moral dilemmas to raise profound questions about justice. Jeanette Norden put a human face on neurological disorders, or sparked interest in the brain with her own sense of awe over the one organ that "controls who you are and what you do."

The best teachers didn't ask students to discuss readings; they provoked and guided them into discussing ideas, issues, or problems that some article or chapter might help them approach. The students read those pieces not merely to complete an assignment but to prepare for their intellectual struggle. In the discussion, the teachers asked students what they thought about important issues and problems and why. As ideas began to flow, they pressed them for evidence, questioned them about the nature of the evidence, invoked arguments from the resources, encouraged and allowed

students to challenge each other, pointed out agreements and disagreements in belief and attitude, and raised appropriate questions.

The teachers we studied often chose rooms with moveable chairs. Many professors created permanent small, heterogeneous groups within a larger class and sometimes had those groups work together in class. Some teachers allowed the groups to emerge voluntarily while others spent considerable time creating them, often trying to ensure a balance of advanced and novice learners. Many instructors encouraged students to form groups of three or four, made some group assignments (for example, find and describe an application for this mathematical principle in your field of interest), then found group homes for those few students who did not quickly join one. Others fashioned groups of five to seven people, assigning students on the basis of information collected in survey forms and deliberately trying to maintain a mix of abilities and backgrounds in each one.

Larry Michelsen, an organizational psychologist at the University of Oklahoma, often plays a game that tends to produce heterogeneous communities. If, for example, he wants to create heterogeneity around the number of years of experience in a given area, he asks the student with the most experience in the area to stand some place in the room, the student with the next longest to stand next, the next longest next, and so forth in a line around the room. If he then wants to create, say, six groups, he assigns a number from one to six to each student in the row, moving in order down the line. He then puts all the one's together, the two's together, and so forth. Thus each group consists of people from each of six different places all along the line of experience.

Several factors seemed to make groups work most effectively. Students responded best when they thought of the group as an opportunity to work on authentic problems rather than as an obligation to fulfill a class assignment, and when the experience had



some honorific quality rather than even the hint of remediation. In contrast, some teachers failed with groups either because they gave the students work that required them to do little more than look up "right" answers, or because they compelled the students to work together even when they could work more efficiently alone, or both. The best group work led students to grapple with important questions, to reason collectively through perplexing, intriguing, and significant issues, and to brainstorm solutions to fascinating problems.

Most teachers found heterogeneous groupings more satisfactory than homogeneous ones, and created the diversity around issues of experience and proficiency with the material and the reasoning skills it required. Some teachers let students form their own groups because it gave students control over their own education. "I raise complex questions and then give students resources to help them struggle with the issues," one professor in the social sciences told us, "but I also let and even encourage them to divide up the resources. They make reading assignments to each other." We found little support for group papers, but several instructors told us that they ask (or encourage) students to work collaboratively on resources and ideas for their respective projects.

In one powerful use of group work, the professor gives students four introductions that other students have written to papers and tells them that two of these pieces started papers that eventually won honors while two received a B-minus or lower. He asks the students to read the introductions individually and then to work in their groups to determine which is which and *why* they rank them as they do: "Spell out the criteria that caused you to list any given paper as honors or mediocre work."

After fifteen to twenty minutes, he brings the groups together to report their conclusions and reasons and write them on the board. He then shares his rankings and, most important, his criteria, comparing it with the standards and conclusions they have fashioned.

They begin by negotiating their understanding with one another and then with the instructor as they attempt to build their comprehension of the thinking of a learned community they are trying to join.

To get the discussion going, the best teachers usually pose a question and ask students to spend a few minutes collecting their thoughts on paper or otherwise work on the problem individually before talking. They then ask students to share their thoughts (or solutions) with someone sitting nearby ("think then pair"). The students burst into conversation. After a few more minutes, they might ask pairs to pair up ("think/pair/square"). Finally, they bring the entire class together for a full discussion, starting with the ideas already discussed in the smaller venue, calling on one or two groups to report and defend their conclusions ("think/pair/square/share"). We saw this work well in classes as small as 20 or as large as 200. Marcy Towns, a chemistry professor from Indiana, uses this technique to confront students in large classes with problems that stimulate consideration of important concepts. Suhail Hanna uses it with students learning to write. Paul Travis does something similar to raise questions about historical evidence and interpretation.

Some teachers used the approach to prime students for a discussion. Others used it to spark interaction in the middle of a lecture.[9] In large classes, they might use this "think/pair/square/share" technique to create small groups across a huge lecture hall and to spark dozens of small conversations before building the large one.

If the first law of good discussions is to allow students an opportunity to collect their thoughts (perhaps by writing) and to talk with a neighbor before addressing the whole class, the second rule is to get everyone involved early. Arthur McEvoy, who teaches environmental law at the University of Wisconsin, has used what he jokingly refers to as the "McEvoy-minute around." In small discussion classes, he has everyone sit in a circle. He then gives each student one minute to make his or her initial contribution to the discussion.



"The longer my students sit without saying anything," one professor told us, "the harder it is to bring them into the discussion." Don Saari begins his math classes by questioning students who appear "bolder and ready to jump into the fray." Saari says he sizes them up from the way they sit and look. "How would you do this?" he probes, propping his chin on one hand in the pose of Rodin's Thinker. "That way I can convey a silent message that I will wait for their answer," he explains. Over the first few days, he takes note of the shy students in his class of two hundred, the ones who avoid his gaze, looking to the floor or at their books, pulling themselves back into their bodies. "I will gradually try to help those students feel more comfortable," he explains. "I might talk with them casually before class, get to know a little bit about them, before I call on them."

Like Saari, most highly effective teachers do call on their students rather than just waiting for them to enter the discussion. But they do so with care. As Susan Wiltshire characterized it, they call on people the way they might do so around the dinner table rather than the way they might cross-exam them in a courtroom or challenge them to a duel. Saari's relaxed and humorous style—he is constantly smiling and has a big twinkle in his eye—helps diffuse anxiety. His Thinker pose, his sense of adventure and playfulness, and his reluctance to judge all create a mood of non-judgmental problem-solving. Students generally don't fear being wrong because everyone is wrong at some point as they collectively struggle to understand, and because they know Saari emphasizes understanding over reaching correct answers. "I tell students that it's largely a matter of common sense bolstered by the power of the discipline," he explains. "That encourages them to think, to struggle with ways they might figure out to solve a problem."

In contrast, many less successful teachers play a game that might be called "guess what's on my mind." In that game, there is only one right answer. Some students play it well while others cringe, fearing they might get it wrong and often refusing to contribute.

Ultimately, discussions work well both because the students feel comfortable with one another and the instructor and because the conversation is part of a larger attempt to create what I earlier called a natural critical learning environment. I have already noted that the outline of good lectures contained all the five elements of that environment. It should come as no surprise that the structure of good discussions followed much the same contours. Let's look, for example, at the kind of questions that emerged in case studies or problem-based learning classes.

The best case teachers begin by asking questions such as, What is the key problem we face here? What are we trying to solve? (perhaps using the "write before you talk; talk in small groups before conversing in larger ones" approach). They continue by asking what key facts in this case or that should be used to solve the problem. What do we need to know that we don't know? What are the key definitions and concepts? They might first call on one student, wait for that explanation, and then ask another to summarize what the first person said.

After using such exploratory questions to confront students with a common problem (of understanding, application, analysis, or synthesis) and helping them understand its significance, the best teachers begin to provoke imagination. Are there any good solutions? What are the possibilities? At this level, the instructor might hear wildly conflicting approaches and even ideas that fly in the face of the best scientific and scholarly ideas on the subject (in other words, the students might be wrong!), but they also hear what the students were thinking. Perhaps most important, they get the students to lay their thinking on the table so they can all examine it more closely.

Next, they stimulate some evaluation of those ideas. What solutions (ideas) have we considered? How do we compare solutions? What are the implications of accepting this interpretation, solution, or approach? What are the consequences of doing so? Can you draw



even tentative conclusions? Which is the best solution (idea)? Why? What do you reject? Why?

Finally, the best teachers ask concluding questions: What have we learned here? What else do we need to know to confirm or reject our hypothesis? What are the implications of our conclusions? What questions remain unanswered? How do we answer those questions?

We saw professors in a variety of disciplines and circumstances use this pattern or some variation of it. Sometimes the conversation centered around a case study; other times, a problem, a set of readings that raised some significant issue, a lecture, or even an experiment or experience that all the students had encountered. In some fields, the issues were often conceptual ones (how best to understand this development) or questions of interpretation (what does this text mean and what implications does it have for the larger issue at hand?). In other areas, the problems might be about causes or consequences (in history, for example), while in still other disciplines they were more clinical and applied (in medicine and engineering, for example).

Some of the teachers we studied used this pattern quite formally in generating discussions while others appeared more casual. Samuel LeBaron, a physician who teaches at the Stanford University medical school, for example, believes that students will often learn to think more clearly in informal circumstances than they will when they are playing students. He has found the phrase, "before we get started" a powerful way to create those extramural circumstances in which he can raise many of the kinds of questions discussed above. In a lesson on back pain, for example, he walked into the room and told the students, "Before we get started with the lesson, I've been having these back pains and I just can't get rid of them." With a little complaining on his part, the students began to offer him suggestions while he quietly pressed them for explanations and reasons for their thinking, sometimes subtly challenging a line of thinking with what appeared to be a casual question. Yet in

that informal atmosphere he carried students from exploratory questions through inquiries about evidence to judgments and their implications.

Of course, no one has achieved great teaching with only vigorous vocal tones, a powerful microphone, good posture, honorable intentions, and strong eye contact—as helpful as they may be. One teacher encouraged us to think about "the relationship between a well-built house and a good paint job." The foundations of that structure, its basic design, and its overall construction determine the qualities of the home. Great teachers are not simply great speakers or discussion leaders; they are, more fundamentally, special kinds of scholars and thinkers, leading intellectual lives that focus on learning, both theirs and their students'. Their attention to the details of performance stems from a concern for the learners, and their focus is on the nature and processes of learning rather than on the performance of the instructor.

## HOW DO THEY TREAT THEIR STUDENTS?

A math professor in our study had a student who was having trouble with calculus—or so it seemed. The student actually did fairly well on small quizzes but performed miserably on each major examination. Nevertheless, he didn't give up. Instead, he attended extra sessions, met with his colleagues in small groups to work on problems, and gave every sign he wanted to learn. Nothing seemed to work, however. He flunked all the big tests. By the end of the course it seemed increasingly apparent that he suffered from an awful case of test anxiety.

At the end of the term, the students faced a comprehensive departmental final that the professor had no hand in preparing. A day before the final, the young man stopped by to see the professor, who started talking about calculus with him, at first casually and then gradually more rigorously. "Do you understand this?" he began asking him, and the student would reply each time that he did. The professor then asked him to explain it. After a while he had the student at the board in his office explaining concepts and working through some fairly difficult problems. In all, the teacher spent nearly two hours reviewing calculus with this young man, asking questions and letting him do most of the thinking and talking. Clearly, the student understood far more about calculus than his grades on the major examinations indicated.

After two hours of work, the professor looked at him and said, "You've just taken an oral examination in calculus. I can't tell you what grade you made just yet. I'll have to think about that, but you have at least passed the course." The student asked him what he should do about the departmental final the next day. "Oh, I don't