Schools That Learn

A Fifth Discipline Fieldbook for Educators, Parents, and Everyone Who Cares About Education

A Fifth Discipline Resource
administrators, parents, social workers, and community advocates. Everyone in the room had a powerful attitude, grounded in personal experience with people with disabilities, experience as teachers, and feelings about state budgets and state legislatures. Everyone spoke from the heart; everyone seemed to recognize the reasons why people had come to their views. The problem took on a meaning that it had not had before, as if the great possibility of special education itself hung in the air before the group. Nothing was resolved; no policies were decided on. But after these dialogues, the contentiousness of the issue seemed to disappear, as if people recognized that they had no choice but to approach this problem as members of one body. Later, in other meetings, decisions were made that resolved the question. People said they were far happier with the decisions than they would have been if dialogue had never taken place.

Also see Productive Conversation, page 153, and other examples of team learning practice on pages 110, 395, and 406.

5. Systems Thinking

Developing awareness of complexity, interdependencies, change, and leverage

Most schools are drowning in events. It’s amazing to sit in a superintendent’s office and listen to incoming phone calls—and equally amazing, in a sense, that he or she doesn’t unplug the phone. Each event seems to require an immediate response. A child is hurt on school grounds so an outside supervisor is assigned. A teacher’s parent dies just before midterm reviews, and there is no qualified substitute, so the test is rescheduled. Each time, the superintendent (or another staff member) does a heroic job of fixing the problem: making the fastest possible diagnosis and finding the most immediate solution.

But there’s a very real chance that each quick fix will do more harm than good in the long run. Moreover, reacting to each event quickly, and solving problems as quickly as they come up, helps develop a kind of “attention-deficit culture” in the school system. Moving rapidly from one issue to the next, people grow highly skilled at solving crises instead
of looking for ways to prevent them. In this type of culture, it’s almost impossible to get people to speak openly and candidly about their mutual problems and concerns; those, after all, are “beside the point.”

The discipline of systems thinking provides a different way of looking at problems and goals—not as isolated events but as components of larger structures. The superintendent’s office, after all, is a system: composed of the habits and attitudes of the people who work there, the policies and procedures imposed by the state and the community, and such implacable forces as available money and student population.

A system is any perceived whole whose elements “hang together” because they continually affect each other over time. The word “system” descends from the Greek verb *sunistanein*, which originally meant “to cause to stand together.” As this origin suggests, the nature of a system includes the perception with which you, the observer, cause the system to stand together. Examples of systems (besides the superintendent’s office) include biological organisms (including human bodies), the atmosphere, diseases, ecological niches, factories, chemical reactions, political entities, industries, families, teams—and all organizations. Within every school district, community, or classroom, there might be dozens of different systems worthy of notice: the governance process of the district, the impact of particular policies, the labor-management relationship, the curriculum development, the approaches to disciplining students, and the prevailing modes of staff behavior. Every child’s life is a system. Every educational practice is a system.

The discipline of systems thinking is the study of system structure and behavior; it is enriched by a set of tools and techniques that have developed over the past thirty-five years, particularly since the advent of powerful computers. People who have experience with systems thinking can act with more effective leverage than a “short-attention-span culture” generally permits.

THE CONTINUUM OF “SYSTEMS THINKING”

The term “systems thinking” has been used, in the last two decades, to refer to a confusing array of tools, methods, and practices. *The Fifth Discipline* and *The Fifth Discipline Fieldbook* may have contributed to some of that confusion, by referring to “systems thinking” in inconsistent ways. There is, we now believe, a viable continuum of systems thinking practices, all with different
degrees of rigor, different approaches, and different views of the nature of a “system”:

- **“System-wide thinking”**: Efforts to enact change throughout an organization (like a school system) instead of in one narrow domain. For example, a superintendent may decide that curriculum projects and “School to Work” projects should work together, because, after all, “they are part of the same system.” System-wide thinking is generally more effective than working in isolation.

- **“Open systems thinking”**: Developed by thinkers such as Ludwig von Bertalanffy, Russell Ackoff, Eli Goldratt, and others, this school of systems thinking seeks to understand a system in terms of its inputs, outputs, throughputs, and boundaries.

- **“Human systems thinking”**: Thinkers such as David Kantor and Barry Oshry, for example, have proposed ways that people’s roles and relationships can interact, leading to results that no one would choose but that they cannot escape.

- **“Process systems thinking”**: Emerging through the quality movement and reengineering, this form of systems thinking sees an organization as a set of information flows. By realigning the communication structures, the patterns of behavior of the organization will change.

- **“Living systems thinking”**: Various forms of complexity and chaos theory, along with the theories of Humberto Maturana, David Bohm, and Lynn Margulis, suggest that emergent systems exist—that patterns of order will develop from chaos, much as life-forms develop.

- **“Feedback-related systems thinking”** or just “systems thinking” (sometimes called “system dynamics” or “systems thinking”): A wide array of techniques and tools that have developed out of an understanding of dynamic feedback processes (reinforcing and balancing loops). These tools include simulations, stock-and-flow diagrams, causal loops, system archetypes, and conversations about feedback.

- **“System dynamics simulation”**: The type of system analysis developed and championed by Jay Forrester and his colleagues, in which feedback interactions are represented by nonlinear mathematical equations. Since nonlinear equations describe accumulations and exponential growth, and since these equations are generally too complex for people to manipulate beyond a rudimentary level, system dynamics has depended on computer modeling and simulation.

We think all of these forms of systems thinking are appropriate
for different purposes, in different circumstances. Regular use of any or all of them will build your capability in systems thinking—the ability to see systems more clearly and apply more effective leverage to accomplish your purposes. — Art Kleiner

The iceberg

**Purpose:**
To consider a serious problem and thus introduce yourself to the practice of systems thinking.

**Overview:**
These four questions lead you from the perception of a situation as a series of unrelated events, to view the underlying patterns that connect them.

**STEP 1: EVENTS**
Name a critical event (such as a crisis) that emerged in the last few months in your school or classroom. How have people responded? How have they tried to solve it?

Not long ago, in the city of Crisis Corners, New Jersey, the school superintendent announced her imminent departure. This was upsetting news, since she was the fourth superintendent to resign in twelve years. Rumors spread that the school board fired her. Parents protested. Fac-
tions blamed each other. And word began to spread that, once again, the district had fallen prey to a superintendent who was just no darn good. Seeing this as a full-blown crisis, the school board began a hurried search for a successor, making offers that went far beyond the budget. Teachers and staff members put all innovations on hold, waiting to see what their new administrator would do.

Such responses are typical and understandable. But that doesn’t make them inevitable. What if you saw your event (whatever it might be) as simply the tip of an iceberg? The visible part of the iceberg looks massive and threatening, but most of it is hidden by the surface of the ocean. You cannot navigate around it unless you can somehow penetrate the mysterious ocean and see the structure that holds aloft the visible tip.

**STEP 2: PATTERNS AND TRENDS**

What is the history of the event you described in step one? When has it occurred before? Chart the course of related events over time, on a graph. What patterns do you see emerging?

For example, in Crisis Corners, a systems team looked at administrative turnover over the past ten years and all the related factors they could think of, and came up with a chart looking something like this:

![Graph showing administrative turnover and related events](image)

They could see several events that seemed to correlate with superintendent turnover—a jump in school enrollments in the late 1980s, and the elimination of tenure for administrators in the early 1990s. Perhaps the regional economic boom of the late 1990s had also had an effect. (Other variables, not on this diagram, could also be considered—such as

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*Crisis Corners is a fictional city, but it is based on several true stories of school administrator turnover in urban New Jersey school districts.*
the attitude of the staff toward change or the number of ongoing curriculum reform initiatives.

Systems specialists refer to these diagrams as behavior-over-time diagrams. This is not human "behavior" but the behavior of the system: the patterns of rising and falling key variables. As patterns emerge, it is clear that most of them have been seen before. Rarely are patterns completely new. They may not look exactly the same, but they will certainly look similar to patterns that appeared two, five, or ten years earlier.

Looking at patterns of behavior is often depressing; they make it seem as if fate is inexorable. No matter what you do, you'll fall into that pattern. But that is based on the false assumption that history will repeat itself. Not one endeavor or business, from health care to banking to manufacturing to government, has stayed the same over the past ten years. Education is no exception. Thus, patterns of behavior, while they reveal trends, are inadequate for making decisions. To look more deeply, you need to consider the root causes of the pattern—the interrelated forces that have brought you here.

STEP 3: SYSTEMIC STRUCTURE
What forces seem to create the pattern of behavior you described in step 2? How do these systemic elements seem to influence each other? What fundamental aspects of the school must be changed, if you want to change the patterns?

Behind each pattern of behavior is a systemic structure—a set of unrelated factors that interact, even though they may be widely separated in time and place, and even though their relationships may be difficult to recognize. When studied, these structures reveal the points of greatest leverage: the places where the least amount of effort provides the greatest influence for change. These are not necessarily the points of highest authority; they are the places where the ingrained channels of cause and effect are most susceptible to influence.

Many of these systems have developed over time as the result of habitual approaches to chronic problems. For example, in the story of administrative turnover, perhaps there is a combination of extremely high expectations for student performance and low support for staff development—especially administrator training and development. The district attracts charismatic figures for superintendent and principal positions, encourages them to act as if they know all the answers, and "punishes" them, in subtle and unsubtle ways, when they fail to produce
results in a very short time. Thus, they tend to leave the school district early or get pushed out, thereby creating an even more urgent demand for improvement and a truly heroic administrator next time. Each successive administrator, selected to “compensate” for the “excesses” and “mistakes” of the one who came before, sets a complete shift of policies in motion. The unintended result is a thorough disruption of the school system, with the regularity of the tides, every three or four years.

See page 88 for a diagram of this “administrative turnover” system.

STEP 4: MENTAL MODELS
What is it about my thinking and everyone’s thinking that causes this structure to persist?

Systems often take their shape from the values, attitudes, and beliefs of the people in them. That’s because our mental models, our theories about the way the world works, influence our actions, which in turn influence the interactions of the system.

Consider, for example, the mental models that lead to the superintendent turnover problem. Do people in the school district believe that the leader must be a superhero? Do they feel that any visible flaw is a sign that they have chosen the wrong person? Do they expect him or her to be thoroughly polite and not ruffle any feathers or disturb any sacred cows?

What mental models, in turn, does the superintendent have about the community? About the teachers? About the teachers’ unions? About the students? About the best model for learning? And about him- or herself? Many administrators, as successful and well-educated people, have learned the power of advocacy but are not skilled in inquiry. They tend to hold the mental model that, when faced with a conflict, they can win by arguing more avidly and debating most fervently. In this way, they perpetuate the structure of recurrent misunderstanding between superintendents and the board.

Now consider the problem that you have been charting. Behind each element of the systemic structure is a set of attitudes and beliefs, some of which have been unchallenged, even though they are misleading or counterproductive, because they are unseen. Can you safely bring them to the surface and inquire about them?
The building blocks of systems thinking

Systems continually send signals to themselves, through circular loops of cause-and-effect relationships. Systems thinkers call this “feedback,” because the effect of the system “feeds back,” often after one or two intermediate stages, to influence itself. Over the past fifty years, the behavior of feedback has been studied through mathematical modeling, through computer simulations, and through the observation of systems in the real world. The result is a set of tools for mapping and charting systems. Familiarity with them gives you a language for talking about complex events. More and more people, in schools and elsewhere, understand that language. Its grammar starts here.

REINFORCING PROCESSES: WHEN SMALL CHANGES BECOME BIG

Reinforcing processes are a form of feedback that leads to exponential growth or decline—either in nature or in human affairs. When a plant or animal is born, it begins to consume whatever it needs voraciously. The more it consumes, the faster it grows. The faster it grows, the faster it continues to consume. Its growth accelerates, faster and faster, until it runs up against other forces that begin to slow it down. In all reinforcing processes, small changes become larger. High birth rates lead to higher birth rates; industrial growth begets more industrial growth.

To grasp the often-surprising ramifications of exponential growth, consider an interest-bearing bank account. At first, the interest generates only a few extra dollars per year. But if you left the interest in the bank, the rate of growth would increase, as interest began to accumulate on the old interest. After fifty years of depositing $100 per year (at 7 percent interest), you’d have more than $40,000, more than eight times as much as you would get from depositing the same amounts in a piggy bank year after year. Such unexpected wealth is a truly virtuous spiral. But you’d be caught in a vicious spiral if, instead of investing money, you went into debt for a long time. At first it would seem as if you were paying only small sums in interest. But over time, the balance you owed would grow with increasing speed.

Don’t underestimate the explosive power of reinforcing processes; in their presence, linear thinking can always get us into trouble. For example, schools often assume that they will face steady, incremental growth in their need for increasing classroom space. They are startled to discover that when their new facilities come online, the demand has
already overshot the new supply of desks. It almost seems that the increased availability of space is creating a surge in the school population—and, in fact, that may be one of the factors, by drawing people into the school system.

When someone remarks that “the sky’s the limit,” or “We’re on a roll,” or “This is our ticket to heaven,” you can bet there’s a reinforcing process nearby, headed in the “virtuous” direction the person prefers. When people say, “We’re going to hell in a handbasket,” or “We’re taking a bobsled ride down the chute,” or “We’re spiraling to oblivion,” you know they’re caught in the other kind of reinforcing process—the vicious cycle.

Often the critical factor in a reinforcing process is the availability of information. Systems expert David Kreutzer points out that the number of supporters of Mahatma Gandhi’s protest against the British continued to grow exponentially because there were well-established channels of communication among the Hindus who protested with him. Their practice of nonviolent resistance gave them an ongoing forum within which to keep meeting and planning new actions. By contrast, the spontaneous uprising in China’s Tiananmen Square in 1989 had no underlying feedback loop, no structure for communication. The people gathering in the square did not know enough about each other to keep meeting after the tanks rolled toward the protest. Without that feedback loop, the resistance died; while in India, it led to a revolution.

Reinforcing process: In these behavior-over-time diagrams, a school population starts small but begins to grow dramatically, while the resources available for each student, after a modest decline at first, drop off precipitously. These diagrams show evidence that at least one reinforcing process is operating.

The snowball at the center of this causal-loop diagram represents a reinforcing process. As the school expands capacity to keep up with its growing student population, the community becomes more attractive, and more families seek to live there—putting accelerating pressure on the school for yet more expansion. Until some limit is reached, expansion in the district will not just continue, but accelerate.
A reinforcing process, by definition, is incomplete. You never have a vicious or virtuous cycle by itself. Somewhere, sometime, it will run up against at least one limit. For example, the burgeoning population of a school district eventually reaches a limit on the availability of room or else on the supply of new people eager to settle there. The interest-bearing savings account can reach a limit of human need—sooner or later you’ll need to spend that money, perhaps on a child’s college education. Some limits may not appear in our lifetime, but you can rest assured that they will appear. There is no such thing as infinite growth.

**BALANCING PROCESSES: PUSHING STABILITY AND RESISTANCE**

Balancing processes ensure that every system never strays far from its "natural" operating range—a human body’s homeostatic state, an ecosystem’s balance of predator and prey, or a company’s "natural" expenses, which, whenever you cut them, seem to balloon up somewhere else.

Balancing processes are often found in situations that seem to be self-correcting and self-regulating, whether the participants like it or not. If people talk about "being on a roller coaster," or "being flung up and down like a yo-yo," then they are caught in one type of balancing structure. If caught in another type, they may say, "We’re running into walls," or "We can’t break through the barrier," or "No matter what we try, we can’t change the system." Despite the frustration they often engender, balancing processes aren’t innately bad: They ensure, for example, that there is usually some way to stop a runaway vicious reinforcing spiral. Our survival depends on the many balancing processes that regulate Earth, the climate, and our bodies. The balancing process often represents a built-in intelligence to the system—a governor that keeps it moving toward the same stable goal, no matter how it is perturbed. It’s as if

![Graph showing aggregate test scores over time](image)
the system itself has a single-minded awareness of "how things ought to be" and will do everything in its power to return to that state.

Balancing processes are always bound to a target—a constraint or goal that the forces of the system often implicitly set. Whenever current reality doesn't match the target of a balancing process, the resulting gap (between the target and the system's actual performance) generates the kind of pressure which the system cannot ignore. The greater the gap, the greater the pressure. Until you recognize the gap and identify the goal or constraint that drives it, you won't understand the behavior of the balancing process.

CAUSAL-LOOP DIAGRAMS

Ordinary spoken and written language is linear. We speak of one factor "causing" another: "A causes B." But systems are circular: Factor A never causes factor B; factors A and B continually influence each other. "Causal-loop" diagrams show that influence as arrows, from one element to another and back again. The symbol at the center shows what kind of feedback is involved. For reinforcing processes, we use a "snowball" and/or the letter R. For balancing processes, we use a "balance beam" and/or the letter B.

Causal-loop diagrams for balancing processes don't show just the activity around the cycle but the external "goal" that influences it (usually drawn inside a box). They may also include a visible "delay," which can change the behavior of a system dramatically.

If you are new to systems thinking, you may feel intimidated by these diagrams. The best way to deal with that is to draw some reinforcing and balancing loops of your own. This can be a lot of fun, because you don't have to be correct. The most important thing is to provoke your own (and your team's) consideration of the same old problems from a new, unfamiliar perspective.

Pick a situation in your own school (or elsewhere) that accelerates. What are the factors that reinforce each other? Make a loop. Then try a balancing loop—a system whose factors continually tend toward some (happy or unhappy) medium. Here are some guidelines for drawing the diagrams:

- Start with one key variable—a noun describing some element that you know is involved in the system. Then ask: "What are the other elements that affect that variable?" Work backward around the struc-
A simple causal-loop diagram of high administration turnover.
It starts with the existence of a gap between the school system’s “results” (the performance and learning of its children) and the public expectations held by parents in the district. If the gap is too great, public reaction leads administrators to quit or be fired, leading to an increase in turnover. This changes administrator effectiveness (often for the worse, but always in a perceptible way), leading to a change (after a delay) in the school system results. Focusing on developing administrators’ leadership capability and skills (through mentoring, training, and having them teach in the schools) would be much more productive. It would also be less costly to talk openly about the public’s expectations for the schools.

About each element, ask: “What’s causing changes in this element? What influences it to vary?”

- If you get stuck, try working forward: “What is the effect when this variable changes?” “What other elements must change?”
- Draw arrows to show the direction of movement. It doesn’t matter if the loops go clockwise or counterclockwise but try to set them up so you (and other people) can easily follow the story.
- Put an R or snowball in the center if the system tends toward runaway growth or decline; and a B or balance beam in the center if it oscillates toward some kind of target or stability.
- Keep the loops simple. Draw as few elements as possible, and label each element as simply and concisely as possible. It’s much easier to grasp “Public reaction” than to figure out what “Community levels of satisfaction with the district” means.
- Give your variable elements names that represent levels of activity that may go up or down sometime in the future, even if you only expect movement in one direction. For example, you may expect a burgeoning student population, but “Number of students” is a better label than “More students every year,” because it will apply no matter what happens in the system.
- It’s particularly valuable to include any elements that are at least partly under your influence: “Amount of money invested in staff development” may be a factor that influences teacher turnover. If so, and if you control the staff development budget, this may help you recognize some of the leverage in the system.

Use the loops as the starting point for conversations. After drawing a system diagram, show it to other people. Talk them through the story by starting at one element and describing a typical chain of causality. (“Public reaction leads to higher levels of administrator turnover.
This in turn causes quality to go down, leading to poorer results and more public reaction.” Ask their opinion about what elements have been left out and whether the story, as a whole, rings true to them. Invite them to make up their own causal loops.

For causal-loop diagramming in the classroom, see page 242.

STOCK-AND-FLOW DIAGRAMS
Causal-loop diagrams, while they capture the universal structures embedded in, say, a reinforcing process, do not spell out the unique qualities of a particular situation. For instance, a causal loop that shows student population growth might show that investment in school activities leads to more students moving in. But how much investment is necessary before the school system crosses a threshold of attractiveness? How quickly will new students enter the district, and what does that speed depend on? To predict (or anticipate) a system’s behavior in the future, you must look at the situation with more precision.

That’s the value of the stock-and-flow diagram. It leads the student of systems to specify the interrelationships in an explicit, mathematical way. Every arrow in the diagram can be linked to a formula, which means that other students of stock-and-flow diagrams can comment not just on the assumptions underlying the relationship but on the exact way that one element influences another. Stock-and-flow diagrams are also a necessary next step for simulating the reinforcing process on computers.

A stock-and-flow diagram translates any sort of situation—even the most “qualitative,” immeasurable situation—into five different kinds of mathematical entities:

1. “Stock” (shown in the diagram on the next page by the rectangle): an accumulation of some kind of quantity, either measurable or not. In this diagram it is the number of students in the district this year, but it could also be the level of morale or the satisfaction parents feel with the school.
2. A “flow,” representing the rates at which quantities flow into or out of the stock. Flows are like spigots on a faucet, controlling the amount of water moving, per minute or day, into a bathtub (a stock). Flows can also vary—rainfall per month is a flow that regulates the amount of water in a reservoir, adding copiously to it in the spring and spar-
ingly in the summer. Understanding the pattern of flow is crucial, because it determines the delays in the system.

3. A "converter," representing quantities that impact the stocks and flows. Most of these converters are stocks and flows themselves, but it would make the diagram too confusing to show them that way; they generally mediate between two or more other parts of the diagram in some way that you specify. For instance, the "attractiveness of new families per year in the district" is governed, in part, by the "school investment in capacity," along with other factors. In turn, it affects the rates of students entering and leaving the system.

4. A "connector," embodying the interrelationships among the other three types of elements, shown here by arrows. Each connector has a mathematical formula associated with it, explicitly defining the way that (for example) school investment will rise or fall as the number of students in the district changes.

5. The "cloud" represents areas that exist outside the system at hand, from which flows might originate (or to which they might discharge). In this diagram, clouds represent the population of students elsewhere in the nation.

Developing a stock-and-flow diagram creates a model of the situation at hand—a model that can be programmed on a computer and tested against experience until you feel it is robust.

For more on the STELLA program, which incorporates stock-and-flow modelling into simulation, page 258. For stock-and-flow modeling in the classroom, see page 244.
DELAys: WHEN THINGS HAPPEN... EVENTuALLY
There are often points in both reinforcing and balancing processes where a chain of influence takes a particularly long time to play out. Delays are caused because change takes time; it takes time for the contents of a stock to “flow” in or out. For instance, the stock of high school students has a four-year delay between the time students arrive as freshmen and leave as seniors.

On causal-loop diagrams, delays are often drawn as a kind of “speed bump” on an arrow of influence (see page 88). On stock-and-flow diagrams, the flow inherently governs delays, by regulating the degree to which a stock fills up. Some stocks, called “converters,” also have built-in delays that prevent output from leaving the system until some specified time has passed. However they are rendered, delays can have enormous influence on the system, frequently accentuating the impact of other forces. This happens because delays are subtle: usually taken for granted, often ignored altogether, nearly always underestimated.

When trying to understand a system, it is very helpful to identify the most significant delays in it. For example, consider the time it takes to find a new administrator. This is a time of paralysis for the system. Administrative capabilities drain out quickly. Yet the impact on performance may be slow, because performance takes time to deplete. Therefore, a perceived crisis in performance may occur after a new administrator is already in place. That may lead to public disappointment, months before the new administrator’s practices have had time to show any effect.

System archetypes: nature’s templates
In the 1960s, researchers began to notice that some more complex systems structures are generic—they apply to a wide variety of situations, including many organizational situations. These “archetypal” system structures suggested new, counterintuitive ways to deal effectively with a wide range of organizational and community problems. About a dozen system archetypes have been identified and written about. “Fixes that Fail” is one of the most common, and it often emerges in school reform cases, with a symptom of unintended consequences.

Fixes that Fail: The Forced Change
We’ve all seen it happen many times. A well-meaning and talented principal initiates curriculum reform, the teachers come on board because they
have no choice, and the principal micromanages the effort. Implicitly he says: "We're going to move forward, whether you like it or not."

On the surface these efforts look successful because of the good things that happen. Change occurs, sometimes very quickly, and teachers admit that they learned something. But because the change is mandated, the teachers don't feel they own it; it isn't theirs. There is thus a tremendous cost. Teachers begin to teach "to the principal"; they prepare lessons they think the principal wants to see instead of what the students need. As the teachers close their doors, morale and innovation decline along with communication. Ironically, some of these principals are unbelievable individual educators, however the systemic consequences of their forceful influence as managers leads to the opposite of good education.

With the "Fixes That Fail" archetype in mind, a principal might approach curriculum reform differently. One strategy for dealing with this archetype is to increase awareness of the unintended consequences—to acknowledge openly that the "fix" is just the first effort to alleviate the symptom (and perhaps to meet state guidelines). It will need to be followed, in short order, by a sincere effort to create a teacher-designed curriculum, ideally in a team-based process that draws forth the teachers' creativity and passion. Another strategy is to cut back on the severity and intensity of the fix: to set up curriculum reform in stages, so that people can adapt to it and make it their own. Finally, the most effective curriculum reform initiatives avoid this "fix" entirely. They start an open inquiry on the problems that have led to visible inconsistencies. Maybe the real problem has to do not with the subject matter, but the way it is taught, and training in new classroom techniques (e.g., the use of simulations or team projects alongside lectures) will lead to better results.