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restructuring seeks to accomplish. A high dropout rate among teachers with one to five years of experience may be an indication of this strain. **They typically are the teachers who are given the most difficult class assignments. Teachers, particularly those engaged in restructuring, all too frequently speak of burnout as they attempt to accomplish more in a system that refuses to stretch and yet forces ever "new" techniques, methods, and solutions onto their already overcrowded responsibilities.** **This strain is particularly evident when teachers are not allowed to integrate such efforts at improved practice into a coherent sense of how these fit into their own understandings and assumptions about good learning and teaching.**

In China and Japan, the average elementary school teacher spends approximately 40 percent of the day in planning and curriculum consultation, and rarely teaches more than three hours a day (Stevenson 1992, pp. 74–75). In the United States, that planning time translates into anything from a half hour to one or two hours per week in elementary schools. In high school, what is called preparation time amounts to one hour a day. Exceptions are relatively rare. How can teachers possibly integrate into practice the exploding knowledge base in the neurosciences, cognitive sciences, technology, individual disciplines, and what we now know about how to help children become healthier, more effective human beings, when all they have time for is to implement a predetermined lesson plan hour after hour with a 5- to 8-minute break in between?

Class size can also add to teacher burnout. In many states, elementary schools have at least 35 students per class.

• Notwithstanding all the action and all the problems that we have described, some of the deep beliefs about how children actually learn have never been examined by many of those who are embroiled in the debate. Even people who might have different views of what they want education to accomplish often share deep beliefs about "school" and teaching, which are not grounded in a coherent theory of learning. Their unarticulated beliefs are grounded in the experiences that they have had with their own education. Although the system is at the eye of a storm, the basic beliefs on which

the whole edifice is built remain largely unexamined by the public and by vast numbers of educators. Many of the protagonists, therefore, don't know what they don't know.

Our Map in Outline

When so many well-intentioned and deeply invested people find themselves at loggerheads with each other in so many ways, the problem most likely runs deeper than we have collectively realized. In our examination of many issues—funding, phonics or whole language, site-based management, vouchers or charter schools, business partnerships and the privatization of school systems, demographics, technology, and parenting changes—we have asked a critical question:

Is there something functioning at an even deeper level that makes sense of the conflict and crisis, and that gives us a handle on how to approach the enormous problems we face?

In our research, we ventured into these waters with half a solution. **We were, and continue to be, absolutely certain that a fundamental issue hinges on the understanding that stakeholders have of how human beings learn. We feel that many hold basic beliefs about learning that are far too linked, and the problems in and with education cannot be solved until these beliefs are changed. Thus, our approach is to work with the deeply held beliefs that educators have about learning, with the goal of changing those beliefs and so leading to changes in teaching.**

In the course of our own work with schools, we began to explore even deeper issues. In the journey that we describe in this book, featuring two schools in particular, we were reacquainted with the fact that schools do not operate in a vacuum. **Powerful forces keep traditional classroom teaching in place. We found that we could not describe our change process in isolation without looking at the broader "systems" question as well.**

Ultimately, we believe that there is a coherent way to look at the problems, and there are ways to restructure education, renew educators, and significantly raise the standards of students. Accomplishing

such renewal, however, requires a profound rethinking of much that we have taken for granted. For example, discoveries in biology and physics are making a new view of life and the universe explicit, while prolific uses of technology have enlarged and complicated our lives. At the same time, input from many fields is providing a new understanding of ourselves and the way we learn.

It seems to us that in evolutionary terms, education has worked well over the last 100 years. Although many people have fallen through the cracks and numerous inequities have occurred, the model of education has been a good "fit" for the industrial age. Large numbers of people have been equipped to function in industry. And education and industry have been perceived through the same larger lens.

What is now happening is that the world itself is changing, and the lenses through which we have peered are being replaced. As that happens in other larger spheres of life, a point is reached where education must follow suit.

We are leaving behind one way of looking at the world—a way that is built on a belief in stability and controlled change as ideal. In its place, we're moving toward an emerging understanding of the dynamism of life at every level. It is the understanding of change as natural to every facet of our existence and an embracing of continuing possibility that we have been keeping at bay. Four ideas can guide us in trying to understand change:

1. Disequilibrium is everywhere, and we need to understand that. All systems, including education, are caught up in the turbulence of extraordinary change. To understand and work effectively with any social system at this time, we have to come to terms with new ways of thinking embodied in, but not limited to, what are being called the "new sciences." Among the new ideas that are helping us to rethink our basic assumptions are the notions of complex adaptive systems, self-organization, field effects, self-reference, and the edge of chaos. These ideas are examined in depth in later chapters. That thinking will help us grasp the ways in which the system is functioning and see how to guide and influence the directions we wish it to take.

2. The brain is equipped to deal with a turbulent world. But to understand this, we first need to come to terms with how the brain learns and to see how this knowledge translates into our everyday lives. Research from the neurosciences and many other fields is profoundly changing what we know about how people learn. Traditional approaches to learning and teaching sufficed in a stable and less turbulent world. Today, we have no choice but to ground our work with education in a thorough understanding of how the brain actually learns. The brain, and therefore we, are not limited to the learning of a digital computer. We are meant to learn from naturally complex and "messy" experiences. At the same time, our understanding of stress and the nature of anxiety and trauma is teaching us that we learn best when our emotional lives are orderly and coherent (when they make sense).

3. The change process is intrinsically transformational. Most of the work on school change, even when parents and other stakeholders have been included, has been directed at changing strategies, structures, and external behaviors. In a turbulent world, that approach cannot work. We are now finding out that the key is to assist systems to self-organize and transform themselves. This process can be influenced, but it simply cannot be controlled from the outside.

4. To function best in this new environment, we need to embrace a fundamentally different world view or perceptual orientation. In the course of our work with schools and business, we identified specific approaches to teaching. One favored control and a high degree of stability. Another favored fluid situations and students engaged in self-directed learning. Our greatest surprise was to find that these instructional approaches are grounded in intrinsically different ways of viewing reality. Because people have such differing perceptual orientations, some educators are more at home in the world of change and turbulence than others. It is therefore not simply a matter of changing strategies—it is a matter of seeing with different lenses.

We ultimately concluded that the most important step that we could take would be to come to understand these perceptual differences, and that the key to successfully transforming education lies in transforming ourselves.

Brain-Based Learning

In *Making Connections*, we describe 12 "brain principles" of learning. Figure 1.1 shows our revised principles; Chapter 5 provides a more detailed discussion. The brain principles make provision for the traditional model of teaching. They show, for instance, that every human being has a virtually unlimited set of memory systems that are designed for programming and for the memorization of meaningless information. But our minds also have the need to place memories and experience into a "whole"—and indeed our minds automatically do this. The "whole" is our autobiographical memory, which tells us how things in space relate and how ideas and experiences are connected. Without this type of memory, we could not find the bathroom twice without memorizing our route first, nor could we write a spontaneous sentence recalling an experience. Both memorization and integration are critical, and learning is best when information is embedded in rich, meaningful experiences. We also came to the conclusion that teaching for memorization of meaningless facts and procedures dictated by someone else usually induces *downdshifting*. *Downdshifting* is a psychophysiological response to threat associated with fatigue or perceived helplessness or both (Caine and Caine 1991, 1994a). Downdshifted learners then bypass much of their capacity for higher-order functioning and creative thought.

In brain-based learning, educators see learners as active participants in the learning process. The teacher is not the deliverer of knowledge, but the facilitator and intelligent guide who engages student interest in learning. Students and teachers become partners in the pursuit of understanding. Traditional schooling assumes that children have to take on board lots of "stuff," and then someday they will know how to apply it when they go to work or have a profession. Brain-based learning makes this leap to the real world right from the start.

Brain-based instruction begins with the entire school and the child's whole being. The brain is not divided into individual segments marked "feelings" or "cognitive development" or "physical activity." Rather, active learners are totally immersed in their world and learn from their entire experience. "Children," the saying goes, "learn what they live." Instruction is correspondingly complex. Whereas short lectures and

Figure 1.1
BRAINMIND LEARNING PRINCIPLES

- Principle 1: The brain is a complex adaptive system.
- Principle 2: The brain is a social brain.
- Principle 3: The search for meaning is innate.
- Principle 4: The search for meaning occurs through "patterning."
- Principle 5: Emotions are critical to patterning.
- Principle 6: Every brain simultaneously perceives and creates parts and wholes.
- Principle 7: Learning involves both focused attention and peripheral perception.
- Principle 8: Learning always involves conscious and unconscious processes.
- Principle 9: We have at least two ways of organizing memory.
- Principle 10: Learning is developmental.
- Principle 11: Complex learning is enhanced by challenge and inhibited by threat.
- Principle 12: Every brain is uniquely organized.

memorization play a part, much more learning takes place when learners are constantly immersed in complex experience; when they process, analyze, and examine this experience for meaning and understanding; and when they constantly relate what they have learned to their own central purposes. When teachers assist students in engaging their own purposes, teachers may find that skill development, with its emphasis on practice, rehearsal, and refinement, becomes more effective. The challenge, therefore, is to fit skills and content to the learner, rather than fit the learner to the curriculum. We go in much greater depth on what this means later in the book. An example:

I teach 4th and 5th graders all subjects. The thing that works most for me about Open Charter School is that I have moved away from standing in front of the classroom. I have become a learner along with my children. I work side by side with them in their learning rather than assuming that everything that comes from my mouth is the most important thing that is going to be important to them.

Which ones do you agree with?

Then we asked people: "If you really believe this, to what extent does your own school and your own teaching reflect it?" This turned out to be a provocative exercise. At its best, it led to sincere questioning about the difference between what we say we believe and what we actually believe. At its worst, the exercise became an invitation to do a great deal of blaming.

Most teachers, other educators, and the public have a mental model of learning and teaching formed and, we would maintain, physiologically entrenched by their early experiences in school. Five or six education courses in a postbaccalaureate program or college lecturing tend not to genuinely challenge teacher's mental models and do little to disturb these deeply held assumptions about schools, teacher roles, and learning. In short, we all tend to reduce what is new—and that includes innovative strategies and thinking—to fit (or accommodate) our current mental models.

Based on our studies, we believe that one reason why education continues to go through so many phases with "strategies that work," only to ultimately end up with business as usual, is that mental models of teaching and learning are not changing. Changing on the surface means acquiring new vocabulary and new formal explanations without challenging the basic beliefs that drive our moment-to-moment actions. We end up like the principal who was overheard excitedly telling a friend, "Oh, we did brain-based learning last year; this year we are doing constructivism."

To Change Practice, Change Minds

If mental models drive the decisions that we all make, the implication is that to successfully improve education, we have to change the mental models that educators have of learning and teaching. We therefore wanted our theory to form the basis of a new mental model in the people with whom we worked. We set out to demonstrate that our theory can act as a practical guide for a living, dynamic new way of approaching learning and teaching for schools, teachers, and students.

We believed, and wanted to test the belief, that our theory, properly understood, would naturally drive changes in instruction and influence

decisions that the school, staff, and faculty made. By looking at learning and the learner in a new way, we expected teachers to more or less naturally create, modify, expand, and adapt their own teaching to reflect new understandings. In effect, if educators changed their minds about how education worked, changes in practice would inevitably follow.

Teacher Change and Transformation

When we first attempted to use the theory as the basis for restructuring, we discovered just how challenging it is to translate words on a page to a living, present-day school context and practice. Although educators loved the ideas expressed in *Making Connections*, implementing the theory turned out to be another matter entirely. All of us had to learn that instant solutions did not automatically surface from the theory and that working with the theory in mind meant, first of all, taking time to share and change powerful assumptions about learning and teaching. We were looking at assumptions that guide our moment-to-moment decisions about what we actually do when we teach.

Our understanding came with time. Our learning embraced elements of action research and hermeneutics. This kind of research is qualitative, quantitative, participative, and dynamic. We observed, connected to our knowledge, collected data, asked questions, searched for answers, read profusely, modified and expanded our assumptions, and started the process all over again. This was the same process, we should add, that we sought to induce in the people with whom we worked.

On the one hand, we found enormous enthusiasm and excitement. People had a sense of possibility and were exhilarated by the phenomenal range of projects, potential for creativity, and variety that brain-based learning supports. On the other hand, we faced (and still face) the constant threat of exhaustion and frustration that accompanies any change process. We found human beings whose routines and relaxed interactions with family and friends have been severely strained.

Real change is also extremely difficult because it challenges traditional and personal beliefs and asks us to revisit and reinterpret

our own experiences and our own sense of self. Here's what one teacher participating in brain-based restructuring said about it:

I don't think it can be overemphasized how scary all this change is. I've always been willing and quite good at rearranging the deck chairs. I've never been asked to transfer from a steamship to a starship before. I can sagely intellectualize about why and even how. Maybe the key is to remember it's not a leap but a journey where I can control the pace.

Our process together was an exercise in honesty and frustration as we began to uncover the forces that held current assumptions in place. The tension between teachers' need for techniques and strategies for the next day and our own emphasis on changing beliefs about learning and teaching required not only patience but the capacity to admit and accept that such a fundamental change does not happen overnight.

Our Main Surprise: Different Ways of Perceiving the World

As we worked with and observed teachers, both in our schools and around the United States, we began to see and confirm differences in what we call "instructional approaches." Though the details had not been clear to us, the central thrust of the differences was expected. After all, it was clear that those who used a stand-and-deliver model had to differ in significant ways from those who elicited student interests and then embedded content as appropriate. We ultimately distinguished between what we call Instructional Approaches 1, 2, and 3. Figure 1.2 (see p. 25) is a summary of the approaches, and we describe them in depth in Chapter 10.

As we pursued the matter, we also found something more. It is clear that the different instructional approaches reflect different mental models of teaching and learning. Mental models, however, go much deeper and further than we expected. Mental models about teaching are themselves grounded in even more fundamental ways in which people look at things and interpret their world. The differences were something that we had intuitively felt but had not adequately antici-

pated or understood. Richard Elmore recounts an experience in restructuring:

I recently gave a talk about school restructuring to a gathering of high school principals and superintendents from school districts that identified themselves as reform oriented. The common theme of their reforms was changing the high school schedule to lengthen the standard 45- or 50-minute class to something longer, perhaps as much as 90 minutes. . . . When I asked them why they chose to concentrate so much energy and attention on changing the schedule, they first looked at me as if I had descended from another planet. . . . To them it was obvious that changing the schedule would lead to a different kind of teaching, but it wasn't necessarily obvious what kind of teaching that might be. My favorite commentary on this problem is the teacher who was quoted as saying, after his school changed from 45- to 90-minute periods, "Oh, good, now I can show the whole movie." It is not obvious, in other words, that changes in teaching practice follow from changes in structure (Elmore 1995, pp. 23-26).

FIGURE 1.2
SUMMARY OF THE THREE INSTRUCTIONAL APPROACHES

Instructional Approach 1 can generally be described as a "stand-and-deliver" model. This approach relies on top-down thinking and the control of information and facts to be disseminated by teachers.

Instructional Approach 2 is considerably more complex and sophisticated than Instructional Approach 1. It is still primarily a command-and-control mode of instruction, with many of the same beliefs and practices as Instructional Approach 1, but there are some critical differences. Teaching tends to be organized around concepts with an eye to creating meaning rather than just for memorizing. To this end, it uses complex materials and can incorporate powerful and engaging experiences.

Instructional Approach 3 is what we had envisioned as brain based. It differs radically from Instructional Approaches 1 and 2 because it is much more learner centered, with genuine student interest as its core. This kind of teaching is more fluid and open. It includes elements of self-organization as students focus individually or gather collectively around critical ideas, meaningful questions, and purposeful projects. Instructional Approach 3 teaching is also highly organic and dynamic, with educational experiences that approach the complexity of real life.

FIGURE 1.2
SUMMARY OF THE THREE INSTRUCTIONAL APPROACHES

We finally described these more fundamental ways of looking at things as "perceptual orientations." The perceptual orientations frame the ways in which educators can think and perceive. The orientations set limits on what teachers can conceive of. Thus, those at Perceptual Orientation 1 cannot think out of the Instructional Approach 1 box. Those at Perceptual Orientation 2 can think about and potentially do both Instructional Approaches 1 and 2. But only those who are at Perceptual Orientation 3 can think in sufficiently fluid and integrated ways to embrace all three instructional approaches. One aspect of the perceptual orientation is a core difference between those who rely on the external power given them by the system and those who have a sense of self-efficacy and are self-reliant. The former find a stand-and-deliver model of teaching quite natural. The latter are much more capable of accepting and working with the individual choices expressed by students.

We describe the differences generally in terms of a distinction between Perceptual Orientation 1 and Perceptual Orientation 3. We suggest that there is a transitional phase, what we call Perceptual Orientation 2. And we argue that most work on restructuring education is currently directed at a shift from Perceptual Orientation 1 to 2, and that this thrust is essential.

Our Theme

A new way of thinking is required by the paradigm shift—but that way of thinking cannot be taught. As we explored the differences in perceptual orientations, we came to believe that system change requires educator change, and that educator change is a matter of personal transformation. The source of the resistance of schools to change lies in a system that is itself maintained by a set of absolutely compelling deep beliefs about learning, teaching, and the nature of reality itself.

In a sense, the traditional system was well served by the old paradigm. There was a good match between system and beliefs. That reciprocal relationship is now breaking down. A turbulent system requires a different set of beliefs—a different perceptual orientation. We need a new match.

All educational issues need to be reconceived in terms of the new sciences and a basic understanding of perceptual orientations. For example, people are legitimately concerned with raising educational standards. However, our conclusion is that the people who are capable of teaching to a new and more complex set of standards are those who see complexity as natural. Perceptual Orientation 3 must be supported in educators, therefore, if standards are to be raised significantly. However, the system itself is going to have to be reconfigured and must function in different ways if the fluid and dynamic instruction associated with Perceptual Orientation 3 is to be possible.

That, therefore, became the focus of our work, and of this book.

This Book

Ultimately, this book describes a journey involving two specific schools and an unlimited and unnamed number of others that engaged in a process of restructuring based on changing mental models. It also includes corporations and businesses that were involved in exploring our process. It draws on more than 100 hours of recorded video and audio documentation showing the changes that took place in thinking and practice. In addition, we sent our own research questionnaire to numerous schools and individual educators.

Our objective is to contribute to a broader understanding of the change process—to help redraw a map of what it takes for educators and, in particular, teachers to change how they think and what they do as a result. This map will show what happens to men and women when they let go of the limitations of their old beliefs and expand them to include new lenses.

We divide the book into three distinct sections; each can be read separately as a "book" by itself.

Section 1. Theory: The Foundation

Section 1 deals with the changes in our collective philosophy as the new sciences, systems thinking, and comparable developments in