

GIVING WINGS TO NEW IDEAS
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**CHAOS, COMPLEXITY, AND FLOCKING BEHAVIOR:
METAPHORS FOR LEARNING**

by Stephanie Pace Marshall

Sir Isaac Newton saw the universe as an orderly clock. Today, scientists describe it as a shifting kaleidoscope. Could this new metaphor hold the secret for the transformation of learning communities?

As human beings, we always have grounded our institutions, including our schools, in the science of our times. How scientists view the natural world always has had profound implications for how we constructed our world.

As educational leaders, we have worked hard using our current understandings about teaching and learning to design systems we believed would enhance the achievement and creative capacity of students and staff.

While we have been doing this, science has undergone a revolution--a profound paradigm change that will forever alter the way we view and make sense of our universe, ourselves, and our institutions. The application of this new understanding to our work and our relationships can inform our role as leaders as we create authentic, empowered learning communities.

It is fashionable in the 1990s to speak of paradigms and paradigm shifts. When a paradigm shift occurs in science, the scientists' conception of the world changes: this is precisely what has happened. A "new" physics for a new social order is emerging.

Discoveries in modern physics have caused the scientists' description of the universe to change from the metaphor of a clock to the metaphor of a kaleidoscope, and this metaphor and all that it suggests holds great promise for transforming our schools into authentic learning communities.

For three centuries the dominant scientific world view has been the image of a static, repetitive, predictable, linear, and clockwork universe. Sir Isaac Newton gave us classical physics, the laws of gravitation and mechanics, and the description of a deterministic world. This Newtonian world view also profoundly influenced our psyche, our beliefs, our behavior, and consequently, how we designed our institutions. We have been obsessed with linear systems and their effect has controlled almost every dimension of our culture.

We have efficiently managed our world by drawing lines and boxes around everything and by separating things into discrete observable, measurable categories. We created dichotomies, divisions, departments, boundaries, and closed systems. We focused on predictive cause-and-effect models of human behavior; we separated knowledge into disciplines. We designed hierarchies and linear structures. We divided people into management and

labor. We fragmented ourselves, our beliefs, our behavior, our organizations, our learning, our schools, and our world. We separated our bodies from our minds, our minds from our hearts, and our hearts from each other. We forced compassion to compete with intellect.

Deriving our insight from Newtonian physics, we behaved as if we believed that by studying the parts we could understand the whole, and that analysis inevitably leads to synthesis. But this shouldn't surprise us. After all, isn't that the way a predictable and clockwork universe works?

By design we have constructed and operated our schools as we have understood our world, and these constructions have produced learning-disabled institutions, students, and staff, including us, who have suppressed creativity and potential to survive. This efficient, orderly, and linear design of schooling no longer makes any sense.

It belies what the neurosciences teach us about how the brain functions and learns. It challenges the personal, active, volitional, and social dimensions of learning that are so essential to authentic meaning.

A New Scheme

As complex learning systems, schools are far more organic and dynamic than linear. We, therefore, must design them to function less like clocks, and more like kaleidoscopes, and to do so, we must ground our educational transformation in the science of our times. We must understand, however, that the paradigm of new physics does not replace the paradigm of the old, and it doesn't explain all phenomena.

Because we now understand that most of nature (weather, ecological systems, developing embryos, and even the brain) is not linear, we need a different conceptual scheme and a different way of viewing and understanding the universe. Then we need to apply this understanding to the reinvention and transformation of America's schools.

The new vision of reality we are discovering is grounded in the interrelatedness and interdependence of phenomena. Albert Einstein reminded us that "no problem can be solved from the same consciousness that created it. We must learn to see the world anew." The new view of science reveals a universe of inherent order. It is, according to Margaret Wheatley, author of *Leadership and the New Science*, "a universe rich in processes that support growth and coherence. Nothing happens in a quantum world without something encountering something else. Nothing is independent of the relationships that occur." Even in the most seemingly chaotic systems, like the movement of clouds or the swirling motion of a liquid, an internal structure exists.

Order is created by "strange attractors"--forces or shapes of probability that seem to prevent the system from going beyond certain invisible boundaries. It is self-referencing. One of the most powerful illustrations of this construct of emergent order is found in the field of complexity theory, that deals with the structure and order of complex, dynamic, and adaptive systems, such as an ecological system.

What is so fascinating about these complex systems is that the order that emerges does so from a simple set of rules that govern the interaction of the individual components of the system to each other, and not the total system itself. From this interaction of the individual components, system stability emerges. This has been simulated in a computer program with interesting results.

Learning from BOIDS

One of the most intriguing of these simulations is called "The Experiment of the BOIDS." In this experiment, the program attempts to capture the essence of emergent order, in this case the flocking behavior in birds, by placing a large collection of independent bird-like agents called BOIDS into an obstacle-filled environment.

Each BOID follows three simple rules, according to M. Mitchell Waldrop, author of *Complexity: The Emerging Science at the Edge of Order and Chaos*. It tries to:

1. Maintain a minimum distance from other objects in the environment, including other BOIDS;
2. Match its own velocity with the BOIDS in its neighborhood; and
3. Move toward the perceived center of the mass of the BOIDS.

This simulation has been run thousands and thousands of times, and amazingly, with these three simple rules, a flock forms every time. What is even more surprising, however, is that not one of the rules given to the BOIDS said "Form a flock."

Individual Relationships

Four observations in this simulation have profound implications for us, not because we are trying to get flocking behavior, but because we are interested in complex behavior, like learning and teaching, emerging from individual relationships.

- Rules that create complex flocking behavior do not relate to flocking behavior. They relate to what an individual BOID should do in relation to other BOIDS.
- Flocks form from the bottom up and not from the top down.
- The close interaction of the BOIDS with each other allowed the flock to adapt to changing conditions naturally. The focus of each BOID was on ongoing behavior and not the final result.
- Complex behavior, like flocking, need not have complex rules. Simple rules will yield profoundly complex results. Perhaps this is the most important observation of all.

Moving to Order

How does something so seemingly remote and unconnected to our life's work as chaos, complexity theory, and flocking behavior possibly contribute to our ability to be leaders in educational transformation? What these new understandings of the natural world enable us to do is to challenge and then change the current context of education by creating a

completely new one. I am not talking about moving boxes on an organizational chart. Re-invention is not about changing what is, but about creating what is not.

The current context of education, which is grounded in unverbally underlying assumptions and invisible premises of a linear, predictable, hierarchically controlled and rigidly structured world, must be discarded to allow for the emergence of self-organizing systems that are held together by a compelling and shared vision of what they can become, by a deep set of core values, and by a commitment to goals and objectives, collaboratively established, collectively assessed, and individually supported.

In short, the paradoxical conditions necessary for educational transformation are individual freedom of choice and collective responsibility for the whole--individual and group autonomy and interconnections.

As we begin to create authentic learning communities, we must ask several critical questions:

- What are the sources of the order we wish to create, and where do they come from?
- How will we create coherence, integration, and purpose in our community?
- What structures can we derive that will support and celebrate learning, that will enable rather than deplete, that will evoke rather than direct, that will be fluid and flexible over time?
- How do we connect our need for autonomy and freedom with our organization's and our public's need for accountability and order? What might that order look like?
- What simple rules or parameters will enable complex learning, creativity, experimentation, and growth to occur?
- What are the "strange attractors" of our community? Are they explicitly known and understood by all? How can we sustain their power?
- How can we be sure that we are enabling potential to flourish?
- What are the skills we need to discard to enable our community to find its own identity?
- How can we remove boundaries and maintain security and trust?
- How do we sustain relationships and meaning? How do we support growth and change?
- How do we give ourselves permission to fail? What does failure look like in this place?
- How will we recognize if the love, faith, and trust we bring to our community begins to diminish? Will we be courageous enough to take the risks required to enable them to emerge once again?

These are difficult questions, but they are essential if we are to change the context of education. We cannot change what we do until we change how we think, and we cannot change how we think until we change who we are.

One simply cannot transfer as a whole any particular model or body of knowledge from one system to another. The models are informative, but

knowledge, models, and expertise are co-created by thoughtful people working in and with their environment. Because of this, we need to trust, more than ever before, our own capacity to re-invent ourselves.

Our world is a non-linear, adaptive, dynamic, and pattern-seeking world of inherent order, interconnections, and potentials. It is a world where increasingly complex behaviors are created by very simple rules--rules that govern the relationships of individuals to each other and are established from the bottom up.

It is a world where deep inner creativity and coherence are woven into the very fabric of nature. What the world of new science says to us is that if we are truly going to create learning communities for the 21st century, we must look differently at our classrooms, our schools, and our work. We must view them as dynamic, adaptive, self-organizing systems, not only capable but inherently designed to renew themselves and to grow and change--not by rules established from the top, but by relationships created from within.

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"Re-invention is not about changing what is, but about creating what is not."

As educational leaders working in collaboration with others in our neighborhood, we have remarkable opportunities now to change the face of public education in our nation by widening the circle of hope and opportunity and by being the dream catchers for our children's future.

We cannot restructure a structure that is splintered at its roots. Adding wings to caterpillars does not create butterflies--it creates awkward and dysfunctional caterpillars. Butterflies are created through transformation.

This means that it starts with us.

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