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Book Review

Chaos in the Classroom: A new theory of teaching and learning, by E. J. Davis, T. J. Smith, & D. Leflore. Durham, NC: Carolina Academic Press, 2008.

> *[E]ducation is a nonlinear process,*
> *Where input does not equal output,*
> *Where cause is widely separated from effect,*
> *And time is one-directional.*
> Davis, et al., 2008, p. 7.

The underlying premises for *Chaos in the Classroom* are that learning and education are nonlinear and complex, and that time in the context of teaching and learning is irreversible. In order to create learning environments wherein critical, creative thinking occurs, the authors provide a way of rethinking our educative agenda from the perspectives of what they term as first, second and third order chaos. Understanding learning dynamics from the perspective of chaos and complexity theories while delineating these varying perspectives of chaos entails changing paradigms and metaphors for teaching and learning. Grounded in practical examples from K-12 as well as university classes, this short tome offers an accessible and pragmatic way of rethinking classroom dynamics and learning theory as it applies to classroom settings.

The book begins with an approach to learning theory that accommodates brain-based research, social constructivism, multiple intelligence theory, and chaos theory. The need for revisiting our ideas about learning to accommodate these multiple perspectives is important, according to the authors, in order to orchestrate learning environments that are supportive of critical thinking and creativity, understanding "an environment that fosters critical thinking is multilevel and diverse, with as many different perspectives as there are students and teachers" (p. 6). Chaos theory is used as "a window to the learning process" whereby "education is [viewed as] a nonlinear process, where input does not equal output, where cause is widely separated from effect, and time is one-directional" (p. 7). Building on ideas from chaos dynamics, including representations of dynamical systems using phase space diagramming, the authors appeal to the fundamental basis of chaotic systems, quoting Gleick (1987), that "simple systems give rise to complex behavior; complex systems give rise to simple behavior; and more importantly, the laws of complexity hold

universally, caring not at all for the details of a system's constituent atoms" (p. 304).

Building on the premise that the laws of complexity hold universally for complex systems, the authors extend ideas about brain-based learning theory to classroom dynamics. They delineate what it may mean to perturb the learning environment, to create chaos within the classroom, to look for and learn to recognize strange attractors, and to enable students to develop critical approaches to their own learning. Using phase space diagramming of classroom interactions, they depict conversational complexity and strange attractors as emergent ideas in the classroom. Examples of what they refer to as level one, level two, and level three chaos in the classroom are presented where "it is the third level that produces the wild and turbulent strange attractors, and it is this level that results in deeply creative/critical thinking and activities" (p. 49).

Within the classroom, perspectives of learning are framed by notions of density, sensitive dependence on initial conditions, iteration, strange attractors, and fractals. Density is a measure of student involvement over time while sensitive dependence on initial conditions is both recognition that prior knowledge shapes and influences learning and that learners bring very different individual experiences and understandings to each learning opportunity. Iteration becomes an important tool as students test out their ideas and listen to the ideas of others, building on each others' understandings and questions. The form of interaction occurring in the classroom can be traced through phase space as an indication of complexity. The more complex the classroom dynamics, the more levels of understanding that occur and the greater likelihood for creativity and critical thinking to occur.

Contrary to traditional perspectives of classroom control and managed learning goals, the undercurrent of classrooms guided by principles of chaos and complexity is to maximize perturbation, to push students and their understandings to the edge of chaos, "the point at which variables combine in such a way as to produce suddenly different behavior" (p. 80). Reframing to Piagetian disequilibration theory, the authors note the value and desirability of creating pedagogic "catastrophe shelves" whereby students' curiosity and need to make sense of anomalous data push them to deeper levels of understanding. The teacher's role, in such a perspective of classrooms, becomes one of facilitator, problem poser, and orchestrator of catastrophe as catalysts for learning.

Different kinds of dynamics can occur as the teacher creates opportunities for students to actively interact with one another and with ideas at multiple levels. The first kind of chaos, referred to as "Level One Chaos" by the authors, is characterized by a single point strange attractor. As students negotiate meanings and share multiple solution paths in a mathematics classroom, for example, there may become a single point attractor of agreed upon understandings and consensus on underlying concepts or efficiency of approaches. When alternative ways of solving a problem are of equal merit, a second level of chaos

may emerge. "Level Two Chaos" in classrooms occurs when two or a fixed number of equally valid solution paths are shared. The third level of chaos in the classroom, however, is often where the most creativity occurs.

> The *third level* is characterized by a system that moves through many points in many dimensions, creating a robustness that is not easily perturbed thus creating its own time and space, and generativeness or creativeness that can at any point create a different time/space. It is unpredictable locally but predictable globally. The energy that is created in this third level comes from its characteristic far-from-equilibrium properties, and this energy sustains it over long periods of time. Rather than tending to entropy, the system is inclined to suddenly change direction or focus and this new focus now becomes robust in a new time/space (p. 85-86).

Examples of "deep chaos" are when students work on their own to create and solve problems, identify and extend areas of interest, or independently generate new topics or areas of study. Capitalizing on student differences in understandings, interests, experiences, abilities, and backgrounds, introducing and supporting chaos recognizes the value of letting go of control and opening up the classroom spaces for critical, reflective, and generative learning to occur.

Promoting and utilizing principles of chaos and complexity in the classroom is not new. William Doll has been discussing these ideas for over twenty-five years and his book *A Post-modern Perspective on Curriculum* (1993) has become a classic in applying principles of chaos and complexity to teaching and learning. My own book, *Curriculum Dynamics* (2002) describes the theoretical and philosophical bases for opening up classrooms to interactive complexity and chaotic dynamics. What is valuable about this book, *Chaos in the Classroom: A New Theory of Teaching and Learning* is not the "newness" at all, but the continuation of a complex conversation that problematizes theories of learning and classroom dynamics. Offering specific classroom examples of how the ideas they are presenting can be enacted, this book is accessible to a wide range of levels of understandings.

The development of this book in relative isolation, not being conversant with other books in the field of chaos and complexity in education, suggests the broad-based nature of changed perspectives that pervades any single, narrow focus of inquiry. As Prigogine and Stengers (1984) described, over twenty years ago, rather than bringing science to a standstill, the discovery of complexity has actually provided the impetus for and convergence of new ideas for understanding the world. That Davis et al. (2008) have continued the conversation and shaped the discussion in education in ways that are accessible to pedagogues at all levels is worthy of celebration and relevant to the on-going interpretive framing described by Prigogine and Stengers. Theories of teaching and learning continue to be challenged and principles of chaos and complexity are relevant to

social systems, including education and classrooms, as well as biological and physical systems; that chaos and complexity theories are being used to interpret classroom and the human dynamics of teaching and learning suggests fidelity of these theories for significantly changing the way we come to know and shape our world.

REFERENCES

Doll, W. (1993). *A post-modern perspective on curriculum.* New York: Teachers College Press.

Fleener, M. J. (2002). *Curriculum dynamics: Recreating heart.* New York: Peter Lang.

Gleick, J. (1987). *Chaos: Making a new science.* New York: Penguin Books.

Prigogine, I. & Stengers, I. (1984). *Order out of chaos: Man's new dialogue with nature.* New York: Bantam Books.

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