

Chaos & Complexity Theory

SPECIAL INTEREST GROUP NEWSLETTER

American Educational Research Association

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Getting Down to the Practical Side of Business

Our “business” meeting will be on Thursday from 12:25 - 1:55 at the La Jolla room in the Marriott (South Tower Level 4).

Join us with a friend. The business meeting serves multiple purposes for this SIG: business and organization, a chance to showcase particular ideas or applications of interest to the general membership, and—not least—to provide a time to sit, talk, and get to know other members and to introduce potential new members to the SIG. It is often those informal discussions around common interests that are the most exciting moments of a conference.

We will hold elections for officers and are looking for folks willing to serve in all offices: president, treasurer, newsletter editor (this job!), program chair, and webmaster. Have an idea for the SIG? Suggest a project. Bob Kahn will report on the progress of our group and will no doubt preview plans for the future. (See Bob’s letter on the back page of this issue.)

This year’s membership demonstration will be a discussion entitled “The Practical Side of Chaos” chaired by Noel Gough of Deakin University. The discussion will be based on two papers: “The fractal nature of a mother and son’s mathematical activity” by Elaine S. M. Simmt, University of Alberta, and “Using chaos theory to inform high school redirection” by James H. Lytle, University City High School, Philadelphia. These authors will demonstrate in their different ways how a “principled holism” that takes into account the particularities of each situation can be used to inform and extend educational practice.

Reflections

A QUESTION OF WHICH METANARRATIVE

We are all familiar with François Leyotard’s early 1980’s statement that post-modern is “incredulous toward metanarratives.” By now it has almost become a mantra in postmodern circles. However, for those of us taking a “chaotic” approach to this new ism—instead of the usual literary / political approach—it seems that not only is a new metanarrative appearing but a new type of metanarrative is appearing. It is chaos theory which has this honor—complexity or nonlinear dynamical theory, if one prefers.

As I am reading books by Kauffman (*At Home in the Universe, Origins of Order*), Capra (*The Web of Life*), Argyros (*Blessed Rage for Order*), Davies (*Cosmic Blueprint*), and Prigogine (*End of Certainty*), chaos theory is definitely emerging as a metanarrative. What seems central here is that this is the first theory which deals with creativity as both a natural and emergent phenomenon. That is, creativity seems to be a natural occurrence in the universe, provided the conditions are correct. This naturalness gives us a new view of evolution, one which is neither imposed nor random. Development, indeed, even progress (that is, movement over time toward complexity), occurs as a natural interaction of forces (chemical elements, biological beings, social institutions, if you like) of which we are ones. Thus, there is a sense of system here but a system that is open and unpredictable, yet determined by both past interactions and present ones. This unpredictable but determined frame is, of course, an essential part of chaos theory.

This sort of a metanarrative is a far cry from the ones we’ve seen in the past—all closed, deterministic, predictable. This one is open, dynamically emerging (with determinism as a part), and quite unpredictable (although short term probabilities do exist). Considering that our concept of curriculum was born of 17th century, Protestant methodology, it is certainly filled with senses of the closed, deterministic, predictable. Without such a milieu we could hardly have conceived of I.Q. being a valid concept, nor could we justify the averaging of grades—to pick just two of many examples.

The challenge I now see before us is to develop a curriculum theory and various curriculum designs which do honor to the openness, dynamic emergence, and (patterned) unpredictability of the chaos theory metanarrative. Quite a task, to use a modernist phrase and concept.

—Bill Doll, Louisiana State University

James Lytle’s paper is based on his experience as the new principal of a large urban high school which was faced with a demoralizing ten percent cut in funding two weeks into his tenure. How he dealt with it and how chaos theory informed his thinking should make fascinating listening.

Elaine Simmt will present evidence that mathematical compe-

tence is itself fractal; that is, that the patterns that appear in one area of a student’s knowledge reflects the larger pattern of his or her understanding. Using an enactive framework, she will present an example of mother-son interaction that demonstrates her point.

All in all this should be an intriguing and invigorating business meeting.

Roundtables Explore the Implications of Complexity

MONDAY: “THE COMPLEXITIES OF DEVELOPMENT & THOUGHT.”

Marriott, Marina E, South Tower, Level 3. 1:15-1:55.

THURSDAY: “COMPLEX IMPLICATIONS FOR INSTRUCTION & POLICY”

Marriott, Marina Ballroom E, South Tower, Level 3. 12:25-1:05

The SIG has two roundtable offerings this year. The emerging foci around development and thought in one and the instructional and policy emphases in the other are an interesting indication of the directions in which research is maturing. Roundtables provide a chance to really talk with the authors about their work—take advantage of the opportunity to question the authors!

DEVELOPMENT & THOUGHT

TABLE 27: Dynamics of Children’s Friendship—A Random Dynamical Systems Approach.

Lutz-Michael Alisch, Technical University Dresden, Germany

TABLE 28: A Review of the Basic Principles of Catastrophe Theory and Their Application to Learning and Development. *Matthijs Koopmans, York College, CUNY*

TABLE 29: Analysis of the Discovery of Chaos: Social and Cognitive Aspects. *Jong-Baeg Kim, University of Wisconsin, Madison*

TABLE 30: The Autopoietic Nature of Thought. *Sherrie Reynolds, Texas Christian University*

TABLE 31: Chaos/Complexity Theory, Hermeneutics, and Construction of the World by Children and Those Who Work with Them. *Karen VanderVen, University of Pittsburgh; Doris Fromberg, Hofstra University; Carlos A. Torre, Southeastern Connecticut State University; Michael J. Nakkula,*

Harvard University

INSTRUCTION & POLICY

TABLE 23: Principles of Self-Organization: Ecologizing the Learner-Instructor System. *Sasha A. Barab, Indiana University, Bloomington*

TABLE 24: Complexity Theory for Classroom Management. *David Chawaszczewski, University of Michigan, Flint*

TABLE 25: The Gaze and Autopoiesis: A Case Study in Student Assessment. *Jean-Claude Couture, University of Alberta, Canada*

TABLE 26: The Development of a Complex, Dynamic Causal Model for Cyclically Organized Processes of Cumulative Advantage and Disadvantage in Education. *Ton Jörg, IVLOS Institute of Education, The Netherlands*

TABLE 27: Chaos and Standards: A Solvable Educational Paradox. *Martin R. Ramirez, Illinois Mathematics and Science Academy*

SIG Symposium Focuses on Learning

“THE SCIENCES OF COMPLEXITY, LEARNING, AND THE EDUCATIONAL PROCESS: EMERGING PERSPECTIVES ON WAYS OF THINKING AND DOING”

Convention Center, Room 3, Upper Level. Thursday, 8:15-10:15

The focus of this symposium is teaching students how to think using the analytic framework of complexity. The authors’ concern is to develop a way to help students grasp the very different style of understanding used in complex

analyses of phenomena. Rick Ginsburg will act as discussant.

•Thinking Like a Tree. *Mitchel Resnick, MIT Media Laboratory*

Mitchel Resnick will discuss the use of StarLogo to develop “ecological thinking”—such as understanding why the tree walks.

•Statistical Mechanics for K-12: An Emergent Model of Gas Laws. *Uri Wilensky, Tufts University*

Uri Wilensky explores the ways in which students can use sophisticated modeling software to recognize the emergent nature of the gas laws.

•Reconceptualizing Categories

Without “Necessary and Sufficient” Features: Dynamical Categories.

John St. Julien, University of Delaware

John St. Julien discusses the implications of situated knowledge and connectionist learning for the design of instruction—and software.

•Complexity and Cognition: Ways of Thinking About Self-Organization, Emergence, and Natural Selection. *Michael J. Jacobson, University of Georgia*

Michael Jacobson will report on his studies of student mental models used in solving problems and the implications of his findings for the design of instruction.

Reflections

From the Chair

Dear members,

I am sorry that we have not been in touch more frequently this year on a formal basis, but a lot of informal contact is going on. Our Conference Chair, William Doll, Jr. (of Louisiana State University) has arranged an excellent conference program for San Diego. John St. Julien (the University of Delaware) has the website set up well. Do look carefully in this newsletter for further information on both the Conference and internet possibilities.

Next year will be different! Elections will be held at the business meeting at AERA. We are looking for people to help expand the group, and if you would be willing to serve, do let me know as soon as possible, at the address below, or preferably by e-mail to: rkahn@cctr.umkc.edu

Interest in chaos and complexity theories continues to increase. Much of the earlier hype has happily faded away, but there is a lot of substance now in the current contributions. I have been enjoying Ivars Peterson's new book, *The Jungles of Randomness: A Mathematical Safari* (John Wiley, 1998). Many of you will recall his earlier *Newton's Clock: Chaos in the Solar System* (W. H. Freeman, 1993). Also, there are two excellent earlier articles in *Physics Today*: David Ruelle's "Where Can One Hope to Profitably Apply the Ideas of Chaos?" (July 1994) and Edward Ott and Mark Spano's "Controlling Chaos" (May 1995). More recently, Brent Davis has offered some excellent educational themes in the *Journal for Research in Mathematics Education* (1997--Vol 28, No 3 pp. 355-376--"Listening for Differences: An Evolving Conception of Mathematics Teaching") and in *Harvard Educational Review* (with Dennis J. Sumara—Spring 1997, pp. 105-125—"Cognition, Complexity, and Teacher Education").

I look forward to meeting old friends and finding new ones in San Diego. Do let me know if you have specific suggestions about the group or would like to help out in some way.

Sincerely, Bob Kahn

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LOOKING FORWARD

Resources

On the Web

<http://lpsl.coe.uga.edu/Jacobson/ctcs/>

Take a look at the Cognition, Technology and Complex Systems group website. It represents an NSF funded project which centers on teaching the concepts of complexity and contains much of interest to educators.

This location is one of the few to tie education directly to complexity, and to offer a glossary and a list of offline resources. Of special interest is a page linked to downloads of modeling programs valuable in teaching the concepts of complexity.

<http://www.udel.edu/aeracc>

The Chaos and Complexity SIG now has a relocated and updated website at Delaware. You'll find up-to-date information on the annual meetings, the latest version of the newsletter in pdf format and an annotated list of C&C links. Hook into the email list via directions on these pages. Please email the webmaster (stjulien@udel.edu) with suggestions for additional services and the latest news.

Become a member. Or give this to a friend!

You'll receive our newsletter, advance notice of sig activities, and other opportunities.

Mail this form along with a \$5 check payable to AERA SIG to:

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