Is Complexity Science Embedded in Transformative Learning?

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Abstract: *This paper discusses evidence that Jack Mezirow's (1991) seminal work on transformative learning drew heavily from the precursors of complexity science without making the connection explicit, a trend still present in the transformative learning literature. The use of concepts from complexity theory and its interdisciplinary contributors can improve our understanding of transformative learning and its development.*

Small raindrops on windows, growing as the rain falls, moving slowly downward and connecting with other drops, until the drops reach a transforming point and flow down in a river together. Making connections from disparate pieces creates a complete, fluid, and transformed picture that flows and changes directions as new ideas and understandings are added. This process was the genesis for the purpose of this empirical project. While reading about complexity science, the science of change (Capra, 1996), and chaos theory, two adult educators had the same question: Why did Mezirow (1991), the father of transformative learning theory, not mention complexity when referring to factors that contribute to transformations; and why did his description of transformation center on a "disorienting dilemma" (Mezirow, 1991, p. 218)?

Throughout the 20th century, as complexity science emerged, by explicitly embracing the concepts of neuroscience, immunology, economics, organization theory and network science, all sciences made tremendous advances (Mitchell, 2009). A few education theorists moved in this direction (Doll, Fleener, Trueit, & St. Julien, 2005; Fenwick, 2003, 2009; Karpiak, 2003, 2006) in hopes of achieving similar gains in education. At previous AERC meetings, others have begun exploring the intersections of complexity science concepts and adult education (Dirkx, 1998; Kang, 2005; Mealman & Lipson, 2002; Swartz, 2008; Tang, 1997; Taylor & Marienau, 2002), but seldom explicitly and not from a transformative learning (TL) perspective. We believe that uncovering the latent connections between transformative learning theory, in particular, and complexity science will enhance both theory development and the education of adult education scholars. Complexity science clarifies aspects of TL theory not yet adequately explored, such as what exactly transformation means. Rather than layering more new perspectives of transformation, the purpose of this study is to contribute to theory development by recovering the roots of TL and indentifying points of intersection with complexity science so that new theoretical exploration and understanding can be initiated from those places.

Theoretical Framework

Complexity science, or the science of complex systems, is an interdisciplinary field of research that arose in the 20th century as an outgrowth of general systems theory, cybernetics, and artificial intelligence (Capra, 1996; Mitchell, 2009). Spurred by the mathematical insights of chaos theory in explaining the behaviors of unpredictable, constantly changing systems, complexity science attempts to understand "how large numbers of relatively simple entities organize themselves, without the benefit of any central controller, into a collective whole that creates patterns, uses information, and in some cases evolves and learns" (Mitchell, 2009, p.38.)

A central concept is that living systems thrive on connectedness. In dynamic co-evolution with their environment, they reach a critical point of chaos at which they spontaneously self-organize into a new, ordered pattern and evolve into new structures with greater complexity (Prigogine & Stengers, 1984). This unpredictable, non-linear process uses self-reinforcing feedback loops to amplify the effects of change, so that small changes can result in large effects. This creates instability that leads to sudden emergence of new forms in transformative self-organization.

Transformative learning theory in adult education (Mezirow, 1978, 1991; Taylor, 2008) theorizes similarly about a learner's process of using cycles of self-reflection and critical reflection in discourse with others to challenge one's existing pattern of meaning making, especially its uncritically assimilated aspects, leading to a more complex, connected and inclusive pattern of meaning making. The impetus for these cycles of self-reflection could be an evolutionary process of adult development or a personal crisis that creates instability and triggers a newly patterned meaning perspective that leads to new ways of acting in the world. Transformative learning theory traces its history to Mezirow's (1978) identification of perspective transformation in women returning to college. Thirty years of theory evolution produced eight current perspectives on TL, Mezirow's being dominant (Taylor, 2008). His view sees individuals negotiating and acting upon their own purposes and meanings, rather than on those uncritically assimilated from others; altering prior interpretations when creating new meanings to guide future actions; and accomplishing this process through evolution of transformed schema or via personal or social crisis.

Methodology

This is a qualitative study using content analysis of text as methodology. A qualitative approach allowed in-depth textual analysis and emergent design as discoveries were made. Purposeful sampling identified representative texts**.** Utilizing the research questions (a) Where is complexity science present in transformative learning theory?; and (b) What are the patterns of connection among these concepts across authors and over time?, Mezirow's (1991) seminal theoretical work was subjected to textual analysis using a detailed coding tool. Specific concepts from complexity science were identified, such as embeddedness, emergence, non-linearity, order-disorder, patterns of connection, self-organization, as well as related ideas from general systems theory, a precursor of complexity science. We also searched for many authors, such as Kuhn, Lorenz, Prigogine, and Bateson, who are tied to complexity science and/or its antecedents. Four coding levels ranged from a concept being implied in the text without citation in index to citation in the index and detailed in text as an author identified central theme. Then, the same tool was used to analyze the cited sources of these concepts as they appear in Mezirow (1991), his first detailed explication of the theory of transformative learning. Coding of Mezirow's edited texts, representative works of authors from each of the eight major theoretical persepctives of transformative learning (Taylor, 2008), and the proceedings of Transformative Learning Conferences provided a broad overview of the presence of complexity science concepts within the expanse of transformative learning. Due to space limitations, what follows below is a brief summary of the broad picture and in depth focus on the patterns of connection within Mezirow's (1991) first major theoretical development of transformative learning theory. Specific conceptual links to complexity science appear in italics to assist the reader's understanding.

Findings and Discussion

Since the 1991 publication of *Transformative Dimensions of Adult Learning*, critics assert (Taylor, 2008) that Mezirow's rational emphasis on transformation ignores contextual influences and holistic ways of knowing, and that using the individual unit of analysis, context, and social change get little consideration. Through a complexity science lens, this research came to a different conclusion, suggesting that complexity science conveys a different definition and understanding of context and its role in learning, and raising possibilities for a general reconceptualization of TL and teaching. Data demonstrate two major trends in Mezirow's works: 1) there is a presence of concepts consistent with complexity science; and 2) he relied on primary sources with direct ties to complexity while not developing details of complexity science.

Mezirow (1991) actively engaged with concepts from complexity science and by writing about them extended a scholarly invitation to others to do the same. Mezirow explained in 1991 why transformation is important. He introduced the assumption that our world is so full of change *(chaos)* that we need a way to deal with it, thereby *embedding the learner in context.* By writing that *lives spin out of control in an increasingly complex world* unless we form new perspectives, he engaged with ideas of *chaos and order in a dynamic system*. Mezirow indicated that *"liminal spaces" (or edge of chaos)* "in thought and social practice...are where new definitions and new concepts of authority can be negotiated" (p. 3), an idea consistent with *self-organization*. Numerous similar links to complexity appear in the evolution of Mezirow's theory, through his connections to theorists in other disciplines who were writing in the same time period.

Mezirow was heavily influenced by Kuhn (1962), Popper (1960), and Bateson (1972). Transformative learning sounded much like Kuhn's overview of *paradigm shift,* itself connected to complexity science's evolution from chaos theory, in that Kuhn was one of several authors to reinscribe scientific concerns into the larger culture (Aubin, 2002). *Kuhn,* as he was helping to popularize *chaos math,* noted that *complexity is necessary for a 'crisis' to occur, and that crisis is required for a paradigm shift. Kuhn labeled this shift a* ***transformation.*** Mezirow's original theory is an application of Kuhn, popularizer of chaos theory, which is the math behind complexity science. Mezirow also incorporated thoughts about learning and a *Gestalt orientation (the whole)* from Popper (1972), a philosopher of science, thus solidifying transformative learning theory's connection with science. Anthropologist *Bateson* (1972), who brought the *systems understanding of cybernetics* to the social sciences (Capra, 1996), provided Mezirow with a *theory of learning through perspective transformation via changing contexts*. These and many other rich, contemporaneous sources were not specified or fully embraced in subsequent transformative learning theory development, as further findings reveal, so that they have been lost in the current iteration of the evolved psychocritical perspective.

Mezirow (1991) not only made the call for other educators to engage in interdisciplinary exploration, he set an example of how to do this, producing a virtual guidebook that gives direction to researchers toward areas of study that may enlighten their work. As stated in the methodology section, a detailed coded tool was utilized to measure the impact of complexity science on Mezirow's theory development, focusing on his 1991 work, including scientists, philosophers, and concepts prominent in the history and development of the multidisciplinary theory of complexity science. This analysis demonstrates how the concepts contributed to and parallel the transformative learning theory development. For example, in Chapter One, on making meaning, Mezirow draws heavily from complexity science with the concepts of *systems*

thinking in his discussion of *coherence.* He believes that *chaos becomes more controlled* when it is "*becoming more differentiated and integrated or transformed* by reflection on the content or process of problem solving in progressively wider contexts" (p. 6). Furthering this concept within systems thinking, he addresses *complex systems that adapt and create order, becoming more complex as they transform.* He also uses the phrase *"reflective cycles" as a transformative* learning term with a similar function as *"feedback loops"* (p. 4), again consistent with complexity science, although not acknowledged as such.

In looking at Chapter 2 of the 1991 text on meaning perspectives, Mezirow discusses the ideas of Continental philosopher of science Bachelard, language game theorist and Analytic philosopher of mathematics Wittgenstein, physicist and interpreter of 'new science' Kuhn, and systems thinkers Bateson and Popper. In this chapter Mezirow also addresses *sensitivity to initial conditions, adaptable elements, embeddedness, nonlinearity, coherence, networks, paradigm shifts, Gestalt, and self-organization, all core concepts of complexity theory*. Many of these concepts are not simply mentioned in passing, but are utilized as central contributors to the development of his ideas. For example in the third chapter, on intentional learning and problem solving, Mezirow spends ample time discussing the ways in which the learning theory developed by Edward Cell (1984) can be utilized to understand transformative learning. Interestingly, but not surprisingly, Cell's work also contains many concepts and references from complexity science. Some of these concepts include *Gestalt, holism, ordering,* and belief *system mapping*. It is also interesting to note that of the six concepts in the summary section of Chapter Two, four are from complexity science as coded in this research, and three are additionally from philosophy of science.

As stated previously, at the end of each chapter in his book, Mezirow takes the opportunity to summarize the points in his argument that were made. Not only does he enumerate the points, he begins with a paragraph pointing out whose ideas have contributed to his own. Many of these, it should be clear at this point in the paper, are from the complexity school of science and theory. In addressing transformative learning theory in this way, Mezirow has created a road map for scholars to follow. He asks researchers to join him in studying these foundational texts and in referencing these works and ideas in their own pursuit of knowledge, in their own processes of making meaning and transforming their understanding of transformative learning in adulthood.

Some adult educators have accepted Mezirow's (1991) invitation, engaging with concepts from complexity science in an emerging pattern. Beginning with the first Transformative Learning Conference in 1998, this venue has welcomed papers grounded in systems thinking and complexity science, (consistently between 30 and 40%) but this source is almost always hidden behind a social science interpreter. The outstanding 'interpretations' have been Heron and Reason's (1997) integrative psychological model expressed in the research method of cooperative inquiry, and the Kegan (1982, 1994) constructive developmental theory, which is an application of evolutionary organismic biology. For a decade, Heron and Kegan were the centers for clusters for almost all transformative learning writing that connected with complexity science. In the 2000 (Mezirow) edited text, four chapters introduced the work of psychologist Robert Boyd, whose focus is group learning. Usually cited as a way to incorporate Jungian psychoanalytic concepts, his writing is also broadly interwoven with the antecedents and offshoots of complexity science, a connection never made explicit in the transformative learning writing. The Mezirow, Taylor, and Associates (2009) edited text on transformative learning in practice is notably different with only 17% connection, suggesting that incorporation of

complexity science understanding remains more at the theoretical level and is just beginning to make its way into practice. The major clusters continue to be around these three primary interpreters with percolation of theory evident in more citations per paper and new combinations of ideas, particularly among the primary authors in the eight perspectives. What appears to be emerging are sub-clusters around other integral thinkers; the body's emotional experience and flow states; and ecological systems thinking as written about by Capra (1996).

Conclusions and Implications for Practice

Concepts from complexity science are already embedded within the multiple perspectives on transformative learning, but almost never identified as such. Although Mezirow (1991) spends ample time explaining his process of thinking in the development of transformative learning theory, including many references to other researchers, philosophers, scientists, and concepts across disciplines, these concepts are buried in various psychological, sociological, and integral models of development and change. Because their conceptual source is often not clearly stated, some elements are lost or fragmented, making them unavailable for theoretical development within transformative learning theory. As noted by Swartz (2008), use of complexity science in adult education can help demonstrate how different pieces of our lives connect with one another in the educational environment. With this in mind, as teachers and learners interested in bringing greater awareness and transformations for higher levels of understanding, complexity science offers an interesting and provocative avenue for this exploration to continue. It is our belief that uncovering and making explicit the emergent patterns of connection among these hidden concepts from complexity science will contribute to the self-organizing process of understanding and developing theory on transformative learning, as well as illuminating for further exploration and understanding the nascent roots of the theory.

Evidence of this increased understanding of transformative learning that is possible is through exploration and more practical application of complexity science to adult education comes from the work of Karpiak (2008). In a book chapter about qualitative research, she reflects upon the ways in which the world of the social worker participants in her study is mirrored by chaos and complexity theory. Karpiak identifies life experiences featuring "uncertainty, unpredictability, stress, dynamism, chaos, and the emergence of a new order" (pp. 85-86) as evidence of this reflection of the theory, and, like Mezirow (1991), encourages researchers to utilize 'chaos and complexity theories' insights into processes of change as theoretical frameworks for future work. Thus, in heeding these calls for delving into areas of research heretofore incompletely explored, we encourage researchers and learners alike to look to other areas of the sciences to improve and expand our knowledge of the factors that might contribute to our own transformations and to those of our students.

References

Aubin, D., & Dalmedico, A. D. (2002). Writing the history of dynamical systems and chaos: *Longue duree* and revolution, disciplines and cultures. *Historia Mathematica, 29*(3), 273-339.

Bateson, G. (1972). *Steps to an ecology of mind*. New York: Chandler Press.

Boyd, R. D. (1994). *Personal transformations in small groups: A Jungian perspective.* New York: Routledge.

Capra, F. (1996). The web of life: A new scientific understanding of living systems. New York: Anchor Doubleday.

Cell, E. (1984). *Learning to learn from experience*. Albany: State University of New York.

Dirkx, J. M. (1998). Knowing the Self through fantasy: Toward a mytho-poetic view of transformative learning. *Proceedings of the 39th Annual Adult Education Research Conference.*

Doll, W. E., Fleener, M. J., Trueit, D., & St. Julien, J. (Eds.) (2005). *Chaos, complexity, curriculum and culture: A conversation.* New York: Peter Lang.

Fenwick, T. (2003). Reclaiming and re-embodying experiential learning through complexity science. *Studies in the Education of Adults, 35*(1), 123-141.

Fenwick, T. (2009). *Learning through experience: Troubling the orthodoxies and intersectin questions.* Malabar, FL: Krieger.

Heron, J., & Reason, P. (1997). A participatory inquiry paradigm. *Qualitative Inquiry, 3*(3), 274-294.

Kang, D. J. (2005). Neurobiological insight on learning. *Proceedings of the 46th Annual Adul Education Research Conference.*

Karpiak, I. E. (2003). The ethnographic, the reflective, and the uncanny. *Journal of Transformative Education, 1*(2), 99-116.

Karpiak, I. E. (2006). Chaos and complexity: A framework for understanding social workers at midlife. In Anfara, Jr., V. A., & Mertz, N. T. (Eds.). *Theoretical Frameworks in Qualitative Research*, (pp. 85-109). Thousand Oaks, CA: Sage.

Kegan, R. (1982). *The evolving self: Problem and process in human development*. Cambridge, MA: President and Fellows of Harvard College.

Kegan, R. (1994). *In over our heads: The mental complexity of modern life*. Cambridge, MA: Harvard University Press.

Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago: Chicago University Press.

Loder, J. E. (1981). *The transforming moment: Understanding convictional experiences*. New York: Alfred A. Knopf, Inc.

Mealman, C.A. & Lipson, R.L. (2002). Reflective synergy: A research model for collaborative inquiry. *Proceedings of the 43rd Annual Adult Education Research Conference.*

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco, CA: Jossey-Bass.

Mezirow, J. & Associates. (2000). *Learning as transformation: Critical perspectives on a theory in progress*. San Francisco, CA: Jossey-Bass.

Mezirow, J., Taylor, E. W., & Associates. (2009). *Transformative learning in practice: Insights from community, workplace, and higher education*. San Francisco, CA: John Wiley & Sons, Inc.

Mitchell, M. (2009). *Complexity: A guided tour.* New York: Oxford University.

Popper, K. R. (1962). *Conjectures and refutations: The growth of scientific knowledge*. New York: Basic Books.

Prigrione, I., & Stengers, I. (1984). *Order out of chaos*. New York: Bantam.

Swartz, A. L. (2008) Uncovering science in adult education: Welcome complexity theory. *Proceedings of the 49th Annual Adult Education Research Conference.*

Tang, Y. (1997). Synergic Inquiry (SI): An alternative framework for transformative learning. *Proceedings of the 38th Annual Adult Education Research Conference.*

Taylor, K. & Marienau, C. (2002). Developing adult learners: A model. *Proceedings of the 43rd Annual Adult Education Research Conference.*

Taylor, E. W. (2008). Transformative learning theory. In Merriam, S. B. (Ed.). *Third Update on Adult Learning Theory, New Directions for Adult and Continuing Education, 119,* p. 5-15.