

Complexity Theory: Portraits, Principals and Practices of Imagination?

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Abstract

It is common to see terms like “acquiring,” “inputting,” “hard wiring,” “transmitting,” “storing,” “compiling,” and “retrieving”—terms appropriate for structures like desktops—when referencing processes like learning, communicating, thinking, and memorizing. It is important to note that such terms may, in fact, be quite appropriate for mechanically-oriented organizations. But are such notions appropriate for social organizations like schools? Human beings are living, complex organizations. As such, other kinds of metaphorical images may be more appropriate to understand human beings. To this end, the field of complexity science is proving to be a more appropriate framework. As a framework for “possibility,” certain images, principles and possible practices for healthy learning organizations will be considered with a view of one particular democratic school as a model for a healthy learning organization.

Complexity theory: imagining differently

It seems, in rather compelling ways, that the language that people use to describe and understand the many aspects of everyday life in the classroom reflects particular images—metaphorical constructs that suggest how matters pertaining to educational and curricular concerns are *like* something else. There would appear to be ample evidence that metaphors are rather pervasive elements of everyday language: that is, metaphorical language, often viewed as a “device of the poetic imagination and the rhetorical flourish” (Lakoff and Johnson, 1981, p. 3), is an important source for insights into the conceptual landscape of how people understand the world. Moreover, the ways in which we perceive the world, how it is conceived, and how we act and move about are quite inseparable. As such, in the context of education (where “schooling” might be thought of in terms of “change”), some attention to the various ways in which people describe the many aspects of the classroom and learning might be quite necessary to do things differently.

Historically speaking, particular views of cognition have reflected particular kinds of technologies (Davis et al., 2000). That is, the language of learning and its attendant theories have reflected, for many centuries now, mindsets that have characterized processes of learning and knowing in terms of certain kinds of machines: clocks, hydraulics, the telegraph, the telephone, and more contemporary machines like desktop computers and laptops. Moreover, western societies, over time, have grown to speak about themselves in terms of particular organizational principles that are the basis for machines (Morgan, 1997). Machines are supposed to be reliable,

predictable, and efficient; similarly, many of society's institutions have been conceived to function and operate with the same kind of expected precision. Of course, living phenomena do not function in the same manner.

If one were to look at the root of many organizational problems, one is quite likely to find certain management principles present. To be sure, mechanical principles and the machine-like images of organizations that arise from such principles are not inherently wrong—there are times and places for such industrial views and approaches to the purpose and work of an organization. It is important to note that the metaphors that we use are always partial. Like a spotlight, metaphors bring into view certain aspects of what can be seen and understood while casting into the darkness other possible insights (Morgan, 1997). In the very least, we might do well to change our metaphors and, in doing so, enact different organizational principles.

If not images of machines (like desktops and laptops), what images would be better to *complexify* one's understanding of living beings—of what they are *like*? What is the imagination like and how might such a phenomenon be related to the ways in which people envision living phenomenon at all scales of organization—neurologically, biologically, psychologically, socially, culturally, politically, and ecologically? Surely, being present and attentive to the natural world (of which human beings are already and always a part) would be useful. That is, one might turn one's attention to nature for cues to the kinds of images (and, therefore, principles) to describe and understand the possibilities for everyday life of the classroom.

Shifting Our Metaphors: Moving from the "Complicated" to the "Complex"

It is common today for people to use a wide range of terms like "acquiring," "inputting," "hard wiring," "transmitting," "storing," "compiling," and "retrieving"—terms appropriate for structures like desktops and laptops—when referencing processes pertaining to learning, communicating, thinking, and memorizing (Davis et al., 2000, p. 53). It is important to note that such terms may, in fact, be quite appropriate for mechanically-oriented organizations. But are such notions appropriate for social organizations like schools? And what of imagination?

Organizational structures that reflect more mechanical principles have been described as "complicated." Today, the term "complicated" is used to describe two different dynamical phenomena: "simple" systems and "disorganized complexity". Scientist, Warren Weaver (1948), first used these terms in an early *Scientific American* piece wherein he presented a rubric for categorizing different dynamical phenomena. Framed in the language of dynamical systems, "simple systems" were viewed and described in terms of small numbers of independent parts or system variables—phenomena like projectiles, planetary orbits and other well-defined mechanical phenomena.

In time, more complicated dynamical systems were studied where the number of interacting parts or systems variables were increased, in some cases only slightly as

with Poincaré's "three body problem." By the 19th century, however, such systems had grown so complicated that new tools were required. Thus, where the tools of Newton and Galileo were quite appropriate for "simple" systems, statistical approaches were developed to provide a better understanding of systems with numerous *independent* parts. Naturally, trying to analyze large numbers of agents in interaction was—and still is—computationally impractical, if not impossible. But not all dynamical phenomena are, as described here, "complicated".

Weaver described a third category of dynamical phenomena which he termed "complex". This third category of dynamical phenomena included a wide range of organizational structures: physiological systems, biological systems, social collectives, cultural phenomena, and local ecologies. Such a cluster of dynamical phenomena does not surrender well to the approaches and tools of the Enlightenment nor to the 19th century analytical tools designed to interpret chance events or statistical distributions of population attributes or standards for large aggregates of machine parts. Complex systems are in a category unto themselves because they have the capacity to modify themselves or adapt.

Ecological Metaphors: Imagine That!

There is, in fact, a kind of universal aesthetic appeal for things of an irregular, kinky, warped, and rough kind of way that has captured the attention of artists and scientists alike (Spehar, Clifford, Newell, & Taylor, 2003). Within the larger social collective, after centuries of trying to "straighten out" and "manage" the world, many individuals—"new scientists," entrepreneurs, and "post-modernist", for instance—have embraced various complexity-related concepts: concepts like "fractals". The concept of a "fractal" is a common one in complexity-related discussions and post-modern discourses. These perfectly imperfect structural signatures with their cracks and crevices, fractures and fragments, wrinkles and warps are the "new aesthetic" (Briggs, 1992).

Peering deeper into the structures and processes of life and the living world, one can see scales of organized structures that bear a certain resemblance to other structures at other scales of organization. Mathematically speaking, or in the language of complexity, these patterns of life and the living world are said to be "self-similar" or "scale invariant". In the Euclidean world, one finds no such thing as fractals are those "things" that lie in between the integral dimensions of straight lines, flat planes, and 3-dimensional objects. Rather than "levels" or "dimensions," fractals show themselves to us across many different scales where "evolutionary activity creates worlds within worlds, all moving, changing, feeding back into each other from small scale to larger scale, back to small scale" (Briggs, 1992, p. 41). And, thus, one sees objects and patterns that are simultaneously parts of wholes that are also parts of other wholes in the wholeness of an all-at-once connected world.

By way of example, consider a tree—indeed, any other tree-like structure would do,

like a satellite image of the Mississippi River, an image of the circulatory system or branching pattern of the lungs, or a rendering of the trading patterns as represented by stock markets. Fractals are quite different from the linear and accumulative nature of certain non-living objects or objects near death. Certainly, man human-made structures are easy to measure and describe with a range of Euclidean metrics; however, as Mandelbrot, the “father” of fractal geometry, tells us: “clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightening travel in straight lines” (Briggs, 1992, p. 93). Whereas Euclidean geometrical forms push the notions of linearity and knowability, plenty of turns and surprises appear in fractal geometry—as a concept and as its history shows us. Euclidean geometry seems fitting for fixed and static objects, but fractal geometry has shown a better fit for the flexible and emergent forms of nature.

With A little imagination: Thinking differently

Complexity science theorist, Bar-Yam (1997) writes:

Science has begun to try to understand complexity in nature, a counterpoint to the traditional scientific objective of understanding the fundamental simplicity of laws of nature. It is believed, however, that even in the study of complexity there exist simple and therefore comprehensible laws. The field of study of complex systems holds that the dynamics of complex systems are founded on universal principles that may be used to describe disparate problems ranging from particle physics to the economics of societies. (p. xi)

Nature may be quite diverse in its forms and dynamic patterns, but there are shared principles, at root, in the study of complex phenomena. To be sure, thinking in terms of certain concepts and principles may be useful for an understanding of complex, living organizations. Moreover, thinking in terms of healthy organizations in this way has opened up some alternative ways of thinking about a variety of different aspects of education, including the dynamics of classrooms and schools (Author, 2005). As for one’s descriptions and understandings of the ever-evolving world, there is no “final vocabulary” (Rorty, 1989); thus, working towards a deliberate redescription of complex phenomena—by shifting our metaphors—is quite possibly a healthy and useful thing to do. In this section, on the need to think differently, our attention will turn to a few principles of complex dynamical systems—specifically: diversity, redundancy, and connectivity.

Diversity

In terms of the complexity that various kinds of organizations bring to bear, the principle of “diversity” is an important principle to consider. As a structural and dynamic aspect of organizations of all kinds, diversity (in terms of products or processes) is an essential principle for any complex phenomenon. Discussions about

diversity, certainly, are quite common, although such discussions do not always speak to the principle of diversity in the same manner. Much is said about diversity in terms of a wide range of organizations—schools, families, the workplace, and various communities come to mind. And, while it is often said that we should keep in mind the importance of diversity and respect it as a principle, this does not always happen. In some cases, diversity is understood as something to be managed or controlled, a problem to be overcome or even tolerated (McDaniel & Walls, 1997).

It is important to recognize that diversity is not simply a matter of race, gender, sexuality, ability, etc., as it is an important principle for all scales of organizational phenomena. And, while it might be tempting to look at some social setting and think there is not “enough” diversity present, the organization can hardly be seen as homogeneously given or pre-determined. Rather, where there are differences, one has to ask if some difference is, as Bateson (1972) writes, the “difference which makes a difference.” In a classroom, for instance, where students are learning about mathematics, the presence of certain (hopefully diverse) mathematical ideas will matter in such a context. Similarly, a diversity of interaction—students working alone and in pairs, small groups, and together as large class—is important. These kinds of “neighboring interactions” are important where information and ideas are shared and ideas can “bump” into one another. In the classroom—a mathematics classroom or otherwise—a diverse of ideas and interactions is quite important for itself as a learning organization (Davis & Simmt, 2003).

Diversity is certainly an important principle, but too much diversity can prove to be unhelpful. For an organization to cohere, a certain measure of redundancy is necessary. For instance, in a group where everyone were to have a different point of view, the absence of shared ground can only bring the discussion of the ground to an abrupt halt. For this reason, the principle of “redundancy” is the other side of the same coin where “diversity” is on the other side.

Redundancy

Etymologically speaking, a redundancy is an “overflow,” an excess of the kinds of features that might be necessary for a particular phenomenon to happen. Redundancies serve as a guarantee that some aspect of a system can continue to exist and function without crucial missing elements. In highly redundant living systems, “mistakes” and “errors” can happen and yet the system can still remain quite viable. Redundancy, therefore, is characterized by more than simple excesses as it points to the (sometimes) innumerable possibilities for fulfilling some given function of interest (Luhmann, 1995).

Unfortunately, the notion of redundancy is often associated with those aspects of a system that are deemed not necessary and contribute to inefficiency. As such, redundancy is not merely about the “replicative” nature of an organization; it is also a “generative” quality (Kelly & Stark, 2002). Instead of a replication of parts or people,

the redundancy lies in the complex patterns of organizational relationships. In other words, where there is redundancy of relations in an organization, if a particular tie breaks, other relations can be utilized to get around certain problems or blockages. It is in this manner that an organization is generative: the organization re-generates itself around damaged relations, becoming more innovative and adaptable to change.

The redundancy in a system can fill a wide range of purposes as with, for instance, the way that various technologies can be used to communicate with others during times of crisis; the ways in which the nervous and circulatory systems of the human body function (Goldberger, 1997); and, the idea of conversation even is sometimes viewed as a way of eliciting related states or resonating ideas in another person's mind (Norretranders, 1998). On the whole, redundancy and its "diversity" counterpart speak to the nature and principle of "connectivity" to which this paper now turns.

Connectivity

Human beings cannot self-regulate in isolation from the rest of the world (Stacey, 2003). In fact, we need one other another to come into contact with one another to form relationships. Our connections to and with one another are vital and a matter of survival for human beings. Connectivity is not merely important to hold things together; connectivity is important to the health and well-being of all things and is important to notions like "wholeness" and "healing". Still, what is the nature of a healthy, whole connected organization? How might one recognize such a thing?

Such organizations are, in fact, fractal in nature. Healthy organizations, however, are not merely healthy because they are manifestations of particular forms. They are also connected to and with other healthy forms because living organizations need other living organizations to survive and sustain themselves (Author, 2005). Pattern which gives rise to healthy organizations are the same patterns that give life to everything that lives to the degree in which all living patterns might be connected to one another in a massively entangled web of life.

The world, as a result, may be considered one large fractal. But the question of how it became this way, scientifically speaking, must be considered. From a complexity science perspective, the notion of self-organization offers some possible insight.

Acting Differently: The Power of Self-organization:

Human beings as living, complex organizations are always and already learning. Although it is sometimes suggested or implied that learning only happens in educational settings like schools, colleges, and universities, for instance, learning is a process that gives rise to many complex human expressions from birth until death—learning to walk, talking, doing arithmetic and reading, driving the family car for the first time, fitting in with particular cultural norms, and so on. Human beings are

learning all the time and as John Holt (1996) reminds us:

The trouble with talk about “learning experiences” is that it implies that all experiences can be divided into two kinds, those from which we learn something, and those from which we learn nothing. But there are no experiences from which we learn nothing. We learn something from everything we do, and everything that happens to us or is done to us. (p. 26)

Reducing learning to a set of well-defined activities, identities, relations, and behaviours as understood within the context of formal schooling can create some problems for what is to be done or can be done. Moreover, and generally speaking, the implications for viewing learning as anything but a complex process are bound to create problems in and concerns for various theoretical reasons and practical purposes.

One might picture a particular image at this point as a representation for thinking about learning as a well-defined collection of activities, identities, relations and behaviours. The image here is more towards a thermostat rather than, say, some living structure as a metaphorical description of learning and teaching. Descriptions of teaching and learning, it sometimes appears, tend to resemble the actions of the canonical cybernetic structure of the thermostat—the aim of which is to keep the room at a constant temperature. As an analogy, I am suggesting that the nature of a learning organization that resembles a thermostat is to keep the organization “on track.” That is, where there may be minor deviations from particular expectations, a mechanism, in the form of a supervisor or some other authority figure, kicks in to “steer” the organization back on track.

But can schools function in some kind of (strongly) self-organizing manner as opposed to being more strongly directed like a metaphorical thermostat? If the image for a more healthy school setting is a brain, a plant, a school of fish, or some other kind of living organism, then it would be best to think in terms of decentralized self-organizing phenomena. That is, there is no pre-determined, pre-designed, or pre-planned blueprint for the organization. Of course, this runs counter to the usual frames of learning in schools that use and draw upon a clear and strong sense of direction, leadership, and control. (Naturally, this is not the case for every context, every classroom, and every school.)

Doing the Same Things Differently

In some ways, the life of a classroom and that of schools self-organizes. But, more so than not, many people (teachers and students, for instance) speak about being “controlled.” Curricular materials are controlled. Instruction is controlled. Learning is controlled. A great deal is controlled—and imposed upon others. The education system, it could be said, is a rather long chain of command and control mechanisms and structures.

As places where possibility could be the everyday experience for students and teachers, certain principles of complex systems must be taken more seriously than they may already be. For instance, diversity is taken quite seriously in many, if not most, schools. Care and concern for students with different socio-economic backgrounds, families, learning abilities, etc. can be found. But in a system driven by “standards” means that, in the end, all students must be able to successfully complete, in many cases, provincial standardized tests and exams. Although this may not be problematic, there is quite often many ways to do the same thing. In those cases where such an answer is not what a teacher or another individuals marking a test is looking for, the answer is deemed incorrect.

Of course, using standards to evaluate knowledge begs the question of whether or not schools are in the business of “producing widgets” or are they supposed to serve some other purpose? To be sure, such a question speaks to the “ends” of education. But, in terms of the “means” by which certain educational goals may be achieved, we might turn to the self-organizing nature of other complex phenomena for further thoughts. Certainly, some consideration should be given to the teacher and his or her role. Is the role of a teacher to “direct,” “facilitate,” “instruct,” “nurture” or something else? In any case, it suggests that the teacher is actually *doing* something—doing something to others, in this case, children. But what might those of us who are teachers actually think we are doing when we are teaching? And, moreover, what is the nature of the relationship between teaching and learning, between teachers and students?

If one were to ask people about their experiences about going to school and being in classrooms, a variety of different stories would be told. Nevertheless, certain stories seem to persist as shared recognizable experiences. For example, students of the same age sit more or less quietly in rows of desks facing the “front” of the room where an adult imparts a world of knowledge. Students do “work” for grades and are rewarded for good behaviour and following orders. As such, there is, in some sense, confusion about what goes on in schools and classrooms. As Ivan Illich (2000) remarks, we are lead to confuse “teaching with learning, grade advancement with education, a diploma with competence, and fluency with the ability to say something” (p. 1). Put differently, “Government schooling is the explicit attempt to coerce people into accepting their appropriate place in hierarchical, capitalism” (Hern, 1996, p. 1). That this might be what is actually happening in the name of education and in classrooms is hard to ignore.

In spite of the perceived pressures and directives of the state, the dynamics of classrooms are still pretty much influenced by what goes on in classrooms, which include the actions of the teacher and the students. Clearly, the teacher plays a part in the on-going dynamics of any classroom, and with the role of the teacher framed as an “instructor,” the purpose of this person is to “transmit” the “knowledge” of one group of people onto another for various purposes and reasons. Experienced as such, teachers, educators and students do talk about the dynamics of the classroom as if it

were an assembly line or factory. Descriptions of this kind of experience seem to suggest an unhealthy kind of organization where “relationships” are not particularly well developed, and discipline is the order of the day. Classroom teachers need to be in control. For a classroom to be “out of control” would suggest that a teacher does not have a good “grasp” on what is going on, and that the teacher has poor class management practices. The notion of discipline takes on a particular understanding in this case.

It can more or less be suggested that classrooms, schools and learning organizations, in general, are not mechanical structures. Metaphorically speaking, however, some people’s experiences might suggest that schools and schooling are mechanical in nature. But what is it that contributes to this sense of learning, classrooms and schools? How might it feel otherwise?.

Mechanical systems tend to function in particularly well-defined ways. While the “parts” may interact with one another, they do not improvise. Cog A might turn cog B, however, the action is predictable and not open to possibilities other than the prescribed action as determined by cog A interacting with cog B. Put differently, the interaction of cogs A and B does not change anything about their interaction nor the cogs themselves. In some sense there is no relation present and they are isolated. Simplistically put, such might be the case with students, for example, who sit quietly in rows of chairs in a classroom—if students were cogs. Of course, by simply putting students into pods, as is a frequent practice of some teachers, does not necessarily increase the kinds of interactions that might give rise to the learning of particular ideas. The interactions and novel possibilities might be better suited to “ideas bumping up against one another” as opposed to merely providing the opportunity for just any kind of conversation.

Interactions that affect some kind of change are essential to learning organizations that must have some capacity to adapt to or keep pace with an already and always changing world. Students in a classroom where interactions are limited are not simply inert beings: students are not automata, the kind seen on a computer screen. To be sure, on-going interactions in one’s mind are always present, giving rise to the endless, silent (to others) conversations. Even if most or all of the communication were from the teacher, no classroom is void of interaction. There is, however, a lack of diversity in the interactions, and these can only happen through conversation and interaction amongst students and teacher. A certain amount of redundancy is bound to be present which would create a larger emergent collective of ideas within the classroom. As reflected in other forms of healthy organizations, diversity, local connections, and redundancy, therefore, would be necessary conditions for a classroom to be healthy, that is, something which students would not experience if they were disconnected cogs in a machine. When any of these aspects are dampened in physiological systems, for example, death is usually not that far away. And should one wonder why some students are “bored to death”?

So what could one's schooling and classroom experiences look like if one were involved in and felt like a part of a healthy learning organization? What would have happened if, as individuals and collectives, all people in schools followed their own curiosity? Surely, creativity and imagination would be present everywhere, in many diverse forms and activities with many individuals and various group sizes pursuing our own creative ventures. Now imagine this happening all the time. There would be no need to have bells, schedules and timetables to tell people to stop doing what they were doing and working so hard at and move to another place to do something else. Learning happens across many different time scales, seldom fitting into some uniformly structured time-table.

If this were me, on certain days I would feel like spending the entire day in front of a computer creating programs. But, of course, every now and then I would want to go and sing with others in the music room, or go cycling in the country, learn how to make goat's cheese, and study the history of my town. Others would do similar things, following their own interests and engaging with others as they would see fit. Clearly there would be lots of things going on all-at-once throughout the school and in different rooms. The school would be a lively and busy place, and most people would have a good sense of what was going on, and who would be doing it. In other words, as a community I would be strongly connected with so many other different people that I would be able to tap into whatever kind of resource I would need. The notion of relying upon an adult to assist or guide me or answer my question no longer needs to be the case because I already know that Mary, John, Craig and Jenny enjoy singing madrigals; Benny and Sue live on a farm and are more than happy to show me how a farm works; Sally's mom works for the town library and would love to show me through the archives; and, I can apprentice with Thomas on Fridays down at his bikeshop.

This is hardly chaos, and it is not anarchy. But I would suspect that it is much more complex than what most people have experienced at least as far as schooling goes. It is, I strongly suspect, a rather healthy place to simply be—to live and learn.

Concluding Thoughts

The thematic question posed to those attending this year's annual conference on the imagination and education asks: "How can educational goals be achieved with imagination?" The question, however, is ambiguous and, I have tried to address this ambiguity. First, the question asks me as an educator and a scholar to imagine how the goals of education might be achieved. My answer to this question has been that we ought to begin by thinking differently about education. More specifically, I have suggested that a different set of metaphors would be useful and that the field of complexity science might be helpful to think about education differently. In addition, the question also reaches down into the thoroughly pragmatic side of education: What might one do differently, through the use of imagination, to achieve certain educational goals? And my answer to this also relates to those ideas discussed

here on complex dynamical phenomena. Although one might argue that one's thoughts and actions are not inseparable, doing things differently is key here in light of what we know about complex dynamical systems.

Complex systems speak to and announce "possibility". And, if the imagination is about possibility, then clearly approaches to learning and organizational dynamics rooted in "complicated" organizations cannot bring about much possibility, change, innovation, nor the imagination. By some accounts, it would appear that the education system broadly speaking could be described as being "ill" where there is a lack of healthy possibilities. Paradoxically, education continues to hold up a system that "nurtures the worst in humanity and simultaneously suppresses individuality and real community" (Hern, 1996, p. 1) Why does there appear to be so much sickness present in education? What kinds of dynamics would need to be present for a "healthy" educational system, and what would these forms look like to us that we might recognize them?

The form of such schools might resemble a school like Windsor House in North Vancouver, British Columbia. Windsor House is not like your typical school. There are no official classes or subjects, no "teachers" per se, no bells, and so on. It is a parent-participation, democratic, academically non-coercive school with about 170 students aged 5 to 18 and a dozen staff people.. It is also a publicly funded school.

Students may ask for classes and activities, and efforts are made to provide what the students have requested. Staff and parents also offer classes and activities that they enjoy doing themselves. Students are not made to go to classes, nor are they stigmatized for non-attendance. The main focus of the school is for people to run their own lives and be engaged in undertakings of their own choice. It is a vibrant community, and although things change constantly, the main ideas of respect, service, and goodwill are maintained through the hard work and generosity of the core members.

Recognizing schools like Windsor House requires a very different understanding of the kinds of patterns, conversations and interactions that embody the place. As such, there are not going to be any of the usually-taken-for-granted structures of most other schools and classrooms. That is, learning unfolds and emerges across a number of different scales in time and space, and not according to some arbitrary timeline and curricula of subject matter that seldom seems to make sense for so many of these students. It is not so much that school curricula are irrelevant. Rather, it is a question of timing and personal interest. Given the wealth of "resources" the school is quite prepared to deal with the needs of its community members. That is, through the distributed leadership of the community, its relationships with one another, its respect for diversity and diverse interactions across all ages, Windsor House (and schools like it) has a greater capacity for adaptation, change and evolution. It is, I think, what so many people have wished for and continue to wish for: a healthy learning organization. If only others would imagine similar structures for other places

where young people would love to go to learn.

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