Constraints that Enable:
Creating Spaces for Artistic Inquiry

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Abstract

This paper attempts to bridge the gap between art curriculum and the structures of inquiry with which artists engage. A high school fine art photography curriculum and selected elements from that curriculum will be used to illustrate how artistic inquiry can be enacted in an art educational setting. This curriculum was designed around my understandings, as an artist, of what it is like to enter into spaces of uncertainty oriented by questions of inquiry rather than modeling artistic learning after the objects and experiences of other artists. Questions of inquiry scaled from local to global perceptions of self, community and the world, formed the structures of inquiry for artist-students. Through the lens of complexity theory these questions are seen as constraints that enable and that, I argue, create a space of possibility for the enaction of artistic inquiry. Although this curriculum was not designed initially from theories of complexity in education, it serves as a lens through which to view the non-linear processes of the emergence of new forms. In the context of this paper it will be used to describe the space of possibilities offered through the structuring of constraints that enable, informed by my own understandings of inquiring as an artist.

Introduction

What does it mean to inquire through art making, how do I inquire as an artist, and how do I create a space where individual inquiry might happen with my students?

Early into my first year of teaching in a high school fine-art photography curriculum[1] I struggled with how to describe the processes of artistic inquiry to students in my Independent Photography course. The difficulty arose in trying to articulate a structure what was for me a non-linguistic and non-linear process. My artist-students' experiences in art to that point consisted of assignments that centered on photographic technique, the elements and principles of design, and the visual styles of established photographers. At the same time I was in the process of finishing a major exhibition from a post-undergraduate traveling fellowship, the result of three

years of work. Bringing an extended and independent body of work to completion presented an opportunity to reflect on how I inquired as an artist. What I was able to identify was a process of entering into spaces of uncertainty that were orientated by un/articulated questions. This shaped many of my pedagogical approaches that I developed over the course of six years in both tacit and explicit ways.

The characteristic qualities of the experience of artistic inquiry have yet to be articulated into widely incorporated art curricula. Complexity theory, the interdisciplinary science of non-linear systems, will be used as a lens for describing the patterns and processes of artistic inquiry. In particular, a certain sort of questions and prompts—described in this writing described as "constraints that enable"—offer opportunities to create spaces of unimagined possibilities and art curriculum that resemble more closely the practices of artists engaged in inquiry. It is a shift from curricula that models the inquiry of artists and art objects to individual acts of inquiry, situated between and amongst the inquiry of other artist-students, artists in history, cultures and contexts. This paper is a selection of assignments, artist-student works, narratives viewed through the lens of complexity theory.

Constraints that Enable Artistic Inquiry

What would your self-portrait look like if you couldn't include yourself directly?

I presented this question in the second-half of my introduction to Photography course. I also included instruction on a variety of photographic and non-photographic materials that could be used to express aspects of self. From my perspective, at the center of this assignment was the importance of metaphorical embodiment in materials and visual forms. The metaphors we use shape not only our conceptual processes but also the structures we embody, design and how we live (Lakoff & Johnson, 1980, 1999).

Questions that orient inquiry acknowledge and ask for a revaluation of internal structures (including personal history, emotional states and cultural beliefs) and present occasions for the emergence of novelty by challenging prior possibilities (Juarrero, 2002). Complexity theory describes these types of questions and prompts as enabling constraints. They are articulated by Davis and Sumara (2006) as "structural conditions that help to determine the balance between sources of coherence that allow a collective to maintain focus of purpose/identity and sources of disruption and randomness that compel the collective to constantly adjust and adapt" (p. 147). Well structured constraints create a space that can orient and enable artistic inquiry.

Doll (1989) describes the qualities of an enabling constraint in the context of a sixth grade mathematics classroom as something which had "enough of a burr to stimulate the students into rethinking their habitual methods but not so much of a burr that re-organization would fall apart or not be attempted" (pp. 67-68). The questions and prompts used in my photography classroom, took on an existential quality (Castro, 2004), asking for a reordering and reconsideration of accepted understandings and inviting elaboration and extension. Juarrero (2002) adds that, "context-sensitive constraints are thus the causal (but not efficiently causal) engine that drives creative evolution, not through forceful impact but by making things interdependent." (p. 150). Important is that the constraint should either acknowledge

or be recognizable to the individual's own experience, while creating a space that is oriented between the familiar and the uncertain. Constraints that enable provide the opportunity for non-linear dynamic behaviors that are unfolding and expansive like that of artistic behaviors. Hayles (2001) takes a similar approach:

> … in which constraints act in dynamic conjunction with metaphoric language to articulate the rich possibilities of distributed cognitive systems that include human and nonhuman actors. Neither completely constrained nor entirely free, we act within these systems with partial agency amid local specificities that help to determine our behavior, even as our behavior also helps to configure the system. We are never only conscious subjects, for distributed cognition take place throughout the body as well as without; we are never texts, for we exist as embodied entities in physical contexts too complex to be reduced to semiotic codes; and we never act with complete agency, just as we are never completely without agency. (p. 158)

The self-portrait prompt resulted in a wide diversity of work. Each artist-student chooses not only visual metaphors to photograph, but also materials arranged and organized to represent themselves. By the end of the final group discussion the general consensus was that almost everything we photograph is in some way a mapping of our perceptions onto the world around us, a bringing forth a micro-world within the macro-world (Varela, 1999). The photograph becomes an opportunity, not only to capture a moment in time, but also to be able to see the self in the world, as part of the world.

The word *inquiry*, to *inquire*, is derived from the Latin *inquirere*, which is based on *quarere* 'seek.' To seek is an attempt to find, a desire to obtain, and to ask for something. Seek shares an Indo-European root with the Latin *sagire*, 'perceive by scent,' and this suggests that when one is inquiring, seeking, they are perceiving, whether by scent, sight, sound or touch. It is a process of becoming aware through perception. Through questions and prompts, constraints that enable artistic inquiry, artist-students were able to enter into spaces of uncertainty and be able to reorganize previous understandings into new patterns of knowing about themselves in the world. These constraints and many others presented included characteristics like, but not limited to: self-referential, making the familiar strange, and were scaled and expansive. Each question folded into the next a through recursively elaborative processes when "the starting point is the output of the preceding iteration, and the output is the starting point of the subsequent iteration" (Davis and Sumara, 2006, p. 43). In a three-year sequence, beginning questions were oriented around perceptions of self moving towards perceptions of self in communities to generating individual questions of inquiry.

Artistic Inquiry and Art Education

> …when the work is going well, why on earth would we want to know? Most of the myriad of steps that go in to making a piece (or a year's worth of pieces) go on below the level of conscious thought, engaging unarticulated beliefs and assumptions about what art making is… (Bayles & Orland, 1993, p. 59)

Graeme Sullivan (2006) agrees by stating, "what artists do in the practice of creating artworks, and the processes, products, proclivities, and contexts that support this activity is less well studied from the perspective of the artist" (p. 26). Although

Sullivan is articulating this need for arts-based researchers, understanding the patterns, process and spaces that support artistic inquiry offers the opportunity to reorient art curriculum so that it resembles the actual experiences and engagements of the artist.

Manual Barkan (1962) also believed artistic inquiry could be structured into art educational experiences. He did this by organizing art curriculum into four identifiable disciplines: art making, art criticism, art history, and aesthetics (Dobbs, 1992). Discipline Based Art Education (DBAE) prescribes learning about the visual arts through the artifacts and objects of these disciplines. DBAE offers a way to understand the patterns, processes, and structures of artistic inquiry through the objects that resulted from inquiry of artists. However, Gude (2004) describes contemporary DBAE curricula enacted in classrooms as a prescriptive delivery of "the elements and principles, the four disciplines that ostensibly include all the concepts needed to adequately understand art, or the sequence of steps one should always follow in approaching an artwork" (p. 13). She also describes what art educators should be attending to by stating that, "It makes a lot more sense to plan a curriculum focused on understanding the role of artists, artistic practices, and the arts in reflecting and shaping history and culture …" (Gude, 2007, p. 7).

In the approach Walker (2003) describes, emphasis in planning curriculum should be centered around professional artistic practice, which serves as a model for developing questions of inquiry. She describes one the major distinguishing qualities of an artist's inquiry as centered around big ideas that an artist might engage with (Walker, 2001). Although Walker (2004) does not claim or describe a prescriptive structure there is an emphasis on how "the study of individual artists can be extremely profitable in revealing a range of strategies and methods with these different elements" (p. 7). This suggestion seems to align with Barken's original intent to derive from artistic practice pedagogical practice. However, the notion that "artistic activity anywhere, is the same," (Barkan, 1962, p. 14), presents a troubling notion of normalization and generalization of artistic practice and inquiry that returns to Gude's (2004) original criticism of essentialist elements and practices that are generalizable and transferable.

The curricular approaches described in this paper present a reordering of emphasis away from modeling the ideas and objects of established artist towards a process of situating inquiry between and among the vast multitude of themes, artists, cultures and histories. It is in the assumption that an artist's work is self-contained, stable and fixed where much of art education practice resides. The act of choosing exemplars as a focus for inquiry becomes problematic when taking into account that an artwork is more than just the object itself, in fact it is written by the reader of the work and context in which it is situated (Bourdieu, 1996). The notion of an artwork as a text, something that is created in a dynamic system of relationality, which challenges linear conceptions of art educational practice and more resembles to theories informing contemporary art practice. The text is understood through the metaphor of the network where the text extends itself through systematic relationships (Barthes & Heath, 1977). Carter and Geczy state that it is "a continuing process of meaning production" (Carter & Geczy, 2006, p. 129), in which everything needs to be considered: artist, art object, viewer, context and culture. Instead of

focusing art curricula on what is thought to be fixed and static objects as models to reproduce, using constraints that enable as Juarrero (2002) pointed out, drives the creative process by making things interdependent. This orients the artist-student to that which is more interdisciplinary, which is between and amongst knowledge. Rather than conceptualizing curriculum that models artistic inquiry through objects, this approach more closely resembles poet John Dickey's process, where the "self and natural objects seem to radiate back and forth, time becomes circular, not linear. Experience doubles back on itself …" (McHughes, 1997, p. 104). And it is in this feedback loop of question, answer, question and so on, that the emergence of new forms of order occur that could not be predicted by the artist-student, artist-teacher, or art curriculum. This curricular approach seeks to provide an understanding of the "enormous areas of non-conscious, but structured, rules of operation" (Carter & Geczy, 2006, p. 136) in the dynamic, non-linear processes of artistic inquiry.

A Space of Possibilities

If you were to be struck blind tomorrow, what vision of the world would you leave?

I would ask my students this question as the first assignment in my Photography I course. Students would shift uncomfortably and oftentimes a palpable silence would permeate the room. As they would leave, more often than not, I would hear statements like, "This is the hardest assignment. What am I going to photograph? Do you have any examples that I can look at?" There were no examples presented, no master photographers to look at, just a question to begin and orient inquiry.

Dorothea Lange, the Farm Security Administration photographer who documented the narratives of migrant workers in the 1930's depression era United States, inspired the question. Lange stated that she photographed every day as if she were to be struck blind tomorrow (Coles, Heyman, & Lange, 1998). The urgency of this quote resonated with me as an artist. What visual statement would I make today if I were to be blind tomorrow?

Stephanie brought me her first print (Figure 1) still wet in the darkroom tray and asked, "Is this what you wanted?" To which I responded, "Does it matter what I want you to photograph? More importantly, does it address the question in a way that you would feel comfortable with this as a statement of how you see?" We then discussed some of the finer points of photographic printing and the link between visual qualities and emotional expression. Instead of darkroom techniques, Dorothea Lange's photographs, or a specific cultural phenomena becoming the focus of the assignment, they became the support for the artistic inquiry of students.

FIGURE 1. Stephanie's first black and white print, in Photography I, in response to the question: If you were to be struck blind tomorrow, what vision of the world would you leave?

At the final discussion and assessment, a diversity of artworks covered the desks in our classroom. Our conversations moved through the relationships between contextual connections, interpretive possibilities, design qualities, and personal narratives. The object of art, as a result of artistic inquiry, became the occasion to teach about design, photographic techniques, art history, art criticism and context. Questions included: Why is your eye attracted to certain areas of a composition? What could result in a print with rich and varied tonal range? Who in the history of photography is addressing similar concerns? What biases and cultural prejudices are represented in our images? This organizational structure situates inquiry between and among disciplinary knowledge, personal experience, culture and context, rather than toward any one of these things. And in the words of photographer and educator Stephen Frailey (2006), "Students of photography can be empowered by seeing their work as part of a cultural matrix, as entering into a conversation with the professional and historical community" (p. 188). This in not and should not be limited to students of photography and instead should be an attitude for all of art education.

Initial conditions in a complex system's behavior play a crucial role for how global patterns emerge. Important to those initial conditions is that they are context sensitive. Context sensitive constraints honor the ontological structures, the history of structural changes in a system. What should be stressed is that there are not correspondences between the initial conditions and the specific behavior of the complex system, meaning that by asking for A you will get B. Constraints that enable, and in the case of a high school photography class, offered the opportunity for C, X, T and Q to emerge. Discourse around the artwork during the process and after the fact provided deep understandings to those initial experiences and understanding generated when artist-students went to photograph, edit, select and print. What was lacking in DBAE or art educational approaches before was the opportunity for novel experiences to emerge and discourse that provide a vocabulary art to interpret deep personal and cultural experiences rather than the experiences of another used to teach a vocabulary about art. Walk into my classroom and spend enough time there and you would be able to pick out most of the history of art education, from aesthetics, design to critical inquiry, it is all there, just not in the order that is often prescribed.

Emergence and Complexity

It would be beneficial to describe at this point some of what complexity theory can offer in the description of the non-linear processes of artistic inquiry. In 1948, information theorist Warren Weaver (1948) presented a view of scientific understanding that was distinctive in that it addressed: "dealing simultaneously with a sizable number of factors which are interrelated into a organic whole" (p. 539). It was an attempt to expand the study of linear thermodynamic principles to contextually situated and interrelated phenomena. The result was a non-linear, dynamic systems view used to describe events like the collapse of the Soviet Union, stock market crashes, ecological changes, cellular function, and the nature of the mind (Waldrop, 1992). Examples of ant colonies, beehives, and flocks of birds assembling into coherent, seeming purposeful patterns are often used to explain how decentralized, bottom-up emergent complex systems form and function (Kelly, 1994). Rather than

a collection of a great number of variables (complicated) complexity deals with the self-organization and non-linear dynamics of a system made up of many variables (Johnson, 2001; Surowiecki, 2004).

Autopoietic systems are among many sorts of complex self-organizing phenomena that might provide insights into the processes of artistic inquiry. Autopoetic systems are self-generating, non-linear systems that are often illustrated with the processes of cellular functioning (Maturana & Varela, 1980). One feature of an autopoietic system that is relative to this discussion is that it in a sense chooses which phenomena affect it in an environment. According to Maturana and Varela (1992), "the perturbations of the environment do not determine what happens to the living being; rather, it is the structure of the living being that determines what changes occurs in it" (p. 95-96). The emergence of new forms, through the lens of complexity theory, occurs at points of instability where conditions in the environment trigger structural transformations in a system. The openness of complex systems enable a flow of energy and matter, and when increased the system may encounter a point of instability. Capra (2002) suggests that events and situations trigger these points of instability in human organization. This process is described in a number of stages that include: an openness of the system's organization (the ability to incorporate information into a process), its ability to be disturbed or recognize the phenomena in its environment (the ability to perceive and be changed by stimulus), and a network of communication with multiple feedback loops to amplify the encounter (the ability to cycle and recycle perception and stimulus). Capra (2002) summarizes the result of this process by stating:

> After prolonged immersion in uncertainty, confusion, and doubt, the sudden emergence of novelty is easily experienced as a magical moment. Artists and scientists have often described these moments of awe and wonder when a confused and chaotic situation crystallizes miraculously to reveal a novel idea or a solution to a previously intractable problem. Since the process of emergence is thoroughly nonlinear, involving multiple feedback loops, it cannot be fully analyzed with our conventional, linear ways of reasoning, and hence we tend to experience with a sense of mystery. (p.119)

Henri Cartier-Bresson (1999) describes the act of taking pictures as when "all faculties converge in the face of fleeing reality" (p. 16), he describes a process that many artists have experienced, one in which one knows when something 'looks right', 'feels right', or just 'makes sense' suddenly out of nowhere. Granted the actual resulting artwork is situated in culture and context, which is to say that what it looks like or will be is something quite different than anyone else's. Self-organizing phenomena defy linear causal explanation. In the act of inquiry some artists describe a patterned process of coherence, when seemingly out of nowhere something is "just-right" in the process of making art. Returning to artist Henri Cartier-Bresson (1999) who describes this 'decisive moment' as:

> To take photographs means to recognize—simultaneously and within a fraction of a second—both the fact itself and the rigorous organization of visually perceived forms that give it meaning. It is putting ones' head, one's eye, and one's heart on the same axis. (p. 16)

Clarke, a junior in my second year photography course, describes a similar phenomenon. While sitting in a high school assembly he began writing notes on

his arm with a ballpoint pen. Those notes in black ink soon became doodles. He describes what happened next as a process of recognizing order. Moles and scars were circled and then connected with lines. Forms took shape that resembled constellation maps. Clarke began photographing those "maps" drawn on friends to create images resembling star maps and molecular structures. Random noise—doodling—becomes a coherent and recognizable new pattern of relationships represented in his images (Figure 2).

FIGURE 2. From Clarke's series: *Constellations*, an independent series in Photography 4

What we know about complex systems, as mentioned before, is that they are self-organizing. Self-organization is used to describe an autopoetic system and also human consciousness (Nørretranders, 1998). Below the level of consciousness, or "behind the locked door" (Gladwell, 2005), millions of calculations and processes are occurring in our brains and sensory systems. In terms of what happens for Clarke or Cartier-Bresson, or any other artist is a system of experiences and information that is organized into meaningful (for the artist) forms.
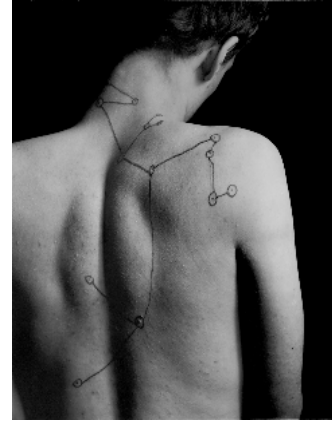
Points of Divergence

FIGURE 3. Selected image from Alex's wrapped human forms series in Photography 3

During one of my prompts that asked students to respond to a personal space, Alex began wrapping dolls and photographing them (Figure 3). What resulted was an exquisite series of wrapped human forms in myriad materials, floating in black, and printed almost life size. When it was the time for our group critique, her classmates gathered around her work, curious as to what had happened. Alex's response was, " I'm sorry Mr. Castro, but I didn't do the assignment." Surrounding her work were the images of her peer's; landscapes and interiors, much as one would expect from a prompt like the one I had given. Seeing her work differ so greatly probably made her feel as though what she did was outside the expectations of the assignment. How would I mark her work according the rubric created? Hours were spent meticulously crafting her images and a well-developed sense of design and color was used. I couldn't help but feel what it would be like to be wrapped in those materi–als, the space within.

Alex's narrative is a common one for artists, who at points in the creative process seem compelled almost to the point of obsession to pursue a particular path of inquiry. This is similar to what Wilson (2004) describes as the postconventional phase, which is:

reached by only a few individuals who have sufficiently mastered conventional art styles and ideologies to the point that they have become dissatisfied by their limitations. The dissatisfaction leads to such things as rejection, significant extension, reapplication of images of one mode of art to another mode of art, or on rare occasions, to the creation of an entirely new form of art. (p. 312)

Any individual rarely reaches Wilson's postconventional phase, in his view. Is this an elitist attitude or an implication of current art educational practice? Where, in Wilson's words, do we build structures for the "idiosyncratic behavior, the minor breaking of artistic rules and conventions, inventive and imaginative combing of images and a stretching from the known to the unknown" (2004, p. 314), that would lead to postconventionalism? Inquiry directed towards the idiosyncratic behaviors of artist's artifacts of inquiry seems to be a second-hand knowing of artistic inquiry that is common in art classrooms (London, 1989). Through prompts and questions, as enabling constraints, spaces are provided to extend into the unknown, where learners have an opportunity to stretch forms through recursively elaborative processes seek emerging patterns of inquiry.

Points of Possibility in Paths of Inquiry

When we seek the reassurance of answers you will commit to the elegance of inquiry. (Frailey, 2006, p. 189)

Jon's first photograph (Figure 4), in response to the question, "If I were to be struck blind tomorrow…" looks down from a bridge at a drainage stream flanked on one side by railroad tracks and on the other side by a wall of graffiti. Throughout the course of the year I began to notice that Jon had a propensity to photograph those places and peoples associated with graffiti art. In his response to "what places are special to me," he photographed inner city graffiti (Figure 5). When working through the questions, "what is family, who is my family," he responded with images of graffiti artists (Figure 6). Initially to the both of us, it seemed that the culture of graffiti

FIGURE 4. Jon's first black and white print, in Photography I, in response to the question: If you were to be struck blind tomorrow, what vision of the world would you leave?

would be his path of inquiry when it came time to work independently in his senior year. However, in the fall of 2005, Hurricane Katrina ravaged New Orleans and it happened that Jon's aunt was living there at the time. On her invitation, Jon went to New Orleans to photograph the aftermath. After his return, his classmates and I noticed a pattern emerging in the hundreds of images he made. On the exteriors of ravaged walls were the spray paint markings of search and rescue teams (Figure 7). In a new context, Jon's response wasn't necessarily about the photographing of graffiti; it was a response to the markings and messages made on the built environment. Jon was asking the same questions, but in a different way, one more centered on the relationship between the marks, messages and surfaces of our built environment.

FIGURE 5. Jon's response to the question: What places are significant to me? Photography 3

FIGURE 6. Jon's response to the question: Who is this person to me? Photography 4

FIGURE 7. Hurricane ravaged New Orleans, from Jon's independent series in AP Photography 5

With scaled and sequenced questions and prompts that enabled inquiry through art making, opportunities for divergence, as illustrated in Alex's narrative and in Jon's unfolding understandings about his own processes of inquiry, are anticipated not predicted. The use of constraints that are not prescriptive, enables and orients inquiry through the process of art making.

As an artist, I embodied eighteen years of formal art education. As a working artist it seems that the structures of inquiry I am engaged in are considerably different than the structures I have experienced and observe in formal K-12 art education today. Can these structures that I experience as an artist be prescribed, predicted and controlled? Yes and no. Yes, in the sense that as an art educator can create spaces that orients inquiry. And no, in photographer and artist Harry Callahan's (Traub, 2006) feeling about the process of teaching fine-art photography stating, "I still don' think you can teach anyone to be creative. All you can do is give them an environment" (p. 208). And this sensibility is what guided my own pedagogy: create the conditions for the opportunity to inquiry as artists, not model artist's inquiry.

Endnote

1. The high school fine-art photography curriculum described in this paper was located in a comprehensive high school on the edge of a major American urban city. It was comprised of five different courses taken in sequence with Photography 1–4 as half year and Photography 5 a full year Advanced Placement course. In Photography 5 (previously Independent Photography), artist-students would submit their portfolios for the Advanced Placement 2-Dimentional Design Portfolio exam. During the course of six years of this curriculum being in place, the National Foundation has recognized artist-students for the Advancement in the Arts as one of the top four programs in the United States. Additional honors include two artist-students being awarded the Presidential Scholars in the Arts Medal, the highest award given to high school students in the U.S.; a Gold

Portfolio Award and the most Silver Portfolio Awards of any high school photography program from The Alliance for Young Artists and Writers, a national program designed to recognize the emergence of an authentic voice and vision; and a 100% success rate on the Advanced Placement 2D Design Portfolio exam for five consecutive years. All told the program would have close to 200 students enrolled at any given time.

References

Barkan, M. (1962). Transition in art education: Changing conceptions of curriculum content and teaching. *Journal of Art Education, 15*(7), 12–18.

Barthes, R., & Heath, S. (1977). *Image, music, text*. New York: Hill and Wang.

Bayles, D., & Orland, T. (1993). *Art & Fear: Observations on the perils (and rewards) of artmaking*. Santa Cruz, CA: Image Continuum Press.

Bourdieu, P. (1996). *The rules of art: Genesis and structure of the literary field*. Stanford, CA: Stanford University Press.

Capra, F. (2002). *The hidden connections: Integrating the biological, cognitive, and social dimensions of life into a science of sustainability*. New York: Doubleday.

Carter, M., & Geczy, A. (2006). *Reframing art*. Oxford, UK: Berg.

Cartier-Bresson, H. (1999). *The mind's eye: Writing on photography and photographers*. New York: Aperture.

Castro, J. C. (2004). *Responding to existential questions: a holistic approach to teaching photography*. Baltimore: Maryland Institute College of Art.

Coles, R., Heyman, T., & Lange, D. (1998). *Dorothea Lange: Photographs of a lifetime*. New York: Aperture.

Davis, B., & Sumara, D. (2006). *Complexity and education: Inquiries into learning, teaching, and research* (1st ed.). Mahwah, NJ: Erlbaum.

Dobbs, S. M. (1992). *The DBAE handbook : an overview of discipline-based art education*. Santa Monica, Calif.: Getty Center for Education in the Arts.

Doll, W.E. (1989). Complexity in the classroom. *Educational Leadership,* 65–70.

Frailey, S. (2006). Valentine. In C. H. Traub, S. Heller & A. B. Bell (Eds.), *The education of a photographer*. New York: Allworth Press.

Gladwell, M. (2005). *Blink: The power of thinking without thinking* (1st ed.). New York: Little, Brown and Co.

Gude, O. (2004). Postmodern principles: In search of a 21st Century Art Education. *Art Education, 57*(1), 6–14.

Gude, O. (2007). Principles of possibility: considerations for a 21st-century art & culture curriculum. *Art Education, 60*(1), 6–17.

Hayles, N.K. (2001). Desiring agency: limiting metaphors and enabling constraints in Dawkins and Deleuze/Guattari. *SubStance, 94*(95), 144–159.

Johnson, S. (2001). *Emergence: The connected lives of ants, brains, cites, and software*. New York: Scribner.

Juarrero, A. (2002). *Dynamics in action: Intentional behavior as a complex system*. Cambridge, MA: MIT Press.

Kelly, K. (1994). *Out of control: The new biology of machines, social systems, and the economic world*. Reading, MA: Addison-Wesley Pub. Co.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh : the embodied mind and its challenge to Western thought*. New York: Basic Books.

London, P. (1989). *No more secondhand art: awakening the artist within* (1st ed.). Boston, MA: Shambhala.

Maturana, H.R., & Varela, F.J. (1980). *Autopoiesis and Cognition: The realization of the living*. Dordrecht, Holland: D. Reidel.

Maturana, H.R., & Varela, F.J. (1992). *The tree of knowledge: The biological roots of human understanding*. Boston, MA: Shambhala.

McHughes, J.L. (1997). From manuscript to performance script: The evolution of a poem. In R. Kirschten (Ed.), *Struggling for wings*. Columbia, SC: University of South Carolina Press.

Nørretranders, T. (1998). *The user illusion : cutting consciousness down to size*. New York: Viking Penguin.

Sullivan, G. (2006). Research acts in art practice. *Studies in Art Education, 48*(1), 19–35.

Surowiecki, J. (2004). *The wisdom of crowds : why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations* (1st ed.). New York: Doubleday.

Traub, C.H. (2006). Learning from the Bauhaus: An interview with Harry Callahan. In C.H. Traub, S. Heller & A.B. Bell (Eds.), *The education of a photographer*. New York: Allworth Press.

Varela, F.J. (1999). *Ethical know-how: Action, wisdom, and cognition*. Stanford, CA.: Stanford University Press.

Waldrop, M.M. (1992). *Complexity: The emerging science at the edge of order and chaos*. New York: Simon & Schuster.

Walker, S.R. (2001). *Teaching meaning in artmaking*. Worcester, MA: Davis Publications.

Walker, S.R. (2003). What more can you ask? Artmaking and inquiry. *Art Education, 56*(5), 6–12.

Walker, S. R. (2004). Understanding the artmaking process: Reflective practice. *Art Education, 57*(3), 6–12.

Weaver, W. (1948). Science and complexity. *American Scientist, 36*(4), pp. 536–544.

Wilson, B. (2004). Child art after modernism: Visual culture and new narratives. In E. Eisner & M. Day (Eds.), *Handbook of research and policy in art education* (pp. 299–328). Mahwah, NJ: Erlbaum.