Complex Constructivism: Rethinking the Power Dynamics of "Understanding"

SARAH SMITHERMAN PRATT
The University of North Carolina at Greensboro

Constructivists herald their learning theories different from—better than—direct instruction; however, deeply embedded in the mantra of constructivism is the idea that the teacher is the "understander" and the student is the "understandee." The act of interpretation is imposed on the "understandee" and there is no question that the "understander" – who determines that understanding has been achieved – is interpreting "correctly." This notion of understanding in educational research maintains the power dynamics of knower/learner. This power play is what I question and critique. Using complexity theory as a lens for this critique, I explore possibilities for dynamic and hermeneutic interpretations of what is being "understood," specifically through the recursive potential found in "complex" conversations. I draw on complexity research to elucidate how, in terms of "understanding," recursion is different from repetition. Learning and teaching do not need to be restricted to internal re-presentations of a world "out there." Experiences, interpretations, learning, teaching, and epistemologies are all dynamic negotiations that occur in-between. This space, which Ted Aoki (1996/2005) describes as "and/not-and," is "a generative space of possibilities, a space wherein tensioned ambiguity newness emerges" (p. 318). Exchange of ideas occurs in this space, and these complex conversations allow for

Journal of the Canadian Association for Curriculum Studies
Volume 6 Number 1 Spring/Summer 2008

differences, multiple perspectives, and authentic questions. In complex conversations, we can find possibilities for teaching and learning, even potential ways of being that we do not yet know.

Introduction: Understanding as a Colonizing Act

> The world becomes our representation as we solemnly become the singular representatives of all things. We become, here, the grand colonizers. We become the ones that savage those whom we consider unorganized, uncivilized, illogical, immoral, immature, by rendering them in our own image. We don't allow them a face (difference, here, must be fixed, for to be different is to fail to be at the center); we give them a façade of our own making. Deep in our Western heritage, and threading lines into contemporary educational theory and practice, there is a pleasant, attractive name for this colonization–we wish to understand. (Jardine, 1992/2004, p. 270; emphasis added).

David Jardine (1992/2004) questions our very sensibility about what it means to "understand." In the act of understanding, which he claims is a colonizing act, we as educators seek to shape others into our own rendering. When we believe we "understand" something, we are acting upon someone or something else, bringing them into our internal representation of what we have already framed in our minds. Can we truly understand someone if they are different from what we think and believe? Are we not subject to our own limited "understandings" as we impose our interpretations on others?

I ask these questions and play with understanding elsewhere (Pratt, 2006). The dynamics of interpreting understanding are imposed on the one who is performing the act of understanding—the "understandee"—never questioning the one who determines that understanding has been

achieved—the "understander."[1] The use of understanding in the discourse of educational research, primarily pertaining to constructivist literature, maintains the power dynamics of knower/learner, something that I believe needs to be questioned and (re)considered, in a similar way to how Foucault (1975/1995) questions disciplinary power. He believes this power "appears to have the function not so much of deduction as of synthesis, not so much of exploitation of the product as of coercive link with the apparatus of production" (p. 153). He goes further by outlining how exercise "makes possible a perpetual characterization of the individual either in relation to this term, in relation to other individuals, or in relation to a type of itinerary. It thus assures, in the form of continuity and constraint, a growth, an observation, a qualification" (p. 161). While a seemingly innocuous idea, exercise is problematic when defined by Foucault:

> The theme of a perfection towards which the exemplary master guides the pupil became with them that of authoritarian perfection of the pupils by the teacher; the ever-increasing rigorous exercises that the ascetic life proposed became tasks of increasing complexity that marked the gradual acquisition of knowledge and good behaviour; the striving of the whole community towards salvation became the collective, permanent competition of individuals being classified in relation to one another. Perhaps it was these procedures of community life and salvation that were the first nucleus of methods intended to produce individually characterized, but collectively useful aptitudes. In its mystical or ascetic form, exercise

[1] By using this phrasing, "understandee" and "understander," I am raising the issue of power positions that exist in constructivism. The "understood" in this relationship would be the concept(s) that are being discussed. In constructivism, the teacher is assumed to be the "understander," while the student is situated as the "understandee." See, for example, Cobb & Steffe (1983).

> was a way of ordering earthly time for the conquest of salvation. (pp. 161-162)

Exercise leads to salvation. Similarly, then, understanding brings about success, success for the pupil who follows the master and acquires the prescribed knowledge and acceptable behavior. The power is still in the hands of the master.

In this paper, I question what it might mean to exercise understanding, examining the power dynamics that are present in the way that constructivism is translated into educational research agendas. I outline how constructivism, as it is currently interpreted in educational research, can be perceived in a modernist, rationalist frame or from a postmodern, complex lens. By analyzing constructivism from these different perspectives, I explore the critical potential of complexity for educational research.

Teaching and Understandings

One example for understanding in teacher education in a modernist, rationalist perspective can be found in work of Lee Shulman (1986/2004). Lee Shulman created the concept of pedagogical content knowledge, which he claims is a teacher's ability to choose wisely what would be the most effective way to engage students in understanding particular subject matter, knowing that this decision is situated within that moment of teaching, a cognitive flexibility (Hiebert and Carpenter, 1992). His use of language, however, reveals modern, rationalist interpretations that rely on the relationship of "understander" to "understandee." In this interpretative frame, the issue of understanding carries with it the assumption that in the act of "constructing," students acquire a level of understanding, which is assessed by the teacher. For Shulman, a teacher understands if s/he is able to present or re-present set material in varied ways—to find the most effective way to re-present information. Thus, in Shulman's work, the teacher must be in control, must always be determining what is "best" for the students.

In contrast with Shulman's modernist approach, Ted Aoki (1996/2005) employs a complex perspective in which he considers what teaching might mean in tensioned spaces of both "and/not-and," which he calls "a space of conjoining and disrupting, indeed, a generative space

of possibilities, a space wherein in tensioned ambiguity newness emerges" (p. 318). For Aoki, a teacher is always speculating, attempting to create tensioned spaces of "both and/not-and." By speculating, notions of openness, contemplation, and opportunities for consideration come into play, but not based on the assumption that what another might consider will already be predicted. Aoki wonders how someone can live in spaces of both/and in which possibilities continue to emerge. Understanding, for Aoki, is never static, fixed, or rigid; rather, understanding is always changing, in flux, continually being renewed. In education, Ted Aoki (1986/2005) proposes "curriculum-as-plan" (p. 159) and "curriculum-as-lived" (p. 160). While educators create structures (plans), the curriculum that actually is lived is different from those plans. Aoki proposes that educators can dwell between the two. Furthermore, he encourages educators to be comfortable with teaching and learning as emergent, and not try to control, force, or stifle how interactions might transpire. This approach to curriculum is different from the exercise of dominance, of acquisition of prescribed knowledge and behavior.

What might it mean to understand, then, in education? Brent Davis (1996) utilizes a hermeneutical and phenomenological perspective for understanding "understanding," which he defines as a "dynamic and active process of negotiating and re-negotiating one's world whereby the abstract can never be severed from the concrete" (pp. 202-203). He argues that beyond a cognitive interpretation, understandings are "relationally, contextually, and temporally specific" (p. 200). The responsibility of the teacher, in this frame, lies in the willingness of the teacher to be re-positioned, not as knower but as a significant participant. Lerman (1996) claims that some believe constructivism "can help teachers to remediate children's learning of mathematics. Perhaps it is more appropriate, however, to examine our assumptions and values and their origins, which lead to the privileging of the abstract, particularly in what constitutes mathematics" (p. 144). The teacher can be in relation to, not over, the students, and together all are "thinking the world together" in imaginative and exciting ways.[2] This perspective invites collective,

[2] This phrase, "thinking the world together," is an integral part of the work of David Jardine, Patricia Clifford, and Sharon Friesen (2003).

momentary, situated knowledge, and in this perspective, knowledge is created, not re-presented by teacher to students (Pinar, Reynolds, Slattery & Taubman, 1995). This notion of understanding embraces relationships as part of the adventure of education, but also honors consideration for how we are always situated, how we can create knowledge and information together, and how we are always in relation.

Constructivism as a Modern or Postmodern Ideal

Ismat Abdal-Haqq (1998) defines constructivism concisely as a learning theory which maintains that "individuals create or construct their own new understandings or knowledge through the interaction of what they already know and believe and the ideas, events, and activities with which they come in contact" (p. 2). A more broad definition is given by Nel Noddings (1990), who characterizes constructivism as both a cognitive position and a methodological perspective, first that all knowledge is constructed via cognitive structures and, second, that humans as knowing subjects have a capacity for organizing knowledge (p. 7). Jere Confrey (1990) concurs with these definitions and translates them into what they mean for teaching:

> When teaching concepts, as a form of communication, the teacher must form an adequate model of the students' ways of viewing an idea and she then must assist the student in restructuring those views to be more adequate from the students' and from the teacher's perspective. (p. 109)

The role of the teacher in constructivism is to act as a guide, facilitator, and coexplorer who encourages learners to question, challenge, and formulate their own ideas, opinions, and conclusions. The mode of "teaching-as-telling" is not synonymous with constructivism, for in constructivism, the role of the teacher is to ask questions, to work alongside the student, and to ascertain conceptual understandings and misunderstandings. Eleanor Duckworth (1987) presents her connections between constructivism and teaching in her work with pre-service and in-service teachers, where one objective is that these teachers would notice that the "emphasis was on what the children were thinking, not

on its rightness or wrongness" (p. 87). Constructivism is completely student-centered; learning occurs within the student. The role of the student is to do, to perform, to question, to suggest understandings. The teacher's role is to ask, to question, to hypothesize and test personal assumptions about student understandings, then to question more. Duckworth (1987) asserts that

> as teachers, we need to respect the meaning our students are giving to the events that we share. In the interest of making connections between their understanding and ours, we must adopt an insider's view: seek to understand their sense as well as help them understand ours. (p. 112)

In this process, the teacher is constantly making judgments about the interpreted understandings, and how best to next question the student so the student might obtain a better conceptual understanding. These judgments rely on the teacher's ability to conceptualize, and this form of interaction allows the teacher to maintain the role of "understander," while the student is the "understandee." This modernist, rationalist dichotomy of either teacher or student, either understander or understandee, is problematized in complex conversations; the distinction becomes blurred. Constructivism has particular limitations, including fixed ends to which teachers would like to "lead" students.[3] While this approach is not forceful but much more pragmatic about the path students may take to arrive, it is still the intent of the teacher for students to "arrive" at a certain location. So while constructivism is different from the mode of "teaching-as-telling," I believe it is still often interpreted in a modernist, rationalist frame in which the roles of teacher and student remain fixed, where the teacher remains in control.

Davis (2004) maintains that one aspect of "rationalist teaching is the continuous need to examine learners' understandings," and "with this sort of assumption in place, it only makes sense that the teacher must engage in ongoing comparisons of subjective sense-making and objective

[3] For a thorough analysis of some limitations of constructivism, see Davis and Sumara (2002).

knowledge" (p. 81). To maintain a modernist, rationalist lens, according to M. Jayne Fleener (2002), is to "similarly reflect and perpetuate the oppressive framework of value-hierarchical thinking, value dualisms, and the logic of domination" (p. 47). Much of the current constructivist literature in educational research maintains the "belief that, through rational, dispassionate, objective, replicable means, universal truths can be found, set a value on the kind of knowledge most worth having" (Fleener, 2002, p. 23). This sentiment echoes Catherine MacKinnon's (1987) feminist perspective that "what counts as truth is produced in the interest of those with power to shape reality, and that this process is as pervasive as it is necessary as it is unchangeable" (p. 137). Value judgments and the logic of domination are two aspects of a modernist, rationalist frame that I wish to resist. Constructivism can exist in a postmodern sense, but much work needs to be done in order for this to become an alternative. There are at least four ways in which a distinction can be made between modernist and postmodernist readings of constructivism.

The first significant distinction between a modernist and a postmodernist perspective for teaching is *the interpretation of difference*. As referenced above, Jardine (1992/2004) challenges our proclivities for conforming others to our own image rather than allowing for difference. This translates in educational terms into activities that can be repeated to achieve the same results, as in "what works."[4] In modernist terms, repetition is important. In this sense, repetition involves a recurrence of the same event with the intent of achieving the same result. In contrast, in postmodern, complex terms, recursion is a focus. Recursion is the recurrence of the same event and expecting something different. The notion of recursion can be found, for example, in the work of Jardine (2006), where he writes about Piaget's intellectual history as a way to understand Piaget in context. In reflecting on interpretations of Piaget's

[4] I intentionally use the phrase, "what works," to play against the current discourse in education and politics, specifically the creation of the government-sanctioned *What Works Clearinghouse: A trusted source of scientific evidence of what works in education* (What Works Clearinghouse, 2005). Others challenge this mentality in educational research (Pinar, 2004; Ritchie & Wilson, 2000). See also Biesta (2007).

work for education, he provides a vignette from a classroom conversation:

> What is exciting here is that each new answer was not understood as just one more example to be added to the list. Each example made all the previous examples more interesting, more complex, more reasonable and sensible than they might have been on their own. Thus the conversation began to act recursively. That is to say, instead of a simple additive sequence of examples, each example began to enrich the others and changed how they appeared and how they could be understood. (pp. 83-84)

The conversation described is not an accumulation but an amalgamation of connections that enriches the understandings of all involved, for "learning is an ongoing, recursive, elaborative process, not an accumulative one. Learners are not incomplete beings, but cognitive agents whose universes are always and already seamless even if they are never fixed or finished" (Davis, 2004, p. 130). The activity presented by Jardine (2006) may be repeated, but the complex connections that occur cannot be duplicated. Thus repetition is not achievable, nor is it even desirable for Jardine. Rather, individuals sharing and groups working together bring forth a rich context in which understandings grow and shift and change. The recursive nature of the conversation provides such a moment.

A second point of departure in contrasting constructivism from a modernist lens or from a postmodern, complex lens is *the stages of development created by Piaget*. His stages—sensori-motor knowledge, pre-operational knowledge, concrete knowledge, and formal operational knowledge—are often presented in educational psychology as discrete, separate categories. From a complex perspective, Brent Davis (2004) also provides a history of Piaget, focusing on Piaget's roots in structuralism and in biology. These two fields of study influenced Piaget to perceive of structures that are biologically fluid and constantly in flux. According to Davis (2004), Piaget's theory of construction includes the assumption that what a "person makes of an event is less a function of the qualities of the event and more about the complex history of the agent's

linguistically effected, biologically enabled, and culturally framed structure" (p. 120). Jardine (2006) concurs with Davis and challenges the modernist separation of Piaget's stages by offering instead an ecological perspective of interdependence for these stages. Multiple perspectives and differences become part of the context. Jardine (2006) imagines differently than modernist educational psychologists, who perceive these stages as "somehow strung along a developmental sequence" (p. 76). Instead, what he imagines is that children in our classrooms are

> right there along with us and all the other students, pondering problems and raising questions in their own ways, just as we are there, pondering the same topics in our own ways. We, too, as adults, have work to do in order to understand, say, 'place-value,' in all its complexity in the human inheritance. (p. 76)

The complexities of the human inheritance are a part of Piaget's theory. The role of the teacher is a significant participant, rather than director or guide. Understanding is placed among the conversants, not contained in one or another individual. Individuals are not captured within a particular stage before developing into a better stage. We are all navigating understandings from the perspective of these different stages. We move between and among them.

A third departure is the issue of *predetermination*. Current curricula and textbooks are filled with clever explanations of already formed concepts. The job of the student is to "learn" these concepts, not as new (and ideally, historical) discoveries for themselves but as fixed, static, unquestioned truths. What a difference it might make if teachers were to engage in conversations about topics from various disciplines "as an epistemological system, with its specific dynamics, and in its sociocultural and historical perspective, and not as a finished and static body of results and rules" (Walkerdine, 1990, p. 23). This might allow students to engage in recognitions of how lived experiences and understandings can relate to productions of knowledge—an activity in which they can play a part/role. To be simultaneously "product, producer and process" (Davis, 1996, p. 9) is to exist as complex subjects, where we are cojoined and disjoined. The activities of teaching and

learning, then, are not about "convergence onto a preexistent truth, but about divergence—about broadening what is knowable, doable, and beable" (Davis, 2004, p. 184).

From a postmodern, complex perspective, teaching and learning do not emphasize "what is, but on what might be brought forth. Thus learning comes to be understood as a recursively elaborative process of opening up new spaces of possibility by exploring current spaces" (p. 184). In terms of complexity theory, recursive processes are what create and regenerate life. These processes cannot predetermine all that will occur. Only in reflecting back on the experiences and contexts can influences and understandings be interpreted, for "various pathways of development are possible. Which one occurs will depend on how the individual interacts with the recognized perturbations" (Doll, 1986, p. 16). What can be brought forth is still open to multiple possibilities. This multiplicity becomes significant; the "doing, undoing, and redoing process is essential. Knowledge is not a copy of reality, but a process of construction" (p. 15). Doll (1986) connects Prigogine's interpretation of time with Piaget's notion of construction. As Doll emphasizes in the work of Prigogine, time is an important factor. In fact, in the work of Prigogine & Stengers (1984), they discover that "far from being an illusion, irreversibility plays an essential role in nature and lies at the origin of most processes of self-organization" (p. 8). This important fact, the irreversibility of time, becomes the central theme of Prigogine's (1997) book, *The End of Certainty: Time, Chaos, and the New Laws of Nature*, and leads to his final publication of *Is Future Given?* (Prigogine, 2003), in which he explores the freedom of thought and the inability to predetermine the future. His original work in dissipative structures significantly informed these later works.

A fourth and final difference is *the notion of shared or collective understandings*. The act of coming together is one that Brent Davis (1996) posits is possible for understanding to occur in the collectivity of the participants, rather than individual comprehension. He writes: "In particular, as [the Pirie-Kieran model] has been applied to collective sense-making, the model highlights the manners in which collective understandings do emerge—senses that cannot be located in any of the participants but which, rather, are present in their interactions" (p. 203). Interactions are a significant component of collective understanding.

More than strengthening relationships, interactions involve consideration, judgment, listening, all of which are located among and between individuals interacting.

The absence of collective sense-making—a key pragmatist concept—is one particular concern that Davis (1996) believes reveals problematics associated with locating understanding only in the individual, as if understanding is some product, an end that can be fixedly attained. This fixed end is a notion held by constructivists, an idea that Brent Davis and Dennis Sumara (2000, 2002) challenge. For example, Davis and Sumara (2002) claim that "metaphors of constructing and building have been seamlessly incorporated into the perspective that learning is a matter of internal representation of an external world" (p. 418). To counter the underpinning of learning as an internal representation, Davis and Sumara (2002) offer alternative philosophies, specifically poststructuralism, psychoanalysis, pragmatism, and complexity sciences, as a way to re-read learning and teaching that is not restricted to internal re-presentations of a world "out there." Experiences, interpretations, learning, teaching, epistemologies, all of these are dynamic negotiations that occur in-between, neither yours nor mine, both "and/not-and."

Constructivism, then, as a theory of learning does not need to be limited in its interpretations for educational research. What differs are the lenses from which these interpretations are derived. I have pointed to four ways in which aspects of constructivism can be interpreted differently, whether from a modernist, rationalist frame or from a postmodern, complex perspective. These four examples, (i) implications of difference, (ii) stages of development, (iii) predetermination, and (iv) collective understandings, are merely a sampling to demonstrate how constructivist ideals need not be restricted by a modernist interpretation. In a complex interpretation, interactions and relationships are vital to creating new moments in which we all understand. Connecting these ideas, I utilize the word understanding as interpreting and making meaning in relational and temporal situations. This notion of understanding embraces relationships as part of the adventure of education, but also honors consideration for how we are always situated, how we can create knowledge and information together, and how we are always in relation. In this frame we can imagine possibilities for new understandings.

Conclusion: Complex Conversations

In a speech I heard recently, the presenter repeated the phrase, "Please understand…." I interpret this statement to mean, "Please agree with me." To understand in this frame is to comply or concur with what the speaker is asserting. In contrast, complex conversations involve understanding, not compliance but shared understanding through community relations. Complex conversations include asking questions, but not questions to which one already knows the answer. One particular aspect in considering how complex conversations can influence interpretations for what it means to "teach" is the notion of questioning. Martin Heidegger (1954/1977) posed the idea that "questioning is the piety of thought" (p. 35). The *Oxford English Dictionary* (1989) defines piety as "habitual reverence," "devoutness," and "dutifulness." I believe that Heidegger (1954/1977) is challenging the manner in which we question, that we should be devoted to thinking and that we have a duty to think. This perspective could greatly influence what kinds of conversations are occurring in classrooms (from elementary to secondary to higher education). If complex conversations do not function in the same way as "teaching-as-telling," then questions in a complex conversation will emerge differently than those in the mode of knower/learner (or "understander"/"understandee").

In the struggle to find ways to move away from teaching-as-telling and toward a more conversational, hermeneutical approach to educational research, I am working with others to develop the notion of complex conversations and its impact in education. Complex conversations allow for a continually (re)negotiated set of interactions, and the location of what is understood is always present in the system, not located in the individual.

Complex conversations can occur in ways that allow teachers and students to be reflective. In complex conversations, the roles of teacher as "knower" and student as "learner" are transformed into everyone asking questions to which they may not know the answer. In this sense, "the question does not follow learning; it precedes it. It points to the not yet known and to the wondrous" (Davis, 1996, p. 253). This mode of questioning is different from the "guess-what-I'm-thinking" mentality that occurs in the interactions associated with the "knower/knowee"

mode. It even goes beyond the constructivist notion of "guess-what-the-student-is-thinking" mentality. This follows William Doll's (1993) assertion that in an open, self-organizing system, "teachers need student challenges" (p. 159) in order to create, transform, and learn. Questions are not disruptions; they are necessary for living systems to grow. Understanding, then, occurs as we cooperatively struggle with questions/issues. As both teachers and students, may we be inspired by Doll's (1993) pedagogic creed, to work on "reflecting on the tacit understanding each has" (p. 160).

One example of complex conversations in teacher education can be found in the work of Jayne Fleener and Gloria Nan Dupree (2002). The authors share their ideas for working with mathematics teacher educators. They proffer the notion of autobiosophy as a way to enthrall and engage their preservice teachers to explore who they are in relation to mathematics. Autobiosophy is defined as "building on Wittgenstein's notion of autobiography as confession, denying the Cartesian privileged knower, and engaging in Michel Foucault's critical perspective of the emergence of self through language" (Fleener & Dupree, 2002, p. 75). They describe how their use of autobiosophy in a mathematics education course (in which they cite Foucault (1986) at the end of their explanation):

> provided our students ways of exploring their relationship with mathematics and provided an interpretive framework for understanding how their written and verbal conversations evolved and their understandings changed. Autobiosophy, through gynocritical inquiry, became a tool for our students for (re)inventing themselves, evolving new understandings, changing meaning structures, and "setting up and developing relationships with the self, for self-reflection, self-knowledge, self-examination, for deciphering the self by oneself, for the transformation one seeks to accomplish with oneself as object" (p. 29).[5] (Fleener & Dupree, 2002, p. 75)

[5] This term is more than just autobiography, particularly Pinar's method of *currere*. For an example of *currere* that is used in the classroom, see Doerr (2004), who utilizes Pinar's *currere* in her teaching of ecology. In

The authors invite their students to examine their identity as a knower of mathematics, not in the basic,[6] modernist sense, but in the relational, identity politics way. This method of interrogation of the self with respect to other, echoes Fleener's (2002) sentiments as to what she believes is meaningful as an educator: of imagining "students, learning, and schooling as relationships and contextual" (p. 80). As she says:

> This change in what I believe to be most fundamental, namely that students are complexes of relationships rather than things, living within individual and social contexts, has completely affected what I feel is important in my own classroom, how I approach instruction and think about teaching, and how I view assessment. (p. 80)

This change, what she claims as fundamental, I interpret as a basic for her. Not only does she use autobiosophy as a way to engage in questioning with her students, she also is changed by the relationships that are formed from the act of engaging in conversations. She is a significant participant in which she is just as changed and transformed in her understandings as others are.

In this way, Fleener (2002) demonstrates a "deep appreciation of the virtuality of one's own identity—a knowledge that one's self is a fluid, always-emergent, biological-and-cultural form. Knowing, doing, and being are inseparable" (Davis, 2004, p. 176). Her work is just one example of a postmodern, complex interpretation of education in which

---

her interpretation of Pinar's *currere*, she perceives that Pinar and Grumet used "*currere* to examine the students' responses to their own educational experiences so the teachers-in-training could see for themselves the baggage they would bring with them into their own classrooms" (p. 14). In this way autobiography relates to Fleener & Dupree's (2002) notion of autobiosophy.

[6] Jardine, Clifford & Friesen (2003) argue that the notion of basics does not have to be limited to fundamental building blocks or stepping stones in developmental sequences. They offer a different sort of basics, such as relationships, community, generations, histories, and caring.

the "logics of relationship, systems, and meaning synergistically contribute to a perspective from which the social system of schools may evolve as learning organizations" (Fleener, 2002, p. 78). Constructing understandings, momentary, collective, sense-making moments, can be part of a postmodern, complex logic. A warning, though, for this alternative is given by Fleener (2002) because "discarding the lenses of modernism and finding suitable replacement lenses may make all the difference in the world—as long as we realize that even our new lenses filter our way of seeing and living. We must endlessly recreate heart" (p. 195). Using complexity theory as a lens for interpreting educational research can generate new and different interpretations for learning and teaching, ecologically sensible and hermeneutically engaging. We must remember, however, that complexity theory is also limiting and thus we should continually seek to engage in conversations about educational theories and be open to momentary, shared understandings that are always in flux.

Acknowledgements

I wish to thank Bill Doll and Donna Trueit for our continued complex conversation about teacher education. This piece is, for me, a continuation of our conversation and my connections to cognition and curriculum. I also would like to thank all of the other contributors to this special issue. Their work in the intersections of critical education continue to influence my thinking and living in many ways.

References

Abdal-Haqq, I. (1998). Constructivism in teacher education: Considerations for those who would link practice to theory. *ERIC Digest (ED426986).* Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education. Retrieved online on May 25, 2005, from http://www.ericdigests.org/1999-3/theory.htm.

Aoki, T. (2005). Reflections of a Japanese Canadian teacher experiencing ethnicity. In W. Pinar & R. Irwin (Eds.), *Curriculum in a New Key: The Collected Works of Ted T. Aoki* (pp. 333-348). Mahwah, NJ: Lawrence Erlbaum. (Original work published 1979)

Aoki, T. (2005). Teaching as in-dwelling between two curriculum worlds. In W. Pinar & R. Irwin (Eds.), *Curriculum in a New Key: The Collected Works of Ted T. Aoki* (pp. 159-165). Mahwah, NJ: Lawrence Erlbaum. (Original work published 1986)

Aoki, T. (2005). Imaginaries of 'East and West': Slippery curricular signifiers in education. In W. Pinar & R. Irwin (Eds.), *Curriculum in a New Key: The Collected Works of Ted T. Aoki* (pp. 313-319). Mahwah, NJ: Lawrence Erlbaum. (Original work published 1996)

Biesta, G. (2007). Why "what works" won't work: Evidence-based practice and the democratic deficit in educational research. *Educational Theory*, *57*(1), 1-22

Cobb, P., & Steffe, L. (1983). The constructivist researcher as teacher and model builder. *Journal for Research in Mathematics Education, 14*(2), pp. 83-94.

Confrey, J. (1990). What constructivism implies for teaching. In F. Lester (Ed.), *Constructivist Views on the Teaching and Learning of Mathematics. Journal for Research in Mathematics Education* Monograph Series, Number 4 (pp. 107-122). Reston, VA: National Council of Teachers of Mathematics.

Davis, B. (1996). *Teaching mathematics: Toward a sound alternative*. New York: Garland Publishing.

Davis, B. (2004). *Inventions of teaching: A genealogy*. Mahwah, NJ: Lawrence Erlbaum.

Davis, B., & Sumara, D. (2000). Curriculum forms: On the assumed shapes of knowing and knowledge. *Journal of Curriculum Studies, 32*(6), pp. 821-845.

Davis, B., & Sumara, D. (2002). Constructivist discourses and the field of education: Problems and possibilities. *Educational Theory, 52*(4), pp. 409-428.

Doll, W. (1986). Prigogine: A new sense of order, a new curriculum. *Theory into Practice, 25*(1), pp. 10-16.

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

Doerr, M. (2004). Currere *and the environmental autobiography: A Phenomenological approach to the teaching of ecology*. New York: Peter Lang.

Duckworth, E. (1987). *"The having of wonderful ideas" and other essays on teaching and learning.* New York: Teachers College Press.

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

Fleener, M.J., & Dupree, G. (2002). Autobiosophy through gynocritical inquiry: Exploring women's ideas about mathematics, power, and community. *Journal of Curriculum Theorizing, 52*(1), pp. 65-76.

Foucault, M. (1995). *Discipline and punish: The birth of the prison* (2nd ed.). (Alan Sheridan, Trans.). New York: Vintage Books. (Original Work Published 1975)

Heidegger, M. (1977). *The question concerning technology, and other essays, vol. I.* (William Lovitt, Trans.). New York: Harper Collins. (Original Work Published 1954)

Hiebert, J., & Carpenter, T. (1992). Learning and teaching with understanding. In D. Grouws (Ed.), *Handbook of Research on Mathematics Teaching and Learning* (pp. 65-97). New York: Macmillan.

Jardine, D. (1992/2004). *A bell ringing in the empty sky*. In W. Pinar (Ed.), *Contemporary Curriculum Discourses* (pp. 262-277). Scottsdale, AZ: Gorsuch Scarisbricks. (Original work published 1992)

Jardine, D., Clifford, P., and Friesen, S. (2003). *Back to the basics of teaching and learning: Thinking the world together*. Mahwah, NJ: Lawrence Erlbaum.

Jardine, D. (2006). *Piaget and Education: Primer*. New York: Peter Lang.

Lerman, S. (1996). Intersubjectivity in mathematics learning: A challenge to the radical constructivist paradigm? *Journal for Research in Mathematics Education, 27*(2), pp. 133-150.

MacKinnon, C. (1987). Feminism, Marxism, method, and the state: Toward feminist jurisprudence. In S. Harding (Ed.), *Feminism and Methodology: Social Science Issues* (pp. 135-156). Bloomington, IN: Indiana University Press.

Noddings, N. (1990). Constructivism in mathematics education. In F. Lester (Ed.), *Constructivist Views on the Teaching and Learning of Mathematics. Journal for Research in Mathematics Education* Monograph Series, Number 4 (pp. 7-18). Reston, VA: National Council of Teachers of Mathematics.

Oxford English Dictionary. (1989). *The Oxford English dictionary* (2nd ed.). New York: Oxford University Press.

Pinar, W. (2004). *What is curriculum theory?* Mahwah, NJ: Lawrence Erlbaum.

Pinar, W., Reynolds, W., Slattery, P., & Taubman, P. (1995). *Understanding curriculum*. New York: Peter Lang.

Pratt, S. (2006, September). Playing with our understandings. *Complicity, 3*(1), pp. 91-95.

Prigogine, I. (2003). *Is future given?* River Edge, NJ: World Scientific.

Prigogine, I. (with Stengers, I.). (1997). *The end of certainty: Time, chaos, and the new laws of nature.* New York: The Free Press.

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

Ritchie, J., & Wilson, D. (2000). *Teacher narrative as critical inquiry*. New York: Teachers College Press.

Shulman, L. (2004). Those who understand: Knowledge and growth in teaching. In S. Wilson (Ed.), *The Wisdom of Practice: Essays on Learning, Teaching, and Learning to Teach* (pp. 187-215). San Francisco, CA: Jossey-Bass. (Original work published 1986)

Walkerdine, V. (1990). The role of mathematics education in building a democratic and just society. *For the Learning of Mathematics, 10*(3), 20-23.

What Works Clearinghouse. (n.d.). *What Works Clearinghouse: A trusted source of scientific evidence of what works in education*. Rockville, MD: Author. Retrieved October 23, 2005, from http://www.whatworks.ed.gov/.

About the Author

Sarah Smitherman Pratt is an assistant professor in the Department of Curriculum and Instruction at the University of North Carolina at Greensboro, where she focuses on middle grades and secondary mathematics education. Her current research is focused on complex conversations and how these types of interactions can promote mathematical thinking in the classroom.