Discursive Construction of "Good Teaching:" A Crossdisciplinary Framework

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Abstract

Theorizing about good teaching is complicated by the preparadigmatic state of learning theory, the existence of separately conceived and independently coherent notions of learning championed in various branches of psychology (e.g., behavioral, developmental, cognitive, sociocultural). Historically, educators have responded by partnering with one or another of the schools (usually the dominant one, as with behaviorism or cognitivism through much of the last century). More recently we've aligned with dialectical theories like situated cognition theory or social constructivism that explore the complementarity of independently conceived notions of learning within a complex unity. Both of these solutions are problematic, the former because any individual conception of learning is incomplete with respect to the agendas of education, the latter because dialectical syntheses tend to be theoretically intractable and intuitively opaque. The current paper stakes out a new response to the preparadigmatic status of learning theory. The *crossdisciplinary* approach identifies the independently coherent notions of learning that motivate educational practice, and articulates discrete pedagogical practices, each indexed to a single notion of learning. This strategy breaks with our current construction of good teaching as a unitary or integrated set of practices that somehow is to address all of our valued learning goals. Adopting this approach redraws the relationship of pedagogical theory to psychology and to the world of educational practice.

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> When all is said and done, the fact remains that some teachers have a naturally inspiring presence and can make their exercises interesting, whilst others simply cannot. And psychology and general pedagogy here confess their failure and hand things over to the deeper spring of human personality to conduct the task. (William James, 1899/1958, pp. 80-81)
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> The goal of teaching is learning, not teaching. –Hugo Rossi

What is good teaching?

Perhaps no other question has exercised educational researchers more strenuously over the past 100 years. Oh, the problem is not one of definition–educators generally understand good teaching to mean teaching that supports student learning. The problem is characterizing good teaching, identifying its means and methods.

Our difficulty has stemmed not from a paucity of ideas and intuitions about good teaching, but from a surfeit. Sober reflection on the question seems to have led sincere scholars and educators in widely varying directions. In the political context of education, debates about the character of good teaching often have been heated, even acrimonious. Values issues seem to be inextricably entangled in conversations about good teaching.

Turning to psychology, educators have been attentive to theorizations of learning. If good teaching supports learning, then being clear about learning should go quite some way to resolving controversies and conflicts about teaching. But, alas, psychology does not speak with a single voice. Learning is variously addressed within a range of psychological traditions–e.g., behavioral, cognitive, developmental, sociocultural–each working from intuitions and assumptions about learning that are largely independent of the others, each employing its own methods and models. In Kuhn's (1970) terms, psychology is a *preparadigmatic* science, with competing schools pursuing their own approaches in the quest to eventually establish a paradigmatic consensus for the field (Flyvbjerg, 2001).

In view of the current fragmented state of scholarship about learning, I propose a rather simple and straightforward solution to the problem of characterizing good teaching: (1) identify the independently coherent notions of learning that motivate us as educators; and (2) drawing on relevant psychological theories, develop discrete models of good teaching each indexed to a single notion of learning. In this way we can segregate issues of efficacy–how do we best support student learning–from values issues–what kind(s) of learning should we seek to support.[1]

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[1]Educational psychology has a long tradition of categorizing aspects of learning for instructional purposes (e.g., the Bloom et al. *taxonomy*, 1956, and Gagné's *types of learning outcomes*, 1965). However, generally, these elements are understood as hierarchically organized, indicating an overarching integrative assumption. The crossdisciplinary approach takes the notions of learning as wholly independent, each a separate platform from which to consider pedagogical practice.

At this point, I anticipate the reader, browsing through *Educational Researcher*, is ready to flip over to the next article. There is something that rankles about the idea of refracting "good teaching" from a holistic conception of classroom practice to a set of discrete, special-purpose, methods.

Certainly, the problem of our fragmented understanding of learning has been recognized before as a major challenge for educational theory. Cobb (1994) organized an important collection of papers within this journal to address the conflicting conceptions of learning promoted by constructivist and sociocultural theorists. And Sfard (1998) spoke eloquently of the "incommensurability" of what she called *acquisition* and *participation* metaphors of learning. But both of these distinguished theorists concluded we need to coordinate or to balance competing intuitions about learning as we frame visions of good teaching. Segregating good teaching into discrete, independent, technical practices seems intellectually trivial, as well, unresponsive to the deeper needs of educational practice for cohesive direction.

Caveat Emptor! You have been warned. Pursuing the crossdisciplinary approach outlined here diminishes the ambitions of educational theory, both with respect to the world of educational practice and to the theoretical traditions that have nourished us over the past century. Yet in exchange we gain a shared metalanguage that coordinates and amplifies our pedagogical efforts beyond what's previously been imagined as possible. It remains to be seen whether this trade-off comes to be received as a strategic retrenchment, or a deal with the devil.

I outline the gains and losses before laying out the crossdisciplinary framework.

Gains:

Pedagogical Principles: The strategy of developing independently coherent characterizations of good teaching has been developed to address three major problems of pedagogical theorizing. The first is our inability to articulate pedagogical principles. For if our intuitions and understandings about learning are fragmented across a range of psychological approaches, then principled accounts of good teaching–accounts that explicate how teaching is intended to support learning–only can be formulated locally, relative to the independently conceived notions of learning. This is why our current integrative pedagogical discourse, in which "good teaching" somehow simultaneously is to address learning in its varied manifestations, is big on platitudes, big on grand visions, big on intractably dense dialectical analyses, and big on vignettes that illustrate good teaching, but short on principles that explain how teaching supports learning. As Greeno, Collins, and Resnick (1996) challenged, the priority for theory is "to develop ... new possibilities for practice, not just to provide inspiring examples, but also to provide analytical concepts and principles for people who wish to use the examples as models in transforming their own practices" (p. 41). We meet this challenge by localizing conceptions of good teaching to the discrete intuitions and understandings we have of learning.

Professionalization of Teaching: The second major problem, already alluded to, is the politicized character of our pedagogical discourse stemming from the interpenetration of values issues with issues of efficacy. Given the diverse metaphors and intuitions about learning that motivate educators, it is to be expected that values issues will arise as to which sort(s) of learning are to be pursued with students. However, our construction of good teaching as a unitary or integrated set of practices leaves little discursive space for this variation: Either your approach is good teaching, or my approach is good teaching, but not both. One's opponents always are seen as promoting ineffective practices, rather than just different learning goals (e.g., the *Reading Wars* and the *Math Wars*). This is a discursive form that ultimately demeans teacher professional knowledge, and

indeed, the field of education itself. The "Promised Land" of crossdisciplinarity is one in which teachers possess principled pedagogical knowledge and expertise in various genres that can be coherently articulated and rigorously defended in terms of learning principles. Such teaching expertise also is more objectively documented and assessed than is possible in the existing discursive context in which good teaching is largely an interpretive judgment (Eisner, 2002). Thus teaching and teacher education assume a more professional posture. Of course controversies and disputes about learning goals are not eliminated in this fashion, but teacher expertise is protected from these arenas of disputation.

Structured Space of Pedagogical Theorizing: The third benefit of the crossdisciplinary approach addresses a problem that may not previously have been noted, indeed, that crossdisciplinarity brings into focus, and resolves, simultaneously. This is the problem of the unstructured discursive space of our pedagogical theorizing. New teaching methods are proposed with some regularity in the educational arena. Almost always, there is theoretical justification offered for the proposed method. Sometimes one or another learning theory is applied to teaching, sometimes cognitive processing research or neurological based insights are called upon, sometimes critical theory, sociological theory, or metaphysical or spiritual bases are cited. Essentially, each new proposal creates its own universe of discourse within which it is to be analyzed and evaluated. We lack crosscutting perspectives to help us organize and interrogate the mountain of pedagogical proposals that have been, and continue to be, generated. Often we are reduced to the indignity of quantitative outcome comparisons in selecting curricula–as if some common metric captures the whole realm of our pedagogical interests.

If we take seriously the proposal that a set of discrete intuitions about learning can be identified that undergirds our pedagogical intentions, it becomes possible to structure the discursive space of pedagogical theorizing according to a set of standard questions:

- What form(s) of learning are intended to be supported by the pedagogical approach?
- How effective is the learning support offered by the pedagogical method, as judged in terms of the pedagogical principles that already have been articulated for that genre of teaching?
- In case multiple forms of learning are intended, how coherent and consistent is the coordination of learning emphases within the overall pedagogical method?

In this way, pedagogical methods, diversely conceived, can be located within a structured space of learning intentions, and evaluated according to fixed principles of efficacy. This system of questions may seem innocuous and unremarkable. Its potency will be demonstrated later in this article as we hold up current and past recommended pedagogical methods to the prism of crossdisciplinarity revealing glaring holes and inconsistencies in the support given to learners, and see how partial have been prior analyses conducted from an integrative perspective on good teaching that provides almost no analytic purchase.

Losses:

These promised gains come with a steep price tag, for adopting a crossdisciplinary approach entails abandoning our partnership with psychologists in the quest for a paradigmatic consensus about learning, and our co-partnership with teachers in the critical values issues of education. These alliances are central to our self-identity as educational theorists, to our motives for being educational theorists. Yet our over-riding imperative is to help teachers help students to learn. In stepping back from our partnership with psychology we become better able to exploit the insights into learning that psychologists have gleaned. In stepping back from our co-participation with teachers in values

issues, we empower them to own those issues as part of their professional self-identity. In the process we create a new kind of identity for ourselves as educational theorists. Whether that identity is a comfortable one, whether it comes to feel right to us, will take some time and patience to figure out.

Stepping Back from the World of Theory: To understand our current relationship to psychological theory, it is necessary to step back in time to the founding of psychology as a scientific enterprise, often marked by the publication of William James' (1890) two volume *Principles of Psychology*. One of the first preoccupations of the new science was investigation of the transfer of training assumptions of faculty psychology (e.g., Thorndike & Woodworth, 1901). These early studies found the prevailing belief in broad transfer of learning to be unwarranted. Through preceding centuries, the classical (Aristotelian) theory of faculty psychology, and its associated theory of mental-disciplines, had served as the basis for pedagogical thought (Hilgard, 1996; The New Encyclopedia Britannica vol. 28, 2000, p. 437: EB inc, Chicago). So, psychology's attack upon transfer of training effectively dislodged the existing foundations for educational practice (Hall, 2003). As a result, education attached itself to the new science, not as a separate and independent field of inquiry, but as a client discipline, dependent upon psychology for our legitimacy and intellectual authority.

Client status is not necessarily a liability for a field of professional practice. For instance, medicine–to which education is so often unfavorably compared (Hemsley-Brown & Sharp, 2003)–could well be characterized as a client discipline to an array of biological sciences (biochemistry, anatomy, genetics, etc.) which legitimize medical practice and structure its methods. But being client to a mature science that already has achieved paradigmatic consensus is not like being client to a preparadigmatic science whose branches are still in competition with one another. As Kuhn (1970) noted, the competitive process is inescapably sociological rather than purely intellectual. Viewed through divergent paradigmatic lenses, different aspects of observed phenomena become highlighted as problematic. Establishing consensus across a field is never a matter of invalidating the perspectives of other schools, but of offering a sufficiently comprehensive account of the diverse phenomena to attract established researchers from other schools, and especially new researchers just entering the field. Like old soldiers, old paradigms never die, they just fade away.

This competitive orientation influences the rhetorical structure of preparadigmatic science in contradictory ways. On the one hand, scientists are engaged within their own school in a rationally evolving discourse about the phenomena of interest. On the other hand, to maintain a competitive posture the accomplishments of a given approach tend to be exaggerated, with intended or expected advances promoted as solid achievements. The history of psychology is replete with the dynamic of exaggerated claims beaten back by exponents of competing schools. For instance, Skinner's (1958a) attempt to extend behavioral psychology from unmediated response conditioning to verbal behavior was famously rebuffed by Chomsky (1959) at the start of the "cognitive era" (Gardner, 1987). Similarly, the now mainstream cognitive science has clashed with newer upstarts like situativity (situated cognition) theory (Anderson, Reder, & Simon, 1996, 1997; Greeno, 1997) that have emerged in part because of a perceived failure of cognitive science to adequately extend from decontextualized problem solving to contextual reasoning (Brown, Collins, & Duguid, 1989; Greeno, 1993; Hirst & Manier, 1995). This bluff and bluster of competing schools is characteristic of preparadigmatic science, and vital to the maturing of the science (Kuhn, 1970).

As a client discipline to psychology, education has not been positioned to critically evaluate the claims and counterclaims of the various psychological schools and to make our own determinations as to what is useful and important. Rather than a disinterested senior partner, psychology has

maintained a keen interest in how education incorporates psychological theory. As Thorndike (1910) put it, "school-room life itself is a vast laboratory in which are made thousands of experiments of the utmost interest to 'pure' psychology" (p. 12), and many psychologists have actively participated in applying their theories to education. Within the sociological context of psychology, education is a most useful pawn through which to announce the power of a particular school (Lagemann, 2000). Unfortunately, as I will show, educational practice has sometimes been the site for the most exaggerated, least careful, claims by psychological theorists intent on advancing the aspirations of their science, ahead of its actual accomplishments.

But these historical particulars aside, what concerns us here is not so much what psychologists have done to us in advancing their competitive interests, as what we have done to ourselves in adopting the perspectives of psychology on learning. For the historical imperative of preparadigmatic science is to unite the field around a single paradigm. Thus across the broad terrain of psychology, the only tenet that learning theorists of every persuasion hold in common is that a single perspective (eventually) encompasses all of the relevant phenomena of learning. So it is that psychologists of all stripes talk of learning as a unitary phenomenon (albeit, complex and multifaceted). And education, as a client discipline to psychology, adopts this unitary assumption about the nature of learning (and hence, of good teaching), ignoring the evidence, everywhere present, that at this historical juncture learning is variously understood within unreconciled psychological traditions. It is only by adopting a crossdisciplinary perspective–by looking across the psychological disciplines, rather than participating in them–that we have the dispassionate distance we need to effectively utilize the diverse offerings and insights into learning that psychology thus far has achieved in its various schools. In this respect, the crossdisciplinary challenge is not merely a technical redirection of perspective on good teaching, but a declaration of independence for education from domination by psychology.

Stepping back from the World of Practice: The foregoing analysis of education in relation to psychology is not intended to suggest bad faith on the part of psychologists, but to explore the historical processes that have worked to shape our pedagogical discourse. Nor does my painting of a paternalistic relationship of pedagogical theory to the world of pedagogical practice in this section allege bad faith on the part of educational theorists. On the contrary, psychologists have been most sincere and passionate in their efforts to contribute to education, and many educational theorists have been scrupulously attentive to including teachers as partners in educational theorizing (Schubert, 1992; Wagner, 1997; ??). The problems in both cases are structural, and no amount of good will or good intention can have effect until those structural problems are identified and dealt with.

The dynamic that has worked most profoundly to disempower teachers in relation to pedagogical theorists is the location of pedagogical theory at the speculative edge of psychology. In a preparadigmatic context, each branch of psychology pursues it's independent intuitions about learning, but always peripherally attentive to the interests and accomplishments of its competitors. The trajectory of research tends to be outward from powerful, but local, initial insights toward the broader concerns of the field, a trajectory inevitably marked by increasing theoretical complexity and opacity. Because our discourse constructs good teaching as an integrated set of practices, education must draw from those aspects of psychological theory that most fully embody a comprehensive vision of learning, always to be found at the speculative edge of any approach.

There is something inherently unsound about an applicative field that draws on the most opaque and least secure aspects of a science. Imagine, for instance, if engineers had to master the latest version of string theory or dark matter in order to erect bridges or build electrical circuits. Then

physicists would constantly need to be holding the engineer's hand, developing oversimplified accounts that might still be instrumentally useful, modeling engineering practices rather than explicating principles, concealing the partial and incomplete nature of their own grasp of the theory from the practitioners who rely upon them for guidance, and retooling engineering discourse whenever a newer formulation of the theory gained currency in the academy.

Ironically, stepping back from our partnership with psychology in its search for a unified comprehensive account of learning enables us to help constitute pedagogical discourse as more intellectually rigorous and grounded. For the discrete notions of learning that motivate educators have resonances in various of the psychological schools. By restricting our interest singly to independently coherent notions of learning, we are able to draw much more from the core insights of the various psychological schools, eschewing the complex and opaque cutting edge. In this way, we articulate models of good teaching that are more stable, and more intellectually tractable, thereby facilitating intellectual autonomy for the field of the pedagogical practice.

To understand what is at stake in this change in relationship to the world of practice it is useful to observe the bifurcated results of the current pedagogical reform movement. The good news about teaching reform always seems to involve teachers in extended engagement with psychological theorists together thinking through the dynamics of learning/teaching taking place in the classroom–what are now commonly referred to as *design experiments* (Brown, 1992; Collins, 1992; Confrey, 2006). These are symbiotic relationships in which theorists provide the intellectual and values parameters in development of teaching models that come to be embodied in the practices of their teacher colleagues. Within this relationship, teachers are effectively enculturated into a complex system of ideas about how learning, holistically conceived, is supported by newly framed practices of teaching. It is these exemplary instances of teaching that have come to serve as models and inspiration for the pedagogical reform movement.

The bad news about pedagogical reform comes in the efforts to scale-up teacher preparation programs beyond the immediate enclave of the researcher to the broader professional community. For without more transparent and accessible principles of learning, the complex vision of teaching reform loses all intellectual shape: "Activities, as opposed to ideas, are the starting points and basic units of planning, and little thought is given to the intellectual implications of an activity" (Windschitl, 2002, p. 138). As Knapp (1997) observed in his review of systemic reform efforts in mathematics and science education, "the more easily imported practices (e.g., the use of manipulatives in mathematics in the elementary grades) have become part of teachers' repertoires, while the full understanding of what these practices may mean has not" (p. 255) (see also, Cohen, 1990; Oakes, Hunter-Quartz, Ryan, & Lipton, 2000; O'Connor, 1998).

As tempting as it may be to blame teachers for their inability or unwillingness to grasp the subtlety, depth, and nuance of our pedagogical inventions, the responsibility for articulating coherent and accessible theorizations of teaching and learning rests with us, not them. Crossdisciplinarity reminds us that psychology has yet to achieve a consensus about the nature and character of learning that could serve as the basis for explicating how practices of good teaching, holistically conceived, are intended to support learning. In the meantime, we can continue to hold up for teachers the grand illusions of coherence that reflect the *aspirations* of psychological science, or we can cobble together a set of petite visions grounded in psychology's actual accomplishments across its various schools. Choosing the latter option, we relinquish our intellectual monopoly over education's intellectual capital; as well our privileged voice in the values issues of pedagogical practice.

The Crossdisciplinary Framework

The crossdisciplinary framework is built around 3 metaphors for learning. Learning as *habituation*, addressed in behaviorist and some cognitive science theories, informs the educational goal of skill acquisition. Learning as *construction*, addressed in Piagetian constructivist learning theories, informs the educational goal of concept development. Learning as *enculturation*, addressed in sociocultural theories, informs inculcation of valued cultural dispositions as an educational goal. The ontological claim for these metaphors is not biological or genetic–I am not proposing that human beings come equipped with three distinct learning mechanisms corresponding to the three metaphors. Rather, the claim is that these metaphors underlie our cultural commonsense about learning and motivate the diverse educational practices and projects associated with teaching across the broad span of education. For instance, note that NCATE (2002) structures its evaluation of teacher education programs around documentation of skills, knowledge, and dispositions–learning products that correspond with the three metaphors. However, the crossdisciplinary metaphors were arrived at independently, as my own distillation of education's valued learning goals.

It might seem a framework based on culturally given categories needs no theoretical elaboration. However, our metaphorical intuitions about learning of skills, concepts, and dispositions have been taken up into an integrative discourse that subverts the distinctive character of these learning products. It is common to talk of "understanding the skill," "practicing the concept," or "inculcating thinking skills," each of which intermixes metaphors for learning. The theoretical work of crossdisciplinarity, undertaken in this section, is to refine the notions of learning as habituation, construction, and enculturation so that skills, concepts, and dispositions become articulated as discrete learning products, making our discourse resistant to the rampant mixing of metaphors that undermines the possibility for intellectual coherence.

In refining these learning metaphors, psychology has been an invaluable resource. For psychology often draws from our culturally shared metaphors for its basic images and intuitions (Leary, 1994; Olson & Bruner, 1996; Sternberg, 1997). As Fletcher (1995) put it, our culture's "folk psychology is built into scientific psychological theories in a more thoroughgoing fashion than is commonly realized" (p. 97). Psychology is valued as a fellow inquirer into matters of mutual concern.

That said, this relationship is not the accustomed one in which psychology provides the sole, authoritative definition of learning for education. As we will see, psychology is uneven in its elaboration of these key metaphorical senses of learning, forcing us to draw on other sources for insight. More importantly, as a preparadigmatic science psychology's imperative is to span and ultimately unite the broad interests in learning. Thus psychological theory tends to move in the wrong direction, away from simple but local characterizations of learning and toward complex interpretations that seek to bridge disparate intuitions. As a result, my use of psychology is highly selective, calling only on those theories that most effectively highlight a single metaphorical notion of learning, often relying on earlier, more narrow, versions of the theory over contemporary forms. Psychology is an important resource, but the guiding intuitions for these three sketches of learning are the culturally given meanings for the metaphors themselves, as interpreted in education's varied pedagogical projects.

The collage of metaphors offered here is not dissimilar from the framework of *behaviorist*, *cognitive*, and *situative* approaches chosen by Greeno, Collins, and Resnick (1996) to organize their analysis of perspectives on cognition and learning. However, this proposal shifts some of the categories in their standard rendering. For Greeno, Collins, and Resnick (1996), the cognitive rubric combines "general cognitive abilities, such as reasoning, planning, solving problems, and comprehending

language" with "understanding of concepts and theories in different subject matter domains" (p. 16). The constructivist rubric offered here includes only understanding of specific conceptual content, with general cognitive abilities seen as arising from cultural enmeshment. Correspondingly, my enculturation rubric extends beyond a situative "focus on processes of interaction of individuals with other people and with physical and technological systems" (p. 17) to include the general cognitive abilities that may develop through such cultural enmeshment (Figure 1). This realignment is consistent with Cobb and Steffe's (1983) Piagetian distinction between *microschemes*, which are "'content' oriented" and *macroschemes*, which are "'thought' oriented" (p. 87), of which only the former are investigated in constructivist teaching experiments (see also Sternberg, 2008).

<table>
<tr><td colspan="4">Greeno, Collins, and Resnick (1996) model</td></tr>
<tr><td>BEHAVIORIST APPROACH</td><td colspan="2">COGNITIVE APPROACH</td><td>SITUATIVE APPROACH</td></tr>
<tr><td>skills</td><td>subject matter concepts</td><td>general cognitive abilities</td><td>processes of interaction</td></tr>
<tr><td>HABITUATION</td><td>CONSTRUCTION</td><td colspan="2">ENCULTURATION</td></tr>
<tr><td colspan="4">Crossdisciplinary metaphors</td></tr>
</table>

Figure 1. Alignment of the crossdisciplinary framework with a standard learning theory framework

It should be noted that theories of learning–however organized–cannot determine pedagogical methods, any more than biological understanding of a disease determines a medical treatment. Nevertheless, in education as in medicine having a clear perspective on the processes one is attempting to influence is of central importance to practice. The pedagogical methods presented here are informed directly by insights into learning, as newly construed in this work. As well, this organization of learning theory helps us to disentangle viable elements of pedagogical intention that are sadly knotted together within our current integrative discourse on learning and teaching. In important ways, the pedagogical methods presented here are a distillation of the many of currents of contemporary pedagogical theory.

Teacher Centered and Student Centered Pedagogies:

The crossdisciplinary framework encompasses two pedagogical methods for each of the three learning metaphors, a student centered pedagogy and a teacher centered pedagogy. In the usual pedagogical discourse student centered (or learner centered) and teacher centered are code words for reform-oriented instruction and traditional instruction within a polarized discursive frame. There is an underlying difference in attitude about the respective roles of students and teachers signaled by the two rubrics. Teacher centered instructors provide resources for learning that students, as independent learners, are expected to capitalize on and internalize. Student centered teachers worry that students may not be positioned to benefit from these bare instructional resources, so structure pedagogical practices to provide more extensive support for learners (McCombs, 2003).

In the crossdisciplinary uptake of this construct, student centered and teacher centered methods are both seen as legitimate; however, whether teacher centered methods are appropriate depends on special student characteristics that would enable independent uptake of the instructional resources provided by the teacher. Refracting the notion of student centered and teacher centered

across the 3 metaphors, for each metaphor I articulate a student centered pedagogy appropriate for all students, and a teacher centered pedagogy appropriate only for students with certain characteristics. However, the student quality that enables independent uptake of learning resources varies from one learning metaphor to the next, depending on the key student characteristic associated with that particular learning metaphor.

METAPHOR	**Habituation**	**Construction**	**Enculturation**
WHAT IS ACQUIRED	Skills	Concepts	Dispositions
PEDAGOGICAL OBJECTIVE	Proficiency with Routine Exercises	Conceptual Restructuring	Culturally Appropriate Participation
STUDENT CENTERED PEDAGOGY	Extrinsically Motivated Repetitive Practice	Hypothetical Learning Trajectory	Nurture Classroom Microculture
TEACHER CENTERED PEDAGOGY	Repetitive Practice	Lecture	Modeling (acculturation)
TEACHER CENTERED REQUIREMENTS OF THE LEARNER	Motivated Learners	Metacognitively Sophisticated Learners	Culturally Identified Learners

Figure 2. Crossdisciplinary framework of pedagogical practices

Figure 2 provides a schematic overview of the crossdisciplinary framework, including student centered and teacher centered pedagogical methods for each of the three learning metaphors, and student characteristics that authorize the teacher centered pedagogy as educationally appropriate. My claims for the crossdisciplinary framework are alarmingly comprehensive:

- The metaphors of habituation, construction, and enculturation constitute the underlying cultural commonsense about learning that motivates all of our pedagogical enterprises; and

- The 6 pedagogical methods encompass the pedagogical intuitions for supporting student learning realized in the varied pedagogical proposal that have been, and continue to be, introduced into the space of pedagogical practice.

So the framework offered here is not just a set of resources for organizing teaching practice, but an analytic tool for untangling and evaluating all pedagogical methods, proposed and realized.

Such sociology of knowledge claims are not easily established, certainly not within a single paper. However, the final two sections of this paper provide a start toward this goal, as we apply the crossdisciplinary framework to unpack the learning intentions of key pedagogical methods, thereby gaining insight into a wide range of vexing issues and problems of pedagogical theory and practice. It is this relentless resolution of issue after issue through crossdisciplinary analysis that suggests the utility of adopting the crossdisciplinary framework as the discursive heart of a new pedagogical strategy.

Learning as Habituation

Habituated learning is association of stimulus and response patterns through repetitive practice. While long the focus of behaviorist learning theories, habituated learning perhaps is most cleanly illustrated in the *Implicit Learning* studies of cognitive psychology (Reber, 1967; Stadler & Frensch, 1997).[2] In this genre of research, complex correlations among stimuli and responses are established through repetitive exposure. In a typical study, subjects are provided some pretext for attending to a stimulus set, without reference to underlying structures that are the actual learning target. For instance, subjects may be directed to memorize a list of letter strings without being told the letter strings have been generated by a finite state grammar according to certain fixed rules (Reber, 1967). With sufficient exposure, subjects show evidence of having acquired competencies related to the grammar, for instance, they "recall" grammatical strings they've not encountered more frequently than non-grammatical strings consisting of the same letters. Interestingly, subjects in such studies typically have no conscious awareness that they have learned a pattern, or even that there is a pattern to be learned.[3]

It's important to emphasize that habituated learning is not an intellectual process of "figuring out" the structure of the stimulus domain. Rather, features of the patterns of co-occurrence and covariation become operationally linked in the cognitive system. As Reber (1993) explained,

> When a cognitive scientist constructs a stimulus environment, he or she may do so on the basis of some set of principles that have the effect of creating an environment that reflects particular patterns of co-occurrence and covariation among its elements. But [for subjects] there are no *rules* here, just patterns of co-occurrence and covariation. The cognitive scientist may *think* that there are rules that characterize these covariations, and in fact, she or he is certainly entertaining a particular clutch of these–namely, the ones begun with. (p. 116)

Skills Versus Concepts

The fact that habituationist learning is not a matter of consciously mastering some underlying grammar of relations doesn't mean that conscious processes can have no role in facilitating

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[2]As Reber (1993) noted, "there are remarkably close ties between the typical experiment on implicit learning and the standard study of conditioning. The commonality lies in the detection of covariation between events, which, I will argue, is the deep principle in processes as seemingly disparate as classical conditioning and implicit learning. Moreover, this conceptual parallel can be shown to hold, even though on the surface the implicit learning experiment appears to be one of abstract induction and the conditioning experiment one of simple association" (p. 7).

[3]This last statement is hotly controversial, and most often denied by current scholars. When Reber first introduced this paradigm about 40 years ago, he named it implicit learning with the clear intention that explicit, conscious representations of the underlying structures were not present, or not relevant to learning. His initial studies aroused no interest among psychologists for almost two decades (Berry, 1997). When interest began to grow in this paradigm, psychologists were deeply uncomfortable with the complete segregation of implicit from explicit knowledge. Berry's (1997) edited volume, *How Implicit Is Implicit Learning*, and Frensch & Cleereman's (2002) *Implicit Learning and Consciousness* show the range of opinion on the matter. Critics of the fully implicit character of implicit learning have gone to great lengths to document trace aspects of conscious awareness connected with implicit learning studies. Could this reflect preparadigmatic angst at the possibility of separate constructions of learning?

learning. Indeed, explicit instruction about underlying relations has been shown to focus the perceptual apparatus on relevant aspects of the stimulus display thereby facilitating the implicit process of feature correlation and consequently increasing the rate of learning:

> The most plausible interpretation [of our study] here, and the one that has interesting applications for theories of instruction, is that the function of providing explicit instructions at the outset is to direct and focus the subjects' attention. It alerts them to the kinds of structural relations that characterize the stimuli that follow and permits appropriate coding schemes to be implemented. Yet, these instructions do not teach the grammar in any full or explicit fashion; instead they oriented the subjects toward the relevant invariances in the display that followed. (Reber, 1993, p. 51)

The fact that instructors may use a set of rules to generate a stimulus set, and that students benefit from explicit presentation of those rules, has led to considerable confusion about the nature of the learning that ensues from repetitive practice. Educators often conclude that students demonstrating intended skills have understood the rules conceptually, and that this understanding is the basis for successful performance. Neither of these conclusions is warranted given the interpretation of habituated learning presented here.

Skills Versus Dispositions

In our current educational discourse we routinely speak, for instance, of *problem solving skills*, *critical thinking skills*, and *classroom citizenship skills* as instructional objectives. Yet in the crossdisciplinary framework, these are dispositions–distinct from skills, and addressed through pedagogical methods very differently conceived from skills instruction.

To demarcate skills from dispositions, I draw on Chomsky's (1959) critique of Skinner's (1958a) efforts to extend the analysis of behavior to include verbal behavior. The theoretical language of behaviorism extols the objective character of stimuli and responses. Control of behavior requires clear demarcation of stimulus events from non-stimulus events. Similarly, response events need to be rigorously characterized for conditioned learning to be operationalized. Yet this objective character of stimuli and responses was deeply compromised in Skinner's (1958a) work (Chomsky, 1959).

The issue, here, is primarily methodological. Experimentally, or instructionally, one can set out to shape behavior only to the extent one can clearly demarcate stimulus and response events sets for organizing regimes of practice and feedback. For instance, the implicit grammar learning studies use a dedicated symbol system that occurs only in the experimental setting, and thus is demarcated from other aspects of subjects' experience. Similarly, one can interpret, say, routine algebraic symbol manipulation as a skill in that it occurs within a dedicated symbol system and involves codified problem types. A dedicated symbol system is not prerequisite for behavioral control, but its absence still requires clearly demarcated stimuli and responses. For instance, memorizing a verbatim definition occurs within a widely used linguistic system; however, the rigidly defined symbol string demarcates a uniquely identifiable response.

Habituation breaks down as a metaphor for learning useful for teaching in cases where the stimulus or response sets are not demarcated from other elements in the learner's experience. For instance whereas a routine response to routine mathematics word problems can be considered a skill, heuristics for non-routine problem solving resist such codification and are classified here as

dispositions. Heuristic rules are rules-of-thumb that defy the rigorous characterization needed of skills (Polya, 1957), even as non-routine problems lack the defining structural similarity that enables organized regimes of repetitive practice. Similarly, raising one's hand and speaking are distinctive elements of the classroom environment which can become linked through repetitive association organized by a teacher or trainer. However, classroom citizenship more broadly defined resists such codification. For instance, dropping a pencil in class could be an instance of bad classroom citizenship or just a transient event unrelated to classroom citizenship. Disambiguating such instances requires a reference to cultural context, which throws one into the enculturational frame.[4]

Habituationist Pedagogies:

The requirement of well-defined behavioral learning outcomes in behaviorism should not be confused with simplicity of structure. The implicit learning studies can involve complex grammatical relations, even as behavioral learning studies have shaped complex response repertoires. Depending on the particular character of the skill to be developed, the first obligation of instruction is to systematically organize repetitive practice across the range of stimulus conditions so that appropriate subsymbolic discriminations can be established implicitly. Importantly, as noted above, explicit instruction in the form of demonstration and explanation can help focus the perceptual apparatus and facilitate skill development (Reber, 1993). However, this should not be confused with conceptual goals of having students understand the content. For instance, Kirshner and Awtry's (2004) study suggests that non-native speakers could benefit from demonstration of algebra procedures almost as much as native speakers, because algebraic skills are anchored to the visual/spatial organization of symbols in the written text, rather than to explicit propositional accounts of algebraic structure.

Teacher Centered and Student Centered Variations: Gaining substantial skill through habituationist learning requires a great deal of repetitive practice. The responsibility of the teacher centered habituationist instructor is to provide properly organized and sequenced tasks for the student to engage with. This form of instruction is appropriate and effective for students who are independently motivated to persist with these tasks.

Student centered habituationist instruction addresses itself to the student who is not independently motivated to persist with repetitive routine exercises. In this case, the teacher uses a variety of devices to extrinsically motivate students. For example game formats, competitions, praise and encouragement, regimens of reward, and the like are incorporated into instruction to facilitate student persistence with repetitive routine exercises.

Learning as Construction

The construction metaphor draws from Piaget's theories of conceptual development, especially as refocused away from macrogenesis (Piaget's theory of the stages of general conceptual maturation) and toward microgenesis (the development of particular conceptual content) (Steffe & Kieren, 1994), and interpreted in the radical constructivist tradition (e.g., von Glasersfeld, 2000). Conceptual

[4]The issue here is not one of basic learning mechanisms; it's possible the same learning mechanism subserves both habituation and enculturation. The issue is instructional. In order to teach a skill one needs to be able to organize regimes of repetitive experience. This requires clear demarcation of exemplars of the skill from non-exemplars. Lacking this, inculcation of dispositions must draw on a different pedagogical framing.

development as understood in this tradition is an adaptive process. The basic building blocks of conceptual structure are the experienced regularities of our goal-directed actions upon the world, *schemes* in Piaget's (1970) terms. Schemes enable us to anticipate the results of experience, and hence are crucial for the constructive process which is stimulated by "active self-discovery of discrepancies between [expectations derived from] current concepts and actual outcomes" (Brainerd, 2003, p. 271). These discrepancies, or cognitive conflicts, can lead to conceptual restructuring which serves to make the cognizing subject more viable, better able to negotiate the world. This is not a matter of mental schemes coming to more accurately match the world, but of better internal consistency within our personal world of experience. Our experience of the world always is mediated by our current conceptual structures, hence we have no possibility of objective knowledge of the world (von Glasersfeld, 1995).

The idea that concepts emerge and take shape along completely individual and subjective trajectories has led to vociferous criticism of radical constructivism as solipsistic, as picturing the cognizing subject to be encapsulated within its own experience, cut off from essential contact with others (Gergen, 2002; Howe & Berv, 2000; Lewin, 1995; McCarty & Schwandt, 2000; Phillips, 1995). This leads, on the one hand to moral relativism; on the other to an inability to account for intersubjective knowledge:

> Most philosophers charge that solipsism fails as an epistemology, since no has been able to explain adequately how the vast amount that we know on the basis of interpersonal contact ... could be reconstructed on a strictly individual basis. ... von Glasersfeld has responded that, in radical constructivism, there is a need for the individual to construct others, for there have to be (constructed) others to corroborate individual construction. Hence, argues von Glasersfeld, his view is not solipsistic. Unfortunately, this response remains unconvincing. Since the other is constructed and is not independent of the individual mind, it is hard to see what could be meant by "corroboration" here. If the only corroboration I ever get for my ideas is the agreement of creatures who owe their very existence to me, then my ideas are never truly and independently corroborated. (McCarty & Schwandt, 2000, p. 51)

What is important to note about these criticisms is that they point to limitations in the <u>scope</u> of radical constructivism, they are not attacks on the <u>coherence and internal consistency</u> of the theory–indeed, what position could be less assailable than solipsism to charges of internal inconsistency? For the crossdisciplinary project, this distinction is crucial. In abandoning the quest for a comprehensive theory, our interest is exclusively focused on the coherence of the core intuition of a given theorization–even, as indicated in the above quotation, if that core idea is later repudiated or qualified by its lead theorist. The solipsistic character of radical constructivism is one of the principle reasons for adopting the radical constructivist perspective on conceptual construction, for it is the principle of solipsism that highlights the teacher's isolation from the student–the tentative, conjectural nature of her or his model of students' conceptual structures, and the impossibility of transferring one's own ideas to them.

<u>Student Centered Constructivist Pedagogy</u> (Note that "Constructivist Pedagogy" receives a technical definition within the crossdisciplinary framework distinct from much common usage.) From his biological perspective, Piaget understood conceptual development as occurring spontaneously out of an organism's engagement with its environment. He entered educational discourse with reluctance, initially recommending that early childhood educators best facilitate development by providing a rich environment for children to play:

> For Piaget, the key ingredient of construction episodes was the active self-discovery of discrepancies between current concepts and actual outcomes. He argued that this is absolutely essential for children to stumble across such discrepancies *on their own* if cognitive development is to occur. It is not productive, he thought, for teachers and other adults to spell out discrepancies for children or to correct children's erroneous ideas deliberately. This, he thought, circumvents the linchpin of cognitive development, the self-discovery process. (Brainerd, 2003, pp. 271-272)

In student centered constructivist pedagogy, we maintain the Piagetian perspective that learning is occasioned by the student's self-discovery of discrepancies that arise in engaging with an environment. However, it is still possible to articulate a pedagogical agenda that supports the students' productive self-discovery of discrepancies. To facilitate conceptual development in this pedagogy, the teacher needs to have a model (always tentative) of the student's current conceptual structures, including the limitations of those structures relative to a mature understanding of the particular content to be taught. Based on that model, the teacher devises a task environment expected to lead the student to encounter the limitations of their current conceptions in ways that might be productive of conceptual restructuring. This anticipated path of development has been characterized as a "hypothetical learning trajectory" (Clements & Sarama, 2004; Simon, 1995). In this way, "learning is not spontaneous in the sense that the provocations that occasion it might be intentional on the part of the teacher-researcher. In the child's frame of reference, though, the processes involved in learning are essentially outside of his or her awareness" (Steffe & Thompson, 2000, p. 290).

Providing such a task environment does not exhaust the student centered constructivist teacher's obligation. The teacher also helps mediate the student's engagement with the task by (1) monitoring the student's uptake of the task, making minor adjustments or redirections, as needed, (2) closely observing the student to assess the effectiveness of the task in stimulating development, as intended; this may lead to rethinking and revising the model of the student's understanding, and/or the task environment, (3) responding to the student as they engage with the task to help them experience the discrepancies it provokes more fully, and (4) encouraging the student through the frustration that arises when conceptual obstacles are encountered. The success of this methodology requires the teacher to establish and maintain a "close personal and trusting relationship" (Steffe, 1991, p. 178) in which the student's expressed ideas always are valued (see also, Ginsburg, 1997, p. 113). As well, expressed ideas better enable the teacher to monitor the effectiveness of the task environment, and may help the student to notice the discrepancies that are productive of learning.

In developing this pedagogical model, I've relied heavily on Steffe and Thompson's (2000) account of the Constructivist "Teaching Experiment," a clinical research methodology in which a researcher works with one or two students to develop a model of children's conceptual structures by observing those structures in transition. But in the context of classroom instruction, how can one teacher possibly attend in such detail to the cognitive development of many students? Indeed, how can we even conceive of instruction along these constructivist lines if each student's conceptual understanding of a topic is presumed to follow uniquely from their idiosyncratic personal history of understanding? In my view, this theoretical and practical conundrum is responsible for the migration of many educators away from radical constructivism and toward social constructivism, a set of framings that provide much broader theoretical resources, but at the cost of the basic coherence and simplicity of radical constructivism (Lerman, 1996).

My own resolution is to apply the constructivist perspective recursively to the teaching process. As a practical matter, the teacher is not going to be able to develop independent conceptual models of each student in the class. More likely, she or he will work from a single developmental trajectory (perhaps gleaned from the literature) along which students may be variously located. The constructivist question isn't whether this trajectory is correct or accurate as a representation of the diverse student conceptions, but whether it is viable for the purpose at hand: Can tasks developed in respect to this trajectory and mediated in a classroom setting be effective for many students? This is an empirical question, the answer to which often is yes: "The very general constructivist heuristic of paying attention to naïve ideas seems powerful, independent of the details of conceptual change theory. Interventions that merely teach teachers about naïve ideas have been surprisingly successful" (diSessa, 2006, p. 276).

Of course, the classroom setting still is a tricky environment to enact this student centered constructivist pedagogy. Having students work on tasks at their own desks may enable individual students to engage with the task, but limits the possibilities for verbal expression and teacher mediation. Small group arrangements may provide opportunity for students to express their understandings and receive feedback from peers, but the quality of the feedback may be weak. Whole class instruction may enable many students to express their understandings, but limits the opportunity for sustained reflection that students may need to develop their understanding. Effective constructivist pedagogy does not impose a single classroom format on instruction, but it does require the teacher understand the pedagogical enterprise and work to overcome the limitations of whatever format is chosen.

Teacher Centered Constructivist Pedagogy

The pedagogy of student centered construction, just described, requires extraordinary efforts and talents on the part of the teacher to orchestrate cognitive conflicts and help make them salient for the learner. These efforts are needed because of the chancy character of conceptual construction:

> Although the effectiveness of cognitive conflict in leading to subjects' conceptual change is corroborated both in the literature on science education and reading education ... its effect is not automatic. The effectiveness of cognitive conflict depends on the way comprehension is monitored. It depends, first, on the individual noticing the inconsistency and, second, on the way it is resolved. (Otero, 1998, p. 149)

Otero's (1998) observation points to a critical student characteristic that can decrease the need for such strenuous pedagogical intervention: metacognitive sophistication. A student who is metacognitively sophisticated will be more likely to notice contradictory elements and hence to work to resolve them.

The teacher centered constructivist teacher adopts the most obvious and typical pedagogical method for helping students understand concepts: lecture–direct explanation of the mature form of a concept. From a constructivist perspective, lecture succeeds when students have the metacognitive sophistication to orchestrate their own cognitive conflicts; to project the incoming explanations into hypothetical situations that conflict with the expectations generated by their own current conceptual structures. In this case, the teacher's role is limited to organizing and delivering the mature form of the concept. She or he need not have a model of the student's understanding, nor design and mediate tasks relative to that model. Indeed, the teacher need not even adopt a

constructivist perspective on learning and teaching, but may happily believe themself to be transmitting their understanding directly to the student.

Lecture is fully appropriate as a pedagogical method whenever the student's metacognitive sophistication is sufficient to accommodate the gap between current and mature forms of the concept. Students who are relatively sophisticated metacognitively may be unable to productively integrate lecture material concerning very difficult concepts. And even students who are relatively unsophisticated metacognitively can benefit from lecture for sufficiently simple conceptual content.

Learning as Enculturation

I take enculturation to be the process of acquiring dispositions through enmeshment in a cultural community. I interpret dispositions broadly as tendencies to engage with people, problems, artifacts, or oneself in culturally particular ways. The likelihood of acquiring a disposition may be influenced by genetic predispositions. For instance, one might say of someone they have a predisposition toward logical thinking, or they're naturally inclined to be shy. However, predispositions to engage only find expression as dispositions within the context of culture (??).

Note, this interpretation of dispositions differs from the more typical cognitive science rendering in which forms of cognitive engagement are naturalized as capabilities of the cognitive apparatus (e.g., critical thinking, metacognition, general problem solving strategies) (Greeno, Collins, & Resnick, 1996). Dispositions, thus, are reduced just to inclinations or tendencies to employ those capabilities. For instance, Perkins and Ritchhart (2004) present a framework for good thinking based on "viewing dispositions as initiators and motivators of abilities rather than [thinking] abilities themselves" (p. 179).

My interpretation of forms of cognitive engagement, themselves, as cultural products is consistent with Vygotsky's (1981) view that, "the very mechanism underlying higher mental functions is a copy from social interaction; all higher mental functions are internalized social relationships.... Their composition, genetic structure, and means of action–in a word, their whole nature–is social" (p. 164). As well, his practice of mainstreaming special needs children so that they could participate in the cultural development of normal children is consonant with notions of enculturation (Tudge & Scrimsher, 2003).

However, it is noteworthy that Vygotsky (1981) expressed a perspective of higher mental functioning as originating in social relationships, rather than as inherited from the cultural context. Of course, these are not contradictory positions. As a sociohistorical theorist, Vygotsky understood social practices, themselves, to be historically shaped. However, his focus on the social context shows Vygotsky as primarily interested in the emergence of higher mental functions through the active co-participation of the child. His theorization of learning, therefore, is dialectical, doubly focused on the social surround and the individual as jointly producing learning:

> Sociocultural processes on the one hand and individual functioning on the other [exist] in a dynamic, irreducible tension rather than a static notion of social determination. A sociocultural approach ... considers these poles of sociocultural processes and individual functioning as interacting moments in human action, rather than as static processes that exist in isolation from one another. (Penuel & Wertsch, 1995, p. 84)

This seems also to be the case for other theoretical traditions that explore the enculturation metaphor. For instance, Lave (1988) "in dialectic spirit" describes how for situated cognition theory the "units of analysis, though traditionally elaborated separately [for social and individual cognitive theories], must be defined together and consistently" (p. 146). Similarly, (Ernest, 1998) finds "at the center of social constructivism lies an elaborated theory of both individual or subjective knowledge and social or objective knowledge–equally weighted…–and the dialectical relation between them" (p. 241).

The dialectical vision of the individual as actively co-producing learning within a social context pulls the extant socially oriented theories beyond the simple metaphorical notion of enculturation as cultural absorption featured in the crossdisciplinary framework. This extension of learning theory beyond the basic enculturation metaphor is mirrored by the tendency in pedagogical theory to conceive goals of acquiring dispositions only in conjunction with acquiring of skills or concepts. For instance, Greeno, Collins, and Resnick (1996) describe a unifocal pedagogical approach for achieving behaviorist goals and another for achieving cognitive goals. However, for their situative approach, "sequences of learning activities can be organized with attention to students' progress in a variety of practices of learning, reasoning, cooperation, and communication, as well as to the subject matter contents that should be covered" (p. 28). Thus, both psychological and pedagogical theorists have failed to provide the kind of unifocal attention to enculturation bestowed upon the other metaphors for learning.[5]

Lacking a foundation for enculturation in unifocal learning theory, I turn to sociological research undertaken within social psychology that catalogues the effects and distribution of dispositional variation. A paradigmatic example of enculturation is explored by social psychologists under the rubric of proxemics (Hall, 1966; Li, 2001). Proxemics, or personal space, is the tendency for members of different national cultures to draw differing perimeters around their physical bodies for various social purposes. For instance, natives of France tend to prefer closer physical proximity for conversation than do Americans (Remland, Jones, & Brinkman, 1991). I count acquisition of proxemic dispositions as a particularly pure instance of enculturation because it is accomplished without volitional participation. Generally people within a national culture acquire proxemic dispositions through cultural enmeshment without intending it, and even without awareness of the cultural norms.

This pure form of enculturation is possible in a unitary culture in which only a single dispositional variation is present. However, one also can come to be enculturated into a subculture whose dispositional characteristics are distinctive among a range of alternatives (e.g., being a teacher, being a scientist, being a punk rocker). In such instances, inductees often seek to actively acculturate themselves to a subculture, thereby bringing volitional resources to acquiring the subculture's dispositions. I define acculturation as intentionally "fitting in" to a cultural milieu by emulating the cultural dispositions displayed therein. However, this process needs to be understood as embedded within pervasive unconscious processes of enculturation going on around it all the time. A cultural milieu is constituted of innumerable dispositions, of which only a limited number can be consciously addressed through strategies of acculturation. Note that Vygotsky's (1987) Zone

[5]We can only speculate as to why enculturation has not commanded unifocal attention from psychologists and educators. Does this neglect reflect a specter of dualism which values the mind ahead of body, individual ahead of collective (??)? Is it a response to a presumed social contract of schooling that renders dispositions an inadmissable focus for evaluation? Are cultural influences considered too politically radical, opening spaces for counter hegemonic pedagogies of resistance (??)?

of Proximal Development conceives of learning through instruction in ways that are consistent with acculturationist interpretations of learning, rather than the more basic enculturationist processes: "A central feature for the psychological study of instruction is the analysis of the child's potential to raise himself to a higher intellectual level of development through collaboration to move from what he has to what he does not have through imitation" (p. 210).

Educational interest in developing students' dispositions has burgeoned in recent decades, frequently with respect to disciplinary cultures. For instance, van Drie & van Boxtel (2008) address students' "historical reasoning," and Sexias (1993) developed communities of inquiry in the classroom to establish "criteria for historical evidence, methods of determining historical significance, and limits on interpretive license" (Windschitl, 2002, p. 149). Lampert (1990) orchestrated classroom discussion "to parallel the standards for argument in the mathematical community more closely, as truth came to be determined by logical argument among scholars" (p. 35). And Eichinger, Anderson, Palincsar, and David (1991) organized classrooms "so as to reflect particular forms of collaborative enquiry that can support students in gradually mastering some of the norms and practices that are deemed characteristic of scientific communities" (Driver, Asoko, Leach, Mortimer, & Scott, 1994, p. 9).

However, the reference culture need not be a disciplinary culture. For instance, "whole-language advocates see reading as a social, cultural activity–participating in communities of practice within which reading and writing are normal activities and thus are acquired as needed by all members" (Snow, 2001, p. 232). Presumably, the reference culture in this case is some version of "literate society" which may be a subculture of the broader culture marked by social class. Similarly educational goals like critical thinking, metacognition, democratic values, multicultural practices, and so on reflect agendas of cultural development that implicitly value a particular reference culture. The inherently political questions about which cultures are to be promoted within educational settings are made explicit in the crossdisciplinary focus on enculturation.

Enculturation Pedagogy

The enculturation/acculturation distinction points to two pedagogical strategies that can be discerned in the literature: a student centered *enculturation pedagogy*, and a teacher centered *acculturation pedagogy*. In the enculturation pedagogy, the teacher begins by identifying a reference culture and target disposition(s) within that culture. The instructional focus is on the classroom microculture. The enculturationist teacher works to shape the microculture so that it comes to more closely resemble the reference culture with respect to the target dispositions. Students, thus, come to acquire approximations of the target dispositions through their enmeshment in the surrogate culture of the classroom. Yackel and Cobb (1996) most clearly articulate an enculturationist pedagogical agenda in their discussion of *sociomathematical norms* as the targeted dispositions of mathematical culture (e.g., the preference for mathematically elegant solutions) that come to be "interactively constituted by each classroom community" (p. 475).

Enculturationist pedagogy presents the teacher with a "chicken and egg" problem. Students can acquire the target dispositions only to the extent these dispositional characteristics already are constituted within the classroom microculture. However, for the classroom culture to embody these dispositional norms, (at least some) students must already manifest them in their interactional repertoire within the classroom. Yackel and Cobb (1996) borrow the construct of "reflexivity" from ethnomethodology (Leiter, 1980; Mehan & Wood, 1975) to elucidate the problem:

> With regard to sociomathematical norms, what becomes mathematically normative in a classroom is constrained by the current goals, beliefs, suppositions, and assumptions of the classroom participants. At the same time these goals and largely implicit understandings are themselves influenced by what is legitimized as acceptable mathematical activity. It is in this sense that we say sociomathematical norms and goals and beliefs about mathematical activity and learning are reflexively related. (p. 460)

The solution to this problem constitutes the critical expertise of the enculturationist teacher. As Yackel and Cobb (1996) illustrate, through subtleties of attention and encouragement the teacher, over time, exerts considerable influence on the modes of engagement manifest within the classroom microculture. This is necessarily a progressive agenda in which modes of engagement initially encouraged by the teacher reach a level of general currency in the classroom microculture, eventually to be replaced by yet more sophisticated forms of engagement. For instance, a teacher who seeks to foster abstract forms of logical argumentation associated with mathematical culture initially may encourage empirical justification over argumentation based on deference to authority, only later to discourage empirical justification in favor of abstract implication (Stylianides & Stylianides, 2009). Thus, enculturationist teaching requires a long-term pedagogical intention undertaken by a teacher who is broadly knowledgeable about, not only the target disposition, but also the developmental precursors that may lead to it, as she or he works with whatever dispositional resources happen to be manifest in the classroom microculture at the current time.

In nurturing a more sophisticated classroom microculture, the enculturationist teacher is not limited to the (relatively passive) tools of encouragement. As a member of the classroom community, the teacher can introduce modes of engagement through her or his own participation. What is crucial, however, in enculturationist pedagogy is that the teacher's agenda for participation remain implicit within the classroom microculture. As soon as the agendas for participation becomes explicit, we enter into a politics of cultural identity that demarcates a shift to acculturation pedagogy.

Acculturation Pedagogy

Unlike enculturation pedagogy in which the teacher surreptitiously nurtures the classroom microculture as surrogate for the reference culture, acculturation pedagogy builds on the students' self-identification with the reference culture. The primary pedagogical activity in support of acculturation is modeling dispositional characteristics of the culture. Assuming students are identified with the reference culture and seek to acculturate themselves to it, this instruction provides them an opportunity to appropriate these cultural resources and incorporate them into their evolving repertoire of participatory practices.

The prerequisite for the acculturationist teacher is that she or he *signify* as a member of the reference culture. In the capacity of authentic cultural representative the acculturationist teacher models the mature dispositional practices of the reference culture. Seeking to acculturate themselves to the reference culture, it is the students' responsibility to appropriate the teacher's authentic practices. Note, this is a distinctly different requirement than that specified for the enculturationist teacher who needs not only to be knowledgeable about the reference culture, but also to have developmental perspectives on the characteristic dispositions of the culture. In this way, she or he can nurture increasingly sophisticated forms of the target dispositions as they emerge and develop within the classroom community.

Acculturationist pedagogical practices have obvious application to after-school clubs or to magnet programs into which students self-select based on their identity and aspirations; however, they may be of limited utility in general K-12 education–and even in much undergraduate level university education! I recently had the opportunity to co-teach a senior level university mathematics course with two mathematics colleagues. The purpose of the course was to help students understand, appreciate, and participate more fully in mathematical culture. My colleagues, both senior members of a highly ranked mathematics department, had considerable experience in successfully mentoring doctoral students. The approach they took in our course involved assigning the students problems, discussing the problems with them, and in the process modeling their own unprescripted solution approaches, following fascinating tangents arising from the original problem, communicating their broad perspectives on mathematics, and sharing their excitement and passion for the field. I presume these are methods they would typically employ, with good effect, with doctoral students–students already self-identified as mathematicians. However, the undergraduate students in the course–though seniors–generally were not self-identified as mathematicians, and hence unable to appreciate or make use of the rich cultural resources offered by the instructors.

Identity Politics: Cultures always are in transition under the influence of contact with other cultures (??). Society is teaming with cultural influences that individuals are exposed to in the course of normal social intercourse (??). Sometimes cultural markers are identified and either rejected or embraced depending on the cultural identifications and aspirations of the subject. But oftentimes, cultural influences play out in ways that are transparent to the subject. When I first arrived in the United States as a Canadian emigrant, people I met often commented on my pronunciation of words like “out” and “about” pointing to a phonemic distinction I was unable to perceive. Over the years, those remarks diminished and disappeared. Presumably, such unconscious cultural adaptations as pronunciation patterns are ubiquitous in the context of ordinary social intercourse.

The question of what cultural agendas are to become part of the school curriculum obviously is of broad social and political concern to a society. However, there is a special moral dimension that attaches to adoption of acculturationist pedagogical strategies. Insofar as pedagogical methods remain strictly enculturationist, targeted dispositions are acquired tacitly and organically, as part of general engagement in classroom activity. Students may gradually come to adopt normative cultural practices of the reference culture; however, there is no explicit requirement that this happen; nor are the teacher’s cultural goals made explicit to the student.

It is only insofar as one adopts an acculturationist approach, in which one expects students to actively adopt forms of engagement that are markers of a (possibly) remote cultural location, that one may entangle students in a politics of identity. When acculturationist pedagogy is utilized appropriately–with students who already are culturally identified with the reference culture–issues of cultural conflict or cooption do not arise. However, in our current discursive frame in which forms of cognitive engagement often are naturalized as part of the biological capability of the student, cultural boundaries often are not recognized; the authority of the school is used to enforce expectations that students participate according to the norms of a remote culture (??).

In general, enculturation and acculturation pedagogies have not been distinguished from one another in the literature. For instance, although Yackel and Cobb (1996) present a clear theorization for enculturationist pedagogical practices, they also underscore “the critical and central role of the teacher as a representative of the mathematical community” (p. 475)–a hallmark of acculturationist pedagogy. As a result issues of cultural cooption have not been well understood by educators.

Nor is there an easy resolution of the cultural issues that surface in this crossdisciplinary framing. Even when a teacher intends to adopt a fully enculturationist pedagogical practice, it may not always be possible to do so. In the case of mathematics education, students generally are unaware of mathematics as a distinct cultural location, nor are they aware of its characteristic dispositional markers. Thus, as demonstrated in Yackel and Cobb (1996), enculturationist pedagogies can be implemented seamlessly in mathematics classes. In contrast, notions of scientific method and scientific culture are so salient in the broader culture, that students are likely to interpret science instruction as culturally loaded, even when the teacher takes pains to grow scientific practices indigenously within the classroom microculture of the classroom. As Aikenhead and Jegede (1999) noted,

> when the culture of science is generally at odds with a student's life-world, science instruction will tend to disrupt the student's worldview by trying to force that student to abandon or marginalize his or her life-world concepts and reconstruct in their place new (scientific) ways of conceptualizing. This process is *assimilation*. Assimilation can alienate students from their indigenous life-world culture, thereby causing various social disruptions (Baker & Taylor, 1995; Maddock, 1981); or alternatively, attempts at assimilation can alienate students from science. (p. 274)

Concerns about cultural cooption have longstanding status in education. However, these concerns have tended to be voiced from the educational periphery of social critique (Secada, 2000). The crossdisciplinary framing of enculturation draws concerns about cultural cooption into the heartland of learning theory.

Crossdisciplinary Analysis of Curriculum and Instruction

For readers knowledgeable about the learning sciences, the foregoing sketches of learning and teaching rearrange elements of familiar and valued perspectives. Important theories surely are represented, but fragmented and selectively incorporated. The imperative of the learning sciences to forge a comprehensive theoretical synthesis of learning perspectives is ignored; metaphors for learning are presented as conceptually distinct, denying important and established truths about the mutual interdependence of skills, concepts, and dispositions.

In the remainder of this paper, I press the contrary view that our tradition of integrative theorizing distorts the independently coherent notions of learning described above that form the intuitive substrate of all of our pedagogical enterprises. The rhetorical strategy is to apply the lens of crossdisciplinarity to a broad range of issues and approaches that currently occupy education, thereby highlighting the lack of critical judgment available to us through the integrative lenses of our current framing. I begin this section, with an illustration of the method of crossdisciplinary analysis applied to a pedagogy of important historical significance in education, and then move on to examine contemporary pedagogical practices and key flashpoints educational controversies, highlighting negative consequences of a discourse that regularly and relentlessly dissociates theories of teaching from our intuitions about learning. In the next section, I re-view diverse educational concerns through crossdisciplinary lenses as grounding for the claim that the crossdisciplinary vision spans the broad terrain of our pedagogical interests.

B. F. Skinner's Programmed Instruction

Skinner introduced individually paced programmed instruction as an application of behavioral principles, one that he regarded as central to his legacy to education (Morris, 2003). In this instructional format, students are presented with a succession of text fragments (one or two sentences) each with a blank in place of a key word. The students' role is to read the text and supply the missing datum. The fragments are sequenced in such a way as to involve incremental progress from simple initial prompts to complex terminal performance. In this way it is anticipated students easily can maintain the 95% success criterion for progress to the next programmed lesson. Feedback is immediate and ongoing so as to reinforce participation.

Morris (2003, pp. 242-243) presents a sequence of 35 fragments dealing with electric currents and flashlight circuitry taken from Skinner's (1958b) illustration of programmed science instruction. Here are the first few statements from the sequence:

Sentence to be Completed	Word to be Supplied
1. The important parts of a flashlight are the battery and the bulb. When we "turn on" a flashlight, we close a switch which connects ... the battery with the _____.	bulb
2. When we turn on a flashlight, an electric current flows through the fine wire in the _____ and causes it to grow hot.	bulb
3. When the hot wire glows brightly, we say ... it gives off or sends out heat and _____ .	light
4. The fine wire in the bulb is called a filament. The bulb "lights up" when the filament is heated by the passage of a(n) _____ current.	electric
5. When a weak battery produces little current, the fine wire, or _____, does not get very hot.	filament
6. A filament which is *less* hot sends out or gives off _____ light.	less
7. "Emit" means "send out." The amount of light sent out, or "emitted", by a filament depends on how _____ the filament is.	hot
8. The higher the temperature of the filament the _____ the light emitted by it.	brighter; stronger

In addition to teaching the particular content, programmed instruction was believed to "teach students to study, for instance, to attend selectively to texts and to reject irrelevant material" (Morris, 2003, p. 244).

Performing a crossdisciplinary analysis of a curriculum instance is a matter of evaluating whether skills are promoted, whether concepts are promoted, and whether dispositions are promoted. If it seems the answer to any of these is yes, it is incumbent upon the analyst to identify the particular skills, concepts, or dispositions being addressed, to examine the pedagogy to determine whether a student centered or teacher centered approach is being used, and to evaluate the efficacy of the pedagogy according to the pedagogical principles laid out in the preceding section. In case multiple pedagogical methods are invoked in the curriculum instance, the analyst determines which learning goal(s) predominate, and evaluates whether the coordination of pedagogical methods is organized in a coherent and consistent fashion. In performing such an analysis, the analyst may consult the curriculum author's statements about the intentions and methods of the curriculum as a guide to what to look for within the curriculum. However, the author is not the analyst. The analysis must be grounded in the particulars of the curriculum and its implementation.

Given the authorship of these programmed instruction materials, we might expect to find skills being targeted based on habituationist learning principles. However, identifying particular skills proves problematic. Perhaps verbal response skills with respect to science vocabulary are promoted in this curriculum. For instance, students in science classes sometimes are required to memorize definitions and formulas through repetitive practice so that eventually the stimulus of the scientific term produces the response of a string of words or symbols. However, the amount of practice built into this programmed instruction with respect to individual technical terms is nowhere near sufficient to produce memorization. On the contrary, the sequential statements seem to be constructed so as to systematically develop an explanation of how electrical current functions to produce heat and light within a flashlight. The clear primary goal is to build up mental images and conceptual structures regarding current flow.

Examining the pedagogical method with respect to the construction metaphor, we note that the text forms a kind of lecture on electric current that the student reads, with the participatory activity of supplying the missing word serving to ensure that each sentence is processed and understood. The primary pedagogical method, therefore, is teacher centered construction. We might ask if a teacher centered approach is appropriate given the conceptual complexity of electrical current flow. Indeed, Wandersee, Mintzes, and Novak (1994) noted that current flow is regularly misunderstood by students who construct a variety of incorrect conceptual models that science education needs to address:

> Five distinct models of a simple circuit were employed by these students. The "single-wire" notion suggests that current leaves the battery and travels through one wire to a bulb, which serves as a kind of electricity "sink." In the "clashing currents" model, electricity leaves the battery from both terminals and travels toward the bulb, where it is "used up." In addition to these ideas, three kinds of "unidirectional models" were identified. ... "Unidirectional with conservation" ... is the scientifically acceptably view. (p. 182)

It seems, then, that the teacher centered constructivist approach of the programmed instruction "succeeds" only by ignoring the conceptual complexity of the scientific content, aiming toward a cursory understanding of electric current.

Finally, we examine the practices of reading and studying mentioned above as intended goals of instruction: "for instance, to attend selectively to texts and to reject irrelevant material" (Morris, 2003, p. 244). In the crossdisciplinary framing, these learning goals would count as dispositions–forms of engagement. A full crossdisciplinary analysis would involve identifying the reference culture

(perhaps academic culture) in which the intended dispositions are normative, and examining the culture of participation of students in working through this instruction. Graduate students in one of my courses going through the full sequence of 35 text fragments reported a tendency to word hunt to fill in the blanks, with minimal linguistic and semantic processing. So it is not obvious the extent to which enculturational goals intended by the curriculum are met.

Analysis of Skinner's programmed instruction provides an object lesson regarding the problems of our current integrative discourse in which psychologists interpret learning for educators. Skinner's development of programmed instruction materials constituted part of a concerted attempt to extend behavioral theory from unmediated response conditioning to linguistically mediated behavior (e.g., Skinner, 1958a). As a scientist, this was exactly the right kind of activity for Skinner to be involved in to advance psychology, even as Chomsky's (1959) critique of the effort as "play-acting at science" (p. 559) was an appropriate scientific riposte across the paradigmatic divide. Psychological schools need to project their accomplishments forward into new terrain if paradigmatic consensus ever is to be obtained (Kuhn, 1970).

The problem is that having ceded interpretation of learning to psychology we lose license to bring intuitive judgment and common sense understanding to bear on matters of curriculum and instruction. With the refracting lens of crossdisciplinarity it is plainly evident that Skinner's programmed instruction presents students with explanations of content to promote understanding. Without it, common sense and intuition are disqualified and the connection between instruction and learning becomes a murky matter of theoretical imponderables. The result is not so much that educators become confused about the connections between teaching and learning, as that the intellectual engagement with instruction is severed, and teachers come to implement recommended pedagogical practices formulaically. We will see this characterizes also our current era of reform, as much as the historical efforts associated with behaviorism (Knapp, 1997; Windschitl, 2002).

In the case of Skinner's programmed instruction we were lucky–his instructional materials did provide a coherent approach for students to learn concepts, albeit at a rather unambitious level. As we point the lens of crossdisciplinarity at current pedagogical controversies we find that normative curricular methods in U.S. education sometimes lack any coherent agenda for learning. Teachers implement formulaic practices that have little hope of supporting learning, and students are regularly and routinely exposed to ineffective instruction.

The "Reading Wars"

In this subsection, and then the next, we examine the educational controversies labeled as the *Reading Wars* and the *Math Wars*. In our current discourse these two controversies are regarded as siblings, rehearsing basic disputes about learning and teaching that trace back over a century of conflict: "The 'education sects' that Dewey described so long ago still exist [today]–in reading, in the proponents of 'whole language' and in 'phonics,' and in math, in the advocates and opponents of 'NCTM math reform'" (Loveless, 2001, p. 2). Contrasting with Loveless's assessment, the crossdisciplinary analyses that follow demonstrate stark differences in the structure of learning metaphors underlying these controversies, and in the quality of contribution the competing practices make to informing sound pedagogical practice.

The Reading Wars pits advocates of "phonics" (Burns, Griffin, & Snow, 1999; Fox, 2000; Stanovich, 1986) against "whole language" advocates (e.g., Dechant, 1993; Goodman, 1986; Serpell, 2001). The phonics method provides repetitive practice in a systematic and sequential fashion starting with

basic linguistic elements (graphemes, phonemes), building up to words, sentences, and more extended texts that incorporate the constituent elements already practiced:

> Phonics advocates see reading primarily as a challenging cognitive, psycholinguistic accomplishment–knowing letters and sounds and being able to perform in a certain way when asked to map one onto the other. (Snow, 2001, p. 232)

Whole language methods focus on dispositions of literate society, including inclination to read and strategies of effective reading. Whole language advocates insist that students' involvement with text always be meaningful in the twin senses that texts are comprehensible and that activities of reading are motivated by personal interest and involvement. The pedagogical method is to create a social community in which children engage with reading and writing in pursuit of their interests and communicative needs:

> Whole-language advocates see reading as a social, cultural activity–participating in communities of practice within which reading and writing are normal activities and thus are acquired as needed by all members. (Snow, 2001, p. 232)

What is noteworthy, from a crossdisciplinary perspective, is that both of these pedagogical methods are forms of "good teaching." Phonics approaches the skills of reading in a systematic and effective fashion through repetitive practice. Whole language provides a coherent blending of acculturationist support for students' evolving self-identity as readers with the enculturationist strategy of providing a social microculture within which practices of literacy are normative. Indeed, it is telling that antagonists in the Reading Wars rarely criticize their opponents with respect to the learning outcomes actually supported by instruction. Rather phonics advocates worry that whole language leaves students without needed skills (??), while whole language advocates find phonics methods to neglect valued dispositions (??).

At a pragmatic level, this might suggest the reasonableness of coordinating these two pedagogies, a suggestion sometimes labeled "a balanced approach" (Honig, 1996). However, as good clients to our psychological sponsors, we countenance only one "true" account of learning (and hence of good teaching), making pragmatic accommodations difficult to realize. The incendiary bitterness of the Reading Wars is well known, having spilled over from the academy into the legislative arena (Boyd & Mitchell, 2001; Goodman, 1998), thereby materially constraining the autonomy of educators to exercise professional judgment.

The "Math Wars"

The Math Wars (Schoen, Fey, Hirsch, & Coxford, 1999; Wilson, 2003) pits traditionalists combining lecture and worksheet drills against reformers who prefer inquiry teaching approaches (a set of positions that reflect reform and traditional camps more broadly in education). Traditional textbooks organize mathematics instruction topically; explanations of the current topic are followed by related problem sets. In this way, concepts and skills are intended to reinforce one another. Reformers generally provide open-ended tasks designed to foster mathematical dispositions of autonomy, creativity, and deep interest (among others) as well as conceptual understanding of the content. Thus the Math Wars, features competing blended approaches–a very different structure from the Reading Wars which involves just a single metaphor for learning on each side of the dispute.

Traditional Instruction: From a crossdisciplinary perspective, both sides in the Math Wars have problematic pedagogical agendas. The lecture portion of traditional mathematics instruction typically consists of demonstration of prescribed solution methods annotated with explanation of underlying principles. What is not well recognized is that these components serve different learning agendas: explanation of principles is teacher centered construction aimed at conceptual development; demonstration of procedures serves the purposes of perceptual priming in support of habituated skill development (Reber, 1993).

In my own studies of algebra curriculum, I've found that conceptual explanations consistently lack structural foundation, with the result that lecture is effectively reduced to demonstration of procedures (Kirshner & Awtry, 2004). In any case, students who are not sufficiently metacognitively sophisticated do not benefit from explanation of principles. Thus for many students it is likely that primarily the habituationist intent of traditional instruction is engaged.

The habituationist agenda also is compromised in traditional instruction. In order to focus on conceptual content, textbooks are organized topically, with homogeneously grouped problem sets meant to reinforce concepts presented in the current chapter. The homogenous grouping of exercises means that, with the exception of review practice tests, there is no opportunity for students to learn to discriminate problem types. Students learn how to apply routine solution methods, but not when to apply them, making robust skill mastery highly problematic (Greeno, 1978; VanderStoep & Seifert, 1993).[6]

In combining lecture with repetitive practice, the hope of traditionalists is that somehow concepts and skills will mutually reinforce one another. This hope is sustained by a misunderstanding of the unconscious character of the cognitive correlations that underlie skillful performance. When students do gain some measure of procedural fluency with mathematical symbol systems this is misconstrued by traditionalists as evidence the students have understood and applied the concepts presented in the curriculum (Kirshner & Awtry, 2004). Empirical evidence from the 1992 NAEP study (prior to much influence of reform curricula) does not support this optimistic assessment: "[for] problems requiring [students to have] a greater depth of understanding and then explain, at some length, specific features of their solution, the average percentage of students producing satisfactory or better responses was 16 percent at grade 4, 8 percent at grade 8, and 9 percent at grade 12" (Dossey, Mullis, & Jones, 1993, p. 2).

Reform Instruction: Mathematics reform pedagogy has many variations, but instruction typically involves open-ended, non-routine problems or tasks that students work on and discuss in collaborative groups (sometimes preceded by individual efforts) (??). The tasks or problems are chosen for their rich conceptual affordances. The hope is that students' own thinking about the

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[6]In the early 1980s an engineer named John Saxon developed a mathematics curriculum that avoids the pitfalls of homogeneous problems sets by the method of "gentle repetition" (heterogenous problem sets) (e.g., Saxon 1990, 1991): "As the problems become familiar students can look at a new problem and recognize it by type. This recognition evokes conditioned responses that lead to solutions" (Saxon, 1992, inside front cover). Of course, the cost of heterogenous problem grouping is dropping the expectation of a conceptual agenda. Saxon's approach aroused great antipathy in the mathematics education reform establishment; indeed, it was a request for advice concerning Saxon's algebra text that prompted NCTM's initial moves toward promulgating the 1989 *Curriculum and Evaluation Standards* (McLeod, Stake, Schappelle, & Mellissinos, 1995). The irony is that the mathematics education reform movement was launched out of a defense of traditional practice!

problem (rather than the teacher's ideas) will become the focus of attention, with two kinds of significant benefits ensuing: the "conceptual splatter" (Stanic, Easley, Taylor, & Taylor, 1990) as students' diverse ideas emerge in dialogue will lead to cognitive conflicts and conceptual restructuring for individuals; and the autonomy granted to students will lead to a sense of ownership of mathematics problems, enjoyment of mathematics, creativity in mathematical problem solving, and other valued dispositions that will emerge within the group dynamic. Thus reform pedagogy is a blending of student centered construction and student centered enculturation.

From a crossdisciplinary perspective there is nothing inherently problematic about such a blending, so long as the teacher discerns the inconsistency between these learning agendas and takes responsibility for balancing priorities as instruction unfolds. In its pure form, student centered construction is very much a teacher-mediated pedagogy. The teacher provides a task environment based on an anticipated learning trajectory along which cognitive conflicts may emerge that are productive of conceptual restructuring (Simon, 1995). And she/he engages with the student to support the unfolding of this trajectory. But reform pedagogy places teacher mediation in direct conflict with goals of student autonomy and creativity. Thus the effective reform teacher supports the cultural dynamics of small group interactions while constantly monitoring the conversations, worrying that discussions may not be productive conceptually, and making judicious moment-by-moment decisions about whether (and how) to intervene as a mediator of conceptual construction while doing minimal damage to the agenda of student autonomy and exploration (Ball, 1993, 1996; Marshall, 1994; Nathan, Knuth, & Elliott, 1998; Ross, Cornett, & McCutcheon, 1992; Schifter, 1998; Schön, 1983; Williams & Baxter, 1996).

Unfortunately, this ideal is rarely reached in reform pedagogy–more importantly, it is rarely aspired to! The problem is that within a discursive context in which "good teaching" is assumed to be a self-consistent set of practices, the need to balance competing priorities is obscured, particularly under sway of sociocultural and situated cognition theorizations of learning in which "the *learning* of a subject's cognitive content is considered a process embedded within the more comprehensive process of enculturation" (Perrenet & Taconis, in press, p. 3).

Consider the case of a second-grade teacher who worked intensively with Paul Cobb and his research team for a full academic year (Wood, Cobb, & Yackel, 1995). At the culmination of the year, she finally came to realize that in the interest of students' individual conceptual construction it sometimes is necessary to be "very directive" (p. 421)–a practice that contradicted her efforts to foster students' creative independence as mathematical investigators. She did eventually learn to balance these priorities by, in her words, "'walking the pedagogical tightrope'" (p. 421); but this involved overcoming the presumption of reform that "good teaching" is a self-consistent set of practices that seamlessly mesh together (see also, Sherin, 2002).

For the vast majority of teachers who lack the intensive support of a research team helping them make sense of their pedagogical opportunities, reform teaching has drifted into something quite different than what is sketched above. The surface structure of the classroom still incorporates collaborative working groups seeded by conceptually rich tasks and problems, but the dynamic tension of balancing priorities is drained from instruction (Chazan & Ball, 1995). The teacher feels no obligation to monitor and (occasionally) mediate conceptual construction. And enculturation goals are undertaken with little specificity as to which cultural dispositions are being targeted by instruction, and with little systematic thought to the teacher's role in nurturing those dispositions within the classroom microculture. In short, what should be intense intellectual demands of teaching

in this rather exquisite reform practice are reduced to a formulaic activity structure (Knapp, 1997; Windschitl, 2002).

Viewed through crossdisciplinary lenses, we see that reform mathematics teaching and traditional mathematics teaching both feature incoherent agendas for integrating valued learning agendas: skills and concepts for traditionalists, concepts and dispositions for reformers. The crossdisciplinary framework of learning metaphors and associated pedagogies points to the plurality of ways in which "good teaching" can be realized in education, either as unifocal methods articulated for each learning metaphor or as artful coordination and balancing of the independently conceived pedagogies. But without such a map of the pedagogical terrain–in a discursive framing of "good teaching" that obscures the boundaries between our diverse pedagogical intentions–we have little perspective to offer teachers about the opportunities they have to support student learning or the pitfalls they can anticipate. Our legacy to the world of practice is a confused amalgam of high ideals, platitudes, and dense theoretical dialectics arranged into bitterly antagonistic camps.

Re-viewing Education Through Crossdisciplinary Lenses

The crossdisciplinary framework has two natural domains of application, teacher education and schooling. For the former, we might imagine an undergraduate curriculum that systematically introduces the metaphors for learning, ensuring that teachers understand and can practice the associated pedagogies (as well as associated evaluation methods, yet to be articulated). The teacher centered pedagogies comprise, more or less, what a lay educator might be expected to know about teaching, whereas the student centered pedagogies are the domain of the professional pedagogue. A graduate curriculum might see to the shaping of particular pedagogical styles coordinating various pedagogies according to the needs, values, and interests of the teacher.

In the realm of schooling we can envision various locations at which values decisions might become vested: One might hope the individual classroom teacher might have some say as to the combination of metaphors appropriate to the circumstances of their students; but discontinuities between agendas in neighboring classrooms might make this a problematic arrangement. Alternatively, the government or its agencies might usurp this prerogative at the district, state, or federal level; or independent schools might be organized according to specified learning priorities, creating options for teachers and parents as they select their school site.

But such excursions into practice are surely premature. For crossdisciplinarity threatens to uproot tracts of pedagogical theory, leaving others unscathed. In deciding whether to resist or embrace crossdisciplinarity, theorists are entitled to a glimpse of the landscape of educational theory that is likely to result. I conclude this introduction to the crossdisciplinary framework by looking at its likely impact on various key topics in the terrain of pedagogical theory.

Brain Research and Cognitive Style

In the current educational frame, pedagogical method is informed sometimes by learning theory, but often by perspectives on the constraints and affordances of the cognitive processor for individuals (cognitive style research) or for the species (brain research). Both of these areas are fascinating and important arenas of psychological investigation, in their own right. Of course knowing how brains works is of relevance to education, particular to special education in which aspects of the processor may be abnormally developed or damaged (??). The issue of concern here is their utility as guides for general educational practice, especially given their increasing

prominence in pedagogical theorizing. “Teaching to the brain” and “teaching to the student’s cognitive style” are popular refrains in pedagogical discourse.

If good teaching is understood as teaching that supports learning, then perspectives on learning have a privileged role to play in pedagogical theory. Constraints and affordances of the cognitive processor may be of general heuristic value, in the same way that nutritional guidelines, relaxation techniques, or meditation may be generally ameliorative of learning. But theories of cognitive processing only offer specific guidance to teaching to the extent they inform perspectives on learning. That such literatures are influential independent of specific theories of learning is an index of the weakness of current learning theory as an educational resource. Accordingly, as learning theory becomes more coherently organized and consistently applied to pedagogy, emphasis on brain research and cognitive style are likely to wane.

Metacognition

Metacognition (awareness and control of cognition) and its applications in self-regulated learning and critical thinking are hot topics in education, extolled by pedagogues of almost every persuasion (Alexander, 2008; Burbules & Berk, 1999; Walters,1994; ??).

From a crossdisciplinary perspective, metacognition plays into education in two distinct roles. From an enculturationist perspective, metacognition is a disposition, a culturally specific form of engaging with oneself, that educators often have sought to promote in schooling. Vygotsky had a passionate interest in metacognitive control of cognition as instrumental to forming higher forms of thinking (Tudge & Scrimsher, 2003), and partly through his influence metacognition has emerged as a central goal of enculturation in reform pedagogies as internalization of social processes (Bransford, Barron, Pea, et al., 2006). As Olson (2003) put it, “The normative practice of reason giving and metacognition run together. Explanation, the giving of explicit or public reasons, is not only an important route to assessment, but the route to metacognition, that is, cognition about cognition” (p. 241).

As well, metacognition is important to education with respect to the construction metaphor for learning. Recall that conceptual construction is a somewhat chancy event, the likelihood of which is enhanced for metacognitively sophisticated students who are more likely to notice discrepancies between expectations and outcomes of experience (Otero, 1998). In constructivist learning theory, Piaget’s notion of *reflective abstraction* is understood as central to conceptual development. Reflective abstraction involves two sorts of reflection:

> The first “reflective” type derives from a process Piaget calls reflechissement, a word that is used in optics when something is being reflected, as for instance the sun's rays on the face of the moon. In his theory of cognition, this term is used to indicate that an activity or mental operation (not a static combination of sensory elements) developed on one level is abstracted from that level of operating and applied to a higher one, where Piaget then considers it to be a reflechissement. ...
>
> But Piaget stresses that a second characteristic is required: Reflective abstraction always involves two inseparable features: a “reflechissement” in the sense of the projection of something borrowed from a preceding level onto a higher one, and a “reflexion” in the sense of a (more or less conscious) cognitive reconstruction or reorganization of what has been transferred. (Piaget,1975, p.41, quoted in von Glasersfeld, 1991)

This dual analysis of metacognition helps us to understand deep and enduring problems of current pedagogical reform efforts as described above with respect to mathematics education. Reform pedagogies involving *inquiry groups, communities of learners, knowledge building communities* and the like invoke metacognition in contradictory ways; on the one hand as a valued goal of instruction to be achieved through discussion and argumentation, on the other hand as a needed quality for students to develop conceptually while engaged with the multiplicity of opinions that emerge in conversation. Thus metacognition is exposed as the soft underbelly of contemporary pedagogical theorizing: a desperate hope to build into reform pedagogy the very student qualities needed in order to benefit from that pedagogy. (Perhaps critical thinking skills serves a similar function for traditional pedagogies in which metacognitive sophistication again is needed for lecture methods to be productive of students' conceptual construction.)

Pedagogies of Societal Transformation

Not all pedagogical approaches are motivated by a desire to promote individual learning. A variety of methods including democratic education, liberatory pedagogy, values education, critical literacy (Cummins, 1989, 1994), progressive education, character education, multicultural pedagogy seek through schooling to transform the broader society. Yet these pedagogies only can succeed to the extent that individual students are changed in the process–that they have learned, in some sense. Thus one can bring the lens of crossdisciplinarity to bear on these pedagogies of societal transformation.

Two basic strategies are evident across the broad range of societal transformation pedagogies. Utopian pedagogies (my term) like democratic education and some versions of multicultural pedagogy seek to create within the classroom microculture a microcosm of a more ideal society. Students enculturated into the norms of this classroom society then carry their dispositions outward to political and social engagement in the broader society. John Dewey, and the ensuing Progressive Education Movement, explicitly adopted such a utopian strategy:

> When the school introduces and trains each child of society into membership with such a little community, saturating him with the spirit of service, and providing him with the instruments of effective self-direction, we shall have the deepest and best guarantee of a larger society which is worthy, lovely, and harmonious (Dewey, 1900, p. 44; quoted in Hall, 2003, p. 16)

In contrast with utopian pedagogies that seek to transform society from within, liberatory and critical pedagogies seek to disrupt social arrangements by having students come to "formulate and agree upon a common understanding about 'structures of oppression' and 'relations of domination'" (Burbules & Berk, 1999, p. 53). The pedagogical method, here, is acculturationist, The goal being to enlist students as "'transformative intellectuals' (Giroux, 1988), 'cultural workers' (Freire, 1998) capable of identifying and redressing the injustices, inequalities, and myths of an often oppressive world" (Gruenewald, 2003, p. 4). Thus students are offered an identity structure as social change agents, with the teacher serving as an authentic representative of a culture of resistance.

How do pedagogies of social transformation fare in an educational arena structured by crossdisciplinarity? A key feature of the crossdisciplinary framework is its elevation of enculturation to a fully legitimate pedagogical status. No longer is the cultural space of the classroom a taken-for-granted accompaniment to the real business of teaching and learning, but a precious instructional

resource. Thus even as agendas of metacognition and critical thinking become scrutinized for (possibility conservative) cultural underpinnings, so too for pedagogies of social transformation.

It is too early to tell how badly pedagogies of social transformation would fare under such scrutiny. Presumably, utopian and especially critical pedagogies would become more subject to censure as values decisions related to pedagogy are shifted from educationists to the broader professional and political arenas.[7] Still, the explicit focus on students' cultural locations that comes with the acculturationist perspective on learning may be used to protect students from cultural assaults that may previously have gone unchallenged. As well, an educational process built on clear standards of efficacy might well result in less disparity in educational outcome, and hence less social and economic stratification in the broader society. Alternatively, critical educators might choose to contribute to a genuinely new metaphorical notion of learning based on the method of currere that understands the possibility for a just society as residing in students' psychic development interpreted in psychoanalytic terms (Pinar & Grumet, 1976; Doll, 2000).

Concluding Comments

In this paper, I have presented a system of 6 pedagogical methods crystalized around 3 metaphorical interpretations of learning. The ontological claim is not psychological. I am not claiming the metaphors reflect distinct psychological mechanisms whereby the human organism advances. Rather these metaphors are posited as constituting our cultural commonsense about learning, consequently underlying all of our pedagogical agendas for student learning. And the pedagogical methods are presented as a distillation of the pedagogical intuitions that currently are entangled in our integrative discourse about good teaching. How does one go about evaluating such sociology-of-knowledge claims?

Crossdisciplinarity is a constructed perspective. Initially–a dozen years ago–it was conceived with 5 metaphors for learning, and 5 pedagogical methods, then 7, then 3 metaphors and 3 pedagogical methods (Kirshner, 2002), finally 3 metaphors and 6 pedagogies. Gradually the metaphors have intensified in the detail of their rendering and in their degree of distinctiveness from one another. New psychological theories have been incorporated into the elaborations of the metaphors, others abandoned. Doubtless there will continue to be adjustments to the framing of these metaphors and in the characterizations of the associated pedagogies, perhaps now in conversation with other educators and theorists.

As the framework has evolved its adequacy as a tool for thought steadily has sharpened. The range of educational topics that become viewed or re-viewed through the lens of crossdisciplinarity has extended in breadth, even as the clarity and sense of insistence of each analysis intensifies. Crossdisciplinary analysis of a pedagogical method is a complex and delicate matter. However, the experience of such theorizing is convergent. One feels one has captured something essential and enduring. Gradually the perspective of crossdisciplinarity becomes indispensable–one cannot see the world otherwise. It becomes an objective view.

This, in a nutshell, is the challenge of crossdisciplinarity. Gently received and collectively nurtured, it becomes a shared metalanguage for education enabling the diverse motivations and methods for

[7] Not that educationists have a free hand now (see Wasley, 2006, for a discussion of NCATE's dropping its social justice requirements).

student learning to be consistently understood and realized across the broad span of educational practice. Or it is a straightjacket to be resisted; a stranglehold on the creative openendedness of education that creates the possibility for scholarly partnership with psychology, philosophy, sociology, and other foundational academic fields.

This is a tough choice.

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