Chapter IV
Computers and the End of Progressive Education

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ABSTRACT

Multiculturalism is an essential tool for democratic citizenship in a world made ever more closely interconnected by information technologies. In this paper, I propose a model for progressive multicultural education in the computer age. I begin by describing the Pragmatic Progressive model of learning implicit in Dewey's writing on education. I then discuss two revisions to the model in light of technological developments and theoretical work over the last few decades. Taken together, these revisions suggest that we might profitably revisit—and revise—Dewey's ideas in the post-industrial era. I bring these ideas together to describe a theory of pedagogical praxis that offers an opportunity to move from multiculturalism to multisubculturalism: a view of education that focuses on diverse educational goals rather than diverse pathways to a single pedagogical end—and thus a view of learning more suited to the diverse ways of thinking and living that characterize our increasingly integrated world.

INTRODUCTION

As information and communication technologies bring people, places, and events from around the world to our desktops, telephones, and televisions, the economic, social, and cultural issues of the globe are becoming increasingly, unavoidably, our own (McLuhan, 1964). The concept of diversity is thus a broader and more complex concept than ever before (Ladson-Billings, 2001a), and preparing young people for citizenship in such an interconnected world necessarily means helping them develop the ability to understand complex cultural issues from multiple perspectives. Multiculturalism is an essential tool for democratic citizenship in an interconnected world.

This is not a new idea, of course. Over a century ago the Pragmatists—including perhaps the

best-known Pragmatist in the field of education, John Dewey—saw the essence of democracy in the idea that there is no one truth. Personal beliefs—however deeply felt—were but one possible perspective among many, and as Menand (2001) explains, the central political tenet of Pragmatism was that "the moral justification for our actions comes from the tolerance we have shown to other ways of being in the world" (p. 440). Dewey's Progressive pedagogy, which—based on this Pragmatic view of truth—emphasized learning as a process linking personal interest with activities meaningful in the world outside of school, would therefore seem to be a likely candidate for the development of a multicultural education for the digital age.

In what follows, I will argue that this is both true and untrue. It is true in the sense that computers and other new technologies can help make learning engaging and relevant in some of the ways Dewey suggested. But it is also untrue in the sense that while Dewey embraced diversity philosophically, his pedagogy allowed for only a weak form of multiculturalism. Dewey's multiculturalism celebrated multiple pathways to understanding, but multiple pathways to a single form of understanding. His multiculturalism, I will argue, was a *multiculturalism of means*, rather than a *multiculturalism of ends*.

In what follows, I make this distinction between multiculturalism of means and multiculturalism of ends for three purposes. My first purpose, rather transparently, is to argue that a multiculturalism of ends provides the political and epistemological underpinning for a new structure of education suited to a world made broader and more complex by new technologies. My second purpose is to use this critique to understand why, despite numerous attempts to implement it, the Progressive agenda that Dewey outlined beginning with *School and Society* (1915) has not transformed American education in the century since it was first articulated. My third purpose builds on these first goals to suggest that two important changes at the close of the century—one technological, and one epistemological—provide an opportunity to reinvigorate the Pragmatic Progressive educational agenda as we enter a new social and cultural era.

I begin by describing the model of learning implicit in Dewey's writings, and then discuss two significant revisions to the model in light of technological and theoretical developments over the last few decades. I bring these ideas together to describe my own theory of *pedagogical praxis* (Shaffer, 2004b) that revisits Dewey's ideas in the post-industrial era. In the final section of the paper, I return to the theme of multiculturalism, and argue that pedagogical praxis offers an opportunity to move from multiculturalism to *multisubculturalism*—and with that move, to shift focus from pedagogical means to pedagogical ends as a first step toward a system of education more suited to the diverse ways of thinking and living that characterize our increasingly interconnected world.

Throughout, I hope it will be clear that my purpose is neither to praise Dewey nor to bury him. Rather, I use his work to outline some of the logic that underlies much of Progressive pedagogy. This outline is a basis for critique (in part) but even more serves as a foundation for a new and potentially more inclusive approach to education for the information age.

My hope in providing such an outline and critique is, of course, that it will be of use to instructional designers, developers, and practitioners who are concerned primarily with the application of information technologies in education. To that end, in what follows I provide some examples of these ideas in practice, but the intent of this chapter as a whole is more philosophical in nature: to show that while advances in technology now let us engage students in active learning in a way not possible before, the challenge is not only *how to do use technology well*, but *what to use technology for in the first place*.

This point—that new technology forces us to reconsider both the means and the ends of education—is, I hope, as important for practical designers as it is for theoreticians.

THE PRAGMATIC PROGRESSIVE MODEL

Egan (2002) argues the central tenet of educational Progressivism is that pedagogy should be based on students' "modes of learning and stages of development" (p. 5). That is, Progressives believe that curricula must be adapted to the needs and abilities of learners. Moreover, the particular needs and abilities that should guide instruction are those manifest in out-of-school settings: the seemingly effortless ways in which children acquire language, develop social skills, and learn to participate in games and imaginary play (Egan, 2002; Papert, 1980). Dewey (1915), for instance, uses "an example from an ideal home" (p. 34) as he describes learning based on a child's natural curiosity.

Dewey, of course, recognized that while children are full of "ideas, impulses, and interests," those impulses are "so crude, so random and scattering, so little refined and spiritualized" that the challenge is in finding a way to channel students' inherent interests into the development of "discipline, culture, and information" (1915, p. 37). Indeed, far from the caricature of progressivism as beginning and ending with the child's needs and enthusiasm, Dewey argued: "[A]ttentive care must be devoted to the conditions which give each present experience a worthwhile meaning. Instead of inferring that it doesn't make much difference what the present experience is as long as it is enjoyed, the conclusion is the exact opposite" (1938, p. 49).

For Dewey, then, education begins before and continues after engagement in activity that a student finds personally meaningful. But students' own interests and desires were central to Dewey's educational vision, and his motive for that focus was political. "A progressive society," Dewey wrote in *Democracy and Education* (1916), "counts individual variations as precious since it finds in them the means of its own growth. Hence, a democratic society must, in consistency with its ideal, allow for intellectual freedom and the play of diverse gifts and interests in its educational measures" (p. 305). For Dewey, this form of intellectual freedom was the only freedom of consequence: "The only freedom that is of enduring importance is freedom of intelligence, that is to say freedom of observation and judgment exercised in behalf of purposes that are intrinsically worthwhile" (1938, p. 61). Education for democracy thus had to begin with *individual interests*.

Finding individual interests was not problematic. Indeed, Dewey argued that "the child is already intensely active, and the question of education is the question of taking hold of his activities, of giving them direction" (1915, p. 36). The central challenge in Dewey's theory of experience and therefore his philosophy of education was to take a child's initial interests and expressive impulses and move them down productive lines of inquiry. He describes, for example, "how, beginning with very simple material things, the children are led on to larger fields of investigation and to the intellectual discipline that is the accompaniment of such research" (1915, p. 58).

Dewey's model for the transformation of individual interest into educative experience, was a three-stage process of learning through active engagement in meaningful activity: a *Pragmatic Progressive model of learning.* This view of the learning process permeates Dewey's writings on the subject but, as far as I know, is not fully articulated in any one place in his work. Briefly, Dewey's model began with individual interest, which, in true Pragmatic fashion, he argued must be tested in the crucible of activity in the world. "If the impulse is exercised, utilized," he wrote in *School and Society*, "it runs up against the actual world of hard conditions to which it must

accommodate itself; and there again come in the factors of discipline and knowledge" (1915, p. 38). For example:

Take… the little child who wants to make a box. If he stops short with the imagination or wish, he certainly will not get discipline. But when he attempts to realize his impulse, it is a question of making his idea definite, making it into a plan, of taking the wood, measuring the parts needed, giving them the necessary proportions, etc. There is involved the preparation of materials, the sawing, planning, the sandpapering, making all the edges and corners to fit. Knowledge of tools and processes is inevitable (1915, p. 38).

Dewey argued that as the initial impulse meets the "world of hard conditions," prior experiences are mobilized and past understanding—now applied to new conditions—is refined and reinforced. This was a pedagogical instantiation of the pragmatist credo that successful action creates stable beliefs; or, as William James said with more pith: "The true is the name of whatever proves itself to be good in the way of belief" (Menand, 2001, p. 355). Summarizing the process in *Art as Experience* (1934/1958), Dewey wrote:

Impulsion from need starts an experience that does not know where it is going; resistance and check bring about the conversion of direct forward action into re-flection; what is turned back upon is the relation of hindering conditions to what the self possesses as working capital in virtue of prior experiences. As the energies thus involved re-enforce the original impulsion, this operates more circumspectly with insight into end and method. Such is the outline of every experience that is clothed with meaning (p. 60).

The result is the somewhat curious state of affairs that "a balance between furthering and retarding conditions is the desirable state of affairs—provided that the adverse conditions bear intrinsic relation to what they obstruct instead of being arbitrary and extraneous" (1934/1958, p. 60). The Pragmatic Progressive model of learning thus depended on channeling individual interests into *reflective media*—that is, into media in which the constraints and affordances are relevant to the processes of inquiry being developed.

For Dewey, the "knowledge of tools and processes" to be developed though such experiences was a particular kind of knowledge: it was *scientific*. In *How We Think* (1933), Dewey draws a distinction between the general Pragmatic process of testing beliefs in experience—what he refers to as *empirical thinking*—and the *experimental* or *scientific method*. Scientific thinking, Dewey explains, "replaces the repeated conjunction or coincidence of separate facts by discovery of a single comprehensive fact" (p. 150), and does so based on systematic "observations formed by variation of conditions on the basis of some idea or theory" (p. 150). As Schutz suggests, Dewey saw scientific knowledge as "different from everyday, 'practical' modes of knowledge because it operates in an essentially imaginary world of systematic abstraction" (p. 271).

In this sense, Dewey was firmly within the Euro-American epistemological tradition of belief in experimentation that emerged from the Enlightenment (Ladson-Billings, 2000), and for Dewey this scientific method or experimental approach to thinking was the goal of educative experiences:

[E]xperience may be interpreted either with reference to the empirical or the experimental attitude of mind…. Education takes the individual while he is relatively plastic, before he has become so indurated by isolated experiences as to be rendered hopelessly empirical in his habit of mind. The attitude of childhood is naïve, wondering, experimental… [and] right methods of education preserve and perfect this attitude (p. 156, italics in original).

For example, Dewey explains at great length how cooking an egg (an activity designed to make "a transition from the cooking of vegetables to that of meats") can be a point of departure for such systematic "experimental work" (1915, p. 38ff):

In order to get a basis of comparison they first summarized the constituent food elements in the vegetables and made a preliminary comparison with those found in meat…. They found that starch and starchy products were characteristic of the vegetables… and that there was fat in both—a small quantity in vegetable food and a large amount in animal. They were prepared then to take up the study of albumen as the characteristic feature of animal food, corresponding to starch in the vegetables…. They experimented first by taking water at various temperatures… and ascertained the effect of the various degrees of temperature on the white of the egg. That worked out, they were prepared not simply to cook eggs, but to understand the principle involved in cooking eggs.

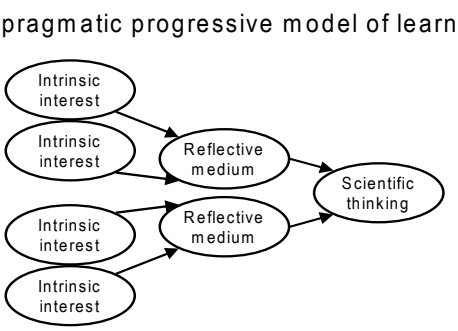
As Rudolph (2004) suggests, Dewey's emphasis in such activities was not that students learn the formal methods of research scientists—the (capital) *Scientific method*. Dewey's description of (lower case) *scientific method* "was *not* to provide a stepwise account of how scientists went about their work" (p. 22); rather Dewey used the Scientific method as a "model of best thinking for individuals to emulate... [and] the extension of the scientific model of reasoning—in its psychological rather than logical form—to the problems and situations of the everyday world was the grand project to which... all his work [was] directed" (p. 23). Thus, the end point of the Pragmatic Progressive model of learning was not the formal methods of science *per se* but *scientific thinking*: a "universal means of approaching any situation from a scientific point of view" (p. 23).

This is not to suggest that Dewey thought that students should only learn Science. He argued, rather, that the various disciplines such as history, geography, literature were critical to the process of education as repositories of knowledge: the "tools which society has evolved in the past as the instruments of its intellectual pursuits" (Dewey, 1915, p. 111). But although Dewey recognized the distinctiveness of the disciplines, they share, in his description, a common epistemological foundation in propositional understanding developed through systematic experimentation. For example, Dewey (1916) explains the value of studying the history of "primitive life" as primarily an experimental endeavor:

Recourse to the primitive may furnish the fundamental elements of the present situation in immensely simplified form…. We cannot simplify the present situations by deliberate experiment, but resort to primitive life presents us with the sort of results we should desire from an experiment. Social relationships and modes of organized action are reduced to their lowest terms. (p. 215)

Overlooking the anachronistic reference to "primitive life" and the now-disputed idea that life in the past was a simplified version of modern societies, Dewey is describing historical inquiry as a process of formal experimentation: history as a form of social *science*, rather than a distinct way of knowing.

Figure 1. The Pragmatic Progressive model of learning implicit in Dewey's most popular and influential works on thinking and learning



Dewey's Pragmatic Progressive model of learning from active engagement in meaningful activity can thus be summarized: under the appropriate conditions, *intrinsic interest*, expressed in a *reflective medium*, leads, with guidance, to *scientific thinking*. (See also Figure 1.)

I hope it is clear that my purpose at this point in the argument is not to attribute particular ideas to the historical John Dewey, whose thinking was clearly subtle and multi-layered about these and many other issues. I am not taking sides, for example, in the recent controversy over whether Dewey's thoughts on the subjects of thinking and learning were constant or showed a radical disjuncture over the course of his career (Glassman, 2001; Prawat, 2001, 2002; Stanic & Russell, 2002)—although I do note that Dewey talks about the same basic processes I describe above in works as early as *School and Society* (1915) and as late as *Experience and Education* (1938), on subjects ranging from *Democracy and Education* (1916) to *Art as Experience* (1934/1958). Nor am I claiming to have produced an exhaustive and definitive distillation of Dewey's writing on the subject of learning. Rather, I have tried to articulate the model of learning implicit in Dewey's most popular and influential works on the subject—the underlying logic of the Pragmatic Progressive pedagogy that the field of education has inherited from Dewey's work.

There is no doubt that the Pragmatic Progressive model of learning has been influential in thinking about education over the last century. Nor, I suspect, is there much doubt that the model has been implemented in only the most limited way in the American education system (Schutz, 2001). Articles are still written to rearticulate Dewey's description of thinking, such as Rodgers' (2002) summary (based on *How we Think*) of reflective thinking as a process of "generating possible explanations for the problem(s) or question(s) posed;…ramifying explanations into full blown hypotheses; and… experimenting or testing the selected hypotheses" (p. 851). She argues that this form of reflection constitutes "a particular, defined way of thinking… [that] can be practiced, assessed, and perfected… [and is] the most essential piece of what makes us human, of what makes us learners" (p. 864). At the same time, however, it is the rarest of schools that is organized predominantly around inquiry projects modeled on Dewey's Laboratory School, in which "cooking became the basis for most of the science taught" and "the children built their own tiny [iron] smelters" (Menand, 2001, p. 322).

This, then, is the dilemma that confronts anyone who wants to build on Dewey's ideas about education: If these ideas are so good, why haven't they been implemented already? Providing a definitive answer to that question is beyond the scope of this particular examination of Dewey's work. In what follows, I focus instead on two changes in recent years that suggest it may be possible to revise Pragmatic Progressive pedagogy as a model for learning through active engagement in meaningful activity in ways that may be more appropriate to—and likely to succeed in—our technology-rich, postindustrial era.

FROM PHYSICAL REFLECTION TO VIRTUAL REFLECTION

In Dewey's articulation, the Pragmatic Progressive model of learning through active engagement in meaningful activity depends critically on the reflective medium in which activity takes place. The "obstructions" to the accomplishment of a student's ends are educative only if they "bear intrinsic relation to what they obstruct instead of being arbitrary and extraneous" (1934/1958, p. 60). That is, the medium must be capable of instantiating the key elements of a domain of inquiry—broadly construed—in a manner accessible to students. This matters because using traditional materials (Cuisenaire Rods, for example) it is relatively easy to capture essential properties of objects in the world, such as shape,

number, or color. Complex social and technical concepts—things like ratio, or feedback, or social justice—are harder to "build" into traditional media.

It is certainly possible, of course, to capture complex concepts in physical materials; but it is often more difficult. For example, Francis Parker, Superintendent of the Quincy, Massachusetts school system and later director of the Cook County Normal School, wanted to implement "reading lessons which would directly enhance the value of thought acquired by investigations" (Parker, cited in Kalmbach, 1996, p. 59)—that is, to integrate the study of reading into the inquiry activities of the school. His solution was to set up a printing press, which older students used to print reports of their research (known as "reading slips" or "leaflets"). These became the primers for reading instruction in the younger grades. Not surprisingly, the process was "expensive and troublesome" (p. 59), and was eventually discontinued. Similar experiments were conducted years later at the Bank Street School with similar results.

In the year 2004, it is hard to imagine, perhaps, that publishing the work of students for others to read might be expensive or troublesome. Any school equipped with a computer and printer (or rudimentary access to the Internet) could accomplish Parker's goal with ease. More generally, computers expand the range of concepts that can be "experienced" far beyond what Dewey might ever have imagined[1] by making it possible to create *virtual worlds* (Barab, Hay, Barnett, & Squire, 2001; Shaffer, in press; Shaffer, Squire, Halverson, & Gee, 2004). Nearly half a century ago, Church (1932) and Turing (1936) proved that a *universal discrete state machine* was capable of carrying out any process that can be described as a simple set of instructions requiring no interpretation in a finite period of time. In other words, a computer can do anything that can be written down as a set of step-by-step rules. The Church-Turing hypothesis is important because sufficiently fast step-by-step processes appear to be continuous.[2] Think of a movie, in which each frame of the movie is a still image. These discrete images are projected in sequence, and when the individual frames are exchanged quickly enough—typically faster than 30 frames per second—the elements of the image appear to move smoothly. This means that a sufficiently fast computer can *simulate* complex events and processes in the world.[3]

Computer simulations thus make it possible to create *computational microworlds*, which Hoyles, Noss, and Adamson (2002) define as "environments where people can explore and learn from what they receive back from the computer in return for their exploration" . More than three decades of research on microworlds has documented the processes at work in a wide range of computational simulations on variety of subjects: mathematics and science in symbolic microworlds such as Seymour Papert's LOGO (Harel & Papert, 1991; Papert, 1980), Mitchel Resnick's StarLogo (Resnick, 1994), and Andrea diSessa's Boxer (diSessa, 2000), or direct manipulation environments such as the Nicholas Jackiw's Geometer's Sketchpad (Goldenberg & Cuoco, 1998; Serra, 1997; Shaffer, 1997a, 1997b, 2002); civics, economics and urban planning in simulations such as Will Wright's SimCity (Adams, 1998; Starr, 1994); history in games such as the Oregon Trail (Smith-Gratto & Fisher, 1999) and Sid Meyers' Civilization (Frye & Frager, 1996; Squire, 2004, in press).

One of the seminal concepts that has emerged from this body of research is the idea of *autoexpressivity* (Noss & Hoyles, 1996). An autoexpressive microworld gives different responses to a student's actions depending on the extent to which the student was explicit about his or her intentions. To take a simple example, an autoexpressive microworld for online journalism might format a story differently depending on whether a student explicitly identifies the lead and nutgraph (the paragraph that explains the key point of the article) in the text of the story. Getting the online newspaper to turn out as expected, the

young journalist is forced to be explicit[4] about the organizational structure of journalistic prose. Acting in this journalism microworld would thus help the student surface, challenge, and ultimately refine his or her understanding of news writing. More generally, the behavior of an autoexpressive medium reflects how a student represents ideas within the grammar of the medium—and thus within the structure of a domain of inquiry (Shaffer, 1998). Students come to autoexpressive microworlds with beliefs (usually implicit) about how the world (or a part of the world) works. As students express themselves in the microworld their understanding runs up against a *simulated* "world of hard conditions" of the kind that Dewey suggested was essential to educative activity (Dewey, 1915, p. 38).

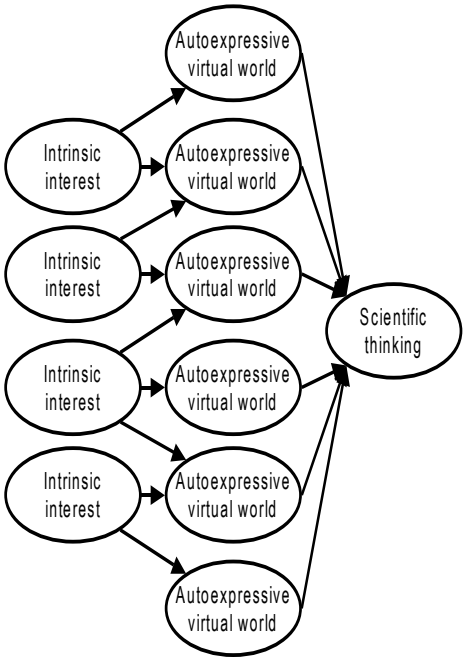
In this sense, then, I argue that any virtual world is a simulation: a computational recreation of some real or imagined world. Any simulation, in turn, is a microworld, in the sense that provides an opportunity, as Hoyles, Noss, and Adamson (2002) suggest, for students to take action in the simulation and learn from the feedback they receive from the computer as a result of that action. Microworlds that are autoexpressive are particularly powerful learning tools because taking successful action within them requires mastering and using the concepts and skills of a particular domain of knowledge.

Put another way, autoexpressive microworlds function as reflective media in the Pragmatic Progressive sense of the term—but now on a much broader scale. Microworlds make it possible to create virtual worlds in which students can interact using a wide range of practices in real and imagined spaces. While the scope of virtual worlds is certainly not endless—at least with current technologies—computers do make it possible for students to participate in adult activities that are hard to access, or even inaccessible with traditional materials. For example, students can use software to develop new mathematical proofs (Lichtfield, Goldenheim, & Dietrich, 1997), collect and analyze real scientific data (Evans, Abrams, & Rock, 2001), publish work on the Internet, run a political campaign ("The Political Machine," 2004), or manage a city (Starr, 1994)—not to mention reenact world history (Squire, 2004) or steal a car ("Grand Theft Auto: Vice City," 2004). Some of these are activities in the real world that are facilitated by work with a computational tool; others are activities in virtual worlds. In both cases, computational tools extend the range of expressive activities in which students can engage.

The argument is, of course, not that virtual worlds are *universally* better than activities in the real world. There are clearly reasons why it might be preferable to participate in a real election for student body president rather than a simulation of such an election. But working in the real world also has disadvantages. Compare, for example, an election for student body president to a simulation of an election for President of the United States. Student elections take longer. They necessarily address a different (and almost certainly narrower) range of issues. And they are not accessible to as many students as a well-designed virtual election could be.

Thus, autoexpressive tools make it possible for more students to learn about the world by participating in a broader range of meaningful activities. Put another way, autoexpressive tools make it possible for more learners and more contexts to come together, expanding the scope of the Progressive pragmatic model. Rather than interests leading to a relatively narrow range of expressive activities that can be conducted within the confines of reflective media available in an industrial education system, new technologies let us imagine an educational experience composed of activities in a wide range of autoexpressive virtual worlds. (See Figure 3) In this sense computers make it possible to dramatically expand the reach of the Pragmatic Progressive model.

Figure 3. A revision of the pragamtic progressive model in light of emerging information technologies



FROM SCIENTIFIC THINKING TO EPISTEMIC FRAMES

As new technologies bring more activities and practices from the world within the reach of students, our understanding of how people think in these broader contexts has expanded as well. For more than a decade, researchers have focused on learning as a process of participation in *communities of practice*. Lave and Wenger (1991) describe a community of practice as a group of individuals with a common repertoire of knowledge about and ways of addressing similar (often shared) problems and purposes. This collection of practices is made accessible to newcomers through the *reproductive practices* of the community: the activities through which individuals come to participate in the practices of—and reframe their identities in relation to—the community. The training and apprenticeship of doctors, lawyers, midwives, and tailors are the reproductive practices through which the next generation of doctors, lawyers, midwives, and tailors is developed.

Much of the work on communities of practice focuses on doing (*practice*) and being (*identity*). The theory of *pedagogical praxis*, which I have developed in more detail elsewhere (Shaffer, 2004b), extends the idea of communities of practice by recognizing that participation in a community of practice also involves developing that community's core *values* and *knowledge*. Furthermore, a community's ways of doing, being, caring, and knowing are organized by and around a way of thinking. Practice, identity, values, knowledge, and epistemology, I have argued, are bound together into an *epistemic frame* (Shaffer, 2004a). Broudy (1977) argues that the oft-discussed concepts of knowing *that* and knowing *how*—of declarative and procedural knowledge—are incomplete without the capacity of "knowing *with*," which he describes as providing "a context within which a particular situation is perceived, interpreted, and judged" (p. 12). In these terms, epistemic frames are the ways of knowing *with* associated with particular communities of practice. These frames have a basis in content knowledge, values, identity, and associated practices, but epistemic frames are more than merely collections of facts, interests, affiliations, and activities. Epistemic frames are a form of knowing *with* that comprise, for a particular community, knowing *where* to begin looking and asking questions, knowing *what* constitutes appropriate evidence to consider or information to assess, knowing *how* to go about gathering that evidence, and knowing *when* to draw a conclusion and/or move on to a different issue. Lawyers act like lawyers, identify themselves as lawyers, are interested in legal issues, and know about the law. These skills, affiliations, habits, and understandings, are made possible by looking at the world in a particular way—by thinking like a lawyer. This is a two-way street, of course: thinking like a lawyer is made possible by these skills, affiliations, habits, and understandings.

Different communities of practice have different epistemic frames: different ways of knowing, of deciding what is worth knowing, and of deciding what constitutes a warrant for a claim within the community. Developing understanding thus implies developing understanding of some particular kind, from some particular perspective, relative to the epistemic frame of some community of practice. This is not to say that epistemic frames are hegemonic any more than identities are. Lawyers don't *only* think like lawyers. They may also be parents, and videogamers, and sports fans, and amateur carpenters. They are able to take on these other epistemic frames and to think and act in these ways as well.

The same is true for doctors and engineers—and Army rangers, plumbers, bricklayers, commodities traders, politicians, and drug dealers—but for different ways of thinking. Knorr-Cetina (1999) defines *epistemic cultures* as the "cultures of knowledge settings" (p. 8)—such particle physics or molecular biology laboratories—within a knowledge society, and Kuhn likewise suggests that normal science progresses as groups are transformed into professions or disciplines by adopting a shared *paradigm*. The theory of pedagogical praxis suggests more broadly that *any* community of practice is a group with a local culture (Rohde & Shaffer, in press; Shaffer, 2004b), and the epistemic frame is the grammar of that culture: the conventions of participation that individuals internalize when they become acculturated (Shaffer, 2004a). These ways of knowing are a critical part of the coherent core around which any community of practice is organized. In this sense, one might think of an epistemic frame as a local instantiation of Foucault's (1972) *episteme*. The episteme of an era, for Foucault, is the relationship between discursive practices (patterns of discourse or forms of interaction) and structures of knowledge (which for Foucault are always intertwined with the organization of power). Episteme exists at the level of the culture, across domains of knowledge and forms of practice. Epistemic frames represent a similarly tight linkage between practices and ways of knowing, but at the level of the local cultures developed by individual communities of practice. Alternatively, one might think of an epistemic frame as a form of Bourdieu's (1977) *habitus*—but habitus as part of a social world in which individuals take on multiple *habiti* as they move among the different communities of practice with which they affiliate. Epistemic frames, in this sense, are the grammar of what Gee (1990; 1992; 1999) refers to as a Discourse: it is the way of knowing associated with a particular way of being in the world, or the internalization (Vygotsky, 1978) of the practices of a particular community.

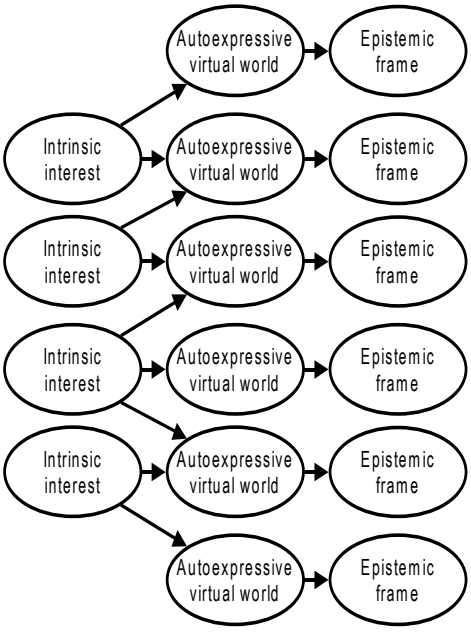
My students and I have undertaken a number of ethnographic studies of communities of practice, with the goal of understanding the genesis of their epistemic frames for new members of the community—a process we refer to as *epistemography*. One study of an architectural design studio (Shaffer, 2003), for example, showed that architects in training are taught to address design problems by developing and articulating a unique *design idea* as a solution to an architectural problem. Design problems are open-ended, in the sense that there are an infinite number of possible solutions. The job of an architect is to choose a particular solution, and then express it clearly and defend it as a viable proposition that organizes the various layers of the project. Journalism is similarly an open-ended field: there are an infinite number of potential stories that a journalist can choose. But unlike in architecture, there are a limited number of ways to tell a "journalistic story." For an investigative journalist, our research shows, the challenge is to find something significant about the systems that impact peoples' lives—what journalists refer to as *the story behind the story*—and then to find an individual whose experience exemplifies that larger issue. Once a journalist finds *the story* of an individual that reveals something about a larger issue, the translation to *a story* (in print or otherwise) is a matter of using a set of well-articulated

journalistic forms. In the epistemology of design, design ideas are valid when they can be expressed so as to provide a coherent organizing principle through the various layers of a design project; in the epistemology of investigative journalism, journalistic ideas are valid when they use a particular set of forms to convert *the story* into *a story* that reveals *the story behind the story*. Bound up with each of these epistemologies is a set of practices (drafting, model-building, and presentation in design reviews, or interviewing, copy editing, and writing), identities (designer, or watchdog and professional pest), values (artistic expression or accuracy), and knowledge (tolerances of materials and rules of perspective drawing or the rules of Associated Press style and Freedom of Information Act requests).

The point of these examples is that scientific thinking (in the sense that Dewey described) is not necessarily the unitary endpoint of educative experience. There exist a range of epistemic frames through which participants in various communities of practice validate their ideas in the world. The general and generic disposition of testing propositions through scientific inquiry may be less significant in organizing activity in the world than the dispositions of particular forms of systematic inquiry as they are enacted within communities of practice. It may be true in principle that all knowledge comes from experience, but the pedagogical issue is that different kinds of knowledge are created through different kinds of experiences.

Put another way, interests that lead to expressive activity in a community of practice have the potential develop the epistemic frame of that practice—and expressive activity in different communities of practice will lead to the development of different epistemic frames. (See Figure 5.)

Figure 5. A schematic diagram of pedagogical praxis as a revision of the Pragmatic Progressive model of learning through active engagement in meaningful activity



MULTISUBCULTURALISM

I argue, then, that the Pragmatic Progressive model as described by Dewey is a powerful way of thinking about learning through active engagement in meaningful activity using computational media. Beginning with Papert's (1980) work in the 1970s, research has shown that microworlds can help students to conduct explorations on topics of their own choosing, and to pursue these explorations according to the dictates of their own interest. Microworlds make it easy to create, manipulate, and explore ideas. When combined with open-ended activities and a flexible learning environment, microworlds thus allow students to develop understanding through the pursuit of expressive projects. This freedom to explore can be both meaningful and motivating for students, affording them a sense of control and personal investment in their inquiry (Noss, Healy, & Hoyles, 1996; Noss & Hoyles, 1996; Papert, 1980, 1993; Shaffer, 1997b).

The theory of pedagogical praxis (Shaffer, 2004b) suggests two important revisions of the Pragmatic Progressive model. First, building on research on computational microworlds, pedagogical praxis argues that new computational media in the form of video games, simulations, and other microworlds expand the range of domains that can be made accessible to students as a medium for meaningful activity. That is, new media expand the potential scope of Pragmatic Progressive pedagogy.

This basic point—that advances in technology can facilitate active engagement in a way not possible before—is critical to understanding the role of new media in learning. It is surely true that any school equipped with a computer and printer (or rudimentary access to the Internet) could accomplish with ease Parker's goal of authentic reading and writing instruction through technology. But my argument here is that while the ability of technology to make an old idea about learning more powerful is important, in so doing it lets us rethink education in a much deeper way. It forces us to think not only about the means of education, but about its ends.

As new technologies make more practices in the world accessible to students, pedagogical praxis suggests that meaningful activities in the world are organized in, by, and around communities of practice. Further, these different communities of practice have distinct epistemic frames. The work of these communities is orchestrated by distinct ways of knowing. Not all thinking is *scientific*—or most effectively characterized as scientific for pedagogical purposes—in the sense that Dewey intended. Rather, there are a number of ways of thinking that characterize meaningful, socially-valued, and socially valuable ways of acting in the world.

These revisions of the pragmatic Progressive model problematize Dewey's claim in *Experience and Education* (1938) that the "scientific method is the only authentic means at our command for getting at the significance of our everyday experiences of the world in which we live" (p. 88). Pragmatic Progressive pedagogy emphasizes the Pragmatic goal of tolerance and with it the Progressive belief in the importance of starting with individual interests as a means of expanding the Democratic experiment. It is a pedagogy that opens multiple legitimate pathways to learning: a multiculturalism of inclusion and diversity (Milner, Flowers, Moore, Moore, & Flowers, 2003), in which the different backgrounds and perspectives of students are respected as legitimate points of entry into the educational landscape. Pragmatic Progressive pedagogy creates a multiculturalism of means, emphasizing the value of multiple routes to participation in the educational process. Students can come to schooling with a wide variety of interests and learn by engaging in a range of projects that explore those interests in more depth. However, as the discussion above suggests, being primarily a multiculturalism of means, Pragmatic Progressive pedagogy assumes a common epistemic endpoint of the educational endeavor. If all good thinking is "scientific thinking," then pedagogy begins with students' interests is necessarily *convergent*: all interests lead to an epistemic Rome.

One might argue that our current system of education is more teleologically diverse than that because curricula emphasize a range of disciplines: science to be sure, but also mathematics, history, literary studies, and so forth. But pedagogical praxis emphasizes the ways in which meaningful activity, carried out in auto-expressive media, potentially provides access to the epistemic frames of a wide variety of communities of practice. From this perspective, even a small number of foundational disciplines make a relatively convergent intellectual framework for a system of education.

Much of the diversity in our current educational system is still predominantly a diversity of means rather than ends. Multicultural curricula writ large take lifeways and cultural experiences as the *content* of the educational experience: they

are the vehicles through which students from a range of backgrounds can access the privileged epistemologies of the traditional disciplines. Or they are the object lessons for the development of social and cultural tolerance: we teach about the way others live as a means to teach respect for the ways others live (Banks, 1999).

I am not for a moment suggesting that these are ignoble goals. Access and tolerance are important virtues of a multiculturalism of means, and a vast improvement (or would be a vast improvement if widely practiced) over many curricula and pedagogies that have been used over the years. But multiculturalism has to be more than merely presenting information about human diversity and societal inequality (Ladson-Billings, 2001a) because multicultural understanding cannot be separated from epistemic questions. As McWilliam (1995) argues, "issues of race, class, culture, gender, and ecology will continue to be marginalized" in "Eurocentric and androcentric knowledges and practices" (p. 61). Thus theorists such as Banks (1999; 2001; 1996), King (2001), and Ladson-Billings (2001b) argue that a necessary (though not by itself sufficient) component of multicultural education is systematic opportunities to "investigate and determine how cultural assumptions, frames of references, perspectives and the biases within a discipline influence the ways that knowledge is constructed" (Banks, 1996, p. 21).

Pedagogical praxis addresses this challenge directly by suggesting that rather than an epistemologically convergent multiculturalism of means, we consider an education based on a *multisubculturalism* of ends: a *co-vergent* educational model in which a range of socially-valued practices determine both the means *and* the ends of the educational process. Because communities of practice develop coherent epistemic frames for new members, the reproductive practices of such communities may make provide an alternative to the current organization of our educational system. Rather than constructing a curriculum based on the ways of knowing of mathematics, science, history, and language arts, we can imagine a system in which students learn to work (and thus to think) as doctors, lawyers, architects, engineers, journalists, and other valued practitioners—not in order to train for these pursuits in the traditional sense of vocational education, but rather because developing those epistemic frames provides students with an opportunity to see the world in a variety of ways that are fundamentally grounded in meaningful activity and well aligned with the core skills, habits, and understandings of a postindustrial society. In effect, pedagogical praxis and its emphasis on the coherent ways of knowing of valued social practices provides an opportunity to develop a curriculum of "'rigor' within diversity" (p. 296) that theorists such as Schutz suggest may be necessary to create truly democratic schools.

Of course, professional practices such as medicine, law, architecture, engineering and journalism are not the only practices with coherent epistemic frames. Professional practices are socially and economically privileged, but pedagogical praxis suggests that any community of practice has such a frame. Just as communities of practice in the world should not be a priori more or less valuable than those in the academy—including the traditional disciplines such as mathematics, history, science, and language arts, which evolved to parse the intellectual landscape of the Middle Ages, and shaped the school curriculum in the 19th century (Donald, 1991)—so communities with economic power and social prestige should not necessarily be more privileged than other communities of practice in thinking about pedagogical ends. Pedagogical praxis suggests that we have an opportunity to reorganize the educational landscape around a fundamental question: Which epistemic frames should students develop to become fully actualized and empowered citizens in a post-industrial society? This is both a practical and a moral—and thus ultimately a political—question. It suggests that in an increasingly interconnected

and interdependent world, we ask not "How can we make sure every student learns math?" but rather "What communities of practice do we collectively value?"

The answer to the latter question may be that learning to participate in the community of practice of academic mathematicians, historians, and research scientists is an important end of the educational process. Or we may decide that the practices of accountants, journalists, and foundation program officers are more useful general ways of thinking about issues numeric, civic, and scientific in the body politic. Or we might decide fundamental skills for life in a global society and economy include a wide range of culturally diverse practices—and that different combinations of practices matter for different students. Of course, this range of practices has existed for the past century, and a reexamination of the ends of education based on valued practices does not depend on the existence of computers. I argue here, however, that computers make socially-valued practices more accessible, and the concept of epistemic frames helps us see that such practices are epistemically viable alternatives to the traditional disciplines as the ends of pedagogical activity.

In other words, as I suggest in the introduction, new technologies ask us to reconsider the ends of education. Thus instructional designers have a responsibility not only to create compelling learning technologies, but to engage in the discussion of what is worth teaching and learning in the first place. Whether or not thinking about this question in terms of epistemic frames is the only answer, or even the best answer, in the digital age, this theoretical issue is eminently and unavoidably practical.

I have written elsewhere (Shaffer, 2004b, in press) about how learning environments can be developed based on valued communities of practice: epistemographic study of ways in which an epistemic frame is developed through the reproductive practices of a given community, followed by the development of technologies that let students begin to develop a similar epistemic frame through a simulation of those practices. While that is no simple feat, it is straightforward relative to the task of deciding which practices should be so modeled. As Anderson (2002) suggests, arguing that all ways of knowing are internally coherent is not to suggest that they are all equivalent, or equally valued. The educational system is notoriously resistant to change (Tyack & Cuban, 1996), particularly changing conceptions of knowledge (Ladson-Billings, 2001a). Thus, we can expect that any process of deciding which practices will reorganize the educational process will be complex and contentious, particularly since no student will be able to participate deeply in the ways of knowing of every socially-valued community of practice. But although the process will be difficult—and perhaps even difficult to imagine in the current educational climate—a reorganization of the educational system based on valued practices has the potential to support a multisubculturalism of ends as well as means: a way for education to speak to students from a range of cultural traditions, to connect, as Dewey suggested, with their intrinsic interests, guide those interests towards meaningful activity in real and virtual worlds, and by linking students with important communities of practice, lead to the development of valued ways of thinking.

Would such a multisubcultural curriculum, by itself, produce an educational system that prepares students for an increasingly diverse and interconnected world? Almost certainly not. But the epistemic ecumenicalism it both demands and makes possible may be a necessary component in a genuinely multicultural system of education. Pedagogical praxis suggests that new technologies provide an opportunity to give students access to a wide variety of communities of practice; that these communities are orchestrated by distinct ways of knowing (and deciding what is worth knowing); and that these epistemic frames of socially-valued communities of practice, made approachable by new technology, may provide a more inclusive model for learning in a technological society.

AUTHOR NOTE

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ENDNOTES

1 My intent is not to suggest that issues of technology access have disappeared. Rather, I highlight the extent to which barriers to this particular pedagogy are significantly lower with computers than with the printing press or other traditional media as enabling tools.

2 This basic insight is not unique to the world of computation, of course. A similar argument resolves Zeno's paradoxes, described 2500 years before the development of the first electronic computer.

3 I do not mean to suggest that simulations depend on visual or other perceptual modeling. Only that they are greatly facilitated by very rapid implementation of complex algorithms.

4 In their original description of autoexpressivity, Noss and Hoyles (1996) focused on its linguistic aspects. In extending the concept, I suggest that *explicit* formulation of intentions is more salient than *linguistic* formulation in the development of understanding (Shaffer, 1998).

Section II
Design Considerations