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Contents

Education has always been awash with new ideas about learning and teaching. Teachers and administrators are regularly bombarded with suggestions for reform. They are asked to use new curricula, new teaching strategies, and new assessments. They are directed to prepare students for the new state standardized test or to document and assess students' work through portfolios and performance assessments. They are urged to use research-based methods to teach reading and mathematics. Among educators, there is a certain cynicism that comes with these waves of reformist exhortations. Veteran teachers often smile wryly when told to do this or that, whispering asides about another faddish pendulum swing, closing their classroom doors, quietly going about their business. How are educators to sort the proverbial wheat from the chaff as they encounter these reform proposals?

Doing so requires a solid understanding of the foundational theories that drive teaching, including ideas about how students learn, what they should learn, and how teachers can enable student learning. This paper's charge is to lay out the central ideas about learning and teaching that run throughout contemporary educational discourse. A handful of significant ideas underlie most reforms of the last 20 years. Our frame includes three contemporary ideas about learning: that learning is a process of active construction; that learning is a social phenomenon, as well as an individual experience; and that learner differences are resources, not obstacles. In addition, we discuss one critical idea about what counts as knowledge and what students should learn: that students need to develop flexible understanding, including both basic factual and conceptual knowledge, and must know how to use that knowledge critically. Our frame is not a dichotomous one, holding that students have either content *or* process knowledge, that students are either passive *or* active agents in their own learning. Rather, we argue that there are shifts in emphasis, moving from more traditional notions of learning and knowledge to conceptions that are broader and more nuanced.

In light of those shifting ideas, we then briefly examine the implications for teaching. Again, we focus on a few key ideas: that teaching is intellectual work; that teachers have a range of roles, including information deliverer and team coach; that effective teachers strategically distribute (or share) work with students; and that teachers focus on challenging content. The "big ideas" of the paper can then be summarized as shown in Table 1.

Table 1. Benchmarks for Learning and Teaching

Benchmarks for…	Moving from…	Moving toward…
Learning	Passive absorption of information	Active engagement with information
	Individual activity	Both individual activity and collective work
	Individual differences among students seen as problems	Individual differences among students seen as resources
Knowledge	What: facts and procedures of a discipline	What, how, and why: central ideas, concepts, facts, processes of inquiry, and argument of a discipline
Teaching	Simple, straightforward work	Complex, intellectual work
	Teachers in information-deliverer role	Varied teacher roles, from information deliverer to architect of educative experiences
	Teachers do most of the work	Teachers structure classrooms for individual and shared work
	Lessons contain low-level content, concepts mentioned; lessons not coherently organized	Lessons focus on high-level and basic content, concepts developed and elaborated; lessons coherently organized
	Teachers as founts of knowledge	Teachers know a lot, are inclined to improve their practice continually

Contemporary Ideas about Learning

Scouring the shelves of any library or bookstore leaves one swimming is a sea of "isms"—behaviorism, constructivism, social constructivism—as well as lists of learning theories: multiple intelligences, right- and left-brain learning, activity theory, learning styles, Piaget, and communities of learners. Here we do not propose a comprehensive list of all contemporary ideas about learning. Instead, we focus on three big ideas that underlie most of current scholarship and practice: learning as a process of active engagement; learning as individual and social; and learner differences as resources to be used, not obstacles to be confronted.

Learning as a Process of Active Engagement

Perhaps the most critical shift in education in the past 20 years has been a move away from a conception of "learner as sponge" toward an image of "learner as active constructor of meaning." Although Plato and Socrates (not to mention Dewey) reminded us long ago that learners were not empty vessels, blank slates, or passive observers, much of U.S. schooling has been based on this premise. Teachers have talked; students have been directed to listen (Cuban 1993). The assumption has been that if teachers speak clearly and students are motivated, learning will occur. If students do not learn, the logic goes, it is because they are not paying attention or they do not care.

These ideas were grounded in a theory of learning that focused on behavior. One behavior leads to another, behavioral-learning theorists argued, and so if teachers act in a certain way, students will likewise act in a certain way. Central to behaviorism was the idea of conditioning—that is, training the individual to respond to stimuli. The mind was a "black box" of little concern. But behavioral theorists had to make way for the "cognitive revolution" in psychology, which involved putting the mind back into the learning equation. As Lesh and Lamon (1992, p. 18) put it, "Behavioral psychology (based on factual and procedural rules) has given way to cognitive psychology (based on models for making sense of real life experiences." In this shift, several fields of learning theory emerged. Neuroscientists, for example, learned that the brain actively seeks new stimuli in the environment from which to

learn (Greenough, Black, and Wallace 1987; Kandel and Hawkins 1992) and that the mind changes through use; that is, learning changes the structure of the brain (Bransford, Brown, and Cocking 2000). However, it is still too early to claim that neuroscience can definitely explain how people learn.

The work of other cognitive theorists helps here. For example, research suggests that learners—from a very young age—make sense of the world, actively creating meaning while reading texts, interacting with the environment, or talking with others. Even if students are quietly watching a teacher speak, they can be actively engaged in a process of comprehension, or "minds on" work, as many teachers describe it. As Bransford, Brown, and Cocking (2000) wrote, "It is now known that very young children are competent, active agents of their own conceptual development. In short, the mind of the young child has come to life" (pp. 79–80). This cognitive turn in psychology is often referred to as a *constructivist* approach to learning.[1]

Understanding that students construct meaning has led to increased attention to students' interpretations of what they witness in class. Recall the game of "telephone": A phrase, whispered from person to person, is followed by hilarity when the last person announces something quite different from what the first said. This game exemplifies the role of interpretation in any human endeavor. At the basest level, what we "hear" is filtered through our assumptions and values, attention, and knowledge. Some students interpret *Moby Dick* differently from the way others do. Some students interpret the film *The Patriot* differently from they way their friends do. All of us, in school and out, shape and sculpt the information we encounter, "constructing" our understanding. Although two students might encounter exactly the same information, as active participants in their own knowledge building, students develop understandings that can be qualitatively different.

Especially important has been the growing revelation of the powerful role of prior knowledge and experience in learning new information (e.g., Bauersfeld 1988; Brown 1994; Cobb 1994, 1995). Students enter school with ideas, and those ideas are a significant force to be reckoned with. Researchers have shown that students' beliefs that the earth is flat last well after teachers and others have told them otherwise (Vosniadou and Brewer 1989). Elementary-age children have been found to hold naive theories of prejudice and discrimination that resonate with the theories of social scientists who have grappled with similar questions about why people dislike or discriminate against those who are different (Rose 2000). Similarly, Byrnes and Torney-Purta (1995) found that adolescents use naive social, economic, and political theories in identifying causes of social issues. Many young children cannot understand why 1/4 is larger than 1/8 because 8 is bigger than 4 (Gelman and Gallistel 1978). Researchers are continuing to uncover how students' preconceptions, nonscientific beliefs, conceptual misunderstandings, vernacular misunderstandings, and factual misconceptions act as powerful filters in what and how they learn.[2]

When we acknowledge that students interpret—and do not automatically absorb—the information and ideas they encounter in the world through the experiences and theories they bring to school, the links between learning and teaching become more complicated. Rather than appearing as a natural result of teaching, learning is seen as inherently "problematic." Teachers might create opportunities for students to learn, but teachers cannot control students' interpretations. Teachers become responsible for diagnosing students' interpretations and helping them alter, edit, and enrich them. But we get ahead of ourselves. Each of the shifts in learning theories that we discuss here has implications for teachers' roles and responsibilities. We discuss these concomitant shifts in the second half of this paper.

One unfortunate consequence of the increased interest in constructivist learning theories has been the wholesale rejection of behaviorist theories of learning by some enthusiasts. This "throwing the baby out with the bathwater" phenomenon is neither new nor productive. Students can learn while they absorb new information (indeed, just because children are sitting still and quiet does not mean that their minds are not racing), just as they can learn through being more active. Similarly, activity does not mean that learning is taking place. Any and all theories are based on limited information; they are conjectures and assertions based on empirical research, and all scientists, including learning scientists—are constantly interrogating their theories. Moreover, there are times when one needs multiple theories. Just as physicists can think of light as both wave and particle, teachers can theorize about learning in both cognitive

[1] As in all fields of scholarship, there is considerable debate between different theories and versions of theories. Theories of constructivism are no exception. For an overview of the theories of constructivism, see Greeno, Collins, and Resnick (1996); for a critical perspective, see Hirsch (1996) and Phillips (1995).

[2] For other examples of this work, see Confrey (1990), Erlwanger (1975), Roth, Anderson, and Smith (1987), Smith (1993), Toulmin (1995), and von Glasersfeld (1987).

and behavioral terms (Wilson 2003). Sfard (1998) argued, in fact, that we need multiple metaphors for learning and that to throw one out in favor of another is dangerous.

Because theories vary in their quality and rigor, it seems imperative that teachers be well-informed, skeptical consumers of "new" educational ideas or reigning theories (Hirsch 1996; Phillips 1995, 2000; Sfard 1998). They interpret, adapt, and combine those theories as they use them in practice. Indeed, current thought suggests that a "balanced" view of learning and teaching is crucial (e.g., Kilpatrick, Swafford, and Findell 2002). Students need opportunities to learn in multiple ways, and teachers need to have a pedagogical repertoire that draws from myriad learning theorists. Recent reviews of the state of the art in learning theory, especially *How People Learn* (Bransford, Brown, and Cocking 2000) and *How Students Learn* (Donovan and Bransford 2005), are particularly helpful resources in culling the major findings from learning research.

Learning as a Social Phenomenon

A second significant shift has involved a growing awareness among learning theorists of the social aspects of learning. Previous generations of psychologists have focused on individuals' learning. Current work has placed more emphasis on the critical role of social groups in the development of understanding. Although solitude and peaceful silence provide good opportunities for learning, the social occasions of conversation, discussion, joint work, and debate also play a critical role in learning. Think of small children when they are first learning to identify dogs. Initially, everything with four legs may be pointed to as "dog": a neighborhood cat, a cow in a field passed while on a drive through the countryside, the gerbil next door. Children learn to distinguish between cat and dog, cow and dog, and rodent and dog by making public their claims and having parents gently amend their pronouncements.

Likewise, mathematicians may hunch over their work alone in an attic study for months, perhaps years, learning—reading books and others' papers, playing with numbers, scratching out alternative solutions. When they think they have it right, they deliver a paper at a conference or submit an article for publication. In so doing, they put their "knowledge" to a public test, where is shaped, edited, and sometimes rejected by conversation, debate, and discourse.[3] Even though Andrew Wiles preferred to work in solitude on the solution to Fermat's last theorem, it was not until he presented his work to multiple and public juries of his peers that his solution was eventually strengthened and accepted (Singh 1997).

This cluster of theories dealing with the social aspects of learning is known by varying labels, including *social constructivism, sociocultural theory,* or *activity theory.* Many theorists identified with these traditions trace their ideas back to Vygotsky (1978, 1981; see also Wertsch 1981, 1985), a psychologist who theorized about the influence of the social world on an individual's development.[4]

Although these theories are not all identical—indeed, there are some considerable differences—they share some concerns and beliefs. First is the point that knowledge is inseparable from practice: we know by doing. This means that we need to look at people while they are doing something meaningful—that is, working on authentic problems—if we want to "see" what they know. Let us consider an example. Many students have difficulty when they encounter fraction problems in school. Lacking real understanding of the concepts involved and experience in finding solutions, they are confused about which procedure to apply or why it is relevant. Yet researchers have observed children and adults demonstrating competencies in solving fraction problems in other, real-world contexts.

Lave (1988), for example, observed a Weight Watchers class in which participants demonstrated their knowledge of mathematics through the measuring involved in learning about appropriate eating habits. Being on Weight Watchers means learning to reason proportionally and reducing serving sizes to control caloric intake. At this meeting, the problem the group was working on entailed figuring out what three-fourths of a recommended serving (two-thirds of a cup) would be:

> In this case they were to fix a serving of cottage cheese, supposing the amount laid out for the meal was three-quarters of the two-thirds cup the program allowed. The problem solver in this example began the task muttering that

[3] One way to learn more about the social aspects of disciplinary communities involves reading biographies and autobiographies of scientists, historians, writers, mathematicians, and so on. See, for example, Collingwood (1946/1956) or Hexter (1971) on history, Hardy (1940/1969) or Wiener (1956) on mathematics, Latour and Woolgar (1986) on science, or any number of stories—such as Dava Sobel's *Longitude* (1995) about the intellectual and political history of an idea. For a more abstract discussion of disciplines as communities, see King and Brownell (1966), Kuhn (1962), or Popper (1958).

[4] For examples of various theories of social constructivism, sociocultural theory, and activity theory, see Bakhurst (1995), Cobb (1994), Dewey (1988), Gergen (1994, 1995), Harre (1986), Lave and Wenger (1991), Newman and Holzman (1993), Rogoff (1994), Tharp and Gallimore (1988), Vygotsky (1978, 1981), and Wertsch (1985).

> he had taken a calculus course in college.... Then after a pause he suddenly announced that he had "got it!" From then on he appeared certain he was correct, even before carrying out the procedure. He filled a measuring-cup two-thirds full of cottage cheese, dumped it out on the cutting board, patted it into a circle, marked a cross on it, scooped away one quadrant, and served the rest.
>
> Thus, "take three-quarters of two-thirds of a cup of cottage cheese" was not just the problem statement but also the solution to the problem and the procedure for solving it. The setting was part of the calculating process and the solution was simply the problem statement, enacted with the setting. At no time did the Weight Watcher check his procedure against a pencil-and-paper algorithm, which would have produced 3/4 cup × 2/3 cup = 1/2 cup. Instead, the coincidence of the problem, setting, and enactment was the means by which checking took place. (p. 165)

Thus, although the sort of problem the man in the Weight Watchers group encountered (i.e., "What is two-thirds of three-quarters?") may throw both children and adults for a loop when they confront it as an abstract "school" problem, it proves far more tractable when individuals learn by "doing"; that is, when they are solving authentic problems situated in meaningful contexts.

A second principle of sociocultural theory is that learning is fundamentally a social phenomenon that takes place within the communities we belong to (including classroom communities). These two beliefs lead to the idea that knowledge and learning exist in the interactions between individuals and the contexts in which they live, in the activities we participate in. Thus, "communities of practice" or "learning communities" become critical to learning. We learn, these theorists argue, by participating in groups—first by observing others do the work and then by gradually becoming a member and full participant of the group. Lave and Wenger (1991) illustrated their theory with examples of different apprenticeships (midwives, tailors, U. S. Navy quartermasters, butchers, and nondrinking alcoholics). Initially, people join these communities and watch, as the theorists suggest, from the sidelines (they call this *peripheral participation*). Over time, and as the newer members become more competent, they move closer to the center of the community:

> "Legitimate peripheral participation" provides a way to speak about the relations between newcomers and old-timers, and about activities, identities, artifacts, and communities of knowledge and practice. A person's intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a socio-cultural practice. This social process, includes, indeed it subsumes, the learning of knowledgeable skills. (Lave and Wenger 1991, p. 29)

A third feature of these theories is that it is within those communities that standards lie. The norms for testing the quality of a performance are determined by groups, not individuals, and one's performance is assessed through genuine participation. In all areas of knowledge, groups of mathematicians and scientists, historians and writers together determine—through criticism, debate, proof, validation, and so on—their shared standards. Similarly, these social entities co-construct the language used in those debates, for the discussions cannot proceed absent a common language (Bakhtin 1981; Bruner 1986; Kozulin 1990; Lave and Wenger 1991; Vygotsky 1978; Wertsch 1985; Wertsch and Rupert 1993).

Although social groups have always played an important role in an individual's learning—parents edit their children's talk, doctors argue over the latest issues raised in the *American Journal of Medicine*—U.S. schools have traditionally focused on the individual aspects of learning. Students have worked quietly at their desks, writing papers, filling out worksheets, taking tests, and reading textbooks. Ideas have not been submitted to public debate. In part this is because teachers must manage groups of children who are not there voluntarily (see Cusick 1992). Rogoff and others (2003) described the typical form of learning in U.S. schools as assembly-line learning, and they contrasted it with learning through participation. Assembly-line instruction is hierarchical; teachers and students have fixed roles; motivation is through extrinsic rewards; and learning is done through lessons that are wrenched from any meaningful context. In contrast, learning through participation is collaborative; roles are flexible; motivation is intrinsic; and the purpose of the activity is clear and meaningful to all participants.

A final feature of these theories is that they highlight the situated nature of learning, that is, that we learn in particular situations and contexts. This might help explain

why transfer—being able to take what one has learned in one situation and apply it to another—is not a given. Students do not necessarily transfer their learning from one problem to the next. Recognizing the important role that contexts play in shaping when and what we learn, psychologists and learning scientists have begun to understand what it takes to help students transfer their learning to new situations. For example, if the initial learning was not robust, students cannot transfer what they learned. As Bransford, Brown, and Cocking (2000) noted:

> Time spent learning for understanding has different consequences for transfer than time spent simply memorizing facts or procedures from textbooks or lectures. In order for learners to gain insight into their learning and their understanding, frequent feedback is critical: students need to monitor their learning and actively evaluate their strategies and their current levels of understanding. (pp. 77–78)

Scholars have also discovered that learners who understand more about their own learning—researchers call this a *metacognitive awareness*—have greater capacity to transfer their learning to new problems and contexts. These insights into transfer allow us to understand more about *what* students need to know (a topic we return to shortly) if their knowledge is to be generative—that is, *transferable* to new contexts.

Theories about shared knowledge and the effects of the community on one's learning have become increasingly important in education (e.g., Cobb 1994, 1998; Salomon and Perkins 1998; Tharp and others 2000; Tobin and Tippins 1993). This interest in sociocultural and activity theory has led some educators and reformers to argue for a wider array of organizational structures in U.S. schools, including cooperative groups, classroom discussions, and student performances. In so doing, teachers are asked to focus not only on individual students but also on the development of "communities of learners." Thus, teachers need to keep their eyes both on the individual learners in their classrooms and on the classroom community created by teacher and students.

Learner Differences as Resources

Another significant shift has occurred in the value that we place on individual and group differences. One of the self-evident truths of schooling is that learners come with different experiences, capacities, understandings, and backgrounds. As the United States has made progress in moving toward its goal to provide a high-quality universal education for all citizens, those differences have increased. When only the sons of ministers and lawyers attended schools in order to follow in the footsteps of their fathers, teachers did not have to deal with many differences, because their students were much like them.

As schools became more democratic, that changed. Teachers had to learn to deal with the inevitable differences that students bring to school. For a long time, however, we spoke of differences as static abilities that determine how much or how fast a learner can learn (often because we believed that there was a single way to learn or think.) Teachers, in fact, often used tests as a way of screening children. Differences were considered deficits. If a child came to school with a background different from that of someone else, teachers often talked about what the different student did not know or had not done. But as our country and our schools learn more about what it means to be multicultural, we have been legitimately chastised for this "deficit model" of students (especially students who are different from us) and urged to think of differences as resources to use, not as obstacles to overcome.

Yet it is not only out of some set of ideological or political commitments that this emphasis on what learners bring has gained popularity. Instead, it is a logical outgrowth of the shift toward a constructivist stance toward learning. If learners construct their own meaning, teachers must know something about where learners start. One cannot build a bridge without a clear sense of the location of both shores. Likewise, teachers cannot create a bridge between subject matter and student without having a clear sense of what students know, care about, can do, and want to do. Rather than treating learners' starting places as "gaps," teachers need to assume that students start in sensible places. Teachers need to "give learners reason" by respecting and understanding learners' prior experiences and understandings, assuming that these can serve as a foundation on which to build bridges to new understandings (Duckworth 1987; Lampert 1984, 2001). In support of this perspective is the fact that psychologists have failed to find a singular theory of learning that would justify a deficit explanation for student differences.

Cross-cultural research on teaching also supports the notion that individual differences among students can be resources. In contrast to the deficit model often seen in the United States, Japanese teachers view individual differences as a natural and beneficial characteristic of the

group. They believe that individual differences produce a range of ideas and problem-solving strategies for students' discussion and reflection. Based on their experience, Japanese teachers can predict the likely responses of students to a topic and use this knowledge of student thinking and the nature of the discussion that is likely to occur to plan their lessons more completely (Stigler and Hiebert 1999).

The differences of which we speak are myriad. Students bring differences in intelligence and interest, in ethnicity and race, in culture and gender. Gardner's (1983) work on multiple intelligences is probably the most well known, although it is part of a stream of scholarship that continues to explore questions of innate and developed ability and capacity. Delpit (1995; Delpit and Kilgour 2002) and Ladson-Billings (1994, 2001) have written eloquently about the complexity of teaching African American students in racially aware ways, and the literature in this field continues to grow, as researchers learn more about the experiences of children who come from different cultures.

Critical to teachers' conceptualizing their students as resources is knowledge of the homes and cultures of students (e.g., Knapp and Shields 1991). Moll (1990; Moll and Greenberg 1990), for example, discovered that Mexican American households are clustered according to kinship ties and exchange relationships. Further, these household clusters develop rich "funds of knowledge"—information about practices and resources useful in ensuring the well-being of all households. Each household in the cluster has expertise needed by the entire cluster—car repair, appliance upkeep, plumbing, education, herbal medicine, first aid, and so on. Together, the households form a cluster for the exchange of information and resources. In this conception of community life, all individuals are not expected to have the same expertise. Instead, knowledge is distributed and communally shared.

Understanding these cultural differences, many scholars argue, would help teachers draw on students' experiences within classrooms, enabling teachers to make more explicit and meaningful connections to students' communities. For example, in Moll and others (1992), teachers in Tucson chose two or three students and conducted interviews with those students and their families so that they might learn more about their community. Working together with the researchers, teachers then began exploring ways to integrate what they were learning about these networks into their classrooms. One teacher used her awareness of a student's experiences with selling candy from Mexico in the United States to create interdisciplinary lessons about candy production. Students studied mathematics, science, and health; one parent came to class and taught the students how to make Mexican candy.

Similarly, teachers might also draw on the work of Rose (1989, 1995) on the Hispanic and Chicano experience and of Au (1981) on the Hawaiian experience, as well as that of Ogbu (1992) on the relationship between cultural diversity, learning, and schooling in rethinking how to tailor instruction to take advantage of student differences. But race and culture are not the only significant differences among our students. With the rise of feminism in academic circles, questions about gender differences have also come to the forefront of American education (see, e.g., Belenky and others 1986; Gilligan, Lyons, and Hanmer 1990; Pipher 1994). Class is also important (although not studied as directly or as often), as are issues of second-language learning. Although it would be impossible for teachers to take into account all of the possible relevant differences among their students, continuing to learn about these differences and adapting one's instruction accordingly is one of the permanent challenges teachers face.

As we mentioned earlier, there are multiple theories of learning for teachers to consider. Here we have neither considered the comprehensive list of those theories nor discussed each in detail. However, we have noted that there are three themes that run across many theories: that students are active constructors of their own knowledge; that learning is both individual and social; and that students are resources to be tapped, not obstacles to be overcome. We now turn to one additional shift in foundational theories, one that concerns not so much *how* students learn as *what* they learn.

Knowing What, How, and Why

The fourth and final significant shift concerns assumptions about knowledge: *what* students should learn. It is no longer enough that students quietly master only the facts and rules of a discipline. Contemporary educational reform demands that students have a more flexible understanding of mathematics and language arts, biology and physics, and geography and history. They must know the basics, but they must also know how to use those basics to identify and solve nontraditional problems. Alternatively described as *critical thinking, teaching for understanding, mathematical power,* and so on, this theory has the underlying assumption that to know a field one must master its central ideas, concepts, and facts *and* its processes of inquiry and argument. Biologists do not sit in lonely labs regurgitating their knowledge of cells. They search out new

problems and use research methods to solve those problems, all the while using their knowledge of the "basics." After those same biologists have solved a new problem, they present it for public critique, submitting their work for critical review by colleagues. If the work is not defensible in this public domain, they return to their laboratories to reexamine their evidence and revise their thinking.

Similarly, if students are to leave school armed with the knowledge and skill necessary to participate as citizens and thinkers, they need to know many things. They need to learn about the ideas, theories, facts, and procedures of a discipline. They need to become fluent with the linguistic systems of a field, developing the skill and knowledge associated with inquiry in that field, which includes both individual methods and the social context of the intellectual discourse. Thus, they need extensive experience with the ways in which ideas are argued and proved in disciplinary fields as well as a deep and thorough understanding of the facts and concepts in each field. Children need to write, the reformers argue, so that they can read critically and not be persuaded by spurious text. Students need to do statistical analyses of problems that they themselves identify so that they might be better consumers of statistics used daily by the press. Students need to read primary sources and work on their own historical interpretations so that they are better able to critique the ones they read (Bruner 1960/1977; Dewey 1902/1956; Schwab 1978a).

Clearly, we run the risk of oversimplification with such a brief tour through very complicated ideas. We do not want to suggest that these ideas about learners, learning, and knowing are either mutually exclusive or monolithic. In fact, their compatibility is one reason for their popularity in the last 20 years. Because disciplinary knowledge is developed in communities, such as those of mathematicians and physicists, the emphasis in these theories on inquiry, discourse, community, and social construction of knowledge support one another. Because we assume that teachers must know what their students know and think, treating students' differences as resources rather than obstacles makes sense. Because contemporary theories of knowledge emphasize individuals and their interpretations, constructivist theories of learning seem reasonable.

But in the last 20 years we have also witnessed considerable debates about which ideas about learning, learners, teaching, and knowledge deserve pride of place. Critics of some standards have rightfully noted that it is problematic to mix images of what students should be learning (knowledge) with how they should be learning (teaching), because teachers ought to have latitude to make their own decisions about appropriate pedagogy. Critics also have worried about the tendency of some educators to adopt orthodoxies that are either limiting or not based on empirical evidence (e.g., Hirsch 1996; Ravitch 2000). Discussions concerning race and culture have raised questions about an oppressive, monolithic "politically correct," "social justice" stance. Further, within the disciplines, considerable debate has taken place about the nature of knowledge, the role of interpretation, and an apparent slide into a frightening relativism.[5]

But recent research suggests that we cannot let political differences obscure the fact that *all* students need deep knowledge of content. Research in cognitive science helps us understand why it is important for students to have both a sound basis of factual knowledge, and a flexible understanding of how to use that knowledge in authentic and new contexts. As Bransford, Brown, and Cocking (2000) argued:

> To develop competence in an area of inquiry, students must: (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application…. To develop competence…students must have opportunities to learn with understanding. Deep understanding of subject matter transforms factual information into usable knowledge. A profound difference between experts and novices is that experts' command of concepts shapes their understanding of new

[5] These differences were at the heart of the curriculum debates of the 1990s. Concerned that the curricular reforms of the 1980s had swung too hard in the direction of teaching for understanding, with too little attention paid to the basics, legislators, parents, and educators began calling for more "balance." California passed the ABCs legislation, mandating the teaching of phonics and basic math facts (Wilson 2003). The NCTM 2000 Standards paid more explicit attention to foundational ideas of mathematics, which was heralded by a number of journalists as a move "back to the basics." The national history standards were roundly criticized for too much attention to interpretation and multiculturalism (Nash, Crabtree, and Dunn 1997), and several organizations, including the American Federation of Teachers, evaluated state standards for their content, precision, clarity, and rigor.

The questions being raised about school knowledge parallel similar questions about disciplinary knowledge. For example, there is considerable debate in the field of history about the roles of fact, truth, and interpretation. When an eminent historian, Simon Schama, wrote a piece of historical fiction entitled *Dead Certainties* (1991) several historians publicly chastised him for toying with questions of historical truth. Similar debates characterize literature, mathematics, and the sciences. In part, these questions arose in the wake of deconstructivism and postmodern thought. See, for example, Fish (1980).

> information: it allows them to see patterns, relationships, or discrepancies that are not apparent to novices. (pp. 16–17)

We can no longer presume that algorithmic fluency is the same thing as conceptual understanding. Over and again, researchers have shown that students can master algorithms yet have little conceptual understanding. Thus, teachers need to make sure that students know content—facts and concepts—and know how to use that content flexibly to solve significant problems. As we have already seen, such knowledge is essential for the transfer of learning from one context to another—in this case, perhaps most significantly, from learning in school to learning and using knowledge out of school. As the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA) portrays learning with understanding, "Understanding for life: We will meet the future head-on if we learn with understanding: linking ideas one to another in a rich intricate web; applying what we learn to answer new questions; reflecting on knowledge; and expressing ideas in creative ways. With understanding, learning becomes personal. It lasts a lifetime" (NCISLA 2005).

Implications for Teaching and Teachers

As we all know, the relationship between learning and teaching is complex. Moreover, research on learning has often been conducted independently of research on teaching, leading to a gap in understanding between the two communities of researchers who understand and work on learning and those who understand and work on teaching. In recent years, scholars have been trying to bridge the gap between these intellectual communities with some modest success (Romberg and Carpenter 1986).

One reason the relationship remains elusive is that learning cannot be mandated; teachers cannot guarantee that a particular student will learn (Jackson 1986). A teacher may valiantly try to teach mathematics to a student, but whether the student learns something depends on many factors within and outside the teacher's control: Is the student motivated? Did the teacher use the appropriate instructional strategy? Is the student interested? Are the classroom and school conditions conducive to learning? Are the student's parents supportive? Is there enough time to digest the ideas and practice new skills? Is there any peer pressure? The list goes on. Nevertheless, these four ideas about learning, learners, and knowledge have important implications for the work of teachers. We propose several.

Teaching as Intellectual Work

Perhaps the most significant implication of these ideas about learning and knowledge is that they imply that thoughtful teachers are intellectuals who think both about subject matter and students, constructing bridges between the two. Reformers long ago learned that curricula cannot be teacher-proof—for teachers inevitably shape the materials they use based on their own knowledge, beliefs, and assumptions (e.g., Clark and Peterson 1986; Cohen, Raudenbush, and Ball 2003; Shulman 1983). Yet widespread belief persists that teaching is a straightforward enterprise. Using textbooks, teachers follow each page, directing students in what they should read and do. If the materials are good, and everyone behaves himself or herself, so the logic goes, students will learn.

That is simply not true. Resources are mediated by teachers and students, and they are situated within contexts that matter (Cohen, Raudenbush, and Ball 2003). Good teachers must think hard about what they want their students to learn, contemplating myriad questions: What is interesting about this subject for my students? What ideas and concepts are particularly difficult? Why? What are the different means I can use to help students grapple with these ideas? What do my students already know that might help? What do they believe that might get in the way? What time of the day is it? The year? How can I use my students' diverse backgrounds to enhance the curriculum? How can I create a community of learners who can support the individual and social construction of knowledge?

Notice here that answering any and all of these questions entails theories and knowledge about learners and learning. Because the situation matters, teachers must think of the time of year, school, classroom, and community (the social contexts of learning). When teachers decide what to teach, they must find ways to emphasize both concepts and facts and modes of inquiry (the nature of knowledge students need to acquire). When teachers consider what students will find interesting or difficult, they need ways to access students' minds; they need to create communities among their students (learners as active constructors of knowledge). Thus, much of teachers' thinking is informed by the ideas about learners and learning we discussed earlier.

The current emphasis on teacher thinking and decision-making has led to a sea change in the way that we think about, observe, and evaluate teachers and their teaching. Research on teaching now entails asking teachers why they act as they do and what they learn from their experiences. Administrators no longer crouch in the back of classrooms,

filling out checklists of behaviors. Instead, teachers and their colleagues (other teachers, principals, and curriculum coordinators) are expected to talk about why they taught as they did, answering questions about their reasons, rationales, and reflections: Why did you teach this lesson? What did you hope to accomplish? What would you change? New performance-based assessments—for example, the assessment system of the Beginning Teacher Assessment Program in Connecticut, teacher portfolios collected through INTASC, and the processes and products required by the National Board for Professional Teaching Standards—assume that to understand teaching, we must observe both thought and action, watching what teachers do and asking them to defend their choices. Such assessments now involve interviews and portfolios, as well as more traditional standardized tests and observations.[6]

The emphasis on the intellectual aspects of teaching is not intended to override the fundamentally moral aspects of teaching. We agree with Palmer (1997) and Schwab (1978b), who argued persuasively that it is problematic to divorce discussions of mind from heart, for the intellect is deeply personal. Rather, this attention to teachers' rationales (including explicated theories of teaching and learning) is intended to hold teachers more accountable for their actions, as any professional is, so that all students are treated equitably and receive comparable high-quality instruction (Ball and Wilson 1996).[7] The recognition that teaching involves both intellectual and moral aspects only adds to its complexity.

Teaching as Varied Work

Another common mistake made in this era of reform is to presume an isomorphic relationship between approaches to teaching and modes of learning. Some "radical constructivists" have argued that teachers must never tell students anything, and that all knowledge must be constructed independently of the teacher's watchful eye. But a teacher might believe that students are active constructors of their own knowledge yet still choose from a broad array of instructional strategies, ranging from drill and practice to recitation, from cooperative groups to simulations. In creating these educational opportunities for their students, teachers use manipulatives and historical artifacts; they create scientific inquiries and mathematical problems.[8]

Because teachers take on different roles in these different instructional configurations, much current talk of teaching explores the use of alternative metaphors to capture the essence of teaching; instead of teachers being thought of as tellers, we hear about teachers being coaches, guides and collaborators. But one metaphor alone will not do, for there are times when teachers must and should tell, and other times when teachers should inquire, using their classrooms as laboratories for their own learning (as well as that of their students). However, because coaches often utilize a broad range of instructional strategies, let us consider the "teacher as team coach" concept further.

The appeal of "teacher as coach" lies in the fact that coaches support players as they learn to demonstrate mastery—even excellence—as independent artisans. Coaches-as-teachers must help players develop foundational knowledge and skill, provide opportunities for practice, facilitate classroom discourse, and keep an eye on the structure and timing of a player's learning. In fact, the teacher-as-coach has been a predominant metaphor in the work of the Coalition of Essential Schools (Muncey and McQuillan 1996; Sizer 1984). Sometimes referred to as "natural learning," the learning involved in team play is often very different from traditional school learning. As Heath (1991) explained:

> Natural learning sites shape the semantic and situational constraints of reasoning in basic ways. Identifying and solving problems, moving from the known to the unknown, and creating meaning through reasoning analogically mark everyday reasoning in situations that integrate individuals into teamwork and depend on guided learning in mixed-age groupings. (p. 103)

This is the kind of learning that many reformers and educators argue for. Consider the reflections of a Little Leaguer who compares his learning on the baseball team to school:

> Like I know how to do things, but not *how* to, so it's more fun to play baseball also because you are active, and there's fun to do baseball moving around and talk all the time. Like in

[6] See Shulman (1986) for a discussion of the paradigmatic shifts in research on teaching, as well as Shulman (1987) for a discussion of the role of knowledge in teaching. Performance-based assessments are the heart of the work of the National Board for Professional Teaching Standards.

[7] For readers interested in literature on the moral aspects of teaching, see Ball and Wilson (1996), Hansen (1995, 1996, 2001), Palmer (1997), and Tom (1984).

[8] For an example of the range of strategies used by mathematics teachers in this country and others, see Schmidt and others (1996) and the analysis of mathematics teaching by Stigler and Hiebert (1999) in *The Teaching Gap.*

> school, you're quiet all the time. In baseball you can talk all you want.
>
> [The coach] taught us to get grounders, like, plant our feet down like this and move down. We wouldn't just be, like, learning; he actually has us do that, and he actually gives us ground balls. Like in teaching, they just tell you how to do it. (Heath 1991, p. 107)

Just as students cannot learn baseball simply by hearing the coach tell about it, they cannot learn history, science, literature, and other academic disciplines only by hearing someone tell them about it. They need to do the kind of work that scholars in these fields do—piecing together evidence, understanding the leaps necessary to make inferences, noting when they have to rely on their own theories of human behavior. Experiences such as these help students develop a critical eye, enabling them to become consumers and users of knowledge. Part of this process involves testing ideas out in public with peers. But to do so, students—like mathematicians or historians—will need to learn how to present and discuss their ideas with others in intellectually productive ways.

To allow for the public testing of ideas, teachers have to create occasions for classroom discourse and act as rudder, keeping the collective discussion and joint work on course. Coaches often have their players consider a hypothetical episode, making explicit various possible responses. For example, a baseball coach might ask the team, "What could have happened if Rob had bunted? What about the man on second?" Then the players might think through various responses and consequences (Heath 1991). In the same way, a teacher might lead a discussion in which students speculate on alternative interpretations of a particular piece of literary or historical text (Hartoonian-Gordon 1991; Wineburg 2001). This type of discussion is but one example of how teachers might make visible to learners not only what is to be known but also how one comes to know it as a literary scholar or historian.

In addition to helping students learn through doing and structuring classroom discourse, coaches must do even more. A coach needs to know each player's individual talents and craft team strategies that take advantage of those talents. Central to the task is helping all players accept the value of individual differences. As Heath noted, "A team cannot expect to have all members at the same level of ability in the same complex skills." In much the same way, teachers who believe that knowledge is constructed and that groups of students and teachers can learn more together than apart must find ways to construct a community of learners that takes full advantage of the breadth of knowledge and experience different members bring.

According to this image of teaching and learning, the ideal classroom will no longer be one in which 30 students are always listening to the teacher or silently working. Part of learning would still involve lecture, drill, and practice, for some basic knowledge must be routinized so that it will inform interpretation and debate. However, students would also work in alternative arrangements—small and large groups—talking to each other, making public their personal knowledge and beliefs, constructing and testing their knowledge with peers and teachers. To help them, teachers would have to understand when and how to use different pedagogical approaches.

To argue for a more varied, eclectic range of teaching methods is not to say, "anything goes." Rather, contemporary learning and teaching theorists propose quite the opposite. Teachers must systematically consider their learning goals and their students, the subject matter they want students to learn, and select pedagogical strategies that will enable student learning. Those strategies ought to be selected thoughtfully, varied in their approaches, and refined over time through reflection.

Teaching as Shared Work

Educators have long been interested in how students learn from students as well as from teachers. Nearly 30 years ago, Schwab (1976) argued for a "community of learners." Several models for teaching and learning presume that teaching is shared work between students and teachers (teachers still have responsibility for making sure that students learn). Cooperative learning, team learning, and reciprocal teaching are but a few examples of the many ways classroom work can be distributed.

Cooperative learning, broadly defined as an educational opportunity in which students learn from one another, has taken numerous forms (e.g., Cohen 1994; Johnson and Johnson 1994; Johnson, Johnson, and Stanne 2000; Kagan 1985, 1993; Slavin 1986, 1990). With roots in theories of social interdependence, collaborative learning has been very successful when implemented well. Slavin (1990) argues that two hallmarks of high-quality cooperative learning are positive interdependence and individual accountability. Team learning is closely related to cooperative learning. According to Senge (1990) "team learning is the process of aligning and developing the capacity of a team to create the results its members truly desire" (p. 236). Reciprocal teaching, another form of teaching as shared work, is a technique

used to develop comprehension of text in which teacher and students take turns leading a dialogue concerning sections of a text. Students are taught to use four strategies in working through the text: predicting, questioning, summarizing, and clarifying misleading or complex portions of the text (Brown and Palincsar 1989; Palincsar and Brown 1984). Designed to improve children's reading comprehension, modifications of reciprocal teaching have been used to teach poor decoders, second-language learners, and nonreaders, including adaptations that involved other pedagogies, such as jigsaw (Brown and Campione 1996). Reciprocal teaching draws directly on sociocultural and activity theories of learning that emphasize the critical role of authentic participation in meaningful, purposeful activities.

It is important to note here that suggesting a reconceptualization of teaching as including more listening to students, sharing of work, and asking of probing questions does not mean telling teachers to stop talking or holding the classroom's center stage. Some overzealous reformers urge teachers to change their practice radically, implying that lectures and direct instruction are "bad." This is not our intent here; the effectiveness of inquiring into students' thinking versus direct instruction is an empirical question yet to be thoroughly researched. Most good teachers presume that they need to use a broad array of very different instructional strategies depending on whom and what they are trying to teach, as well as when and where. The reformist ideas we are discussing here propose integrating more inquiry about students' thought into teachers' practices, as well as strategically deciding when teaching ought to be shared among teachers and their students. Again, our argument is one of shifting emphasis, not wholesale rejection or acceptance of one ideology or methodology. Teachers are eclectic by nature and necessity.

Teaching Challenging Content

Running throughout contemporary visions of teaching is an assumption that teachers will be teaching challenging content. International comparisons, including the work of TIMSS researchers (e.g., Schmidt and others 1996) and Ma (1999), suggest that students in the United States typically get fed a diet of thin content, "a mile wide and an inch deep," as Schmidt is often quoted as saying (e.g., Schmidt, McKnight, and Raizen 1996). Both in survey and videotape analyses, TIMSS researchers found that U.S. students were exposed to a curriculum that was thin and fragmented. "The content appears to be less advanced and is presented in a more piecemeal and prescriptive way" (Stigler and Hiebert 1999, p. 57). In snapshot images comparing mathematics lessons in the United States, Germany, and Japan, these researchers found the distinguishing characteristics of U.S. lessons to be "learning terms and practicing procedures." German lessons, which tended to be teacher directed, focused on "developing advanced procedures." Japanese lessons emphasized "structured problem solving" in which Japanese teachers mediated the relationship between the students and the content.

More in-depth analyses of these images examined three indicators of content: level of difficulty, how extensively content was developed, and coherence. In level of difficulty, U.S. eighth graders studied topics that students in the other two countries encountered a year earlier. The nature of the content also differed. Whereas U.S. lessons did not go beyond the basic definitions and procedures, lessons in the other two countries used the basics to explore the deeper properties and relationships in mathematics. Regarding the degree to which content was elaborated, findings indicate that the concepts in U.S. lessons were simply mentioned or stated, whereas in Japan and Germany concepts were usually developed and elaborated. Finally, with respect to lesson coherence, the researchers found that the majority of teachers in all three countries made explicit links between one lesson and another, but only the Japanese teachers routinely linked the parts of a lesson (Stigler and Hiebert 1999).

Although the United States clearly has a long way to go to meet high national and international content standards, an important point that is usually lost in the sometimes heated debates over high standards versus the basics is that even the basics are challenging if one truly understands them. Consider, as an example, even and odd numbers. Learning even and odd numbers is an uncontroversial part of the elementary school curriculum. In standards documents, it might be listed as "students will be able to identify even and odd numbers." Although most of us would feel relatively confident in our ability to identify an even number, there is much more to it than that relatively simplistic statement. Consider three relevant definitions that are mathematically equivalent:

> **Fair share:** A number N is even if it can be divided into two (equal) parts with nothing left over. (Algebraically, $N = 2 \times k$; i.e., $k + k$.)
>
> **Pair:** A number N is even if it can be divided into twos (pairs) with nothing left over. (Algebraically, $N = k \times 2$; i.e., $2 + 2 + 2 + \ldots + 2$ [k terms].)

> **Alternating:** The even and odd numbers alternate on the (integer) number line. So, starting with the even number 0 (or 2, if 0 makes one uneasy), one gets the even whole numbers from there by counting up by twos. *Note:* This is often referred to as the "skip" or "skipping" method, for children will skip from 1 to 3 to 5 on the number line.

As they learn even numbers, children might ask questions or propose solutions to problems that involve any one of these definitions. Children ought to have opportunities to understand the mathematical operations and concepts that they encounter in ways that go beyond the mere recitation of rules, procedures, or algorithms. Thus, teachers need to understand why these three definitions are mathematically equivalent (i.e., why do they specify exactly the same class of numbers?). Although teachers may get by with thin content knowledge as long as they emphasize facts, procedures, and singular right answers, when teachers move toward inquiry and seek to build on students' knowledge, they need much deeper content knowledge regardless of whether they are teaching high-level problem solving or the basics.

To summarize, there is no one right way to teach well. This does not mean that anything goes, for there are some things we know about teaching. Every teacher needs a repertoire of instructional strategies that range from methods of direct instruction to cooperative and small group work to one-on-one work. No single method will work for a given teacher for all students in each subject every day. Whatever method is chosen, teachers need strong content knowledge to make challenging content understandable and to allow for ideas to be developed fully and coherently. Teachers needs to weigh their options thoughtfully, making decisions about what methods and content best meet their goals and the needs of their students for a given unit of instruction.

Teaching as Inquiry

If students are to serve as resources and teachers are to enhance their professional knowledge constantly, then teaching requires much more inquiry (Duckworth 1987; Lampert 1985, 1990, 2001). We cannot expect teachers to know everything there is to know about the 20- or 30-odd students in each class. In many ways, teachers must act as scientists, investigating students' thinking, finding ways to learn about how particular students are actively constructing their understanding. Teachers must probe students' understanding, sometimes even interviewing them about their thoughts and logic. Instead of being mere founts of knowledge, teachers will also have to become inquirers, asking questions and testing hypotheses about what their students know and do not know.

In addition to learning about their students, teachers need to learn much more about their subject matter. Shulman (1986, 1987) proposed that teachers possess a particular kind of subject-matter knowledge—pedagogical content knowledge—that allowed them to understand how to represent knowledge to their students. Pedagogical content knowledge is born of practice. Although one can learn some things about powerful instructional representations outside of teaching, most teachers acquire this form of professional knowledge through teaching. Such learning continues over a lifetime (Feiman-Nemser 2001). Thus, although experienced teachers might have a wealth of accumulated knowledge from years of work with, say, third graders, there is still much teachers need to learn about the specific third graders they meet each new year, as well as new things about the subject matter they are teaching, the pedagogies available to them, and the most powerful ways to help students interact with that content.

Thus, the significance of inquiry. Some would argue that teachers have always learned from their practice. Yes and no. We have always asked students questions: "Who wants to write the answer on the board? Who had trouble with number 8? What's the capital of Nebraska? Why did Romeo kill himself?" Seldom, however, have we asked those same students to make public their rationales. With little time and many students, teachers typically do not ask questions such as, "Why do you think that? What is your rationale for solving the problem in that way? Could you have done it another way? What do other people think of that answer?" Eager to get on with it, students and teachers alike are accustomed to short, clipped questions and similarly terse responses, assuming that the reasons underlying the responses are self-evident. Similarly, teachers typically process student work quickly, skimming answers, checking proper responses, scribbling red-inked comments. Those same teachers seldom share a student's work with a colleague, asking questions such as, "What do you think this child was trying to do with this story?"

Traditional forms of assessment—often taking the form of standardized tests—have compounded the problem of learning from one's students. Instead of "giving students' reason," such tests assume one right answer and test the child's thinking against that standard. New work in assessment shifts the emphasis and focus away from "right and

wrong" answers toward the collection of data that will help teachers know what students are thinking (Glaser and Silver 1994). Traditional school organizations only make the situation worse. Schools have not been organized to support teachers' learning from their own practice and from one another. Reformers in the 1980s argued that to support teacher learning, schools would need to be redesigned so that they were equally well organized and equipped to support student and teacher learning; hence, the call for professional development schools.

Learning to inquire—both in class in the company of one's students and alone in personal reflection and outside of class in the company of one's peers—is unnerving and time consuming; it also requires the development of new knowledge and skill. Knowing how to listen is a skill to be developed, not an inherited trait granted all teachers, therapists, lawyers, and doctors. It requires sensitivity to better and worse questions, the capacity to read between the lines of a student's response, and use of alternative forms of assessment. Such inquiry would also require that teachers learn a pedagogy of investigation (Lampert and Ball 1998), asking good and researchable questions about their teaching and students' learning; strategically documenting their practice through records that can be revisited (e.g., student work, teacher journals, and videotapes); inviting criticism and debate about one's teaching; and participating in communities of practicing teachers (Ball and Cohen 1999).

This stance—teaching-as-inquiry—will require substantial changes in the culture of U.S. schools. Recent descriptions of practices in Chinese and Japanese schools, however, provide us with images of the possible (Shulman 1983). Researchers have found that teachers in Japan and Shanghai, for example, participate in study groups and lesson-planning groups designed to improve teaching iteratively over time. In Shanghai, for instance, teachers regularly conduct and write up research they have conducted in their own classrooms. In Japan, teachers "polish" their lessons over time (Paine 1990; Stigler and Stevenson 1991). Japanese teachers participate in "lesson study," collaborative groups in which teachers plan, teach, critique, and revise their lessons (e.g., Fernandez 2003; Fernandez, Cannon, and Chokshi 2003; Lewis and Tsuchida 1998). Lesson-study groups have begun appearing across the U.S. public school landscape as a professional development activity (e.g., Paterson School 2 in New Jersey; Viadero 2004). Some U.S. universities and other organizations are studying this approach to instructional improvement and providing information about it. [See NEA Appendix.]

Other forms of teacher inquiry are also gaining popularity. Cochran-Smith and Lytle (1993, 1999), Zeichner and colleagues (Gore and Zeichner 1995; Zeichner and Noffke 2001), and others (e. g., Henson 1996; Stenhouse 1983) describe the power and potential of a scholarship created by teachers for teachers. Alternatively called *action research, teacher research, self-study,* and *a scholarship of teaching,* these approaches reflect a growing interest in enabling practitioners to conduct and report on inquiries into their own and their colleagues' practices. This interest not only concerns K–12 schooling but has become a popular topic in higher education as well, as scholars and the American Association for Higher Education call for a scholarship of teaching (Boyer 1990; Shulman 1993).

Conclusion

The Scottish physicist James C. Maxwell is credited with saying, "There is nothing as practical as a good theory." As experienced teachers, we believe that all teachers operate according to theories. Our practice is driven by our "theories" about what will work for our students. Some of those theories are explicit and are learned in school; some are tacit and are the products of years of experience in schools—as teachers, parents, and students. The theories we briefly explore here have enormous potential both for helping teachers explain why they teach in the ways they do and for disturbing those patterns and prompting teachers to rethink their practice.

Although many people want to claim that teachers are born, not made, we believe that good teaching requires teachers to create and use, expand and reject, construct and reconstruct theories of learning and teaching. Those theories are not intuitions, or "common sense" but carefully crafted lessons learned from years of experience and careful inquiry. We also believe that teachers have more power over their pedagogical choices when they have made their theories explicit and tested them with classroom experience, colleagues' critiques, and knowledge of current research.

We hope that this brief tour through predominant theories of learning and their implications leads readers to consider important questions: How do we think children learn mathematics? Or history? Why do we think that using small groups will help students develop certain understandings and not others? When a textbook seems particularly helpful or harmful, to what extent is the problem located in underlying assumptions about how teachers ought to teach and how students learn best? When we encounter a new curriculum, what are its theoretical

underpinnings, and how do they align with our previous experience and with other theoretical and empirical scholarship? It is only through interrogating our own tacit assumptions about the answers to questions such as these and through the theories produced by new generations of education scholars that we can make progress on that lifelong journey of becoming accomplished practitioners.

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NEA Appendix: Tools for Instructional Improvement

1. Teaching for Understanding:
A Guide to Video Resources

Teaching videos are potentially useful as tools for instructional improvement, especially when used in group settings where teaching strategies can be discussed. The purpose of this NEA publication is to make teacher professional communities, teacher educators, and individual teachers more aware of the growing array of video resources that depict "teaching for understanding." It provides an overview of the types of videos available, describes how they are being used, and includes a selected bibliography of some major, nonprofit sources. (Available from the NEA Professional Library; see inside front cover for ordering information.)

2. Lesson Study Resources

Lesson study is another promising approach to instructional improvement. The following are only a few of the many organizations providing access to research, resources, and networking opportunities for teachers interested in lesson study. Each of these sources has links to other organizations and additional resources.

- The Lesson Study Group at Mills College (http://lessonresearch.net/).
- The Lesson Study Research Group at Teachers College, Columbia University (http://www.tc.edu/lessonstudy/).
- Research for Better Schools (http://www.rbs.org/lesson_study/).

3. Standards-Based Instructional Resources

The professional associations and organizations that developed national content standards have all produced resources intended to assist teachers to implement their standards. Because national content standards and the supporting resources all drew on the same research as this working paper, the resources tend to be consistent with the theories described. The national content standards and supporting resources may or may not be aligned with individual state standards.

The quantity and quality of resources vary considerably by subject. Much more is available in mathematics and science than in other subject areas. Standards-based resources in the core content areas are available from the following sources.

A. Mathematics

- National Council of Teachers of Mathematics (http://www.nctm.org).

B. Science

- American Association for the Advancement of Science/Project 2061 (http://www.project2061.org).
- National Science Resources Center, a partnership of the National Academies and the Smithsonian Institution (http://www.nsrconline.org).

C. English Language Arts

- National Council of Teachers of English (www.ncte.org/store/books/standards).
- International Reading Association (http://www.ira.org/resources/tools/index.html).

D. Social Studies

- National Council for the Social Studies (http://ncss.org).
- National Center for History in the Schools (http://www.sscnet.ucla.edu/nchs).
- National Council for Geographic Education (http://www.ncge.org/standards/).
- Center for Civic Education (http://www.civiced.org/stds.html).
- National Council on Economic Education, National Association of Economic Educators, and Foundation for Teaching Economics (http://www.ncee.net/ea/program).

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