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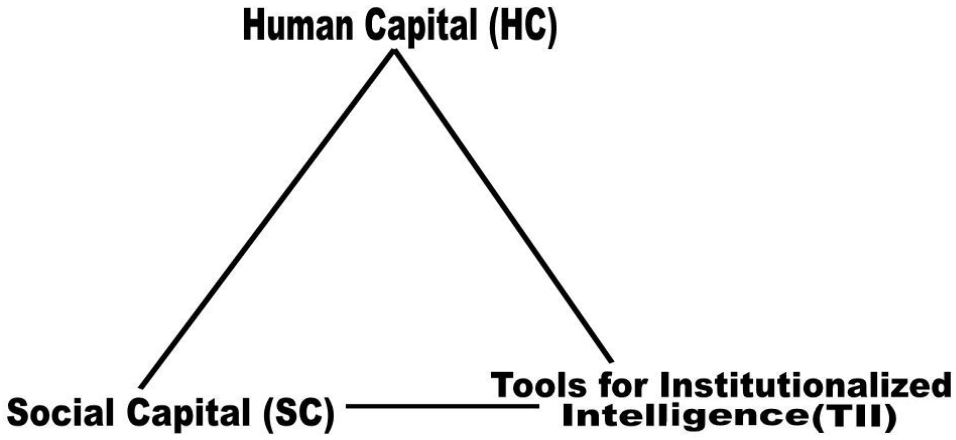
Texas Senate Education Committee
Testimony

The 21st century will require knowledge and skill well beyond the basic levels of reading and arithmetic that U.S. schools know how to produce. Delivering a "thinking curriculum" to all students will require major reform in the ways schools and districts organize their work. A decade into the 21st Century Texas, like the rest of the United States, finds itself nearly as unprepared for its students' and society's needs as when *A Nation at Risk* was published in 1983. We are calling for "career and college readiness" for our high school students and for a focus on learning "21st Century skills. Yet these terms are hard to define and harder yet to translate into meaningful action. Some critics are challenging the very idea that there is anything new about the 21st Century, suggesting that we have always known that a strong education is needed to teach abilities to think and reason; a deep foundation of knowledge in core domains such as mathematics, science, literature and history; and an ability to engage in civic discourse that can solve public problems through respectful argument and information development.

Thinking and reasoning, deep knowledge, and inventive problem-solving have always been educational goals for *some* of our children. Back to ancient times, to pioneer times in Texas and across our country, there have always been *some* schools that taught a few of our children high levels of mathematics, of science, of literacy, and, indeed of problem- solving and reasoning. Now--with a shifting economy, with ever more technology in use, with change coming at rates that call for a continuous ability to invent something new even while meeting all the day-to-day needs of personal and public life-- we need to figure out how to make these high levels of instructional attainment the birthright of *everyone.* We need to set new and higher expectations of educational performance. And we need to back those expectations with policies, practices, and tools that can turn expectations into real achievements.

I am here with you because I admire what Texas has done up to now. I am in fact pleased to have been part of the effort—working in several of the largest school districts in Texas to produce something close to "turnaround" results through targeted investments in developing better teaching . This has been accomplished with tools for training teachers, for charting teachers' progress alongside the progress of their students, and via curriculum and teaching materials that provide a strong foundation for learning even as they invite local adaptation. These are key elements of a powerful *Education Policy Triangle* that is beginning to produce twenty first century results and that can guide Texas toward meeting its new standards and expectations. I frame my comments in terms of an *Education Policy Triangle* is based on a wide body of research in cognitive science, social science, economics, and organizational theory. As important, the three elements of the triangle are recognized by hundreds of educators we have worked with—including many in Texas.



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Human Capital is the basic building block of any organization's ability to produce results. In education, human capital resides in the capacities of teachers and leaders of schools and districts. Human capital is typically measured by credentials, performance observations and individual outputs (student learning). Economists have related student performance on academic measures to the number and type of courses teacher have taken in college or graduate school. Others have directly measured teacher knowledge and shown that higher levels of teacher knowledge produce higher student achievement. Human capital can be increased by hiring and retaining teachers with better preparation, greater knowledge, and good day-to-day performance in the classroom. It can also be increased by careful targeted investment in building social capital and in training built around powerful instructional tools and routines.

Social Capital is a term that sociologists use to refer to resources for action that result from interactions among people. Social capital, in other words, represents the opportunities that people have, and that organizations can create, for acquiring knowledge through interaction with others. Sociologists have now documented links between social capital and the forms of knowledge-based thinking that students acquire. High levels of social capital in a school can create and sustain human capital. For example, a school with a strong professional community can retain its best teachers. Especially important, it has been found that competent teachers are more likely to stay in schools serving the poor if there is a high level of social capital in those schools.

Instructional Tools and Routines are the "meat and potatoes" of effective education. What we teach students and how we teach it determines how much students will learn. We are used to treating curriculum as a local option, and indeed teaching must be adapted to individuals and communities. But

research makes it clear that teaching must also be grounded in solid and tested instructional procedures. Here are some examples:

- A large University of Michigan study compared three comprehensive school reform (CSR) models. Two of the models brought in specific textbooks and teaching materials, specified patterns of student grouping in detail, and trained teachers in specific ways of using the teaching materials. The third model provided structures to support teachers in developing their own instructional programs. The first two models produced significant increases in student learning. The third model had almost no effect on student learning.

- Teacher training and in-service development is more effective when it is built around specific instructional programs and specific content than around generic "methods" of teaching. A group from the University of Pittsbugh developed a curriculum and coaching model for a Texas district based on a well-tested reading comprehension program called *Questioning the Author*. In a controlled study, this program led to significantly higher reading comprehensions scores on the state test, especially among English Language Learners, than a more loosely specified program in which teachers were given only general guidance on how to teach reading comprehension.

- It seems likely that the most powerful way to build teacher capacity, and thereby increase student learning, is to develop social capital around specific instructional practices. In 2001 the Institute for Learning began to design and test intervention programs that explicitly combine instructional tools and routines with strategies aimed at building professional learning communities. In this work, intensive professional development led by subject matter experts, was organized around a spine of curriculum units and lessons that were explicitly linked to the district's official curriculum guidance documents. The units and lessons were designed to educate teachers in high cognitive demand forms of classroom instruction and training . The materials and training processes supported certain local modifications of the lessons, thus adapting to local needs and preferences while maintaining the central instructional core. External evaluators examined the work in several sites, one of them in Texas, and described a substantial change in the teaching capacity and practices in a number of high schools in the four core high school disciplines.

We stand at the cusp of potentially important shifts in how we think about education reform. Resistance to external specification of routines and curriculum seems to be ebbing. But increased policy interest in curriculum-specific instructional practices will bear fruit only if we can learn how to embed detailed curriculum guidance in organizational designs that support the complex sociocognitive practices of participants and the diversity of students in our schools.

Nested Learning Systems for the Thinking Curriculum

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Nested Learning Systems for the Thinking Curriculum

Lauren B. Resnick

The 21st century will require knowledge and skill well beyond the basic levels of reading and arithmetic that American schools know how to produce more or less reliably. Delivering a "thinking curriculum" to all American students requires major reform in the ways schools and districts organize their work. The transformation of the institution of schooling that will be needed to make this aspirational goal a real achievement is daunting. This article examines cognitive science, systems engineering, and social science concepts that are pointing toward a new foundation for policies and practices that may radically improve the proportion of students who can achieve true 21st-century skills.

Keywords: education organization; high-demand curriculum; human capital; instructional leadership; learning systems; professional development; routines; social capital; systems engineering; 21st-century skills

A decade into the 21st century, we still find ourselves nearly as unprepared for what our students and society need from education as we were when *A Nation at Risk* (National Commission on Excellence in Education, 1983) was first published. We are calling for "career and college readiness" for all American high school students and for a focus on learning "21st-century skills," yet we find these terms hard to define, much less translate into meaningful action. The overused phrase *21st-century learning* can take on real meaning only if we compare the challenges educators face now with those faced at the turn of the past century. The idea that virtually all students can, and should, learn a high-demand curriculum, focused on thinking and reasoning and grounded in mastery of complex bodies of knowledge, would have seemed quixotic to thinkers a century ago. In the last part of the 20th century, we began to imagine such possibilities and even establish them as national goals (National Education Goals Panel, 1991). But it has only been in the present century that the concept of college readiness for all has taken root as a serious education policy target.

Figure 1 provides a conceptual graph of the radically changed education aspirations that characterize our present efforts to teach 21st-century skills to virtually all American students (cf. D. P. Resnick & Resnick, 1977). The very concept of schooling for all is only a few centuries old in Western countries. It is a 17th-century invention, born during the spread of Protestant Christianity in Northern Europe and then taken up in Southern Europe as part of the Catholic Reformation. In the 19th century, basic schooling for all became a national aspiration in Europe and North America, aimed at creating "citizens" and competent participants in national defense efforts. These initial mass schooling efforts (the top left points in the graph) aimed to make high proportions of the population "literate" but set a low criterion of what counted as literacy.[1] Catechism, in which individuals were asked a set series of questions culled from specific religious texts and were expected to provide standardized answers, was a basic form of instruction. Participants were judged literate if they could recite familiar texts and answer simple questions on which they had been drilled.

As schooling became more widespread, the catechism form of instruction moved into the lay classroom. The content changed to include basic arithmetic, geography, history, and some science, along with a broader range of texts for reading and writing. But schoolroom discourse remained remarkably unchanged. Students were assigned a text to read or a problem to work, and they were then quizzed by the teachers with a set of questions that basically checked on whether the students had done the assignment (Mehan, 1979; Resnick, Wiliam, Apodaca, & Rangel, in press). Across Europe and America, schooling became part of most young people's experience. But mass schooling did not even try to engage most pupils in the kinds of knowledge-based reasoning and problem solving that characterized elite schooling from ancient times. This elite type of schooling became institutionalized in "academies" and technical institutions in the 19th and 20th centuries (see the bottom right point in the Figure 1 graph).

A sharp distinction in expectations for mass, or "basic," education and what was taught to an elite minority still held in the

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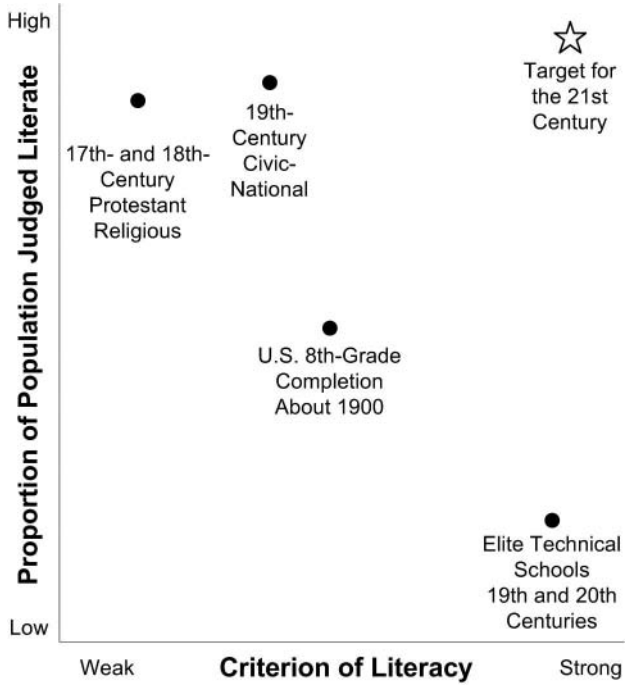

FIGURE 1. *Criteria and expectations of literacy from the 17th to the 21st centuries. Adapted from D. P. Resnick & L. B. Resnick (1977). The nature of literacy: An historical exploration.* Harvard Educational Review, *47(3), 370–385.*

United States at the turn of the 20th century. In 1892, the Committee of Ten, a working group of educators from colleges and universities across the country, attempted to create for the first time a curriculum plan for all students who attended American high schools (Hertzberg, 1988). The program that the committee agreed on included the recommendation to teach English, math, and history or civics to every student in every academic year, along with recommendations for specific course sequences. With expectable debate and quarrels about which schools really counted as high schools and what "all" students should be expected to learn, the committee's program gradually became the core curriculum for American secondary students. Yet by 1910 only about 10% of students attended school beyond the eighth grade. So the Committee of Ten curriculum is perhaps best thought of as America's response to Europe's elite technical schools.

The proportion of students attending secondary school in the United States rose only very slowly over the succeeding decades. At the century's midpoint, roughly two thirds of the school-age population was in high school. Thus the "common core" program for high school a century ago reached many fewer students than today participate in our college preparatory high school programs. A rough estimate of literacy levels in the United States in 1900 (see central point in Figure 1) suggests that only about half of young people were completing eighth grade. Those who did so were literate at higher levels than the mass of 17th- and 18th-century pupils but fell well short of the elite standard that the Committee of Ten was attempting to codify.

Today we are aiming for something new in the world: *An elite standard for everyone* (star at top right of the Figure 1 graph). That is what the term *21st-century skills* really means. The skills are not new (*some* students have been successfully learning them in *some* schools from the beginning of civilization). But the aspiration to successfully teach knowledge-grounded reasoning competencies to everyone is still just that—an aspiration. Is it a sensible one? Is there any reasonable prospect of meeting it? What would it take? Those are the questions I aim to answer in this essay. To anticipate, I will argue that basic human capacity for learning and thinking makes the aspiration humanly possible, if we think in terms of the learning capabilities of most *individuals.* But the transformation of the *institution* of schooling that will be needed to come close to making the aspirational goal a real achievement is huge. I will suggest some steps we might take in the near future. To do this, I will take the reader on a quick journey through a slice of national achievement data from the past two decades and a summary of a consensual cognitive science–based theory of instruction that most scholars of learning and teaching now agree on. I will then examine systems engineering and social science concepts that point toward a new foundation for policies and practices that may radically improve the proportion of students who can achieve true 21st-century skills.

Reaching for the Star: Caught in the Basics Trap

From the 1990s on, the public agenda of raising educational levels for all has been promoted under the banner of the *standards movement,* often accompanied by the phrase "All children can learn." But neither term clarifies just *what* we have expected all children to learn and thus what the standards ought to be. The evidence is now pretty clear. We seem to have figured out how to teach "the basics" to just about everyone—with special success in mathematics. But we are deeply unsuccessful in the rest of our 21st-century agenda of moving beyond basic competencies to proficiency.

Figure 2 shows the National Assessment of Educational Progress (NAEP) fourth-grade math scores over an 18-year period spanning the end of the 20th and the beginning of the 21st centuries. The graph plots scores separately for Whites, Blacks, and Hispanics. There has been a nearly continuous rise in achievement scores over this period among all population groups. The achievement gap has not closed, but it has shrunk somewhat. In fact, and very much worth noting, Blacks and Hispanics were doing as well in 2007 as Whites had been in 1990. The fourth-grade math gap would have closed completely if White students had not continued to improve across the 18-year period! In eighth-grade math, the pattern is similar (Figure 3), with Blacks showing an especially steep rise, but a lower percentage of students is meeting basic eighth-grade goals.

The story is less dramatic for reading, but there is evidence that this achievement gap is shrinking somewhat as well. Over the past 20 years, guided by a growing body of scientific research, there has been substantially more teaching of the components of basic literacy (phonemic awareness, phonics, vocabulary). And this has shown up in higher first-grade scores on basic word decoding skills (National Institute for Literacy, 2008). But by fourth grade, when NAEP first measures reading, the focus is on reading comprehension—*understanding* what you read. There, the gains have been very small.

Overall, then, national achievement results suggest that as a nation we are en route to eliminating basic illiteracy and innumeracy. The really troubling performances of the early 1990s, in

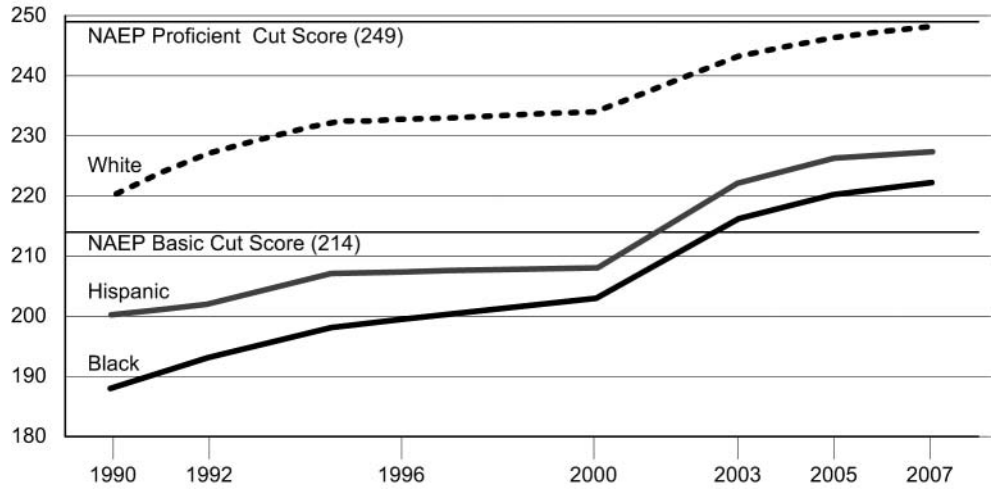

FIGURE 2. *Disaggregated NAEP scores for 1990 through 2007, fourth-grade mathematics. Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), NAEP Data Explorer, available online at http://nces.ed.gov/nationsreportcard.*

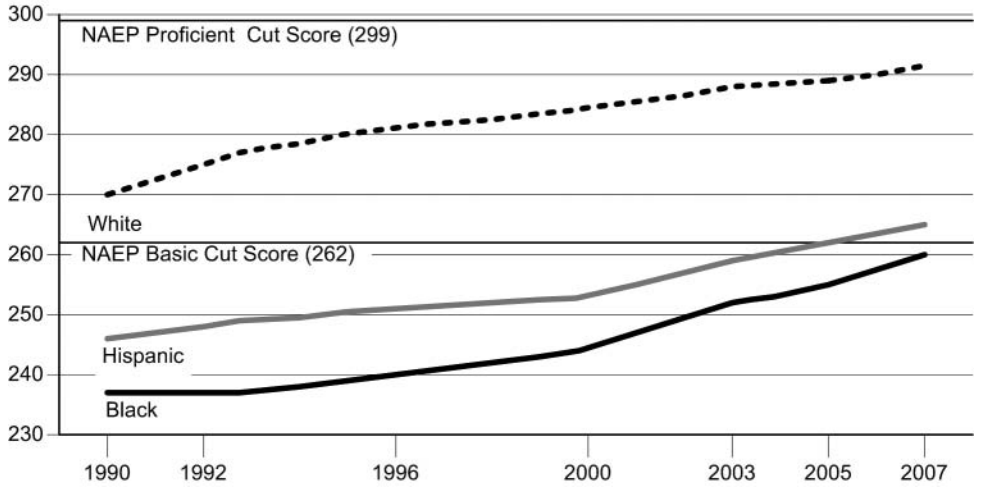

FIGURE 3. *Disaggregated NAEP Scores for 1990 through 2007, eighth-grade mathematics. Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), NAEP Data Explorer, available online at http://nces.ed.gov/nationsreportcard.*

which large numbers of our minority students, along with some White children of poverty, seemed to be fundamentally illiterate or innumerate, have changed. We are on the way to meeting our "basic education" goals—and we have achieved this even as we have absorbed growing numbers of students with limited English proficiency into the nation's schools. It appears that the standards effort, including requirements for disaggregated test score reporting, is having the hoped-for equity effects. We are teaching basic literacy and math to more and more of our elementary school children, and fewer and fewer are being left *way* behind.

We are, however, *very* far from reaching the star. *Proficiency* levels on the NAEP remain low, and there are very few students of any subgroup reaching *Advanced* levels. Furthermore, it now seems likely that the accountability regime that appears to be creating much of the improvement in *Basic* skills may actually be limiting progress toward the kinds of more challenging competencies we seek. The effects of high-stakes, low-cognitive-demand tests on instructional practice have been quite widely documented by now (Koretz & Hamilton, 2006; McNeill, 2002). Most studies show that state tests have led to a noticeable increase in the amount of instructional time devoted to the tested subjects and a corresponding drop in nontested subjects (Center on Education Policy, 2008). Most districts that increased time for English language arts or mathematics also reported substantial cuts in time for other subjects, including social studies, science, art and music, and physical education (Center on Education Policy, 2008).

Even within the tested subjects, it appears that test-based accountability may be narrowing what is taught. In many urban school districts, teachers are emphasizing test preparation over other aspects of their districts' official curricula (Shepard, 2002–2003). As end-of-year testing dates approach, teaching time is spent on test practice. In one district that we have studied intensively, elementary students stop reading and discussing grade-level-appropriate books in February and instead spend time

1920s	Today
Knowledge	
• Bonds and Lists • Few Sources • Controlled • Bounded/Fixed	• Schemas and Structures • Multiple Sources • Public • Exploding/Emergent
Competent Performance	
• Automated Skill • Q & A • Individual	• Argumentation • Discursive • Distributed
Instruction and Learning	
• Practice and Repetition • "Stamping In" and "Stamping Out" • Individual	• Interpretation and Explanation • Self-Monitoring and Self-Management • Social
Aptitude and Intelligence	
• Entity • Intelligence Limits Learning • Bell Curve: Few Are Highly Capable	• Incremental • Intelligence Is Learnable • Open Capacity: Many Can Become Capable

FIGURE 4. *Definitions of knowledge, competent performance, instruction and learning, and aptitude and intelligence to which learning scientists subscribed in the 1920s and today.*

digesting brief passages, accompanied by multiple-choice test items that mimic the ones that appear on the state tests. District leadership reluctantly supports this practice because the tests carry heavy consequences.

Although no one intended such an outcome, the test-based accountability movement seems to have taken the nation back to something like the minimum competency movement of the 1970s (Jaeger & Tittle, 1980), which was an effort to ensure that poor and minority students would at least be taught the basics—but with no grounded approach to high-cognitive-demand learning for the great majority of students.

Reaching for the Star: The Thinking Curriculum

Despite the rhetoric of 21st-century skills, we have by and large built our accountability system so that it actually suppresses the kind of learning that the 21st century calls for. Since the middle of the 20th century, the science of learning, and thus the underpinnings for trying to reach the gold star of knowledge-based reasoning for all Americans, has expanded substantially. The recommendations now coming from an expanded, multidisciplinary learning science community are substantially different from those of the first half of the 20th century (Resnick, 1987b, 1999). The transformation of learning theory over a century of its attempted application to schooling is remarkable. Scientific research on learning has produced changed concepts of *knowledge* itself, new criteria for what counts as *competent performance* and as *intelligence,* new principles for *instruction,* and even new theories of how educational *organizations* work.

Figure 4 compares definitions of knowledge to which learning scientists subscribed in the 1920s and today. Instead of defining knowledge in terms of a bounded list of facts ("bonds" as E. L. Thorndike, 1932, called them) coming from a small number of controlled sources, we now define knowledge in terms of schemas and conceptual structures. We recognize that knowledge comes from multiple sources and that it is often public, rather than controlled by academicians. And we know now that knowledge is exploding every day, that it is *emergent* from the complex interactions in which people engage.

Our changed understanding of knowledge leads to changed views of what counts as competent performance. Automated skill in performance of routines still matters, but 21st-century skills mostly focus on a person's ability to participate in argumentation and discussion. Question-and-answer performances are replaced by discursive processes that include productively challenging colleagues, paraphrasing, and interpreting presentations by others. And although individual performances still matter, much "knowledge work" is "distributed," involving collaboration with others (Resnick, 1987a).

These new concepts of knowledge and competence entail new understandings of how instruction and learning can best proceed. Although practice and repetition still play a role in acquiring a relatively narrow set of skills and information (e.g., solving algebra problems speedily and accurately), we now recognize that reliable learning of complex material will proceed through a process of interpretation and explanation. Instead of just "stamping in" correct answers and "stamping out" the incorrect (as Thorndike taught us in the 1920s), we now try to teach students the metacognitive capabilities of self-monitoring and self-management of learning. And we recognize that there are important social aspects of learning, even when each individual is responsible for mastering some body of skill or knowledge.

There have also been important changes in how we think about aptitude and intelligence. Instead of intelligence being viewed as an "entity," something that people have a fixed amount of and that—for many—limits learning possibilities, we now understand intelligence to be learnable (Dweck & Molden, 2005; Resnick & Nelson-LeGall, 1997) through social processes that include participation in certain forms of high-demand learning.

These changes in our understanding of learning point toward a form of instruction that I have come to call the Thinking Curriculum (Resnick, 1987b; Resnick & Klopfer, 1989). The Thinking Curriculum calls for instruction that is high in cognitive demand (conceptual learning, reasoning, explaining, and problem solving are engaged daily) and that is embedded in specific, challenging subject matter. Evidence has accumulated that teaching cognitive skills in the absence of specific content rarely works. It appears that thinking abilities have to develop in the course of reasoning about specific information and knowledge. At the same time, there is plenty of evidence that drilling on the facts without demands for explanation and reasoning produces fragile knowledge, which is likely to disappear once the test is over and is unlikely to transfer (Chi, 2000). A form of the Thinking Curriculum that uses guided classroom discussion of core disciplinary ideas (we call this *accountable talk*) apparently yields both long-term retention and transfer to other disciplines (Resnick, Michaels, & O'Connor, in press). The strongest examples come from controlled experiments in which an individual teaches elementary mathematics in the Thinking Curriculum style and in the traditional recitation style (e.g., Bill, Leer, Reams, & Resnick, 1992; O'Connor, 2001).

Other studies, in which multiple teachers are trained to teach science or math discursively, produce less dramatic differences in scores but still show significant transfer effects on measures of general cognitive functioning across disciplines (e.g., Adey & Shayer, 2001; Mercer, Dawes, Wegerif, & Sams, 2004).

Scaling the Thinking Curriculum: An Organizational Design Problem

We know that the Thinking Curriculum can actually work for a broad range of individual students. The question now is whether we can figure out how to "scale" the kinds of teaching that are needed to reach the 21st-century star. Doing so will mean preparing educators to adopt a significantly different way of teaching than most of them experienced in the course of their own schooling. Doing so will call not just for pedagogical shifts but also for deeper knowledge of core subject matter than many current teachers have—perhaps especially in mathematics and science.

Consider mathematics, which is the field that has made the greatest advances in codifying methods of teaching that ensure both mastery of basic skills and conceptual understanding and problem solving. To successfully lead a Thinking Curriculum mathematics class, a teacher must be able to recognize the mathematical content embedded in initially ill-formed articulations of concepts and explanations. Then, the skillful teacher orchestrates classroom interactions—including challenges, revoicings, and targeted discussions of student explanations—that bring the important concepts to light in a form that all students can share (Michaels, O'Connor, & Resnick, 2007).

Compared to traditional mathematics teaching (see Stigler & Hiebert, 1999) in which the teacher leads the class through a relatively simple script of choosing and naming the correct steps in a procedural task, Thinking Curriculum instruction calls for guiding an only partially scripted line of talk, one in which children's initial formulations of ideas are halting and filled with nontechnical language.

This kind of teaching is not "discovery learning" in which children are free to explore a problem space, with the teacher riding along for the adventure. Instead every class session has a clear intellectual goal, a kind of "macroscript" for a directed conversation. But the class traverses the script in a series of "byways," some introduced by students who are struggling to articulate their understanding of a concept, others introduced by students already confident in their knowledge. Both kinds of students are likely to be present in most classrooms.

Thinking Curriculum lessons are also not simply "collaborative learning" (Johnson & Johnson, 1986; Slavin, 1996), with which they share important features (most obviously the importance of student talk and explanation and the possibility of groups of students working on their own for portions of the instructional time). In effective Thinking Curriculum classrooms the teacher does *not* simply "step back" and let students discover knowledge or problem solutions for themselves. Instead, the teacher guides a knowledge-driven discussion focused on explaining concepts in the context of specific texts, tasks, and interpretive questions. Every class session—or small-group meeting—has a clear intellectual goal, with students working out specific conceptual understandings under teacher guidance. The teacher is guided by a macroscript that specifies the goal (student understanding of specific concepts) and some likely landmarks along the way, with the route to the goal marked by explanatory byways. These byways are crucial for building understanding, but it is also crucial to return to the planned path (Ball & Lampert, 1998; Lampert, 2001; Lampert & Ball, 1998).

All this requires confident subject-matter knowledge on the part of teachers. What works in the Thinking Curriculum is not generic but deeply subject-specific teaching. Yet considerable research has documented the weak mastery of core subject matter by many teachers educated in our current system (Clotfelter, Ladd, & Vigdor, 2007; D. K. Cohen & Hill, 2000). So there is a substantial challenge ahead for teacher preparation programs and teacher credentialing in terms of creating incentives for high performance and on-the-job training. All these proposed solutions focus on populating schools with better educated teachers (i.e., improving the *human capital* of the education sector—see below for further discussion). That is important. But by itself it will not create enough good teaching to go around—that is, to reach all of our students. The challenge to individual teachers is matched—perhaps exceeded—by the challenge to educational organizations and the policy structures within which they act.

Current policy discussions often aim to solve the problem of disappointing levels of learning by investing heavily in theories of performance management. The prescription for better performing schools, according to this theory, is more frequent measures of student performance and greater attention to this "output" data (in economists' terms, "productivity"). This has led to a virtual industry of student measures that can be administered early and often, in the form of *interim,* or *benchmark,* tests. As noted earlier, these tests have come to control the de facto curriculum, as school districts and school principals—worried about poor performance on state accountability instruments—prescribe more and more test preparation, mostly in the form of practicing items that are very like the ones that will appear on the state tests. These items, for reasons of cost, familiarity, and certain psychometric considerations, are mostly simple multiple-choice questions, with little opportunity for the kind of interpretive knowledge work that the Thinking Curriculum calls for. This growing practice, encouraged by the offerings of test providers, inflates attention to the end-of-year test items and exaggerates the "basic skills" character of the standards movement.

Even if the accountability tests were to be changed substantially (along lines being discussed today in many venues), performance management based on student test scores alone would be a far cry from what is needed to build a new educational and organizational management system that can support, enhance, and sustain the Thinking Curriculum. We need a method closer to systems engineering (Resnick, Besterfield-Sacre, Mehalik, Sherer, & Halverson, 2007), one that examines *processes* along a chain of linked policies and actions.

Process management was widely embraced in the 1980s in the business world under labels such as *total quality management* (TQM) and *ISO 9000*. A catalyst in this movement was then Secretary of Commerce Malcolm Baldridge, for whom the Malcolm Baldridge National Quality Award was established by an act of Congress in 1987. TQM is not specific to any one type of organization and was considered applicable to education and government agencies as well as the private sector. During the

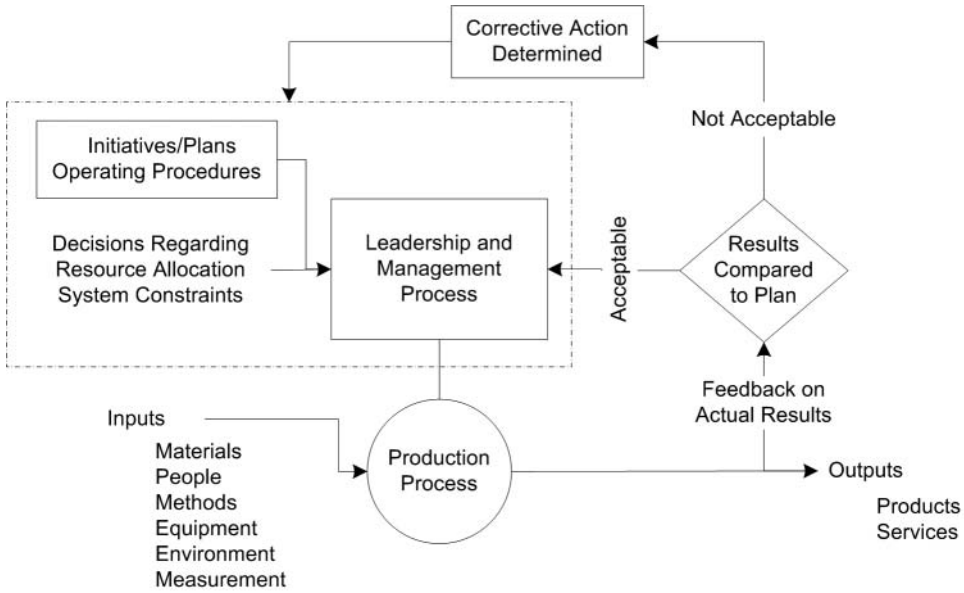

FIGURE 5. *Feedback control system for a manufacturing process. Source: Modified from W. C. Turner, J. H. Mize, K. E. Case, & J. W. Nazemetz. (1992).* Introduction to industrial and systems engineering *(3rd ed.). Upper Saddle River, NJ: Prentice Hall.*

1990s there were attempts—largely encouraged and funded by the American business community—to apply TQM to education (e.g., a Malcolm Baldridge award for school systems was initiated). Key to the TQM management philosophy was that all employees—from floor workers to CEOs—be engaged in seeking quality improvements and that processes as well as outputs be measured and improved as necessary. It is odd that, just as we have truly engaged the agenda of focusing on results, we seem to have left behind the attention to organizational processes that is a crucial aspect of quality management.

Engineering a Nested Learning System for the Thinking Curriculum

The systems engineering concept of process control (Turner, Mize, Case, & Nazemetz, 1992) provides a foundation for organizational design that goes beyond just measuring outputs. Originally introduced for manufacturing organizations, systems engineering approaches have also been heavily applied to the service industry, including financial, medical, and educational organizations. A notable example of how process engineering has focused on the values and needs of people is the redesign of hospital systems—including improved surgery room functionality, reduction of errors in medical procedures and medicine distribution, improved diagnosis systems, improved scheduling to reduce patient waiting times, and effective distribution of information and resources to minimize hospital costs (Sahney, 1993).

Figure 5 provides a schematic of how a process control system would work in a manufacturing setting. The production process (circle in the bottom line of the figure) is where the fundamental work on the "product" is done, using a variety of input resources—materials, people, and so forth (shown to the left of the production process circle). The quality of the end product and the processes used to produce it are both continuously measured. Results are compared to plans (diamond at far right), and a leadership and management team (central rectangle in the figure) uses these measurement results (on outputs and processes) to decide whether the desired objectives and outputs have been satisfactorily met (Davis, 1982). When results do not meet expectations, the leadership and management team (central rectangle) takes corrective actions. Because processes as well as products are monitored, there are opportunities to determine *where* the process has broken down. Initiatives and plans as well as operating procedures may be modified (far left rectangle) by the leadership and management team, and resources may be reallocated to support the changes.

Figure 6 adapts the basic process control model to educational organizations—specifically large urban districts. The figure shows a "nested," or layered, system. The production process of the preceding figure is now the classroom level. Leadership and management processes are shared between the school and the district level. Outputs (student learning) flow out of the classroom and produce data that allow results to be compared to the plan (the diamond to the right). If they are acceptable, the process is allowed to continue. If not, corrective action is determined. The pipes symbolize the ways in which influence can flow between and among levels of the system, sometimes enabling, sometimes constraining, action at the next level.

As a step toward working with urban school districts to build a process-engineering management system, the Processing Engineering for Education Results (PEER) group at the University of Pittsburgh, headed by engineer Mary Besterfield-Sacre, developed a hypothetical flow model of processes from the district to the school level. This is shown in Figure 7. The output of the system (at the right) is expected to be student learning, using multiple measures. Five types of classroom "enablers" are specified. These enablers draw on a substantial body of research—much of it beginning with John B. Carroll's Model of School Learning initially put forward in 1963 and modified by Carroll himself (in 1989) and many other scholars (e.g., Berliner, 2006) in the intervening years. Measures for many of these classroom-level enablers exist and can be used in the process-engineering effort of school districts.

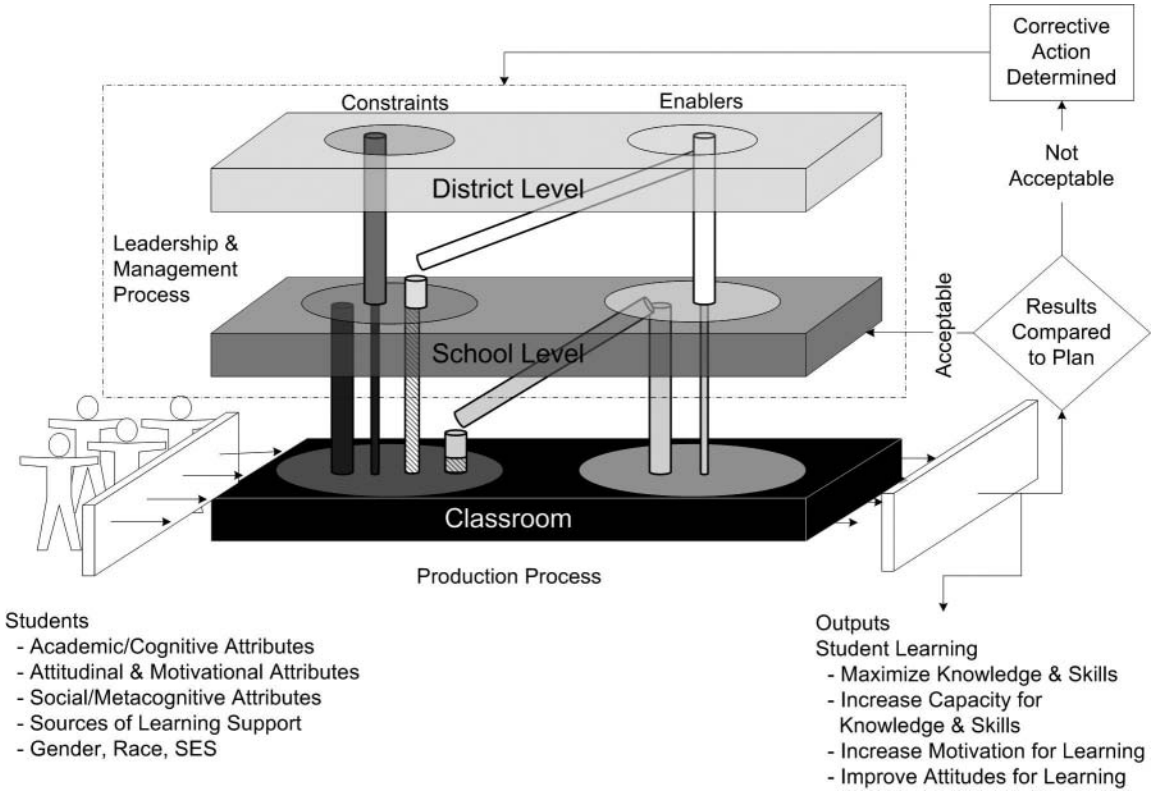

FIGURE 6. *Three-level conceptual model of K–12 district system with process feedback. Source: L. B. Resnick, M. Besterfield-Sacre, M. M. Mehalik, J. Z. Sherer, and E. R. Halverson. (2007). A framework for effective management of school system performance. In P. A. Moss (Ed.),* Evidence and decision making: The 106th yearbook of the National Society for the Study of Education (NSSE) *(Part I, pp. 155–185). Malden, MA: Blackwell.*

To the left in Figure 7 are hypothesized enablers (sometimes constraints) that the school or district introduces (some of the processes fall between district and school or between school and classroom). The research basis for the elements further to the left in the diagram is much thinner than for classroom processes, but there is widespread agreement in the policy making and policy research communities that each of the elements named is potentially important. In fact, many proposed policy initiatives are based on assumptions involving these elements (e.g., hire and reward teachers with more knowledge and skill, provide continuing professional development, modify principal hiring and school assignment policies).

To check our hypothesized process model against the implicit models of leaders in urban school districts, we invited key decision makers in several urban school districts to participate in a series of mapping exercises. More than 100 urban district officials (including superintendents, deputy superintendents, chief academic officers, instructional supervisors, and principals) participated. Participants were given a set of "tiles," each containing one of the elements in Figure 7. They were permitted to discard any elements they did not deem centrally important and to add new ones, if necessary, to reflect their views. Participants were asked to create "influence maps" of their policies aimed at improving student learning. Twenty-eight groups of district officials created 28 different maps using our organizational elements and enablers plus a small number of additional ones that they added.

Although there were variations among the maps, certain characteristics were largely shared. First, our hypothesized system elements did, according to our participants, constitute the fundamentals of the K–12 system. Even though district leaders were instructed to add additional elements as needed, few were added, and there was no consistency among the additions. In addition, the pattern of influence revealed in the 28 separate practitioner maps was quite similar to what is shown in Figure 7.

We combined the qualitative knowledge embodied in our district experts' graphs using an algorithmic approach involving a recursive path-counting routine written in VB.NET (Clark, Sherer, Besterfield-Sacre, & Resnick, 2007). The results of the VB.NET analyses identify frequently occurring paths among the 28 maps developed by our school district participants. These paths represent prominent shared theories of action among our experts for how to influence classroom processes to produce improved student learning. Four high-frequency two-element paths were identified:

Instructional leadership → teacher beliefs
Quality of professional community → teacher beliefs
Professional development → teacher knowledge and skill
School calendar → instructional schedule

Further, four individual elements (instructional leadership, quality of professional community, teacher beliefs, teacher

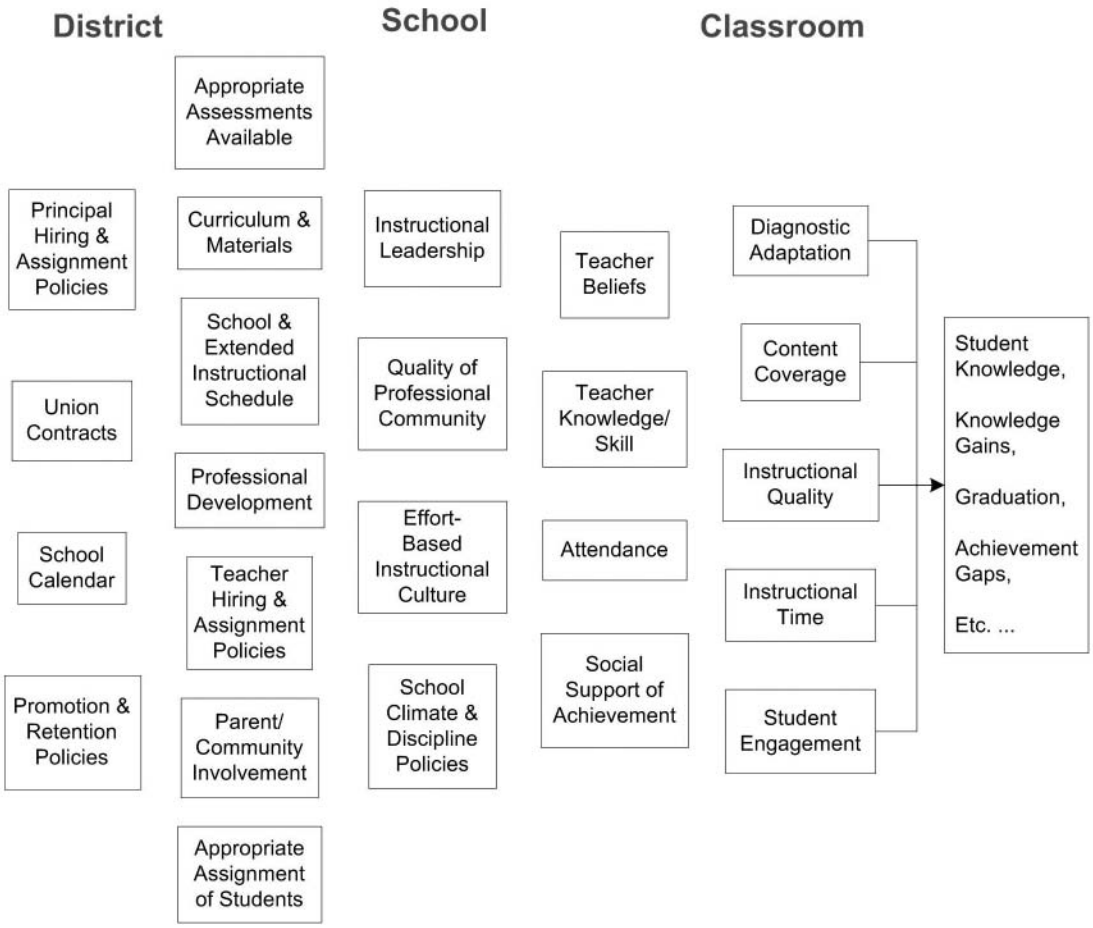

FIGURE 7. *Fundamental elements of the K–12 system according to participant practitioners.*

knowledge and skill) also appeared in frequently identified paths of three, four, or five elements. All 28 groups placed teacher beliefs in their diagrams. All but one included teacher knowledge and skill. Instructional leadership, quality of professional community, and professional development were used with high frequency. Thus, according to our participants, there is a solid core of processes essential to enabling the classroom practices that we know produce student learning.

Policy Planning: The New Reform Triangle

Although the terms *human capital* and *social capital* had deliberately not been used in our mapping exercises (to avoid having technical terms block our experts' ability to articulate their own theories of action), the education leaders we worked with shared the underlying ideas expressed by those terms. Our participants affirmed the importance of organizational features of schools that social scientists and policy experts have been addressing for some time: *human capital* (expressed as "teacher knowledge and skill," "teacher beliefs," and "instructional leadership") and *social capital* (expressed as "quality of professional community" and "effort-based instructional culture"). To these two terms, we add a third: *instructional tools and routines* (expressed as "appropriate assessments available," "curriculum and materials," "professional development"). These three organizational features comprise a new policy triangle (see Figure 8) that is beginning to guide policy designs for improved achievement—although it is rare for advocates or scholars to consider the three in combination.

Human Capital

Economists tend to be especially interested in human capital: what people in the organization know and know how to do (Harbison & Hanushek, 1992). Human capital is typically measured by credentials, performance observations, and individual outputs (in education, student learning). Economists have related

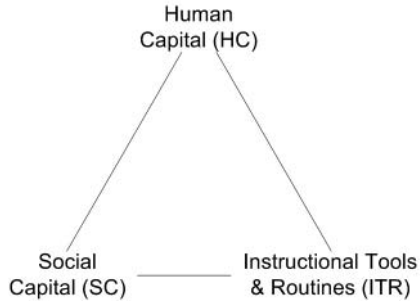

FIGURE 8. *Policy triangle to guide policy design in educational settings.*

student performance on academic measures to the number and type of courses teachers have taken in college or graduate school (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006, 2008). Some recent work using more refined measures of teacher knowledge also shows a significant positive relationship between teacher knowledge and student achievement (Hill, Rowan, & Ball, 2005).

Our expert educators agreed that teacher *knowledge* is an important enabler of the kinds of classroom activity that enhance student learning, but they included teacher *skill* in their definition of teacher competence—referring to teachers' abilities to communicate that knowledge, engage students' interest, and in general create classroom environments for successful learning. They thus embraced the broad view of teacher knowledge introduced by Lee Shulman (1987), who distinguished between *content knowledge* and *pedagogical content knowledge,* arguing that both were essential to good teaching (see also Darling-Hammond & Bransford, 2005). Although popular among educators and education researchers, it has not proved easy to measure pedagogical content knowledge in a way that provides empirical evidence of making a difference in student learning. Some progress is now being made using structured classroom observations (Grossman & McDonald, 2008) and teacher logs (Rowan & Correnti, 2009).

The educators in our study also enriched the concept of human capital by pointing to teacher beliefs (the extent to which teachers believe their students can learn at high levels) as a hypothesized producer of greater student learning. And they identified instructional leadership as an important element in increasing productivity, thus making the quality of school principals an important part of the human capital equation for their schools.

Much current policy discussion is aimed at remedying the human capital gap by processes of selection (including alternative pathways into education careers), retention, dismissal, and differential pay (National Academy of Education, 2009). Across the United States, several experiments are now under way—for example, the Denver school system's ProComp pay for performance system—linking such incentives to specific training and instructional programs.

Even if many of these policies were widely implemented, however, there would be a long period before *most* of the teaching and leadership force in schools would count as highly qualified under new and more stringent definitions of *quality*. In the interim, old organizational practices might actually suppress the development of the new, knowledge-based Thinking Curriculum that is our goal. Thus we will need to consider how to create human capital within education organizations. The two most promising routes appear to be development of social capital within schools and systematic introduction of instructional tools and routines that have the power to directly change classroom practice and thereby increase learning.

Social Capital

Social capital is a term introduced by sociologists (Becker, 1964; Coleman, 1988) referring to resources for action that inhere in the relations or interactions among people—the opportunities that some people have, and that organizations can create, for acquiring knowledge and other resources through interactions with others. *Social capital* is used to refer to social ties and trustful relationships (Adler & Kwon, 2002; Nahapiet & Ghoshal, 1998). A number of sociologists studying processes of education reform have begun to document links between social capital (e.g., groups of teachers professionally engaged with one another within a school) and the forms of knowledge-based thinking that cognitive and sociocognitive instructional theory recommends (e.g., Bryk & Schneider, 2002; Frank, Zho, & Borman, 2004; Gamoran et al., 2003; McLaughlin & Talbert, 2001; Newman, 1996).

Social capital refers to the ways in which people in an organization share what they know. With whom do they talk? How openly or widely do they share information—both positive and negative—about their work? Do they know or care who has expertise? How broad or narrow are their networks? Our expert educator participants referred to social capital mainly as the quality of professional community within a school and viewed it as a primary means of building human capital. Social science research supports their practice-honed view. For example, in a large study of social capital in New York City schools, high social capital (as measured by structured surveys) apparently led many competent teachers to stay in schools serving the poor, even if the teachers had opportunities for better paying jobs nearer to their own homes in the suburbs (Leana & Pil, 2009).

Instructional Tools and Routines

Human and social capital are powerful concepts, but they do not tell the whole story. As do all organizations, schools function through a set of more or less interconnecting routines—"repetitive, recognizable patterns of interdependent actions, involving multiple actors" (Feldman & Pentland, 2003, p. 113). These routines are critical for any organization to function effectively because they provide stability and continuity over time (Feldman, 2000; Feldman & Pentland, 2003; March, 1981; March & Simon, 1958, 1993) and structure action in organizations (Allison, 1971; Gersick & Hackman, 1990). Groups and individuals in the organization develop routines that constitute the normal ways in which work gets done. These routines are not always in the official manuals, but they allow members to perform satisfactorily in the judgment of clients and supervisors and for their own self-satisfaction. Such routines often involve adaptation to internal and external institutional constraints and may also recruit the power of informal "below the radar" work groups, as documented by sociocognitive research (Brown & Duguid, 2000; Orr, 1996; Resnick, Saljo, Pontecorvo, & Burge, 1997; Suchman, 1996). Research has documented the ways in which organizational routines, both formal and informal, frame and enable interactions, provide stability across time, and assist in socializing new organizational members (M. D. Cohen & Bacdayan, 1994; Feldman & Pentland, 2003; Sherer & Spillane, in press; Spillane, Mesler, Sherer, & Croegaert, 2010).

What kinds of routines might be introduced into schools and school systems that would build the human and social capital needed? There are several possibilities—ranging from instructionally based supervision systems to tools and routines for instruction. Stated most directly, it probably would help to put curriculum of known effectiveness, along with materials and procedures for classroom implementation, in the hands of teachers.

Throughout the first half of the 20th century—when school attendance was expanding, people were moving from farm to city, and American cities were absorbing then-unprecedented numbers of internal (South to North) and external immigrants—large school districts laid out well-defined curriculum and instruction plans and expected teachers to follow them. Starting in the 1960s, educational tastes changed and large pressures against "industrial" models of education developed. Over the three and a half decades since David Tyack (1974) described the functioning of centralized school systems as "Tayloristic" (referring to efficiency methods in which teachers were expected to implement detailed programs of instruction on a strict schedule), there has been a growing rejection of the idea of centrally imposed instructional programs. This has been accompanied by a rhetoric of professionalization of teachers, with the implication that professionals should develop their own instructional plans and programs.

Today, the language of professional independence for teachers is so widespread that even when school districts attempt to implement systems of managed instruction as a way of improving educational provision for underserved populations of students, they mostly cast their curriculum offerings as *guidance* for teachers rather than as required programs. Textbooks are adopted but often used only sporadically. In the face of high-stakes accountability for student performance on state tests, most districts offer interim assessments intended to provide guidance on how to meet student needs. In many cases, however, the actual use of such assessments is voluntary. In a recent PEER study of a large Eastern urban school district, for example, teachers reported not regularly using the district-supplied teaching materials in math (which they judged too fast paced for their students), and most did not administer the voluntary end-of-unit assessments that the district supplied.

The resistance to curriculum-based solutions is beginning to decline. There is growing evidence that structured instructional tools and routines for using them can be a powerful route to better teacher performance and increased student learning. In the next section, I report evidence that the three elements of the new policy triangle can be used together to meet 21st-century education reform goals.

Using the Policy Triangle to Improve Educational Results

School-Based Instructional Tools and Routines

Although school districts have, by and large, been shying away from—or not fully implementing—curriculum-based reform, the instruction-based reform strategy has been kept alive in American schools by some of the intervention models that emerged as part of the 1990s reform strategy known as comprehensive school reform (CSR). In the CSR approach, an individual school uses state, federal, or philanthropic dollars to contract with an organization (usually a nonprofit, sometimes a for-profit or a university group) that provides a defined service program, usually one that includes professional development and other support for teachers.

The existence of these CSR schools, using a variety of reform models, provided the opportunity for a research group at the University of Michigan (Correnti & Rowan, 2007) to compare different reform strategies' effectiveness in raising student achievement in elementary schools. The group's Study of Instructional Improvement research program compared schools using three different models of school improvement: Success for All (SFA), America's Choice (AC), and the Accelerated Schools Project (ASP). The first two (SFA and AC) are curriculum-based models in which the external "provider" supplied texts and other teaching materials, specified student grouping and instructional processes in detail, and provided training in specific pedagogical strategies. ASP, by contrast, provided structured support to school staff members to develop their own instructional plans and implementations around a broadly shared philosophy of learning and teaching. ASP, in other words, focused on building social capital, whereas AC and SFA used instructional tools and routines as a route to improved student learning.

The findings were striking. Using student learning as the criterion, the curriculum-based approaches (SFA and AC) performed better than the ASP approach that worked mainly on developing social capital. What is more, the learning gains were tightly tied to the specific instruction that was the focus of the program. Each program showed significant effects only for the core curriculum component it focused on—basic reading skills in the case of SFA, writing skills in the case of AC. In other words, well-implemented curriculum worked, but the effects were specific to the tools and routines introduced by the provider.

District-Based Instructional Tools and Routines

Can the instructional tools and routines strategy be used to increase student learning across a broad swath of schools in a district? This is the question we addressed in an experimental study conducted in several dozen elementary schools in a large urban district in the Southwest, a district struggling to raise achievement among a large and growing population of Spanish-speaking immigrant children (Matsumura, Garnier, & Resnick, in press). The curriculum approach we introduced was based on the reading comprehension program Questioning the Author (QtA) developed by Isabel Beck and Margaret McKeown (2002). The tools and routines of QtA were introduced by placing dedicated literacy coaches into half of the schools under study and training them using a program called Content-Focused Coaching (CFC).

Coaching is a popular intervention in school districts that are trying to raise achievement. It is, in theory, a form of professional development that is school embedded and therefore close to instructional practice. It also—again in theory—uses the best teachers in the system to help build skill among the larger teaching force. Using the PEER process of specifying expected influences, coaching can be seen as a means of upgrading teacher content and pedagogical knowledge, along with teacher beliefs about student ability to learn. As shown in Figure 9, coaching (the central diamond) is expected to enhance key enablers of classroom practice such as content coverage and quality of classroom interaction, thus leading to gains in student learning.

Coaching is rarely enacted according to theory, however. District practices of hiring and assigning coaches, sometimes governed by union contracts, along with job postings and salary

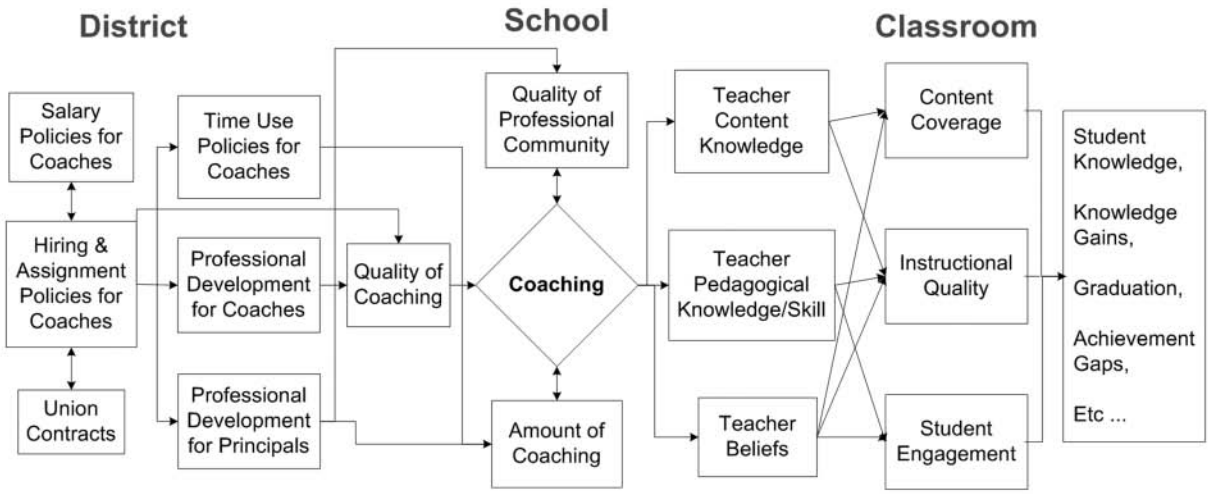

FIGURE 9. *Coaching enhances key enablers and is constrained by district policies and practices.*

policies, often mean that coaches are selected from the teaching ranks by seniority or preference of principals rather than by demonstrated capacity to increase student learning. Coaches' job descriptions are often only vaguely specified. And, reporting usually to individual principals who do not have a developed understanding of what to expect from coaches, they are assigned to a myriad of tasks (ranging from supervising testing, serving as substitute teachers, or providing personal teaching to underperforming students) and do not have the opportunity to develop a systematic coaching relationship with teachers. Figure 9 also illustrates how the quality of coaching in a school district is dependent on a large set of policies and practices (those to the left of the coaching diamond in Figure 9) that are heavily influenced by the district central office.

In our study of CFC, we enacted a carefully focused program of coaching in upper elementary classrooms teaching reading comprehension (Matsumura, Sartoris, Bickel, & Garnier, 2009). The program used to train coaches had been developed over several years at the University of Pittsburgh's Institute for Learning (Bickel & Artz, 2001). We worked with district administrators to select demonstrably successful reading teachers to be trained as coaches. We also worked with school principals to develop agreements that would make it probable that coaches assigned to their schools would be scheduled for regular meetings with subgroups of teachers, would be allowed to make classroom visits to individual teachers, and would not have competing work assignments (Matsumura et al., 2009).

Twenty-nine of the lowest performing elementary schools, all with high proportions of English language learners, were randomly assigned to either the CFC or a comparison condition. Teachers and principals in both sets of schools responded to periodic surveys and interviews. There were systematic observations of classroom text discussions and recording of the complexity of the texts being used in instruction. Students' reading test scores on the state accountability tests were tracked over several years.

Teachers in the CFC intervention schools significantly increased participation in coaching focused directly on classroom practice. The quality of the text discussions in their classrooms improved: The classes read more difficult texts, they actively referred to the texts as they discussed them, and the teachers used accountable talk (Resnick, Michaels, et al., in press) classroom discourse strategies. Students in the CFC schools showed significantly higher reading test scores (effect size = .25 after 2 years). The effect was strongest for English language learners (Matsumura, Garnier, & Resnick, in press; see Figure 10).

Combining Social Capital and Instructional Tools and Routines in High Schools

Many scholars of education practice and reform suggest that the quality of professional community in schools is tightly associated with student achievement. Considerable work has been done to develop ways of managing schools that are likely to build and sustain professional communities (Loeb, Darling-Hammond, & Luczak, 2005; McLaughlin & Talbert, 2001). Indeed, it is possible that the successes of curriculum-based whole-school models are in part due to the professional community commitments that are evoked by the forms of training and support that are part of the implementation packages that the sponsoring organizations build into their programs.

In 2001, the Institute for Learning began designing and piloting an intervention program that explicitly combined instructional tools and routines with professional development strategies

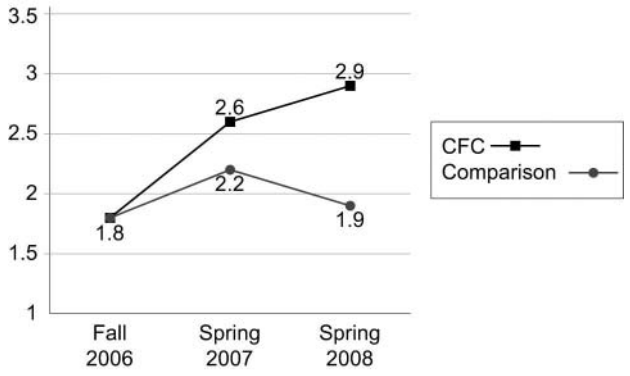

FIGURE 10. *Content-Focused Coaching (CFC) schools showed improved reading test scores.*

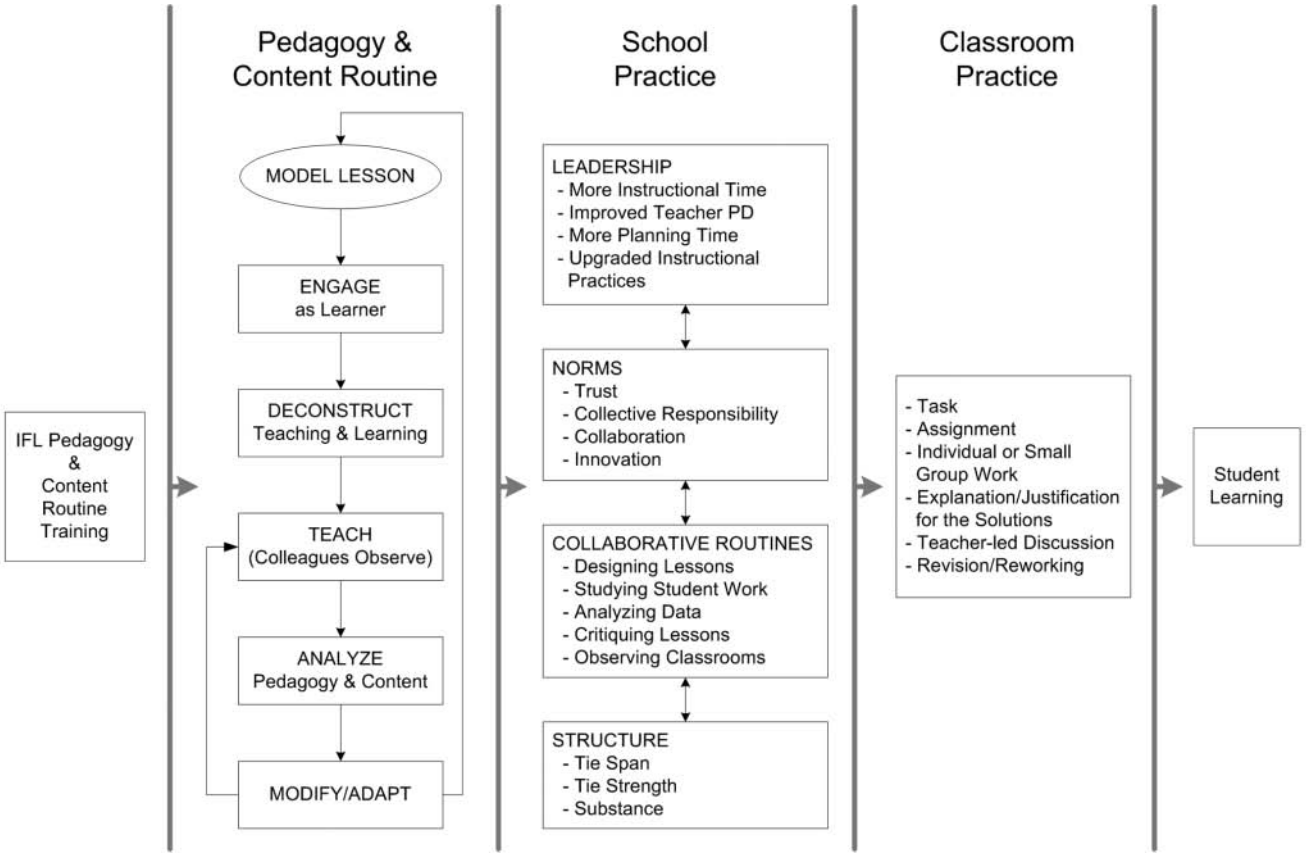

FIGURE 11. *Pedagogy and content routine.*

aimed at building professional learning communities (McConachie & Petrosky, 2010). The institute worked in two urban districts: six high schools in Austin, Texas, in which all teachers in the four core high school disciplines (science, math, history/geography, and English) participated, and schools in the Los Angeles Unified School District in which the departments of mathematics and/or English, along with their principals, agreed to participate.

In both districts, intensive professional development led by subject matter experts was organized around a "spine" of curriculum units and lessons that were explicitly linked to the districts' official curriculum guidance documents. The units and lessons were designed to educate teachers in high-cognitive-demand forms of classroom instruction. The form of training used was intended to induce new forms of professional engagement in what we have termed a "kerneling process" (Resnick & Spillane, 2006; Resnick, Spillane, Goldman, & Rangel, in press) in which formal routines embedded in an institution give rise to a next generation of practices that are kin to the externally introduced routine but not identical to it. Kernel routines are designed to deliberately displace standard routines of practice. Participating teachers are expected at first to follow the new routines quite faithfully. However, the routines have been developed with the goal of encouraging new forms of professional interaction that are consonant with the curriculum plan but crafted by the participants to fit their interactive and learning preferences.

The pedagogy and content routine (PCR) begins by engaging teachers in a tightly crafted routine consisting of a specific set of professional development practices. Training and practice of PCR occurs separately for each teaching discipline, but when the routine is used for several disciplines within a school (as it was in our Austin implementation), substantial "cross-seeding" and development of a larger institutional change within a school is expected to occur.

Figure 11 depicts how PCR works. Teachers, coaches, and lead teachers first experience the sequence of activities described in column 2. They begin as learners of model lessons taught by a trainer. They then engage in a trainer-led process of "deconstructing" or interpreting what their learning process has been and the role of the trainer in evoking their learning processes. Next (still in column 2), participants are asked to teach the model lesson or a modification of their own design. They are observed by the trainer and other teachers, and they then participate with the observers in an analysis of the pedagogy and content of their teaching. Teachers have the experience of both observing and being observed during this phase of implementation—always with careful attention to the content taught and the cognitive processes evoked among students. They next modify or adapt the lesson for future teaching and continue the teaching-observing-analyzing sequence. Alternatively, they can ask for one or more additional model lessons from the spine.

Even as the teacher group cycles through the PCR, the kerneling process is expected to engender new forms of school practice. As shown in column 3, we expect changes in *leadership* activity, in *norms* of trust and collaboration, and in specific *collaborative*

routines and *structures of interaction.* All of these forms of social capital should affect aspects of classroom practice (column 4) and thus of student learning (column 5).

A research team headed by Joan Talbert of Stanford University evaluated the use of PCR in the six Austin, Texas, high schools. The evaluation report (Talbert & David, 2008) suggested that PCR provides an effective vehicle for developing teacher collaboration centered on instruction, as well as for increasing the academic rigor of teaching and learning. However, the authors noted that it would need further central administration support to realize its full effects. Another study in Los Angeles (David & Greene, 2008) yielded similar results in mathematics. Implementation in English language arts, which received less intensive administrative support, was not as effective.

In Conclusion

We stand at the cusp of some potentially important shifts in how we think about education reform. Resistance to external specification of routines and curriculum seems to be ebbing. But increased policy interest in curriculum-specific instructional practices will bear fruit only if we can learn how to embed detailed curriculum guidance in organizational designs that support the complex sociocognitive practices of participants and the diversity of students in our schools. Systems that aim to develop extended knowledge and complex forms of argument and reasoning among students will fail if teachers are restricted to scripted lessons that close off discussion. Instructional tools and routines that seek widespread use by overspecifying behaviors and conversations in the classroom may help in meeting basic education goals, but they will not take us far toward the 21st-century star.

Many scholars and practitioners today recognize that to reap the benefits of more than half a century of cognitive research on thinking and mental capacity building will require serious attention to how education *organizations* function as well as to how *individuals* learn. Social science research has a long history of studying organizations. But systematic applications to education are more recent. And attempts to *design* education organizations and test those designs empirically in a continuous cycle of improvement are still rare. I hope the analysis and examples offered here will become part of a growing program of education research that brings the resources of cognitive science, sociocultural research, and organization theory and practice to bear on our efforts to reach for the star.

NOTE

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[1]The term *literate* here refers not just to reading and writing but also to mathematics and basic knowledge in science, geography, and history.

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TOOLS TO SUSTAIN DL IN SCHOOLS AND CLASSROOMS

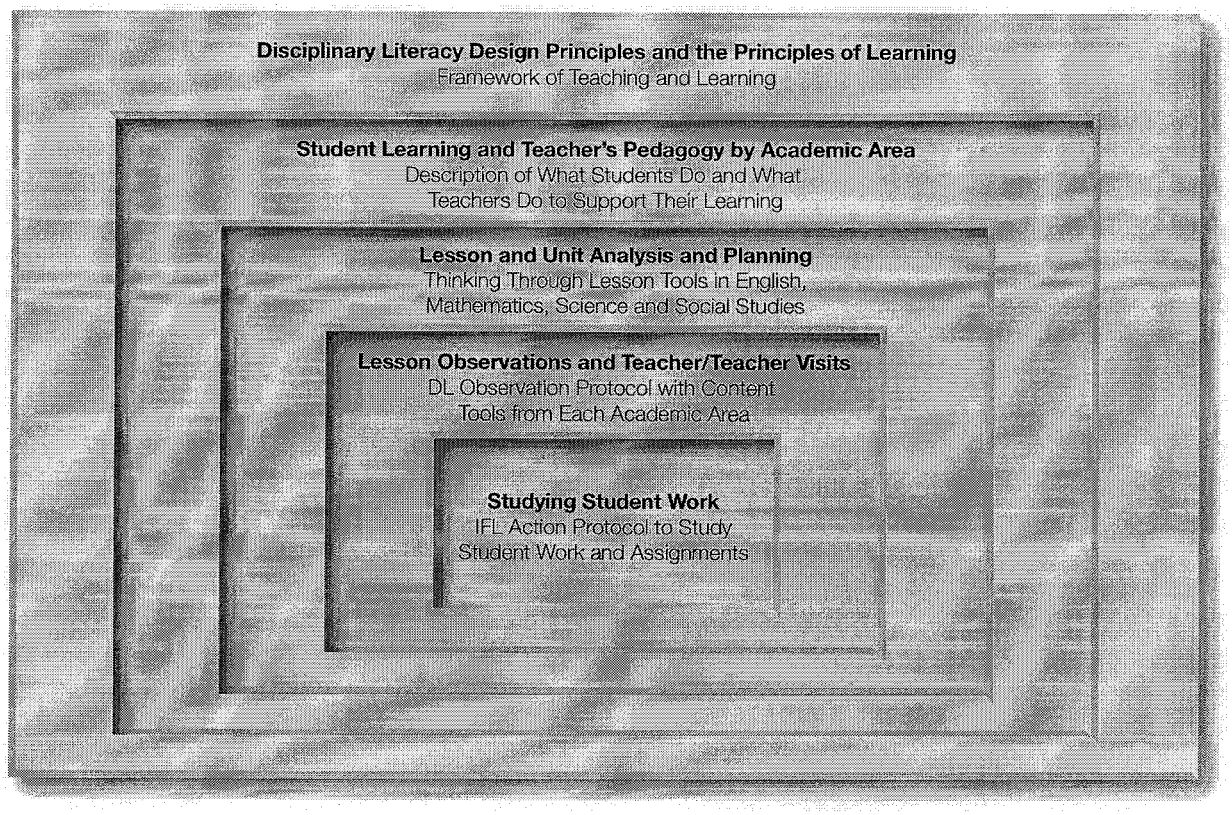
How does a reform persist in the face of changing leaders, teacher turnover, and the press of competing demands at the secondary level? Coburn's research (2003) offers a perspective that includes explicit attention to how the knowledge and authority for the reform is transferred from external sources to teachers and becomes "consequential change" in classrooms. The five identified leadership domains offer a road map. Instantiating use of content and pedagogical content tools turns professional learning and initial applications of tools into internalized habits of professional practice.

For the purposes of this chapter, we will limit our discussion to tools that guide processes and routines to achieve high-quality instruction. These are the pedagogical content tools included in earlier chapters as well as the study and organizational protocols that we reference in this chapter (See Appendix for a list of representative DL tools). Together, they support DL practices and routines in professional learning sessions, PLCs, and enacted lessons.

Figure 7.4., Disciplinary Literacy Nested Instructional Tools, shows the *nest* of instructional tools that learners use at various levels of DL learning. The DL Design Principles and the Principles of Learning (described in Chapter 2) form the overall framework within which the other tools and protocols nest.

The instructional tools carry the theory and research in their design and use. In essence, each tool, whether it is the DL Design Principles or a content-specific one, such as DL mathematics' "Thinking

Figure 7.2. **Disciplinary Literacy Nested Instructional Tools**



Through a Lesson: The Key to Successfully Implementing High-level Tasks," is meant to extend social and intellectual capabilities (Smith, Bill, & Hughes, 2008; Hughes & Smith, 2004). If the key function of this mathematics tool, for example, is to enable the active analysis of levels of cognitive demand/complexity, the tool works to assess math tasks and lessons, regardless of the particular mathematics course. The content tools provoke sustained conversations and reflection on practice within and across role groups and tasks. They are a driving force for the cultural shift into tool-mediated actions by teachers.

Observation and Feedback Routine

The Leadership Domain of Observation and Feedback supports the routine of lesson observations. Resnick and Spillane (2006) provide insight into the significance of routines in transforming instructional practice. They use the phrase "kernel routine" to describe how routines seed and propagate new forms of practice in schools (2006). The idea is to introduce a routine that—because it is highly specified and supported by well-defined tools and strategies—can be implemented quickly at a reasonable level of quality under the guidance of the principal. The routine has to be visibly focused on teaching and learning and responsive to established standards of accountability in the school. Kernel routines serve two core goals. First, a kernel routine anchors school practice in teaching and student learning. Second, a kernel routine connects and weaves together other organizational routines in the school to more fully focus the organization's attention on instruction and learning, rather than on institutional compliance.

To open up instructional practice to examination, administrators and teachers use the kernel routine, "Lesson Observations and Teacher/Teacher Visits," facilitated by the DL Observation Protocol (see Appendix). It is not a stand-alone protocol but is used with a content tool to ground observations in the specifics of the tasks, text, and talk of the academic area being observed. The protocol guides how to observe a lesson and how to be observed teaching a lesson. Unlike formal teacher evaluations conducted by principals and assistant principals, this observation provides formative assessment data useful for promoting deep examination and reflection on practice for the teacher and the observers alike. The data is in the form of evidence-based descriptions and thought-provoking questions from the observing group to the observed teacher with no summative ratings or judgments. It is meant to foster reflection on practice by the observed teacher and those who joined the teacher on the observation and reflection. The protocol with content tool puts in place routines for examining practice with colleagues. At the center of the observation is the teacher, who determines the focus of the observation based on what she or he is trying to accomplish with the DL tools, materials, and approaches. Below a teacher leader comments on the change she saw in observations:

There was a shift from a focus on teachers' to students' learning when we started to use the protocol. The questions and the way that the protocol is organized so that you are looking at it through the lens of what the teachers wants you to focus on which is really helpful. It gives you a context for your observation. More importantly from the protocol, the evidentiary statements are particularly important for talking about it. You have something in front of you that is an actual—this is what actually happened—and allows you to ask questions that are rooted in student learning.

The observation protocol was originally developed as a risk-controlled way for teachers to begin observing others' practice and allowing others, including principals, to observe their practice. The DL protocol's design adheres to the design assumptions of The Learning Walk® tool (Goldman, Johnston, Micheaux, & IFL Fellows, 2001; Institute for Learning, 2008) used by principals, district administrators, and teachers. Both tools support classroom visits tied to teachers' professional learning. Like the DL protocol, The Learning Walk® tool was designed by the Institute for Learning to assist teachers and school administrators in observing classrooms and collecting evidence about how students learn and

teachers teach, and how the teacher's work impacts student learning. Unlike the DL protocol, The Learning Walk® visits are for shorter periods of time than a whole class period, have some procedural differences, and offer more varieties of classroom observations. There is a newer version of The Learning Walk® tool (Apodaca, 2008) that mirrors the DL Protocol and is used by administrators for shorter observations and for observations of multiple room visits during one class period. By visiting several rooms, educators can look for patterns and trends.
Both tools are designed to inform teachers and other school leaders about the instructional core, which represents the critical work of teaching and learning that goes on in classrooms. According to Elmore, there are basically only three ways you can increase learning and performance. One is to increase the knowledge and skill of teachers. The other is to somehow affect content. And the third is to alter the relationship of the student to the teacher and the content (Elmore, 2009; Childress, Elmore, & Grossman, 2006). In order to increase student learning and achievement, teachers and other school leaders must continuously improve the instructional core. The observations are done through the eyes and voices of students and provide teachers face-to-face feedback that has the potential to change practice in an area that teachers themselves specify prior to the observation.

Before use, the tools require training with video and a practice session that employs an appropriate DL content tool. Teacher and administrator observers practice and receive feedback on the quality of their descriptive statements and questions related to the observed lesson. When a judgmental, summative evaluative statement is made, such as, "The teacher's main discussion question was excellent," the facilitator guides the participant to revisit the question to note what was judgmental about it. Then he or she asks the participant to rephrase the observation as a descriptive statement, such as, "Two thirds of the students talked to each other about the question, "Who is a friend to Victor?" during the large group discussion. Most offered different answers using text-based reasons."

The following provides an example of how one teacher utilized DL tools and routines to further her understandings of DL practice. Ms. Thompson, whose science class and lesson were described in Chapter 5, has been engaged in studying DL Science for two years and is exploring implementation of DL more deeply in her classroom. Ms. Thompson's district has made a commitment to school-based PLCs, allowing her time to meet with other colleagues to reflect on their practices. The PLC group has been engaged in studying DL Science practices at the district level through large group professional development and has been building on those experiences through their small group study. After a semester of monthly two-hour PLC meetings, Ms. Thompson takes the next step of inviting science colleagues into her classroom in order to prompt reflection on her teaching and theirs through a DL Science observation. She is working to have students develop evidence-based scientific explanations and asks the group to focus their observations around the probing questions she will use to guide students toward improving their explanations. Specifically, she asks them, How well do my questions increase students' ownership of their explanations? How well do my questions facilitate students' ability to cognitively wrestle with their explanations? While Ms. Thompson is the primary person taking a reflective stance on her practice, the group is also invited to reflect on their common learning and teaching. This shifts the responsibility and intellectual resources from an isolated teacher to a community of learners. After the experience, a teacher described her vision of the observation through a sports metaphor: When you are on a basketball team, you may focus on a specific skill such as lay-ups. You ask your teammates to watch you do lay-ups to help you do them better. As they are watching and giving you feedback, they also get better at their lay-ups. The same thing happens when you invite a team into your classroom to do a DL observation. Your teammates help you improve on a teaching area, and in the process they learn about their practices too.

In the following excerpt, a principal reflects on how the observation protocol assisted increased ownership of instructional improvement from only school principals to teachers and principals.

The DL observation protocol made those visits safe and gave them a structure. Having teachers visit one another meant that no longer was just the administrative team walking through classrooms or observing a lesson, but teachers were as well. That did two things: I stopped (or my assistant principals stopped) being the only brokers of information. I began hearing follow-up conversations in the teachers' workroom or in the hallway, "How did you do that?" "I tweaked my lesson or I rewrote or I thought about it in a different way." So it spawned teacher-to-teacher dialogue about instruction in ways that nothing else we had tried had done.

The second thing it did was the de-privatization of instruction. We couldn't hide behind myths that that is a good teacher or that's just my opinion. As they incorporated the DL model of why that was good instruction, it brought the Principles of Learning to life for them. They began talking about why they made instructional decisions based on research and best practice. It allowed someone like Christine [a teacher leader and department chair] to come to me and say, "It's no longer OK for my colleague across the hall to teach the way she has been teaching." "Well, that's true. What do you want me to do?" She responded, "I am going to practice what I'm going to say with you—but I don't want you to say it." That was a huge shift from someone saying, "It's the administrator's job to tackle instructional issues." While there is still a role for a principal in the process, teacher leaders are willing to have those difficult conversations with their colleagues.

In this particular school, the core content teams organized their own schedules of observations so each teacher was observed once by his or her departmental colleagues and observed other teachers twice per semester. Each observation followed the protocol of a pre-visit meeting where the teacher described what he/she would be implementing from the DL tools and routines, stated goals of the lesson, and provided a focus question to observers. Following the observation, there was a post-lesson discussion for all participants facilitated by the content's teacher leader.

Disciplinary Literacy Nested Instructional Tools, shows the relationship of the tools to one another. This is not a one-way road map. The tools are used within patterned structures of participation that may begin with one sequence but can change later as participants gain understanding and ownership of the tools and processes and are more able to self-direct their learning. The broadest patterned structure includes the cycle of study-apply-reflect-and-assess that moves the use of tools from sessions to smaller PLCs to classrooms and then back into the sessions or PLCs.

By the final level of the graphic, teachers use a protocol to study student work samples, comparing the level of performance to district or state standards and the assignment's written expectations. At first, teachers use student work samples provided by the expert external facilitator. By the second round, teachers analyze their own or colleagues' student work samples and assignments.

DEVELOPING AND PROVIDING PROFESSIONAL LEARNING

Sustained professional development is a complicated matter that involves nested communities of learners in a district as well as various kinds and levels of support for teachers, administrators, and central office staff. At the heart of professional development, adults become learners who experience Disciplinary Literacy lessons and modules, or mini-units, and engage in the kinds of learning they will bring to their students. A key part of this process asks learners to step back from their engagement to

reflect on their learning. Here, a district leader reflects on the impact of his district's DL professional learning:

I believe in the opportunity for teachers to come together to talk about their content and the pedagogy. The professional development in our district has become better. Especially in our DL schools, it is truly centered on their content, and the pedagogy and the on-going assessment is part of that also. For example, teachers thinking constantly about, "What question can I ask or how can I redirect the thinking so that they better understand the concept?" .... It is great work, but we look forward to DL becoming almost second nature to our district so that it is something naturally ingrained into our professional development and in all of our conversations."

District and school leaders must value sustained and robust opportunities to study and practice full, extended examples of teaching and learning that they can emulate, replicate, examine, modify and transfer to curriculum and instruction. (Talbert & David, 2007; Talbert, David, & Lin, 2008; David & Green, 2007, 2006). These conclusions about leaders' perspectives align with the findings of larger-scale professional development studies and policy papers (Coburn & Russell, in press; Correnti, 2008; Penuel, Fishman, Yamaguchi & Gallaher, 2007). That is, teachers are influenced positively to change instructional practice by working with fully developed lessons and tools situated within curricula and courses—not generic strategies and methods that are presented in decontextualized ways.

Cognitive Apprenticeship

As described in the previous content chapters, DL professional learning builds from a model of cognitive apprenticeship. "Cognitive apprenticeship," as defined by Collins, Brown, and Newman (1989), "is an instructional method for teaching an acceptable way of understanding and doing tasks, solving problems, and dealing with problematic situations" (p. 69). The structures, routines and use of tool-mediated actions fostered in each of the academic areas form the basis of this practice-based means of professional development: "The key to cognitive apprenticeship is that models (teachers) demonstrate and explain how they deal with ill-defined, complex, and risky problems and give the learners an opportunity to approximate this behavior under risk-controlled conditions" (Brandt, Farmer, & Buckmaster, 1993, p.75).

Learning as Apprenticeship for Students

As part of adult learners' first year in the DL project, they study the Principles of Learning, in particular Learning as Apprenticeship (Resnick, Hall, & IFL Fellows, 2003). The following text describes features of Learning as Apprenticeship for students:

> *Modeling and observation.* Apprentices spend a significant amount of time observing masters or more advanced apprentices at work. From this observation, mediated by conversations in which critical features of the work or product are pointed out and processes are analyzed, they learn to discriminate good from poor practice, and acceptable from unacceptable outcomes.
>
> *Active practice.* This is the heart of apprenticeship, where most learning comes from actually working at a task or project, rather than learning from a removed position about how it is done. As apprentices to teachers, visiting experts, and sometimes their more advanced peers, students practice learning by developing products and performances under controlled conditions in and beyond the classroom.

Scaffolding. Apprenticeship learning models do not require that beginners do the entire job that they are learning by themselves. Instead, products are created jointly, apprentices doing the part they can, masters or more advanced apprentices doing the more demanding parts. The more experienced person, in other words, provides a form of scaffolding for the work of the beginner. As student apprentices begin to develop competence in a content area—and the self-management skills that develop alongside expertise—teachers gradually reduce the amount of supportive scaffolding they provide and students must make more and more decisions for themselves.

Coaching. Successful apprenticeship also depends on the availability of a coach—a supportive expert who observes and comments on the apprentice's efforts, who challenges and suggests modified ways of working. Student apprentices are coached by their teachers, more advanced peers, and visiting experts.

Guided reflection. Successful learning, like successful teaching and other professional practice, must be a reflective process, one in which individuals are continually considering, evaluating, and improving on their own work. This reflective capacity and disposition needs to be cultivated during the apprenticeship period. It is not just a matter of time for reflection—although that is crucial—but also the opportunity to engage in a reflective process with a community of others (Resnick, Hall, & IFL Fellows, 2003).

Learning as Apprenticeship for Educators

The following section discusses the features of Learning as Apprenticeship, introduced in the text above, but now considered for adult learners.

Modeling and Observation. In modeling and observation, the professional developer enacts the full activity so that learners as observers can develop a mental model or picture of what to do. In DL professional learning, there are two levels to the modeling. First, the teacher as model is enacting an aspect of the lesson for adult learners and then stepping back to guide discussion of the instruction. So there could be thinking aloud to reveal "tricks of the trade" for learners and then thinking aloud to reveal "tricks of the trade" instructionally.

Buyer beware should be stamped on every model a teacher plans to use. It is critical during professional learning to discuss with educators if, when, for whom, and how much of, a model is needed. In DL mathematics, for example, a misplaced model lowers the task's cognitive challenge by eliminating the critical thinking of mathematical activity learners need to do to approximate ways of thinking and working as mathematicians. Modeling is helpful to assist and advance learning when it is placed in the sequence of the lesson at the time and to the degree that learners need it to advance their understanding (Brandt, Farmer & Buckmaster, 1993). The inverse is also true. Modeling stops engagement in grappling with a problem if it takes away the challenge of meaning-making necessary to construct knowledge. The math content chapter, for example, begins with a non-DL classroom example of procedures for solving a math problem being copied onto the chalkboard as "modeled" solutions. These "models" reduced learners to copying solutions.

One challenge to using modeling examples is assessing the level of complexity needed for adult learners to be genuinely engaged in learning anew, knowing that the same model needs to be relevant to their secondary students not yet expert in the content area under study. However, it's worth taking on the

challenge since working in these lesson-specific ways makes it more likely that teachers' approximations will be successful later in their classrooms (Brandt, Farmer & Buckmaster, 1993; David & Green, 2007).

Active Practice. As Resnick noted in the description of Learning as Apprenticeship, active practice "is the heart of apprenticeship" (Resnick, Hall, & IFL Fellows, 2003). One of the challenges in professional learning is reserving time for teachers and teacher leaders to practice as part of sessions so that the DL facilitator can be part of the necessary feedback loop. In DL, learning problems from the disciplines and the pedagogical scaffolding that adult learners use during practice are designed to mirror the kinds of assistance that practitioners of the discipline would be able to access from experienced and capable people working in that discipline. The scaffolding assists learners in *procedural knowledge* or how to do something. Procedural knowledge is equivalent to DL's application of habits of thinking. Learners are guided to use the habits of thinking that they think will help them to reach deeper and better conceptual understanding of the *declarative* or content-learning problems under study. The scaffolding includes structures/procedures and the interactional unfolding of learning activities (Bruner, 1977; Smagorinsky, 2008). The structure and the interactions are designed to assist learners' growing understanding of core concepts and development of habits of thinking, including skills of the discipline. As learners progress, the scaffolding (that is, the structures and interactional unfolding) is gradually removed to encourage and allow learners to self-direct and manage their own learning.

In PLCs, teachers practice refining lesson planning guided by DL tools. For example, English studies teacher leaders facilitate examination of student texts for inclusion and sequencing in units. The tool, DL Criteria of Text Selection, serves as a scaffold for the process. It guides the discussion to issues of text complexity and relevance and brings fresh perspective on the importance of careful sequencing of readings to set up lessons that require retrospective work of one text and across texts. Careful analysis of the lessons' texts raises expectations for the quality of the lessons and has made the standards more relevant according to several teacher leaders. They relate high school teachers' impressions, "We're always being told that the content standards are in the lessons, but now we're asking where, how?" Working from the ELA design features, which require aligning the content of overarching questions to the unit's texts and lesson tasks, helped teachers connect the learning purpose of the standards to the ideas and structures taught from the student texts. As one teacher leader stated, "What content, skills and habits of thinking are you working on in this lesson right now? To make the academic purpose intentional and transparent is one of the purposes of DL."

Learning as apprenticeship supports differentiated instruction. Novice adult learners in the learning community, who have had little or no experience in these kinds of conversations or who may have limited pedagogical content knowledge, have the support of guided practice, a structured lesson or task, and fellow learners with whom to practice. More advanced learners have access to the total model, making it possible for them to accelerate their learning or for the teacher to guide them into more difficult aspects of the modeled performance. The natural differentiation acknowledges that most learning occurs when the teachers' role has been diminished as each learner takes charge of what they are making sense of or producing.

As adult learners work within DL, especially after engaging in the observational protocol with core content tools, they shift their role from that of content expert and source of all knowledge to that of co-learner, resource person, and coach. Stouch, drawing on Merriam and Caffarella's (as referenced in Stouch, 1993) analogy from sports, says, "A coach shares methods, approaches, and strategies for learning—the game plan—as well as the specific plays. While expert knowledge (the specific plays) is still of great value, the coaching is what makes it possible for learners to go out and play successfully,

learning throughout their lifetimes" (1993, p.66). The role of teachers implementing DL lessons and using content-specific tools shifts from keeper and dispenser of knowledge to master inquirer who challenges, assists, and coaches learners.

Coaching. Professional development builds learning how to learn into the sessions and school practice for teacher leaders and coaches engaged in the DL project. Given the realities of funding in districts, it is rare for middle and high schools to have full-time coaches in each of the four academic areas. Instead, districts arrange for talented teachers, some of who are also department chairs, to have reduced teaching loads, so that they can also work as disciplinary coaches and members of the school's guiding coalition. They become the voice of the content expert at strategic planning meetings and the trained facilitators of teacher-based PLCs and of other professional learning experiences. If a department chair is not selected, it is necessary to include the department chair in the training to ensure that a key departmental and school spokesperson is fully knowledgeable about aligning established departmental policies and procedures with DL student and teacher needs.

The table below shows the coaching structures that are part of DL systemic practice (Staub & Bickel, 2003; Bill, 2007, Staub, West, & Bickel, 2003).

Guided Reflection. During the guided reflection phase of Learning as Apprenticeship in DL sessions, the DL facilitator and learners discuss what has been learned, how it was learned, and when and where the learning could be used. It is also a time for the adult learners to step back from the lessons and, as teachers, consider how the learning applies to their own teaching practice. A key aspect of this reflective process is developing the disposition that teaching and learning are worth examining. Adult learners are guided to learn what to notice while developing the habit of practice of how to notice by slowing down to examine critical attributes of practice. For example, learners answered the following reflective questions after developing their first draft of an inquiry-based English studies unit.

What did you notice when you compared the questions on the unit architecture? Which questions did you mark as ones that will maintain cognitive demand and require students to do independent thinking? Why those questions? What do you notice about the questions you did not mark? Then... What did you learn or what insights did you gain from comparing the questions? How might you use this as you continue to develop the unit? (Petrosky, McConachie, Mihalakis, 2007)

CONCLUSION

In DL, external facilitators and instructional leaders guide teachers to reflect on their practice with a more trained eye. Artifacts of practice that depict the work of teaching (such as student work samples, teacher assignments, a lesson or unit plan, or a video of an enacted lesson) are used as "sites for critique, inquiry, and investigation. Teachers have the opportunity to develop knowledge central to teaching by engaging in activities that are at the heart of a teacher's daily work" (Smith, 2001, p. 2). Teachers who integrate DL practice into their own become the advocates of its value. And they take this stance because of the positive changes that they see in students and their professional community. In the words of one teacher leader,

I think that the students in general have become part of the process. The students are involved in the talk, the rubric process, the grading process. They help with what is expected of them through developing criteria and so I think the students have become more active in the classroom, instead of being passive. The DL tools, the Principles of Learning, make everyone in the process more active, not

only the process but also the content. We are not just given information, but we are all part of developing understanding together.

In our PLCs, we work together to improve our practices, to make our group a stronger group. We talk together; teachers talk to each other, helping each other improve their practice, helping each other learn. If you use DL practice, the students become a group helping each other learn. They literally become a PLC. They do. They start to sound just like our group sounds when all are working together. Same thing happens with adults that happens with students—both have a-ha moments.

Implementing DL systemic practice involves creating a complex web of interactions with multiple role groups working together. First, in unison to build the vision and reality of a school's intellectual coherence, and then by academic area to revitalize each discipline's intellectual coherence with students.

DISCIPLINARY LITERACY (DL) OBSERVATION PROTOCOL

Overview

The purpose of a DL observation is to provide support for teachers who are trying out DL methods in their classrooms. Like The Learning Walk® routine, the DL observation has the following features:

- It is grounded in a commitment to an effort-based concept of intelligence and education;
- It uses a content tool and the lens of the Disciplinary Literacy Design Principles (which are grounded in the Principles of Learning);
- It is not evaluative;
- It is focused on student learning as much as on teaching;
- It is always part of a recursive professional development cycle;
- It is evidence-based rather than judgmental;
- It uses a particular protocol that must be learned and followed.

Unlike The Learning Walk® routine, the DL observation lasts for the entire class period. Also, the teacher takes an active role in determining what she wants the observation participants to focus on in her classroom.

Setting up the Observation

As the Academic Area Coordinator or Director, Department Chair, Coach, or Lead Teacher, part of your responsibility is setting up situations where teachers may observe each others' classes with the goal of questioning and refining instructional practice together. Therefore, an observation is best situated in the context of your ongoing professional learning. What has your study group/PLC or department been working on in your school-based or district-wide professional development in the academic area's study of DL? How might you explore aspects of this professional learning via classroom observation? How might observing in teachers' classrooms provide a learning opportunity to discuss a particular methodology and/or particular academic area content? These are all questions to consider as you work with teachers to set up an observation.

Once a teacher has agreed to host an observation, have **a conversation with that teacher** about the indicators on a observation content tool and the DL Design Principles for the appropriate academic area, using the following questions to shape your discussion:

- What is the teacher working on with respect to the Disciplinary Literacy Design Principles in ELA, math, science, or social studies/history?
- What aspect of instruction and/or student learning would s/he like to get feedback on from colleagues?
- How might you formulate this as a question or state it as a lens through which colleagues may observe the class?
- How does this focus align with current or past professional development? How might it foster future professional development?

Preparing for the Observation

Prior to the day of the observation, you and/or the teacher should circulate the following among the participants and the principal of the school:

- The DL observation content tool for the appropriate academic area
- The focusing question or lens for the observation
- Details about time, location, etc.

Conducting the Observation

A DL observation should take place in three stages:

Stage 1: Pre-observation meeting (1/2 hour)

The participants, observation teacher, observation coordinator, and the principal should meet for half an hour right before the observation. As the leader of this observation, you need to make sure that participants understand the following:

- The nature of the observation (see "Overview" above)
- The components of the DL Observation Protocol and the content observation tool and coversheet
    - You can have participants complete the pre-observation section of the cover sheet at this time while they listen to the teacher describe the lesson objectives and the focus question/ lens for the observation.
- The fact that they are there to provide constructive feedback that is directed towards the focusing question and that utilizes concrete evidence from the class observed.

Stage 2: Classroom observation (entire class period)

Participants then move into the classroom for observation, trying to be as unobtrusive as possible. Depending on the classroom community and culture, participants may or may not take notes during the observation in the notes section of the protocol. This is a decision you must make in advance with the teacher and then communicate in the pre-observation meeting.

Stage 3: Post-observation feedback meeting (1/2 hour)

After the class ends, the participants and the teacher reconvene for a final discussion. Participants should take five minutes to write their feedback on the cover sheet. The observation leader then runs the discussion, making sure participants stay true to the focus question/ lens and provide concrete examples as illustrations of their feedback. The teacher should have an opportunity to respond to the feedback as well.

Reflection and Next Steps

After the feedback portion of the observation is over, you may want to take some time to discuss the process and what you all learned from it. You may do this informally in discussion, or more formally in writing. Some aspects to consider in your reflection are:

- New ideas or practices I learned about today.
- Thoughts about my past practice based on today's new learning.
- Thoughts about what I want to do differently in the future.
- Thoughts about what I want to learn.
- Thoughts about where the group learning should go next.

In your role as an academic area leader, you may use these reflections to influence future professional development, planning, and/or other classroom observations.

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Mathematics Observation Feedback
Grade Level _____ School _____ Observer _____

ACADEMIC RIGOR IN A THINKING CURRICULUM

Where does this class fit in the arc of lessons?_____

The Task

A. ____ requires students to follow ONLY steps or procedures.

OR

B. ____ requires students to think and reason about mathematics.

The Explore Phase of the Lesson

A._____ The teacher circulates asking questions about ONLY the steps and procedures but NOT the mathematical meaning.

OR

B._____ The teacher circulates:

- asking students questions to find out what students are doing, and thinking, about the mathematics (assessing questions).
- asking students questions to advance their understanding of the mathematics or problem solving strategies.
- encouraging students to engage in talk with each other about their understanding of the mathematics or their problem solving strategies.

The Analyze, Share and Discuss Phase of the Lesson

A. _____The discussion among students is focused on ONLY steps/procedures for solving a task rather than the meaning of the mathematics.

OR

B._____ Individuals or groups present solution paths with no discussion among students.

OR

C._____ The discussion among students is focused on the meaning of a math concept.

CONNECTIONS

- Students discuss the relationship between the mathematics in pictures, tables, graphs, equations, or contexts.
- Students make connections between concepts.
- Students compare problem types.

ANALYSIS

- Similarities and differences between solution paths are discussed by students.
- Students look for and discuss patterns.
- Students make generalizations about mathematics concepts.

KNOWLEDGE

- Errors are discussed by students.
- The mathematics displayed is accurate.

ACCOUNTABLE TALK

The teacher:

COMMUNITY

- asks for clarification of ideas.
- encourages students to talk with each other.
- invites students to ask questions.

REASONING

- presses for connections between representations in order to understand mathematics.
- presses for similarities and differences between solution paths.
- presses for the meaning of the mathematical concepts.
- presses for connections to other tasks.

KNOWLEGE

- accurately uses or presses for math terms.
- presses for accurate use of representations.
- presses for correct solutions.

The students:

COMMUNITY

- share how they arrived at a solution.
- repeat other's methods.
- ask questions of each other.
- add onto other's ideas.

REASONING

- share their understanding of the math concept.
- make connections between solution paths.
- make connections between representations.
- challenge ideas.

KNOWLEDGE

- offer and discuss counter-examples.
- use accurate terms and strive to solve problems accurately.

Who owns the learning?
Teacher 0----------1 ---------2 ----------3 ---------4 ----------5 ----------6 ----------7 ----------8 ----------9 ---------10 Students

To what extent do students advance in their problem solving?
0----------1 ---------2 ----------3 ---------4 ----------5 ----------6 ----------7 ----------8 ----------9 ---------10

What percentage of the students "puzzle it out or have an "aha" moment about math relationships and concepts?
0----------10----------20----------30----------40----------50----------60----------70----------80----------90----------100

NOTES:

Principles of Learning

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Principles

Organizing for Effort
- Clear and high expectations.
- Fair and credible evaluations.
- Recognition of accomplishment.
- Curriculum geared to standards.

Organizing for Effort

Clear Expectations
- Standards available and discussed.
- Models of student work.
- Students judge their own and others' work.
- Intermediate expectations specified.
- Families and community informed.

Clear Expec

Fair and Credible Evaluations
- Exams referenced to standards.
- Curriculum and assessments aligned.
- Grading against absolute standards, not curve.
- Reporting system makes clear how students are progressing toward expected standards.
- Public accountability systems and instructional assessments aligned.

Fair and C Evaluation

Recognition of Accomplishment
- Frequent recognition of student work.
- Recognition for real accomplishment.
- Clearly demarcated progress points.
- Celebration with family and community.
- Employers and colleges recognize accomplishments.

Recognitic Accomplis

Academic Rigor in a Thinking Curriculum
- Commitment to a Knowledge Core
  - An articulated curriculum that avoids needless repetition and progressively deepens understanding of core concepts.
  - Curriculum and instruction organized around major concepts.
  - Teaching and assessment focus on mastery of core concepts.
- High Thinking Demand
  - Students expected to raise questions, to solve problems, to reason.
  - Challenging assignments in every subject.
  - Extended projects.
  - Explanations and justification expected.
  - Reflection on learning strategies.
- Active Use of Knowledge
  - Synthesize several sources of information
  - Test understanding by applying and discussing concepts.
  - Apply prior knowledge.
  - Interpret texts and construct solutions.

Self

Academic Thinking C

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# of Learning

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Socializing ntelligence

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Accountable Talk®

- Accountability to the Learning Community
  - Students actively participate in classroom talk.
  - Listen attentively.
  - Elaborate and build on each other's ideas.
  - Work to clarify or expand a proposition.
- Accountability to Knowledge
  - Specific and accurate knowledge.
  - Appropriate evidence for claims and arguments.
  - Commitment to getting it right.
- Accountability to Rigorous Thinking
  - Synthesize several sources of information.
  - Construct explanations and test understanding of concepts.
  - Formulate conjectures and hypotheses.
  - Employ generally accepted standards of reasoning.
  - Challenge the quality of evidence and reasoning.

Socializing Intelligence

- Beliefs
  - I have the right and obligation to understand and make things work.
  - Problems can be analyzed and I am capable of that analysis.
- Skills
  - A toolkit of problem-analysis skills (meta-cognitive strategies) and good intuition about when to use them.
  - Knowing how to ask questions, seek help, and get enough information to solve problems.
- Dispositions
  - Habits of mind.
  - Tendency to try actively to analyze problems, ask questions, get information.

Self-management of Learning

- Meta-cognitive strategies explicitly modeled, identified, discussed, and practiced.
- Students play active role in monitoring and managing the quality of their learning.
- Teachers scaffold student performance during initial learning, gradually remove supports.
- Students become agents of their own learning.

Learning as Apprenticeship

- Students create authentic products and performances for interested critical audiences.
- Experts critique and guide student work.
- Finished work meets public standards of quality.
- Learning strategies are modeled.

Notes