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Higher Order Skills, Job Design, and Incentives: An Analysis and Proposal

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There is a growing consensus that the curriculum as taught in schools is "out of balance." Emphasis on basic skills outweighs to a far greater extent than appropriate the emphasis on problem solving and higher order skills. Drawing on ideas about the effects of specialization from behavioral decision theory and on recent work in the economics of organization, this article proposes structural changes in the teaching job to address this problem. The possible limitations as well as advantages of the proposal are discussed.

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For the last decade, education reform has been a major area of policy action in the United States. Governors and state legislatures across the country have been actively instituting new policies, encouraging new practices, and until very recently appropriating new monies.[1] Although one could argue that it is too early to see the effects of these actions, the results so far have not been encouraging.[2] The 1986 NAEP mathematics assessment, for example, showed some increases in student proficiency, but the gains were made mainly by students at the bottom of the distribution and were confined to lower order skills.[3] The NAEP reading assessment produced similar results.[4] The state-by-state NAEP comparisons of student math performance in 1990 showed continued mediocre achievement levels.[5]

Some argue that we have not seen significant results because the early reforms were misplaced. They placed too much emphasis on "top down" mandates, for example, new certification procedures for teachers and new graduation requirements for students, which simply asked for more of the same rather than for basic changes in teaching practice and curriculum content. The way to significant change, policy analysts now argue, is to design reforms geared to lower levels in the system, i.e., reforms that affect teachers in the classroom.[6] The strategies involved in this "second wave" of reform typically center on changes in curriculum and testing policies.[7]

The catalyst for this article was a presentation made by Paul Milgrom at the Winter Colloquium Series, Stanford Center for Organizations Research, Stanford University, February, 1990. Discussions with James Greeno and comments by Hank Levin and Allan Odden were helpful, although the views presented here are my own.

[1]For data on increases in educational resource levels, see Allan Odden, "Sources of Funding for Education Reform," in *Innovations in Education*, ed. John Rich (Boston: Allyn and Bacon, 1988).

[2]Susan Fuhrman, William Clune, and Richard Elmore, "Research on Education Reform: Lessons on the Implementation of Policy," *Teachers College Record* 90 (1988). Also see William Cluen, Paula White, and Joanne Patterson, "The Implementation and Effects of High School Graduation Requirements" (New Brunswick, N.J.: Center for Policy Research in Education, 1989).

[3]John A. Dossey, Ina Mullis, Mary Lindquist, and Donald Chambers, *NAEP: The Mathematics Report Card: Are We Measuring Up?* (Princeton, N.J.: Educational Testing Service, 1988).

[4]National Assessment of Educational Progress, *The Reading Report Card: Progress Toward Excellence in Our Schools* (Princeton, N.J.: Educational Testing Service, 1985).

[5]Ina Mullis, John Dossey, Eugene Owen, and Gary Phillips, *The State of Mathematics Achievement: NAEP's 1990 Assessment of the Nation and the Trial Assessment of the States*, Executive Summary (Washington, D.C.: U.S. Department of Education, OERI, Report No: 21-ST-03, June, 1991).

[6]Marshall S. Smith and Jennifer O'Day, "Systemic School Reform" in *The Politics of Curriculum and Testing*, eds. S. Fuhrman and B. Malen (Philadelphia: Falmer Press, 1991), pp. 233–267.

[7]See Susan Fuhrman and Betty Malen, eds., *The Politics of Curriculum and Testing* (Philadelphia: Falmer Press, 1991).

This article is also concerned with changes that would affect teachers in the classroom, specifically their instructional behavior, but it takes an organizational, rather than a general policy, focus. It questions the relationship between organizational arrangements in schools and the type of student learning that takes place. It views teachers as organizational actors who carry out their work with considerable discretion. It uses a principal-agent approach (described later) and applies basic ideas from organization theory[8] and ideas from recent work in the economics of organization[9] as a framework for discussing how restructuring the teaching job and using incentives selectively may direct the instructional behavior of teachers. This article also discusses how different assumptions about the process of learning affect the application of these ideas. Before proceeding, however, it is necessary to describe those particular aspects of teaching behavior of concern in this discussion.

The Nature of Teaching

Teaching is a complex and imprecise activity involving multiple objectives, many different types of tasks, and the possible use of a large variety of different materials. The teacher operates on the front line, constantly making decisions in an environment that is dynamic and, to a significant extent, unpredictable.[10] While some teachers are more productive than others,[11] the mix of subjective characteristics and behavioral practices that lead to success defies specification.[12] Although some claim they know good teaching when they see it, it is probably safe to say that there is no consensus on the list of critical ingredients that make up good teaching. This is especially true for teaching higher order thinking and problem-solving skills.[13]

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[8]Herbert A. Simon, *Administrative Behavior*, 3rd ed. (New York: Macmillan, 1976). See also James G. March and Herbert A. Simon, *Organizations* (New York: Wiley, 1958).

[9]Bengt Holmstrom and Paul Milgrom, "Multi-Task Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics and Organization*. Forthcoming.

[10]See Gaea Leinhardt and James G. Greeno, "The Cognitive Skill of Teaching," *Journal of Educational Psychology* 78 (1986): 75–95, for description of the cognitive task of teaching.

[11]See, for example, David Armor et al., "Analysis of the School Preferred Reading Program in Selected Los Angeles Minority Schools" (Santa Monica: Rand, 1976). Also see Richard Murnane, *Impact of School Resources on the Learning of Inner-City Children* (Cambridge, Mass.: Ballinger, 1975).

[12]This does not mean we know nothing. For recent comprehensive review, see Merlin C. Wittrock, ed., *Handbook of Research on Teaching*, 3rd ed. (New York: Macmillan, 1987).

[13]Thomas J. Shuell, "Cognitive Conceptions of Learning," *Review of Educational Research* 56 (1986): 411–436. See also Magdalene Lampert, "What Can Research on Teacher Education Tell Us About Improving Quality in Mathematics Education" *Teaching and Teacher Education* 4 (1988): 157–170.

Given the complexities and uncertainties in teaching, it is not surprising that teachers exercise considerable discretion in their classrooms.[14] It is also not surprising that there is tremendous variation in what gets taught and how it is taught from classroom to classroom. Porter, for example, in a study of fourth and fifth grade mathematics instruction in Michigan found that the teacher in his sample who taught the most mathematics taught the equivalent of 23 weeks worth of mathematics more than the teacher who taught the least![15]

While there is little agreement about the details of teaching practice, there appears to be a growing consensus that the curriculum as taught in schools is "out of balance."[16] Most analysts feel the emphasis on basic skills outweighs to a far greater extent than appropriate the emphasis on problem solving and reasoning.[17] Teachers in the Porter study of fourth and fifth grade mathematics instruction, for example, spent 75 percent of their instructional time on drill and practice of basic mathematics skills. The general emphasis on rules and right answers in mathematics teaching[18] should probably not be surprising. Minimum competency testing, a major component of the "first wave" reforms, focused educators' attention on this area of student learning.[19] But, perhaps more importantly, teachers may concentrate more heavily on teaching basic skills because they are easier than reasoning skills to teach, their output can be measured more accurately, and there are fairly well developed programs of practice to guide the teachers' work with students.[20] Teaching higher order skills, in contrast, is a par-

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[14]David Cohen, "Policy and Practice: The Classroom Impact of State and Federal Policy," (Lansing: Michigan State University, 1990). Also, in the High School and Beyond Survey, teachers themselves reported high levels of control over what goes on in their classrooms. On a six-point scale where "6" refers to total control, 92 percent reported "5" or "6" for teaching techniques; 72 percent for content and skills taught in class; 68 percent for student discipline; and 65 percent for textbooks and materials.

[15]Andrew Porter, "A Curriculum Out of Balance: Elementary School Mathematics," *Educational Researcher* 18 (1989): 9–15.

[16]See, for example, Porter, op cit.; National Council for Teachers of Mathematics, *Curriculum and Evaluation Standards for School Mathematics Education* (Reston, Va.: NCTM, 1989); National Research Council, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education* (Washington, D.C.: National Academy Press, 1989a); National Research Council, *Reshaping School Mathematics: A Framework for Curriculum* (Washington, D.C.: National Academy Press, 1989b).

[17]See Robert Calfee, "Those Who Can Explain, Teach. . . ," *Educational Policy* 1 (1987): 1–27, for current and desired practice in the teaching of reading.

[18]Susan Stodolosky, *The Subject Matters: Classroom Activity in Mathematics and Social Studies* (Chicago: University of Chicago Press, 1988).

[19]David K. Cohen and Deborah L. Ball, "Relations Between Policy and Practice: A Commentary," *Educational Evaluation and Policy Analysis* 12 (1990): 249–256.

[20]For example, see the work of Madeline Hunter, "Teaching Is Decision Making," *Educational Leadership* 37 (1979): 62–67.

ticularly demanding type of teaching;[21] operational definitions of it are not specific,[22] and there are no clear guides to instructional practice.[23]

A number of states in the "second wave" of reform have initiated policies that seek fundamental changes in instructional emphasis. The California *Mathematics Framework,*[24] for example, is designed to correct the basic skills instructional imbalance and to promote critical thinking and problem-solving skills among students. Initial reports of progress in California classrooms suggest its objective will not be easily accomplished.[25] Studies of individual teachers show that teachers interpret the framework differently and exercise considerable discretion in putting it into practice. As a consequence, the influence of the state's framework, at least as exhibited in its preliminary stages, is inconsistent. Considerable variability in emphasis on basic skills and higher order skills remains from classroom to classroom.[26] Despite calls throughout the profession for more attention to reasoning skills, teachers in 1990 still reported putting more stress on teaching facts, concepts, and procedures than on teaching reasoning and communication skills in mathematics. This tendency was especially pronounced for teachers of lower ability students.[27]

The allocation of teachers' instructional time between developing basic skills and developing higher order skills is the central concern of the analysis in this article. More generally, largely because of equity implications,[28] this article is also concerned with the great variability in teaching behavior and teacher effort from classroom to classroom. The analysis proceeds from the assumption that, in order to change the behavior of individual teachers, attention-directing mechanisms need to be developed at a level close to the classroom. The effects of national or state level directives or exhorta-

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[21]M. Lampert, op. cit.

[22]M. Lampert, op cit. Also see T. J. Shuell, op. cit.

[23]Teacher behavior in this regard is probably related to the more general phenomenon —labeled by James G. March and Herbert A. Simon, *Organizations* (New York: Wiley, 1958), as "Gresham's Law of Planning"—that routine work drives out the non-routine.

[24]California State Department of Education, *Mathematics Curriculum Framework for California Public Schools* (Sacramento: State Department of Education, 1987).

[25]See special issue of *Educational Evaluation and Policy Analysis* 12 (1990).

[26]David K. Cohen and Deborah L. Ball, "Policy and Practice: An Overview," *Educational Evaluation and Policy Analysis* 12 (1990): 347–353.

[27]I. Mullis, J. Dossey, E. Owen and G. Phillips, op. cit.

[28]The inequities may, indeed, be systematic, with children from disadvantaged backgrounds receiving a disproportionate amount of basic skills instruction. See Robert Calfee, "Curriculum and Instruction: Reading," in ed. Barbara Williams, Peggy Richmond, and Beverly Mason, *Designs for Compensatory Instruction* (Washington, D.C.: Research and Evaluation Associates, 1986).

tions alone are likely to be weak at best.[29]

I should make clear here that the argument I present is a pragmatic one that takes into account what I view to be serious implementation constraints in the classroom and, thus, my proposal, while perhaps optimal, is not ideal. Cognitive psychologists have provided important new insights into the processes by which individuals learn and develop understanding.[30] This article does not question these findings. Rather, it takes an organizational focus that incorporates into the analysis the possibility that the high quality instruction called for by this research is unlikely to occur in the typical American classroom given the way the work of teachers is currently organized. It then proposes a possible solution to the "curriculum imbalance" problem using ideas about the effects of specialization from behavioral decision theory[31] and recent work in the economics of organization on job design and incentives.

The Model

The analysis that follows draws heavily on a principal-agent[32] model, developed by Holmstrom and Milgrom,[33] in which the agent is performing a job that involves more than one activity. In our case, the "agent" is a teacher who performs two major types of instructional activities, those directed to developing higher order thinking capabilities and those directed to developing basic skills. The "principal," the school district in this example, has a preference for the teacher's allocating his or her time between these two activities and this preference does not necessarily coincide with the teacher's preference. A central element of principal-agent models, in general, is that monitoring the agent's behavior for conformity to the principal's preferences is either imperfect or too costly to be feasible. Certainly this is the case with teachers because of their sheer numbers and because they generally work independently behind classroom walls.

The Holmstrom and Milgrom analysis shows that, if the principal compensates the agent for one dimension of the job, e.g., students' basic skills

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[29]See, for example, David K. Cohen, "Policy and Practice: The Classroom Impact of State and Federal Policy" (Lansing: Michigan State University, 1990). See also Milbrey McLaughlin, "Learning from Experience: Lessons From Policy Implementation," *Educational Evaluation and Policy Analysis* 9 (1987): 171–178, for discussion of policy implementation research.

[30]See, for example, reviews in Lauren B. Resnick and Leopold E. Klopfer, *Toward the Thinking Curriculum: Current Cognitive Research* (Alexandria, Va.: Association for Supervision and Curriculum Development, 1989).

[31]Simon, op cit. Also March and Simon, op. cit.

[32]Principal-agent models are models in which one person (the principal) attempts to induce another (the agent) to act in the principal's interest. The principal is assumed not to be able to monitor perfectly the agent and/or to have the information required to judge whether the agent has undertaken the action the principal would have liked.

[33]B. Holmstrom and P. Milgrom, op. cit.

development, the agent will divert attention to that task away from other dimensions of the job. Such reallocation of attention is one of the main reasons that education analysts have opposed merit pay plans in education.[34] Merit pay critics rightfully argue that education has multiple objectives and rewarding on the basis of the one that is most easily measured, typically basic skills, distorts behavior in unwanted ways. In these situations, Holmstrom and Milgrom argue that paying fixed wages, even with the principal exercising only limited control, is optimal. The problem we are then left with, of course, is that education authorities have only weak and indirect control over teachers' allocation between basic skills and higher order skills instruction. The idiosyncratic experience, beliefs, and knowledge of individual teachers and whatever norms happen to be operating in the school determine teachers' behavior. Some analysts find this situation unsettling; "instruction is too important to be left entirely to schools and teachers."[35]

Holmstrom and Milgrom go on to argue that a solution to such a problem might lie in restructuring the job. That is, in our case, rather than settling for a situation of no control or, worse yet, a situation in which teacher behavior is distorted in unwanted ways, the teaching job itself is redesigned. Tasks are grouped in ways that allow more control over the extent to which teaching attention is allocated to basic skills and higher order skills. Holmstrom and Milgrom suggest dividing tasks into jobs based on the difficulty (or ease) of measuring performance. In the case of teaching, this would mean dividing the job of a teacher into two jobs, one geared to basic skills development and one geared to the development of higher order thinking skills.

Dividing teaching into two jobs—a basic skills specialist and a higher order skills specialist—may not make sense for higher grade levels, where the line between different types of skills is likely to be murky, but its application to lower elementary grades is worth consideration. In lower grades, basic skills development, for example, learning to decode sounds in reading and learning basic operations in mathematics, is a major objective. There are also reasonably well developed and fairly accurate ways to test the acquisition of basic skills, as well as highly articulated strategies, techniques, and technologies[36] available for teaching these skills.[37]

There are clear advantages to this division of labor. The primary one

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[34]See David K. Cohen and Richard Murnane, "The Merits of Merit Pay," *The Public Interest* 80 (1985): 3–30. Also see Donald T. Martin, George E. Overholt, and Wayne J. Urban, *Accountability in American Education: A Critique* (Princeton, N.J.: Princeton Book Company, 1976).

[35]Cohen and Ball, op. cit., 1990, p. 350.

[36]These technologies include computer-based as well as teacher-directed activities.

[37]Jere E. Brophy and Thomas Good, "Teacher Behavior and Student Achievement," in *Handbook of Research on Teaching*, ed. Merlin C. Wittrock, 3rd ed. (New York: Macmillan, 1986): 328–375.

is that there would be more systematic control over the extent to which students receive nurturance in the development of higher order thinking and problem-solving skills as well as instruction in basic skills. Such control would have two direct effects. First, to the extent that additional attention to higher order skills contributes to an important dimension of student learning now generally underemphasized, it would benefit the overall quality of the education program. Second, by better controlling the attention given to basic skills and higher order skills, it would reduce inequities among students at least in this dimension of the educational services that they receive.

Specialization and incentives. The attention-control mechanisms that result from, or are facilitated by, separating teaching basic skills and developing higher order skills into distinct jobs are of two types. The first derives from subtle behavioral control processes generally associated with specialization. The second is based on the creation of conditions that make the development of effective incentive schemes possible.[38]

Because each of the two jobs would be unambiguously labeled as a specialist position concerned specifically with either developing students' higher order skills or developing basic skills, we would expect teachers to come to identify with their position's objectives in the same way that organizational actors come to identify with the goals of their subunit in an organization.[39] The process by which individuals identify with a subunit is largely a cognitive one resting on ideas of "bounded rationality."[40] The basic idea is that individuals are not able to fully grasp complex situations because both their time and their cognitive capacities are limited. As a consequence, they tend to simplify situations, for example, by attending to stimuli selectively in order to make sense of them. The boundaries of a position play an important function in this regard. They frame an individual's focus by defining relevant issues, accepted behavior, and the appropriate interaction network. The position, therefore, establishes the behavioral alternatives and frames of reference the individual considers when taking

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[38]There has been considerable recent interest in the use of incentives among state education policymakers. See Craig E. Richards and Mwalimu Shujaa, "State-sponsored School Performance Incentive Plans: A Policy Review," *Educational Considerations* 17 (1990): 42–56. Also, see Martin, Overholt, and Urban, op, cit.

[39]DeWitt C. Dearborn and Herbert A. Simon, "Selective Perception: The Identifications of Executives," *Sociometry* 21 (1958): 140–144. See also Richard Cyert and James G. March, *A Behavioral Theory of the Firm* (Englewood Cliffs, N.J.: Prentice-Hall, 1963); Simon, op.cit., 1976; March and Simon, op. cit.; Herbert A. Simon, "Organizations and Markets," *Journal of Economic Perspectives* 5 (1991): 25–44.

[40]Simon, op. cit., 1976; March and Simon, op. cit., 1958.

action.[41] Simon put it succinctly: "Behavior is very much a function of the position."[42]

In our case, the "identification" of specialist teachers with instruction in particular skill areas would presumably direct teachers' energies to their specialized concerns and reduce the likelihood of their diverting attention to other areas. It would also heighten teachers' sensitivity to new information relevant to their specialty, say, new research findings or techniques associated with teaching higher order skills or basic skills.[43] In addition, it would legitimize higher order skills specialists' engaging in the more novel forms of classroom work associated with explorations into this area of teaching.[44]

The subtle control processes associated with specialization are particularly relevant for directing the behavior of higher order skills teachers, although they would apply to basic skill teachers as well. In the case of higher order skills instruction, however, we are as yet unable to measure accurately and cost effectively the acquisition of these skills;[45] nor are we able to define with any precision teaching techniques that lead to their development.[46] In other words, standard forms of organizational control—process controls and output controls—are not appropriate for directing these teaching tasks. But, as Simon has argued and as we stress here, "the impor-

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[41]The classic study demonstrating this phenomenon was done by Dearborn and Simon, op. cit. They asked business executives to identify the most serious problem facing a firm. Almost without exception, executives framed the problem of the firm in terms of the particular function of their subunit, e.g., sales, manufacturing, etc. That is, the objectives and experiences of their local subunit formed the lens through which they interpreted the organization's situation.

[42]Simon, op. cit., 1991, p. 37.

[43]March and Simon, op. cit. See also John D. Steinbruner, *Cybernetic Theory of Decision* (Princeton, N.J.: Princeton University Press, 1974).

[44]Paul E. Cobb, Erna Yackel, and Terry Wood, "Curriculum and Teacher Development: Psychological and Anthropological Perspectives," in *Integrating Research on Teaching and Learning Mathematics*, ed. Elizabeth Fennema, Thomas Carpenter, and Susan Lamon (Madison: Wisconsin Center for Education Research, 1988): 92–130, for example, found that teachers attempting "constructivist teaching" felt tension between this innovative approach to teaching mathematics and the more conventional forms of instruction that they believed were institutionally sanctioned.

[45]See Richard Shavelson, Neil Carey, and Noreen Webb, "Indicators of Science Achievement: Options for a Powerful Policy Instrument," *Phi Delta Kappan* 71 (1990): 692–697, for discussion of problems with current testing and suggestions for modification of achievement testing to capture students' conceptual understanding of subject matter and problem-solving skills. Also see Walter Haney and George Madaus, "Searching for Alternatives to Standardized Tests: Whys, Whats, and Withers," *Phi Delta Kappan* 70 (1989): 683–687.

[46]More accurately, there have been many suggestions for ways to teach thinking skills, but they have been subjected to little systematic empirical analysis. See Raymond Nickerson, David Perkins, and Edward Smith, *The Teaching of Thinking* (Hillsdale, N.J.: Lawrence Erlbaum, 1985), for summary. Also see review by Putnam, Lampert, and Peterson, op. cit., on diverse views of researchers on what "understanding" in mathematics means.

tance of identification in the motivations of employees" should not be underestimated.[47]

Basic skills teaching is different in two important respects from higher order skills teaching. First, we are able to measure the acquisition of basic skills fairly accurately and, secondly, there are developed technologies for teaching them.[48] These differences make it possible to bring performance incentives into play as an additional attention-directing and motivational device. While performance-based pay in education has far from a propitious history,[49] a large part of the problem, as mentioned earlier, is that education has multiple objectives and any sole performance measure is inadequate and, as a consequence, lacks legitimacy. Defining a job as specifically focusing on basic skill development obviates this problem.

Rewards could presumably be based on either individual teacher performance or school performance, although school-based rewards have important advantages over individual rewards. School-based rewards are likely to foster, for example, cooperation, peer support, and information sharing among teachers as well as group monitoring of individual performance.[50] One can imagine, for example, a basic skills team[51] with joint responsibility for planning, managing, and overseeing the basic skills development of all students in an entire school. School-based rewards are also likely to be "fairer" than individual rewards since the benefits, for example, of solid skills training in Grade 1 may not show up clearly until Grade 2. Rewarding only the Grade 2 teacher for these gains is likely to be distortionary.[52]

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[47]Simon, op. cit., 1991, p. 36.

[48]Jere E. Brophy, "Research on Teacher Effects: Uses and Abuses," *Elementary School Journal* 89 (1988): 1–21. See also Brophy and Good, op. cit.

[49]Martin, Overholt, and Urban, op. cit. Also see Bernard Rapple, "Payment by Educational Results: An Idea Whose Time Has Gone?" The MacArthur/Spencer Special Series on Illinois School Finance (Normal, Illinois: Illinois State University, 1990); Richard Murnane and David K. Cohen, "Merit Pay and the Evaluation Program: Why Most Merit Pay Plans Fail and a Few Survive," *Harvard Educational Review* 56 (1986): 1–17.

[50]See discussion by Edward E. Lawler, *Strategic Pay: Aligning Organizational Strategies and Pay Systems* (San Francisco: Jossey-Bass, 1990), esp. pp. 108–131, for models and benefits associated with incentive pay for performance at the subunit and organizational level rather than at the individual level.

[51]The team could be composed of highly trained master teachers skilled in assessing students' development, diagnosing special problems, and devising focused instructional strategies. Teacher aides and computers could assist in delivering basic skills instruction.

[52]One might argue that school rewards would lead to "free rider" problems, but presumably these problems would be at least partially controlled through group pressure. In any case, the additional benefits of within-school teacher collaboration and cooperation would probably more than offset such problems.

Problems and Limitations

There are, of course, potential problems and limitations to restructuring teaching jobs and using incentives in the ways proposed here. Below I discuss four possible problems. The first is the relative efficiencies associated with teaching higher order skills and teaching basic skills. The second is the responsiveness of teachers to economic incentives. The third is behavioral distortions associated with dividing the teaching job. The fourth concerns the reaction of teachers to the proposed changes. While further research is necessary to assess accurately the seriousness of each of these problems, none of them seems likely to overwhelm the benefits associated with the job design changes herein proposed, if higher order skills truly represent an important and neglected instructional area.

Relative efficiencies. A basic issue associated with the analysis here concerns the production relationship between teaching basic skills and developing higher order skills. The benefit of the approach I propose depends on whether, and if so the extent to which, the two activities—teaching basic skills and teaching higher order skills—are independent activities or complement each other in the production process. They are independent if one activity has no effect on the output or the cost of the other activity. Teaching art, for example, may have no effect on teaching or learning reading. If the activities are independent, and both should have attention, there are *always* gains to dividing the teaching job in the way proposed above. Activities are complements to the extent that doing more of one activity increases the output of the other or reduces the cost or effort required by the second activity for a given level of output. In other words, there are spillovers from one activity to the other.

The Holmstrom and Milgrom analysis assumes independence between activities, but a large body of literature on learning by cognitive psychologists argues that the activities are not independent.[53] In our terms, there are spillovers. The psychological literature on learning is large and complex.[54] For the purposes of the argument here, we greatly simplify this literature and identify three possible types of relationships between higher order and basic skills activities that have some basis in research on learning. The first is that the development of higher order skills facilitates the development of basic skills. The general argument is that a conceptual understanding provides meaning to new information and new knowledge, thereby making it both more accessible and more easily assimilated by the

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[53]See Putnam, Lampert, and Peterson, op. cit., for an excellent review of diverse perspectives on mathematics learning.

[54]For reviews, see Alan H. Schoenfeld, ed., *Cognitive Science and Mathematics Education* (Hillsdale, N.J.: Erlbaum, 1987). Also see Putnam, Lampert, and Peterson, op cit., and Schuell, op. cit., 1986.

learner.[55] Conceptual understanding may also increase one's dexterity with basic skills. "Number sense," for example, may facilitate the flexible use of basic mathematical operations.[56]

Alternatively, one could argue that a command of basic skills facilitates the acquisition of higher order skills. It provides students with basic facts and tools for pursuing greater avenues of learning and provides the building blocks for constructing abstract understanding. Students who have command of a greater number of facts are considered to have clear advantages making connections and developing insights and valid generalizations over students with fewer facts.[57] Additionally, the facile application of basic skills frees up some of the "cognitive load" on an individual's processing capacity that can then be directed to solving higher order problems.[58]

A third type of relationship is implied in the view that the acquisition of skills, especially those associated with higher order thinking,[59] is furthered when the learner is actively involved in a purposive activity.[60] The

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[55]However, Pearla Nesher, "Are Mathematical Understanding and Algorithmic Performance Related?" *For the Learning of Mathematics* 6 (1986): 2–9, has "pointed out that there is little solid evidence for the belief that solid conceptual knowledge of a topic will produce correct procedures as a natural consequence" (Putnam, Lampert, and Peterson, op cit., p. 84).

[56]James G. Greeno, "Number Sense as Situated Knowing in a Conceptual Domain," *Journal for Research in Mathematics Education* 22 (1991): 170–218.

[57]This is related to studies that show the problem-solving behavior of experts and novices can be distinguished more by differences in the store of easily accessible specific knowledge than by differences in the use of general problem-solving strategies. See, for example, Michelene T. H. Chi, Robert Glaser, & E. Rees, "Expertise in Problem Solving," in *Advances in the Psychology of Human Intelligence* ed. Robert Sternberg (Hillside, N.J.: Erlbaum, 1982): 7–75. Also see reviews by Robert Glaser and Michelene T. H. Chi, "Overview" in *The Nature of Expertise*, eds. Michelene T. H. Chi, Robert Glaser, and Marshall J. Farr (Hillsdale, N.J.: Erlbaum, 1988) xv–xxviii; and Putnam, Lampert, and Peterson, op. cit.; and Thomas J. Shuell, "Phases of Meaningful Learning," *Review of Educational Research* 60 (1990): 531–547.

[58]Annette Karmiloff-Smith, "Micro- and Macrodevelopmental Changes in Language Acquisition and Other Representational Systems," *Cognitive Science* 3 (1979): 91–118, has shown that children change the representational systems they use as they master new procedures. They appear to strive for a balance between encoding and decoding efforts. Once a procedure becomes automatic "the child steps up to a metaprocedural level and considers the procedure in its own right."

[59]This view assumes that knowledge is structured and connected and not decomposable. The work, for example, of Lampert, op. cit., 1986, and Alan Schoenfeld, "On Mathematics as Sense-making: An Informal Attack on the Unfortunate Divorce Between Formal and Informal Mathematics," in *Informal Reasoning and Education*, eds. David N. Perkins, Judith Segal, and James Voss (Hillsdale, N.J.: Erlbaum, 1989), takes this view.

[60]An often cited example of research showing the importance of the effects of meaningful involvement of learners on learning is a study by Terezinna Carraher, David Carraher, and Analucia Schliemann, "Mathematics in the Streets and in School," *British Journal of Developmental Psychology* 3 (1985): 21–29, on the ability of Brazilian street children to develop strategies to solve arithmetic problems they confronted when selling in the street and their inability to apply the algorithms they had learned in school to solve the same problem.

role of the teacher is to present the problem and react to the reasoning strategies attempted by the student. The strategies a student considers are viewed to be a function of the knowledge structures and information already held by the individual student.[61] This "constructivist" approach to teaching and learning is discussed in more detail later.

Each of the views above suggests some level of interdependence between higher order skills development and basic skills development. While it is probably reasonable to assume that there is some degree of reciprocity between the two types of skills, research has not established what it is; nor has it identified the relative contribution of different teaching emphases[62] to the development of different skills.[63]

A limiting case would be where the only or most efficient way to teach basic skills, for example, is through teaching higher order skills. That is, if teaching basic skills supplementally does no good, or no more good than teaching basic skills indirectly through other types of teaching, then there is obviously no point in having a separate teacher focus on basic skills. This extreme case is highly unlikely given what we know about learning. In all other cases, separating the teaching job into two specialist jobs has conceivable advantages.

A related issue is coordination. Coordination issues are, of course, central to the study of any form of organization. In the analysis here, if we assume that the teaching and learning of basic skills and higher order skills are somehow related, having two teachers rather than one creates coordination problems. The basic skills teacher may pick up information about a problem with an individual student that would be relevant to the work of the higher order skills teacher or vice versa. Because there are costs of getting this type of information to the relevant teacher, coordination is less likely to happen than if the same person were performing both tasks.

The relevant question is whether any loss in teaching efficiency from coordination failures would be significant enough to overcome the advantages of task specialization. Given general agreement about the need for higher order skills development and given the current lack of emphasis on this area of learning in the typical American classroom, it is highly unlikely that losses due to coordination would be greater than the benefits derived from specialization. In addition, to the extent that these losses are important, management could presumably facilitate coordination to reduce the losses to some degree. (Such coordination already occurs in many schools

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[61]See Resnick and Klopfer, op. cit., for a review of this approach to research on teaching and learning.

[62]The gains or losses to specialization might vary by field, e.g., math or social science, and/or by type of student, and/or by level of learning. For discussion of domain specificity in learning, see Richard Glaser, "Education and Thinking: The Role of Knowledge," *American Psychologist* 39 (1984): 93–104. See Shuell, op. cit., 1990, for discussion of phases of learning.

[63]Lampert, op. cit.

between teachers of subjects such as social studies and language arts.)

Responsiveness to economic incentives. Some analysts have argued that teachers are not motivated by economic incentives,[64] as we have proposed for basic skills teacher. The rewards that motivate teachers, they claim, are the intrinsic rewards that come from student learning. While student learning is no doubt rewarding to teachers in significant ways, this does not imply that economic rewards are not also important. In fact, the evidence could be interpreted as demonstrating the contrary.

Experiments with performance contracting in schools in the U.S. in the 1970s, for example, show that teachers do, indeed, change their teaching behavior in response to incentives.[65] While their responses are not those that we hope a well designed incentive scheme would elicit,[66] they demonstrate the power of incentives in affecting teacher behavior. The experience in England in the late 19th century, despite its well-known failings,[67] also shows the power of economic incentives in focusing teacher efforts.[68] More recently a study of the South Carolina policy of school performance rewards[69] shows the program to have positive, though modest, effects on student achievement.[70] The effect was strongest on schools with lower resource levels and historically lower levels of student achievement. We

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[64]See discussion in Douglas Mitchell, Flora Ortiz, and Tedik Mitchell, *Work Orientation and Job Performance: The Cultural Basis of Teaching Rewards and Incentives* (Albany, New York: SUNY Press, 1987).

[65]Edward Gramlich and Patricia Koshel, *Educational Performance Contracting* (Washington, D.C.: Brookings Institution, 1975).

[66]Teachers concentrated their efforts on students in the middle of the distribution because their efforts with these students were likely to produce the biggest payoffs. See Gramlich and Koshel, op. cit. Clearly, incentive schemes would have to be tuned in ways that direct teachers' behavior more appropriately.

[67]These included lower pay for teachers, increased distrust between "inspectors" and teachers, higher levels of anxiety for both teachers and students, a neglect by teachers of brighter students (who would do well on the examination without teachers' help) and the bottom ranked students (who were unlikely to pass the examination even with extra help). See Rapple, op. cit., for discussion. An incentive system would obviously have to be designed to take these negative possibilities into account.

[68]Grants to schools were based on both the achievement of students and attendance. Teachers responded by focusing their energies narrowly on the areas tested and on students whose performance would lead to passing exam scores with their help. See Gramlich and Koshel, op. cit., for discussion. Also see Rapple, op. cit. They also monitored school attendance by children more carefully—Rapple, op. cit.

[69]South Carolina's School Incentive Reward Program (SIRP) was established in 1984. Schools compete for rewards with schools that are assigned to the same comparison band. The bands are defined by characteristics, such as student SES, students' test performance on the Cognitive Skills Assessment Battery (CSAB), and teachers' average education level, that are likely to affect student performance but are beyond the control of individual schools. Schools compete on the basis of student achievement gain, teacher attendance, and student attendance. See Craig Richards and Tian Ming Sheu, "The South Carolina School Incentive Reward Program: A Policy Analysis," *Economics of Education*, forthcoming, for more details.

[70]Richards and Sheu, op. cit.

should also note that the teacher union head Albert Shanker, who presumably is well aware of the professional needs and preferences of teachers, has advocated the use of performance incentives for schools.[71]

If we assume valid performance measures (and for basic skills we clearly have these) and assume reasonable understanding of how to produce the measured output[72]—the two conditions economists claim are necessary for an effective incentive system[73]—it seems difficult to argue that economic incentives would not affect the behavior of basic skills teachers. History, however, has taught us that the design of these systems should be crafted carefully.[74]

Behavioral distortions. Another possible concern, and one also associated with spillovers, is distortions. In some cases, depending on the degree of distortion, dividing the teaching job could result in less than optimal results. An extreme situation that one can imagine is a higher order skills teacher refusing to answer a question by a student about a mathematics procedure because the teacher was not being rewarded for student learning in this area (and someone else was) or simply because the teacher claimed "it was not part of the job." The student clearly would have been better off if the teacher answered the question when the student was motivated to ask it, but the teacher's job description and the incentives in place distorted the teacher's behavior. Few teachers would probably ever behave this way, but the scenario does illustrate a potential problem associated with splitting the teaching job.

Reactions of teachers. There are two concerns that might be raised about the reactions of teachers to redesigning the job of teaching as proposed here. A first concern might be that incentive systems are at odds with current movements toward teacher professionalism and greater teacher involvement in school-level decision making. This concern would be justified if the compensation system were based solely on a "piece-rate" system. But the type of incentive scheme developed for teachers would probably be similar to those operating in other professions, for example in medical partnerships, law firms, and business firms where performance incentives are in the form of bonuses awarded over and above base salary. Additionally,

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[71]Albert Shanker, "The End of a Traditional Model of Schooling—and A Proposal for Using Incentives to Restructure Our Public Schools," *Phi Delta Kappan* 17 (1990): 345–357.

[72]See Edward Haertel, "The Valid Use of Student Performance Measures for Teacher Evaluation," *Educational Research and Evaluation* 8 (1986): 45–60, for discussion of factors and procedures that should be taken into account in developing valid student performance measures to evaluate teachers.

[73]See discussion in Murnane and Cohen, op. cit.

[74]Details of an incentive scheme, e.g., differential rewards for the performance of students at different achievement levels, could have significant effects on the behavior of teachers. Such details, however, are beyond the scope of this analysis, although they would clearly have to be considered in any implementation attempts.

studies in private industry have shown that sub-unit or organizational level incentive plans are particularly successful when coupled with participative approaches to management.[75] Given the trend toward greater teacher empowerment, this same coupling of participative management and incentives is likely to take place in schools. Therefore, while concerns about teacher professionalism and empowerment are understandable, it is unclear that redesigning the teaching job would produce negative effects in this regard. Indeed, the changes might facilitate greater professional decision-making discretion for teachers as similar changes have in industry.[76]

A second concern might be that differentiating the job could lead to status differences among teachers, specifically, a lower status for basic skills teachers. Again, this concern is understandable, but it is unclear that such status differences would emerge. Although the technology associated with teaching basic skills is better understood than the technology for teaching higher order skills, teaching basic skills is far from routine.[77] It still requires the exercise of considerable professional judgment in diagnosing students' level of skill development and selecting and adapting teaching strategies and materials for particular needs. In addition, the relative numbers of different types of teachers may affect status rankings. There might be only one basic skills specialist for an entire school. This teacher's job would be similar to the expert manager of a highly technical production system. It would entail monitoring the development and progress of students in the school, identifying and developing treatments for exceptional cases, directing a staff of aides, and incorporating appropriate computer-assisted instruction. It seems unlikely that this teacher would be considered lower status than the higher order skills teachers in the school who work regularly in classrooms with students. There is also no evidence that other types of educational specialists, e.g., reading specialists, have lower status than other teachers.

While research to date and a priori reasoning suggest the above problems would not outweigh the benefits associated with a redesign of the teaching job as proposed here, the problems do highlight areas to monitor in any implementation effort.

Further Advantages of Job Redesign in Teaching

Teaching higher order skills in the ways called for by recent cognitive research on learning is a demanding form of teaching, requiring skills and

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[75]Edward E. Lawler, "Gainsharing Theory and Research: Findings and Future Directions," in *Research in Organizational Change and Development*, 2, eds. W. A. Pasmore and R. Woodman (Greenwich, Conn.: JAI Press, 1988).

[76]A general finding in organizational research is a negative relation between the extent of output control and the extent of process control.

[77]There is a growing body of research, for example, attempting to understand better the typical computation errors that students make. See Putnam, Lampert, and Peterson, op. cit.

knowledge that are different from those traditionally required for teaching in the U.S.[78] Training teachers in this area has proved to be very difficult.[79] It is also an area in which everyone may not be equally adept[80] or comfortable.[81] Constructivist teaching, a form of teaching that is based on the active construction of knowledge by the student in problem-solving situations, currently viewed by many psychologists as perhaps the most productive form of teaching,[82] is especially demanding.[83] The question here is whether it is reasonable to expect, first, that the average elementary school teacher in the U.S. is capable of this form of teaching and, secondly, whether the teacher is motivated to carry out this more exacting work.[84] We entertain here the serious possibility that the type of teaching now being called for is beyond the reach of many teachers for either ability or motivational reasons. Given these difficulties, redesigning the teaching job along the lines proposed here has other advantages in terms of learning, sorting, and insurance.

One advantage, mentioned earlier, of separating the teaching job into two jobs is that specialist teachers are more likely to be attuned to and responsive to new developments in teaching higher order skills than generalist teachers. In other words, higher order skills teachers are likely to learn new teaching skills more fully and more quickly than generalist teachers. Training programs could also be targeted to the teachers most likely to benefit from them. It follows, therefore, that students would be working sooner on developing higher order skills with newly trained specialists than they would if we attempt to develop these higher order teaching skills in all teachers.

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[78]Current conceptions of learning from cognitive psychology, for example, require that a teacher be not only well grounded in the subject matter, but also aware of the cognitive processes and prior knowledge of the individual learners confronting the material. See Shuell, op. cit., 1986. Also, see Lampert, op. cit., 1988.

[79]See, for example, the difficulties reported by Thomas Good, Douglas Grouws, and Howard Ebmeier, *Active Mathematics Teaching* (New York: Longman, 1983), in training teachers to focus more effectively on "concept development" in contrast to rote skill development in mathematics instruction.

[80]Lee Shulman, "Knowledge and Teaching: Foundations of the New Reform" *Harvard Education Review* 57 (1987): 1–22, for example, found teachers with a better understanding of mathematics taught math more conceptually than other teachers.

[81]Lampert, op. cit., 1988 argues that one reason teachers may resist teaching conceptually, at least in mathematics, is that they "lack appreciation for the central ideas in the subject matter." In other words, she offers the very straightforward explanation that teachers would be unlikely to be motivated to teach something they did not understand.

[82]See Resnick and Klopfer, op. cit., for papers on this point.

[83]See, for example, discussion in John D. Bransford and Nancy J. Vye, "Cognitive Research and Its Implications for Instruction," in Resnick and Klopfer, eds., op. cit., of the teachers as "coaches" of learners and the characteristics of effective coaching.

[84]New research findings and the resulting development of new curricular materials could eventually lessen the demands of this form of teaching.

Another advantage of specialist teaching jobs is that teachers themselves can select a specialty area if they prefer the type of teaching associated with it. Teachers comfortable with and skilled at more traditional teaching, for example, can specialize in the basic skills area and be rewarded for their good work. We would expect that they, too, would be especially attuned to developments in their field and would receive specially targeted training.[85] Teachers presumably could also "retool" and switch specialty areas if they so chose.

A third advantage of having two types of teachers is insurance. Given the inherent difficulty and uncertainty associated with developing higher order skills,[86] having a separate teacher specializing in basic skills insures that students will at a minimum develop these lower order skills.

An additional advantage of the organization of teachers' work proposed here is equality. As mentioned earlier, there is tremendous variation across classrooms in the emphasis given to different skill areas. Heavy emphasis on basic skills appears to be particularly likely in low-achieving schools. Dividing the teaching job into two specialty areas assures, to a large extent, that all students will receive instruction in the development of higher order thinking as well as basic skills.

Summary

This article is concerned with the current imbalance in basic skills and higher order skills instruction in the U.S. Drawing on ideas about specialization from organization theory and on recent thinking in the economics of organization, we suggest redesigning the job of teaching by dividing it into two jobs—one specializing in higher order skills and one specializing in basic skills. We argue that such a division would result not only in higher quality education, but also in a more equitable delivery of services from classroom to classroom. While redesigning the teaching job has some disadvantages (we have discussed some of these in this article), we argue that the benefits of the approach may far outweigh the downside effects.

We also argue that specialization makes the development of incentive schemes for basic skills teachers justifiable on economic theory grounds. Thus, the limited use of incentives proposed in this article is qualitatively different from performance-based incentive designs attempted in the past. Details of an incentive system appropriate for education, however, still need careful crafting in order to reap the benefits of incentives and to avoid the

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[85]There is an active line of research by cognitive psychologists, for example, that attempts to identify the systematic, but incorrect, computational errors students make. See discussion in Putnam, Lampert, and Peterson, op. cit.

[86]Putnam, Lampert, and Peterson, op. cit., point out that cognitive psychologists have mainly studied how individuals develop mathematical knowledge through natural interactions with the environment; they have not told us "much about how this development might be constrained or guided through powerful instructional experiences" (p. 93).

pitfalls made evident by earlier experiments.

From a policy perspective, the type of structural change proposed here provides a fairly simple mechanism for directing teachers' energies to an important area—higher order thinking and problem-solving skills—that is currently not receiving sufficient attention. The most commonly mentioned strategy for redirecting teaching practice is teacher training. History, however, suggests that the effects of training programs alone are likely to be weak, scattered, and inconsistent. Certainly, the job redesign proposed here would have to be accompanied by teacher training efforts, but the proposed structural changes, we argue, would provide a motivational basis not only for teachers' focusing on neglected instructional areas but also for their incorporating training more fully into classroom practice. That is, the structural changes would serve to couple motivational forces with expertise.

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