The Study of Instructional Improvement

Working Paper

Instructional Innovation: Reconsidering the Story[1]

D.K. Cohen

John Dewey Professor of Education, and Professor of Public Policy

and

Deborah Loewenberg Ball

Arthur F. Thurnau Professor of Education

The University of Michigan
Ann Arbor, MI 48109

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In this paper we set out the developing theoretical frame for The Study of Instructional Improvement, and use it to address issues of instructional innovation in public schools.

Since we have been at work on aspects of this subject for years, we have incurred more than a few intellectual debts: to Anthony Bryk, Larry Cuban, Fred Goffree, Milbrey McLaughlin, Will Onk, Alan Ruby, David Tyack, and Janet A. Weiss, with whom one or the other of us has discussed one or another of the issues; to Brian Rowan and Steven Raudenbush, with whom we have been trying to turn several of the ideas into a research program; to Charles E. Lindblom, who originally encouraged Cohen's study of practice, and offered penetrating comments; to Carol A. Barnes, who worked on an earlier version of parts of this paper; and to M. Magdalene Lampert, for a continuing conversation about teaching.

In this paper we revisit the widely reported failure of instructional innovations.[2] The key symptoms, reported in many studies, include the adoption of only selected elements of innovations, superficial enactment, extensive variability in the fragments teachers adopt, and rapid turnover of innovations in schools and classrooms. Our reconsideration arises from the view, which has grown during our studies of teaching and efforts to change it, that most efforts to explain the enactment of instructional innovations have not satisfactorily considered the central issues. They concern teaching and learning.

I. WHY INNOVATIONS FAIL

Researchers have offered several different sorts of explanations for the failure of instructional innovations. One concerns the lack of fit between innovations' designs and classroom practice. Many innovations did not take account of practitioners' needs and priorities; the ones which worked were those few which enabled users to adapt them to local needs (Rand Change Agent Study). And while many innovations were aimed at practice, they did not take account of its realities, including classroom discipline and the demands of daily teaching, school organization. Child-centered teaching is the classic case (Cuban, 1984). Since this and other innovations were not cognizant of these realities, they were either ignored, adapted superficially, or sometimes "hybridized" by practitioners who picked up some elements and blended them with established practice. Many other innovations were not aimed at practice, but were about something else, which Tyack and Cuban refer to it as "policy talk", hence they had little effect on practice. And when innovations are sometimes well enacted, it turns out to be because of the special interest of "early adopters" who have special affinities with particular innovations, but rarely get enacted well beyond that (E. Rogers; R. Elmore).

A second sort of explanation is based on researchers' view of differences among innovations. Instruction, it is said, cannot easily be changed, hence instructional innovations either were less widely adopted and enacted, or were enacted broadly but superficially (Cohen; Sizer; Tyack and Cuban). Age-grading and the junior high school were widely adopted and implemented, but some others, including most innovations aimed at teaching and learning, were not. This suggests two different stories, one of great success for innovations which do not deeply affect instruction, and another of extensive failure for those which do. But it is difficult to sustain the argument that some innovations are deeply instructional and others not, and that the former are much more difficult to enact. One problem is definitional: how do we distinguish between instructional and non-instructional, or deep and shallow innovations? Junior high schools changed the organization of schooling, but they may or may not have changed instruction, depending on how they were defined and enacted. Textbooks are indisputably a key element of instruction, yet, unlike many other instructional innovations, they were universally adopted and surely changed teaching and learning. The same thing can be said of standardized tests, which by many accounts also have dramatically changed teaching and learning.

These points open up a problem of analysis. If innovations which deeply concerned teaching and learning were harder to enact, how can we explain the nearly universal use of textbooks,

[2] "Innovation" refers to any deliberate attempt to change instruction. Instruction is our shorthand for teaching and learning.

standardized tests, ability groups and the very rapid recent growth of computers in classrooms,[3] but the much less wide adoption of educational radio, television and child-centered teaching? It is not obvious that it would be easier to teach to tests, or maintain ability groups, than to use radio and TV in classrooms, though no comparative evidence seems to exist. Some innovations may be more difficult, but instructional innovations seem to be found all along the continuum of difficulty. We need justifiable distinctions within the class of things which we want to explain, and better explanations of concepts like difficulty.

The first set of explanations doesn't help with these problems of the second set, for the first are partly or wholly organizational. Responsibility for innovations' failure is attributed to mismatched goals, priorities, and consultation, between innovators and practitioners. Even the evidence considered in many cases is organizational: for instance, in <u>How Teachers Taught</u>, Larry Cuban uses evidence on classroom organization (seating patterns, etc), as proxies for instruction. These explanations have merit. Many instructional policies and programs have not attended to practice, and some are little more than political chatter. But the explanations also have limits. The common remedy for the ills of innovation, proposed in most of the studies above, is to involve practitioners in designing or adapting them. Many of those studies argue that if innovations are to have any effect in practice, they must be developed with or by practitioners. But school restructuring and decentralization created opportunities to do just that. Practitioners were given extensive latitude to improve education, were told that change would depend on their efforts, and often were given time and authority to make change. Yet research shows that teaching and learning in most restructured and decentralized schools seem little different than in ordinary schools.[4]

To satisfactorily explain why most innovations seem not to dramatically change instruction, we must explain why innovations which remedied the presumed cause of that failure, by involving practitioners, also failed. That brings us to a third set of explanations. Restructuring and decentralization gave practitioners extensive room to redesign instruction, but few did so. When Richard Elmore, Penelope Peterson and Sarah McCarthy tried to explain the difference between restructured schools in which teaching changed and those in which it did not, they pointed to direct help in changing instruction. In schools which had extensive opportunities for teachers to learn how to fill the innovation with instructional content, they did, but in others without such opportunities, teaching changed little. Fred Newmann and Gary Wehlage reached a similar conclusion in their study of restructuring, in which they report that the few cases of instructional change which they found were marked by extensive opportunities for practitioners to learn. Seymour Sarason's classic study of the new math in the 1950s and 60s curriculum reforms, argued that one reason the new curricula fared so poorly in classrooms was that they did not take account of teachers' need to learn a great deal if they were to respond constructively. A research group of which we were part made a similar argument about the role of professional learning in recent efforts to improve math teaching in California elementary schools (Cohen and Ball, 199?; Spillane and Thompson, 199?). Those ideas were developed further in a more detailed analysis of evidence on California teachers' responses to the math reform (Cohen and Hill, 2000).

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[3] Another modest indication of the fragility of existing explanations is that ten years ago Larry Cuban argued -- seemingly plausibly -- that computers would not be widely adopted. But now they seem to be rapidly becoming universal in schools (see his TC Press book).

[4] Elmore, Peterson, and McCarthy; Newmann and ihlage 1995 report; Lee results; Elmore and Burney on District 2, NYC.

These are instructional, not organizational, explanations, for they point to professionals' opportunities to learn about teaching and learning as a critical influence on enactment. We pursue that line of thought. We argue that understanding change in instruction should be grounded in a theory of instruction -- a conception of teaching and learning which can be developed and justified with evidence and argument -- for that can help us to see what change might require. We sketch such a theory, and use it to derive some elements of a theory of instructional innovation, including requirements for enactment. Those ideas lead us to more developed explanation of innovation failure, which is grounded in instruction and the organization of instruction.

II. INSTRUCTION

Although many people think of instruction as what teachers do, we define it as interactions among teachers, students and content, in environments. The interactions occur in such varied settings as distance learning, small groups in classrooms, informal groups, tutorials, and large lectures. Instruction thus is not created by teachers alone, or students, or content, but in their interactions (see Figure 1). Moreover, "interaction" does not refer to a particular form of discourse, but to the connected work of teachers and students on content, in environments.

In order to ground our discussion of the practice we think of as "teaching," and to begin to expand it, we begin by dropping into a classroom in which third graders are working on multiplication. About three years ago, this district made an investment in mathematics through the adoption of an innovative mathematics curriculum, and offering ongoing professional development for teachers. Some parents appreciate the new curricular thrust, others are skeptical, still others are frustrated. The building principal is concerned that children's skills may suffer and presses teachers to make sure that they continue drill and practice so that students will develop proficiency. Recently, the state has introduced a new competency test on which students will need to do more than get the right answers: they will also need to explain their solutions.

> At the beginning of the period, the teacher has posed a problem to the class. Distributing bags with about 60 small square ceramic tiles to each student, she has asked them to build rectangles using the tiles. She begins by asking for an example. One student volunteers, "12 squares can make a rectangle." "Good," the teacher smiles. "How did you make it? Can you show us?" The student comes to the overhead projector, and arrays two rows of six tiles. "Ohhh!" exclaim several students. "I did 12 a different way," says another child. "Me too," chorus several others. The teacher asks another student to show his. He quickly builds one, three by four. "Are there others?" asks the teacher. There is a pause. "You can think about this while you work," she says, smiling. She directs them to work independently, trying to find as many rectangles as they can, and to record them on their sheets.
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> She walks around, observing their work, and occasionally asking a question, or providing help. She comes upon Rami, who is sitting, despondent. Leaning over, she sees that he has nothing on his paper, not even the examples they did together. He says he doesn't understand. Crouching down beside him, she pulls out six tiles, loosely arrayed. "Can you make a rectangle"? she asks. He is silent, and makes no move. "Do you know what a rectangle is?" she probes. Rami shakes his head. The teacher draws a couple of rectangles on his paper, a circle, and a triangle. She also draws an open figure with four sides, but not connected at one corner. He lights up and points to the circle. "That's a circle," he says.

He points to the rectangle and says , "This?" The teacher nods and tells him, "A rectangle is a shape that has four sides and four square corners.

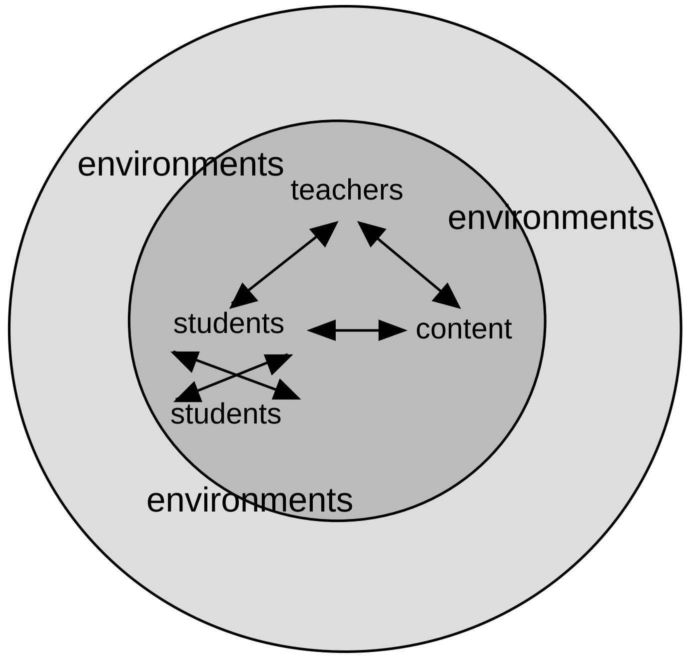

FIGURE 1. INSTRUCTION AS INTERACTION OF TEACHERS, STUDENTS, AND CONTENT, IN ENVIRONMENTS[5]

Are there others here?" They continue to work for a couple of minutes. Near the end, she draws a square and asks Rami whether this was a rectangle. The girl sitting next to him looks over and says, "No, that is a square." "But it has four sides and four square corners," objects Rami. "You are right, Rami," says the teacher. "A square is a special kind of rectangle. What is special about it is that all the sides are the same length. But it is still a rectangle, and some people get fooled by that. Very good!"

The teacher walks away, and Rami begins to work on the problem. After about 15 minutes, she calls the class back together. She asks whether someone would like to share a solution. Several children want to, and the next few minutes are spent with children offering solutions. With each one, the teacher asks the child to show the rectangle and to explain how it is a solution to the problem. The children, some with help, are able to say why their shape is a rectangle, with reference to the definition, and to show its dimensions. "Mine is a rectangle because it has four square corners, and it also has four sides. One side is 8 and one is 4. There are 32 tiles altogether in it."

The discussion continues. The teacher begins a table to record the solutions. She decides to ask for solutions beginning with the smallest rectangle. She asks them what would be the smallest rectangle they could make. One child proposes 2. Another says, "What about 1?"

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[5] This depiction of instructional relationships is familiar: Dewey relies on the idea, as did Jerome Bruner and his associates in creating MACOS, David Hawkins, Milbrey McLaughlin and Joan Talbert, Theodore Sizer, and others. But it also is strange, for many researchers and practitioners refer to teaching as though it was something done to learners.

> Lighting up, Rami shoots his hand in the air. "Just use one tile!" he announces. "'Cause that's a rectangle of 1, and its sides are also 1 and 1, and one times one equals one. It's a rectangle because even squares are rectangles – they're just special 'cause their side are the same!" No one questions this, but several children add the case of 1 to their own lists.
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> After about 20 minutes, the class has produced 17 solutions. The time for math is over, but the problem is not. The teacher distributes a simple worksheet with rectangles drawn, which asks the students to fill in the dimensions that produce them. She plans to use this to more formally discuss multiplication the next day. She doesn't have time to explain the sheet, and makes a note to herself to talk about it briefly before they go home. She knows that if she sends it home without a little more explanation, many of the children will have trouble at home, and their parents may not be able to help. She knows that the parents know multiplication, but this development of it may not be apparent to them. She wants the students to feel successful with the work, and also to be prepared for the next steps with the content tomorrow. She wants to make sure that the children get plenty of practice with the different combinations of factors, since the fourth grade teachers are adamant about students knowing multiplication facts. But she is also worrying a bit about the new state assessment which will present them with problems on which they will not only know these facts, but also be able to explain their solutions to problems such as the sort of reasoning she was trying to get them to do in class.

What we call teaching in common parlance is not what teachers do and say and think, which is what many researchers have studied and many innovators have tried to change. When we scrutinize this example, we see that "teaching" is what a teacher does, says, and thinks with her learners, concerning materials and tasks, in a particular social organization of instruction, in environments, over time. What we often mistakenly refer to as the practice of teaching is a collection of practices, including pedagogy, learning practices (individual and collective), the design of instruction, and the management of instructional organization.[6] There are more instructional practitioners than teachers, and more practices than pedagogy.

Teaching and learning are practical activities, and our interactive view opens up problems of practice which teachers and learners must solve.[7] By calling them "problems" we write as much analytically as behaviorally. Though many practitioners attentively deal with them as problems, we see them as a way to ground a theory of teaching and learning in practice. The problems refer to domains of instructional practice; whether solved attentively or not, they are critical for teaching and learning.

A. COORDINATION. If instruction occurs in interactions among teachers, learners, and content, there will be many opportunities for un-coordination, because the interactions can be so complex and easily fragmented. The most fundamental dimension concerns coordination of academic tasks among teachers, students, and content. The teacher in our example may be trying to work on multiplication, but her students may be fiddling with their pencils, passing notes, or drawing. When

[6] For convenience we often refer in what follows to "instruction", in which we comprise this clump of practices, rather than either teaching alone, or the more clumsy "teaching and learning with materials".

[7] We use "solve" in the sense of manage, or cope with, and imply no satisfactory solution. Nor do we suppose that all teachers and students address these problems attentively. The problems are a rhetorical device which are use to define the conceptual terrain of teaching and learning.

she begins class the next day, a couple of her students will likely have forgotten their homework, and the students who were absent today may not understand what is being discussed. A new student may be pulled out for testing. Even if everyone works on the task, and knows what is being asked of them, some teachers might address it algorithmically while the curriculum developers intended the problem to support the development of mathematical ideas.

Our teacher walked around during class, observing students. She came upon Rami who was in the dark, and worked to get him on track. If teachers do not have some way to probe students' ideas, they remain unaware of how they understand the task and the topic. Students may not be doing or learning what teachers assume. Teachers may be connecting on the task with half the class, while the other half is in the dark.

That instruction occurs over time creates another fundamental problem of coordination: How does this tiling task connect for each student with the work tomorrow and whatever happens two weeks later? How do students and teachers make the small bites of work in lessons develop learning over time, across such obstacles as absences and forgetting?[8] Other dimensions of coordination include among subjects within classrooms, and among classrooms within grades. If the fourth grade teachers in our teacher's school expect students to have memorized multiplication facts, our teacher must somehow figure out how to coordinate among their expectations for her students, what the third grade curriculum emphasized, and what she herself thinks matters. She also has to manage connections between home and school: If parents do not understand the homework sheet, students may be lost, or worse – parents may disparage the work as "not math," discouraging students from school mathematics.

Each dimension of coordination contains a set of potential problems in instruction, and barriers to learning. If students and teachers are not focused on the same task, learning is likely to suffer. If students' learning is not paced so as to maintain appropriate cognitive demand, students may be overwhelmed or bored, and learning will suffer. The fewer steps that are taken to insure coordination of these and other sorts, the more diffuse and less effective instruction is likely to be.[9] If our teacher merely assigned the task and later collected and graded papers, she would have a different lesson than she did, interacting as she did during the class period. She was able to mediate the un-coordination in many ways – for example, through her trouble-shooting work with Rami, her set-up at the beginning of the lesson, through the thought she gave to the homework task.

Solutions to coordination problems entail both instructional content and organization. Content is required because knowledge and materials would have to be consistent across several dimensions of coordination. Organization is required because some means of collective action, whether by managers, teachers, students, or all three would be required.

The difficulty of such collective action varies with the conceptions of knowledge, teaching, and learning which are at play in instruction. Knowledge, for instance, can be treated as fixed or constructed. In the first case it is a given, while in the second it is at least partly a matter of invention and interpretation. Teachers' efforts to coordinate their work with students' in the latter case is more difficult than in the former, for when knowledge is a matter of invention and

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[8] See Lampert, Teaching Problems, for a discussion of coordination problems.
[9] There also are structural features of coordination, including the ways in which time and instruction are organized in periods, days, school years, vacations. Student mobility within and between schools also bears on coordination.

interpretation, it is more complex. Consider the difference between coordinating among students' conceptions of the five causes of the American Revolution in conventional historical studies, as against coordinating among students' interpretations of the Revolution's origins. Teachers have much less evidence to work with in the first alternative, since the students' command of the "facts" suffice to indicate whether they have satisfactorily performed the task. Knowledge also exists in fewer dimensions; there are only facts for teachers to check, as opposed to weighing evidence, probing interpretation, and testing the relations among them. Coordination also is more difficult in the second case because there is greater uncertainty. There can be less ambiguity about what the five causes are than about whether students are considering the same bodies of evidence, whether their interpretations are plausibly related to the evidence, and what the proper grounds for evaluating and comparing interpretations might be.

Learning also can be treated quite differently, as a process either of assimilation or re-invention. Coordination is much easier in the first case, because teachers need only check to see whether students remember the proper formulas, algorithms, or procedures, and can work them satisfactorily. To learn is to have mastered such things, and to produce them on demand. Teachers can know whether students are learning what they are teaching with a quick check in recitation or homework. But if learning is discovery, it is much more difficult for teachers to ascertain if students are learning what they are trying to teach. One reason is that teaching is much less direct: teachers set general tasks or problems, and invite students to work them out, as in our example. There often are many solution paths, and while some may be more efficient, others may be more inventive. It is much more difficult for teachers and students to know if students are on a productive track: teachers and students have much more complex and ambiguous tasks to manage as they try to coordinate their efforts.

The difficulty of coordinating teaching and learning also varies among environments. It is less difficult in environments with coherent organization and guidance for instruction, and more difficult in incoherent environments. U.S. instructional environments present distinctively incoherent organization and guidance. These environments exist outside of instruction, but they can permeate the transactions among teachers and students in ways that affect both curriculum and learning. For example, as our teacher tries to develop multiplication concepts and skills, she is also trying to deal with some of her students' parents' questions about the district's new emphases in math. She suspects that those students are doing less well than they otherwise might partly because their parents disparage the math assignments. Moreover, she is aware of multiple signals about instruction, including the fourth grade teachers' expectations, her principal's exhortations to make sure all students develop basic skills, the district's investment in the new curriculum which focuses on concepts together with fluency, and the new state assessment that includes some open-ended items that require students to produce explanations for their solutions. Fragmented organization within and among education agencies often produces profuse, uncoordinated guidance for instruction, and can create organizational and cultural barriers to collective action. Lacking strong and focused leadership at the school and district level, students and teachers find it difficult to fashion coherent guidance from the blizzard of messages.[10]

[10] State standards-based reform has sought to order the confusion, but it has not much reduced the proliferation of guidance, and in some cases has increased it. New guidance which calls for coherence has been overlaid on many earlier layers of less coherent guidance. Or new conventional guidance was added in response to the more ambitious guidance of standards-based reform. This reform also never offered a way to reduce the variety of organizations which act on schools, and the guidance which they direct at classrooms.

B. RESOURCE USE. If instruction is interaction, then resources are only potential until they are used. The primary resources are students, content, and teachers. Bringing these three elements together in productive ways is at the heart of good instruction. How well teachers can hear, interpret, and make use of their students is crucial, as is students' ability to make sense of and use their teachers. Both teachers and students must be able to make use of the instructional materials and tasks designed to engage them in learning content. If teachers cannot make good use of such materials, or if students cannot understand or engage them, then no matter how good the materials are, they do not contribute effectively to instruction. Resources -- including everything from learners' work to teachers' content knowledge to state policy -- become active only as they are used in instruction. Resource use covers an enormous range: teachers use materials, students use teacher-set tasks, teachers and students use (take more or less advantage of) reduced class size, etc. Teachers and learners contribute to instruction largely through the use that they make of each other and other resources.

Resource use depends critically on the users. Students who have learned how to reflect on their ideas, listen carefully, and express themselves clearly are likely to be better users of teachers, other students' contributions, and materials. They also are likely to make it easier for other students and teachers to use their ideas. Teachers who know a good deal about a subject, and how to make it available to learners, will be more likely to frame instructionally productive tasks, and to turn students' work and ideas to pedagogically fruitful use. For instance, our hypothetical teacher used her knowledge of multiplication and geometry to exploit the task. Discovering that Rami does not know what a rectangle is, she used the material to bring him into the task, using her knowledge to help him see how to use the task to learn. She showed Rami a square in developing his concept of a rectangle, something he needed even to engage the task. She was able to see what was obstructing his engagement with the work and was able to use her knowledge of mathematics to help him get from being stuck to making good use of the task. Her mathematical insight was critical, for she was able to exploit the arithmetic and geometric dimensions of the problem without sacrificing either. Had she seen this as only as a matter of developing multiplication facts, or of work on rectangles, her interaction with students and their work would have unfolded quite differently.

The quality of teachers' knowledge use bears on their efforts to coordinate instruction. Teachers whose knowledge of subject matter is superficial would be unable to use knowledge of mathematics to work with students like Rami, to connect his understanding to instructional tasks.

The quality and extent of use also depends on the resources being used. Materials which are artfully designed to enhance access -- for instance, curriculum which offers teachers and learners a variety of avenues into it, and enables teachers to learn how to use it -- will enable more fruitful use than materials which were not so designed, other things being equal. Materials which are well designed to enhance some users' understanding of others' use of the materials -- such as curriculum which helps teachers to learn what sense students make of it, and the like -- also will enable more fruitful use than materials which were not so designed, other things being equal. Class size reductions which are both substantial, and accompanied by opportunities for teachers and students to learn how to take best advantage of them, will enable more fruitful use than class size reductions which were not so designed. Similar observations can be made about a host of other resources, from money to time to expertise.

How students and teachers organize their interactions also shapes resource use. Those who create classroom cultures which support the respectful expression, explanation, and scrutiny of ideas will generate more usable material for instruction, and will have more resources to make good use of it, than classrooms in which conventional lecture and recitation are the rule. In our example, the teacher's practice of walking around to peer over students' shoulders gave her access to what students were doing. The established norm that children question one another and her allows for a probing engagement with the task that would not be as possible in a conventional classroom, which lacks such norms. How well teachers and students make sense of, communicate about, and use materials and each others' contributions, are mediated not only by their individual knowledge and beliefs, but also by collective culture and norms. Organization and culture are intrinsic features of resource use, not mere external influences on it.

Quality in instruction thus does not inhere in teachers' qualifications or the caliber of materials, but in how they are used in instruction, and in how instructional organization and culture support or inhibit use. Teacher quality is less a matter of formal qualifications than whether they know how to make pedagogically fruitful use of materials, students' work and ideas, and their own subject matter knowledge. The quality of materials depends not only on how accessible and engaging they are for learners, but also on how well they enable teachers to learn about them, about how students are likely to make sense of them, and how to respond. Students' ability thus depends partly on how well teachers probe, understand, and use students' work. Even the advantages or disadvantages that students are said to "bring" to instruction are partly a matter of what their teachers can see and hear in students' work, and how skillfully they use them. Students' ability is therefore in part interactively determined. In another classroom, perceived and questioned by a teacher who knew or could use mathematical knowledge less well, Rami might have been seen as "not ready" and given a simpler assignment. What reformers and researchers term "instructional capacity" is not a fixed attribute of teachers, or students, or materials, but a variable feature of interaction among them.

The difficulty of resource use depends in part on the versions of knowledge, teaching, and learning at play in instruction. If knowledge is treated as fixed and given, teachers' and students' use of materials will focus on facts, algorithms, and formulas. But if it is treated as constructed students' will use materials to frame interpretations, discover relationships, and apply knowledge in new situations. The latter is more complex, and opens up more uncertainty, while the former enables teachers to simply use materials as they appear, as scripts or assignments.

Similarly, if learning is treated as assimilation, resource use for teachers can be restricted to extracting formulas, algorithms, and lists for presentation to learners. But if it is treated as re-invention or discovery, teachers must use materials to invent tasks which enable reinvention and discovery. Creating materials which are usable in the second sense is more complex and demanding than creating materials which are usable in the first sense. Using the second sort of materials also is more complex, and opens up much more uncertainty for teachers and learners, than using materials of the first sort. When learning is treated as discovery, teachers have more difficulty knowing if they have made good use of their knowledge or students' work.

Resource use also partly depends on the environments of instruction. Teachers who work in schools which focus on students' work, and offer opportunities for teachers to learn how to understand and interpret it, will be better able to make sense of students' ideas. The more teachers' professional education focuses on knowledge of the subjects they will teach, how to make them pedagogically usable, and how learners make sense of them, the more likely they will be artful users of materials and students' work. Teachers who use texts and tests designed to enable them to learn about the subject and how students understand it, will have more opportunities to learn how to improve instruction. But most teachers do not have such professional education or materials, nor do most work in such schools. The environments of U.S. schooling weakly support resource use. Resources are most often seen as a matter of provision, not use.

C. INCENTIVES. Teaching and learning of any sort require effort, and, as in any interaction, they create some social friction. Incentives are required, within instruction, to exert the needed effort and overcome the inevitable friction, but the incentives conflict. Teachers have good reason to press for ambitious work and to exert themselves, for their professional success depends on learners' success -- or on being able to explain why learners did not succeed. Learners also have reasons to work hard, for it could satisfy their curiosity and wish to learn, enhance their sense of competence, and enable them to meet teachers' and parents' hopes. But teachers and learners also have incentives to do less ambitious work, for ambitious performance increases effort and friction, as learners encounter more difficulty, uncertainty, risk of failure, and more chances to disappoint themselves and others. Teachers who press for such work are more likely to encounter learners' resistance, frustration, and failure, even if greater success beckons. Learners and teachers who do less ambitious work reduce these problems and increase the chance of some success. Teachers and students thus face a dilemma: should they aim low, accepting modest results in return for some success, or aim high, risking difficulty, resistance, and failure in hope of great improvement for learners and impressive accomplishments for themselves? Incentive conflict is internal to teaching and learning, and to teach and learn is to manage them.

In our example, the teacher poses a challenging problem to her students: how to tell whether one has all the rectangular arrangements possible for a given number of tiles? Her set up of the problem – finding arrangements for 12 -- at the beginning of class helps both to create some sense of confidence that they can get started and – since one last step is left open -- that it might be interesting, too. She is attentive to who is stuck, and when she finds Rami, she provides the support he needs to get into the problem, to believe himself capable of doing the work. She has tried to frame a challenging problem in ways which will offer students enough support to successfully attack the problem, hoping thereby to mobilize incentives for them to persist.

Incentives interact with resource use: in order for teachers and students to mobilize incentives for demanding performance, they depend on effective resource use in order to do so. The difficulty of mobilizing incentives for ambitious performance depends in part on the conceptions of knowledge, teaching, and learning which are in play. If knowledge is treated as fixed and given, and learning as assimilation, students need only focus on facts, algorithms, and formulas. But if knowledge is constructed, and learning is re-invention or discovery, students must focus on much more complex tasks as they frame interpretations, discover relationships, and apply existing ideas in new situations. The former conceptions of knowledge and learning are less engaging for some, but are more secure and less trouble for others, for they are less complex, and entail less uncertainty, invention, and cognitive demand. Had our teacher passed out a basic multiplication facts drill sheet, the work would have been more constrained and what it took to solve the problems would have been much clearer. But the conceptions of knowledge and learning which were embedded in the tiling problem require more of teachers, for they must hold knowledge in more complex and flexible form, engage with more complex and uncertain work from students, and cope with greater difficulty and risk, and more resistance.

The environments in which teachers and students work also bear on their management of conflicting incentives. If schools are linked to institutions of higher education or firms which press hard for ambitious performance, teachers and students are more likely to press themselves to do quality work than if schools are linked to institutions which do not press for such performance. Our teacher knows that the state assessment asks students not only to give answers to problems but also to write out explanations for their solutions, which supports her effort to press herself and her students to more challenging levels. Teachers and students who work in schools whose principals and parents urge ambitious performance will be more likely to do such work themselves, and to press each other for it, while equally able colleagues in schools whose principals and parents prefer less ambitious performance will have more difficulty mobilizing incentives for demanding work. Another third grade teacher with many of the same ideas and similarly knowledgeable, but teaching in a state with a high-stakes basic skills inventory, is less likely to feel support for intellectually complex performance. While many U.S. school systems, families, principals, firms, and institutions of higher education encourage demanding schoolwork, many more do not, and some oppose it.

D. MANAGE ENVIRONMENTS. Teachers and students solve the problems discussed above in and with environments. Instruction cannot be separated from supposedly external influences, including other teachers, school leaders, parents, district policies, state requirements, professional education, and much more.[11] Our teacher does not work in a compartment sealed off from the tugs and pulls on the math curriculum, and on schools more generally. She is aware of some of the criticisms, and guards herself from becoming a target for them. She feels some parents' concerns through their childrens' resistance in class. Such environmental influences depends partly on the perceptions, interpretations, and responses of teachers and students. Our teacher used the districts' math initiative to support teaching which already was headed in that direction; she used that element of the environment to advance instructional purposes which she embraced. But she knows teachers for whom the initiative has been a real problem, and who have refused to substantially alter their focus. Environments influence instruction as they are enacted, and thus managed, by teachers and students.

This holds for a great range of environmental influences. Poor students are said to bring educational "disadvantage" to classrooms, but such disadvantage is not delivered intact. It is influential only as it is enacted. Some teachers act as though disadvantaged students are capable of only rudimentary work, while others, who teach the same students, act as though they need only extra help to do well. Our teacher's work with Rami is a case in point. Still a limited English speaker, Rami might be seen by some teachers as not capable of the same work as the other children. But our teacher sees him as capable and helps to make him so. She acts as though she knows that his English does not mean he cannot think well about the mathematics. The effect of disadvantage depends partly on how teachers interpret the influences which learners import to classrooms, and how they organize teaching and content in response.

Though teachers help to shape this environmental influence, action in the environment also affects teachers. If school and district leaders place a high priority on improving teachers' work with disadvantaged students, the chances are greater that teachers will try to overcome the effects of students' disadvantage than if leaders ignore the matter, or argue that nothing can be done. Our teacher's superintendent is deeply committed to making sure that students succeed in the district.

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[11] As an analytical matter, this problem is not distinct from those of coordination, incentives, and knowledge use. But as a practical matter it is so important that I treat it as distinct.

He mobilizes resources, and models commitment by running an after-school homework club. If school and district leaders also engage teachers in the effort, offer them opportunities to learn how to improve, and support teachers' and parents' efforts to improve teaching and learning, the chances are even greater that teachers will constructively deal with student disadvantage. Managing environments depends on the clarity and authority of environmental priorities, on teachers' and learners' attention, and on their will and skill to respond.

In conventional views of the relations between environments and practice, the two are separate: teachers practice on and with learners, and cannot work without them, for the chief results of practice are co-produced with, and occur in, learners. Thus it seems sensible to think of teachers and learners as doing technical work inside practice, and of environments as influencing them from outside. But learners are creatures of the environment, coming from and returning to families, communities, and cultures. They are delegates from worlds beyond the technical and professional, yet they are essential to work in that technical world. As they enact knowledge and beliefs acquired at home, they import elements of the outside world into instruction. Teachers do similar things, as do materials.[12] Teaching thus cannot be conceived as internal technical work which is influenced by external environments, for teachers who work with learners and materials which embody elements of the world that is conventionally thought to lie beyond practice. The outside is in certain respects inside, and to work inside is, in certain respects, to work with and on elements of the outside. Teachers and learners work on a boundary, where they habitually manage often difficult relations between the inner and outer worlds of practice.

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Instruction requires the solution of several difficult problems, including incentives for performance, resource use, coordination, and managing environments. The more ambitious instruction is, or the less support there is for effective teaching and learning in the environment, the harder it becomes for learners and teachers to solve those problems. Each problem has organizational dimensions, solutions to which are critical to effective teaching and learning. They include coordination of teaching and learning within instructional units, over time, among classrooms within schools, and dealing with environments. Solving those problems requires leadership, whether embedded in the knowledge structure and norms of instruction, in positional authority, or both.

III. INNOVATION IN INSTRUCTION

We derive several elements of a theory of instructional innovation from these ideas about instruction. Since innovation is a practical activity, we frame this work with a question which parallels the one we addressed to instruction: what problems must innovations solve if they are to have a reasonable chance of success?

A. INSTRUCTIONAL DESIGN. Innovation in instruction would be impossible without a design of some sort, including goals, a view of what materials, instructional actions, organization, and other things would enable schools to achieve the goals, and some sense of who would need to do what. A credible design for improved teaching and learning thus is central to any instructional innovation. Further, if the four problems above are key to instruction, they also would be crucial to improving instruction; if so, a defensible design would include means to deal with them. We discuss each briefly.

[12] Content too often is framed in materials so as to carefully manage the boundary between instruction and its environments -- as in the case of U.S. textbooks intended for sale in Southern states, which fail to mention evolution

Coordination within instruction. The likelihood of change in practice would depend partly on the extent to which innovations design for coordination. A curriculum which offers learners many more opportunities to represent and understand mathematical ideas is more likely to be enacted if it offers teachers parallel knowledge of math, and using that math pedagogically. An assessment that addresses new science topics is more likely to affect instruction if it was accompanied by curricula for students and teachers which presented the new topics. These examples address the instructional infrastructure of coordination. Intervention designs which contain such infrastructure are more likely to enable enactment, because they would contain ways to address such problems as task focus, understanding among teachers, students, and materials, pacing and progress over time, and consistency among classrooms within time.

Coordination is both an intellectual and an organizational problem. Since schools are aggregations of classrooms, and students progress among classrooms within schools, coordination among classrooms and over time opens up substantial problems of coordinating intellectual work within a fairly complex organization. Doing so requires teachers' involvement, but in matters of academic substance, and organizational issues which bear on that substance. It also requires leadership which is sufficiently in command of the intellectual agenda to address the combination of academic and organizational issues. If designs for instructional innovation are to address the key problems of instruction, they would have to design for these sorts of coordination.

Since the environments of U.S. schools are incoherent, designing for coordination should bear on managing the environment. That would entail designing not only for instruction and instructional organization within classrooms and schools, but also for schools' management of environmental influences on coordination.

Resource use within instruction. To improve teaching and learning is in part to enable more effective use of such resources as time, knowledge of academic content, students' ideas, and materials, including texts, assessments, and related materials, and tasks. Instructional designs could attend both to enabling more effective use of existing resources, and to providing new resources only in ways which would improve use. Innovators might design means to improve teachers' and students' use of time, or teachers' use of professional development. They might design a new math curriculum to include a parallel curriculum with which teachers would learn the math, how to turn it into productive learning tasks, and how to represent mathematical ideas in ways that are pedagogically fruitful, etc. Instructional designs also might attend to teachers' skill in using (probing and interpreting) students' work, and using the results in instruction.

Designs which addressed these matters would have consequences for teachers' work. If new curricula contained appreciable material to support teachers' learning, use of the materials would require that teachers find time to learn from the materials, away from class. Learning how to more effectively probe students' understanding would require opportunities to experiment, practice, and develop new skills. Those things would take time, and might benefit from work with other teachers. They also would open up such organizational issues as the design of teachers' work, their job descriptions, and their work together. Addressing these issues would require teachers' involvement -- but again in central matters of academic work -- and leadership.

These examples only scratch the surface of designing for improved resource use, but they suggest its potential scope. Dealing with use complicates instructional design, but since instruction depends on how teachers and students use each other and materials, design for use is critical. Such designs would require that innovators address both intellectual and organizational matters, since improved resource use is not only a matter of creating more usable materials and opportunities for teachers and students to learn, but also of organizing to enable better use of resources.

The difficulty of such design is complicated by the environments of U.S. schools, which offer little support for effective resource use. If instructional designs did seek better use, they would have potent reasons to deal with managing the environment. They could focus on changing the environment, for example by trying to redirect state or local professional development programs to support improved student learning, or they could try to compensate for environmental problems by devising independent professional development which supported improved student learning.

Mobilize incentives. Instruction requires incentives for performance within conventional teaching and learning, and improved instruction requires increased incentives. The greater an intervention's academic ambitions, the less likely teachers would be either to believe that students could do such work, or to know how to help them do it.[13] A design problem for interventions is creating incentives for more demanding instruction, for lacking such incentives, intervenors would be asking teachers to encourage learners to do work that the teachers themselves could not understand or do, or that they believe students could not do, or both. That mixture of incapacity and disbelief would stifle teachers' incentives to press students for better performance, and reduce students' incentives and opportunities to learn. Innovators could try to design ways to create new academic norms, by teaching school leaders to create cultures of high performance by using school assemblies, teacher and student recognition programs, monthly prizes, and other activities. They could teach parents to create new norms for students by helping them with schoolwork and pressing for better results. Or they could do both.

Though both could be reasonable, they would be limited by teachers' and perhaps students' views of students' capabilities, and by teachers' professional knowledge and skill. Incentives based in new normative cultures could only work within the limits of teachers' knowledge and beliefs. Breaking that barrier would require a design which worked inside instruction, not just through school organization or culture. Since teachers succeed through their students' performances, the most potent incentive for them to aim higher would be evidence from their classrooms that they and their students could accomplish more than they had thought. Generating such incentives would require a design which accomplished three things: enable teachers to change their minds about students and themselves; enable them to learn how to improve their teaching; and improve students' learning and ideas about their capability.

One way to do these things would be instructional materials and methods which helped students and teachers to both improve performance and generate evidence of such performance. If teachers could help students to learn more, and learn to produce more articulate evidence of their ideas, and if teachers learned how to probe and understand such evidence, they would have taken several steps not only to better instruction, but also to generating incentives for more demanding learning and teaching. For such a design would contain means to encourage ambitious work within instruction in

[13] Seymour Sarason's account of the New Math in The Culture of School and The Problem Of Change probes this unfortunate consequence of many ambitious curricula.

ways which mobilized incentives to take on the difficulties and risks. It would require that teachers had opportunities to learn how to both improve and interpret students' work, and to effectively respond to it. Professional learning opportunities which were grounded in the student curriculum, and focused on interpreting and improving students' work, might be useful in that regard. Teachers might make better use of such opportunities if they worked together, compared notes, and learned from each other as well as outsiders. That would require an organization of instruction which supported such collaborative work and learning. If so, solutions to the problems of coordination and resource use would be part of solving the incentive problem, and such designs thus would blend organizational and academic content.[14]

One problem is that the environments of U.S. schools offer weak incentives for demanding instruction. Designing instruction to improve incentives for performance thus might include designing ways to turn elements of the environment to better use, as in enabling local leadership to more actively encourage better school performance, or in devising private sector schemes to reward schools which improved teaching and learning which would compensate for environmental problems.

Manage environments. Our discussion implies that innovations are more likely to succeed if they help enactors deal with environments which bear on instruction. Better curricula are no more likely to succeed if they offer no means to deal with generally weak external incentives for performance, than external incentives which offer teachers and students no means to improve coordination and resource use in response. Devising improved instruction includes managing the environments which bear on instruction, just as devising effective external efforts to improve performance includes
finding ways to support better problem solving within instruction.

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These four problems of instructional design become more difficult as innovations grew academically more demanding. Incentives for performance, for example, might be fairly easily managed for innovations which depart only a little from conventional practice; modest encouragement from principals or parents could suffice. But those which depart sharply from conventional practice increase risk and difficulty for teachers and students, as well as the chance of conflict in the environment. Such innovations would require designs which not only encouraged and enabled ambitious performance, but also helped teachers and students to deal with the environments which bear on their efforts.

B. ENACTMENT[15] Instructional design is fundamental, but several other problems appear as innovators consider enactment of their designs.

B.1. Elaboration[16] Innovators would have reasons to elaborate instructional designs, if

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14 Most innovations have either ignored this problem or focused only on one part of it -- i.e., the presumed motivational effect of lively curriculum, or the "drive" of external incentives. But designs for improved instruction require means both to mobilize and sustain strong incentives for teachers' and students' performance within instruction, and to enable teachers' and students' to learn how to better use educational resources. That would be true for teachers in any school, but it has particular salience in high-poverty schools, where many teachers think they know learners are incapable, think they know that the learners' families are to blame, and think that they already are doing their best as professionals.

15 In what follows we refer to teachers and others as "enactors", to avoid connotations of mechanical "implementation". We use the term "innovator" and "intervenor" interchangeably".

they consider enactment. For the problems of design discussed above are complex, and the more innovations were elaborated -- i.e., articulated, mapped, and explained -- the more the designs could inform understanding and action. The more sharply innovations depart from conventional practice, the more useful elaboration would be, because such approaches to instruction would be less familiar. Designers and enactors could learn from unpacking what goals, materials and principles implied for practice.[17]

Every innovation is elaborated in some degree. Some leave it at statements of goals, principles and visions which suggest general directions, but no more. Others are more elaborated, including curriculum, examples of intended learning and teaching, and assessments.[18] Fully elaborated instructional designs are impossible, for even modest departures from conventional practice are too complex for exhaustive planning, and the most routine classroom includes many unpredictable events. Some things are best worked out in practice, and much elaboration would occur in interaction with practice, not in advance. Given the many uncertainties of instruction, even very elaborated designs leave room for much invention, as enactors reorganize practice around them. Well- elaborated innovations thus are only a beginning to changing practice, and any attempt at elaboration entails trade-offs between designers' view of what is essential, and limits on what can be spelled out.

From one angle extensive elaboration seems essential: it illuminates the design's implications for use, alerts designers and enactors to work to be done, and reveals potential problems. Less elaborated designs would not only be less useful but even self defeating, for they would tacitly delegate large amounts of invention to enactors, increasing the probability they would interpret designs as versions of conventional practice, since such designs would provide little guidance for anything else. Other things being equal, more elaborated designs would improve enactment by providing frameworks to inform innovators' actions and practitioners' response. But other things are not equal, since more elaborated designs are more work, more costly, and may tell potential adopters more than they think they want to know. Constraining instructional designs to general principles would not reveal much about its operation to designers or users, and would increase the chances of weak enactment, but it costs less and may have more appeal to potential adopters.

Elaboration typically is treated as a matter of principle -- some argue that innovators should not constrain autonomy and invention, while others contend that little would happen without detailed directions. But to elaborate instructional designs is not necessarily to constrain, for there are very different sorts of elaboration. An intellectually ambitious elementary mathematics curriculum which sought to encourage learners' construction of mathematical knowledge could be elaborated only in terms of its broad objectives. It could be further elaborated in terms both of its objectives and its main academic themes. It could be more elaborated in terms of its objectives, main academic themes, and the types of activities entailed. It could be even more elaborated in terms of its all those things, and extensive examples of desired student performance.

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[16] Thanks to Joshua Glazer, Matthew Janger, and Donald Peurach, for assistance in developing some of the ideas in this section and the one following.

[17] Conceived in a linear way, elaboration lies on the boundary between design and enactment, but if innovation is conceived as recursive, elaboration is more likely to be a continuing process.

[18] Since policies and interventions often are aimed at students but depend on professional educators, what follows applies both to the elements of policy that centers on student learning and to the elements of policy that centers on educators'' learning.

Or it could be differently elaborated in lists of topics, the order of coverage, suggested tasks for each topic, and even scripts of teacher-student interactions.

There are significant differences among these versions of elaboration. The first would offer users only a little guidance, leaving it to them to invent or adapt nearly everything. The second would offer a bit more guidance, and the third a bit more. Still, all three would delegate most instructional design to enactors, and thus are likely to have the negative effects noted above. The fourth and fifth would offer a great deal more guidance, but very differently. The fourth approach is elaborated chiefly in terms of examples of student performance, and offers guidance through them, while the fifth is elaborated in terms of plans and scripts for many elements of instruction. The fourth approach would not much constrain teachers, for they would have opportunities to choose materials, decide about the order of operations, approaches to teaching, pace, among other things. The fifth approach is elaborated with detailed directions for teaching rather than detailed examples of students' work and teachers' actions. The latter can be thought of as normative instances which teachers use as they navigate, and from which they can learn, while scripts take over the navigation.

Elaboration thus can either open up or constrain opportunities to invent and exercise autonomy. It can mean scripts, but it can take other forms which enrich understanding and are less prescriptive. For instance, more elaborated designs in the fourth mode above could help to identify sites for learning in an instructional design, and examples of students' and teachers' work could serve as checks on enactment, which would advance learning and improve practice.

B.2. Development Innovators also have reasons to create opportunities for adopters to learn how to enact instructional designs. For the core problems of instruction are quite complex, and enacting designs which addressed them in any detail would require learning for all concerned. Development is our term for creating and offering the materials and social processes which support learning an innovation. It is particularly critical because innovations, like other features of the instructional environment, must be apprehended and interpreted by teachers and learners in order to be to be enacted. All influences on instruction are mediated through the ideas, norms, and beliefs which are at play in interactions of teachers, students, and content. The more sharply innovations depart from conventional practice, the more new ideas, beliefs, academic norms and practices enactors would have to learn, and the more enactment would depend on that learning. Such learning would require teaching, and more teaching would be needed as innovations drew further from conventional practice.

All innovations are developed to some degree, for all include some means to acquaint enactors with new practices. These may include brief or extended professional development, parent education, examples of adoption processes, and video materials that depict teachers' knowledge, norms, and skills in ways that would help them to learn.[19] The extent of development varies greatly among innovations: some leave learning to enactors, while others offer extensive opportunities for them to learn. Development can be accomplished in ways that offer rich guidance with few constraints on invention and autonomy, in ways that are quite constraining, or combinations in between. For example, the intellectually ambitious elementary mathematics curriculum which we used to discuss

[19] Development is not the mere enactment of elaboration. For example, a direct instruction scheme could be extensively elaborated, but have materials for teacher education which were thin and mechanistic. Development may or may not express the promises of elaboration.

elaboration could be developed in ways that parallel the options for elaboration. If it was elaborated only in terms of its objectives, development would likely be restricted to creating opportunities to learn about those objectives. If it was elaborated in terms of its objectives and its main academic themes, development could include opportunities to learn about the nature of the themes and how they compared with others. If the innovation was elaborated in terms of its objectives, main academic themes, and the types of activities entailed, development could follow suit, adding opportunities to probe examples of the activities, objectives and themes.[20]
If innovations were additionally elaborated with examples of student performance, there would be extraordinary opportunities for development. These could be created in ways which constrained teachers, if the examples of student performance were presented as canonical cases, but they could also be presented as opportunities to learn about differences in student performance, as well as about the content, student thinking, and how teachers might respond. A range of student work would enable educators to compare, learn about the differences, and relate norms of professional conduct to evidence of teaching and learning. But if the curriculum was elaborated in lists of topics, the order of coverage, suggested tasks, and scripts of teaching, opportunities for development would be more constrained. Scripts can be learned by rote or with some added explanation, but very detailed direction for teaching locates guidance for instruction outside of teachers, thus constraining their opportunities to learn.

The first version of development would offer users modest opportunities to learn, but would impose modest burdens on innovators; nearly everything would be left to enactors. The second would offer slightly more opportunities to learn and comparably increased burden for innovators, and the third a bit more. Still, all three delegate most learning to enactors, and modestly burden innovators. Most enactors would be unlikely to learn much, either about enacting innovations or how to extend and adapt designs. The fourth approach would open up extraordinary potential for learning, but would create no small burden for innovators, while the fifth offers more limited opportunities to learn and comparably reduced burden.

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Elaboration and development present important choices to innovators and enactors. On the one hand they offer significant advantages, for better elaborated and developed designs offer clearer guidance about the innovation, and more opportunities to learn. But such designs would take more time, forethought, and money, and would turn innovation into a much more complex enterprise than has been typical. The abundance of information would make decisions about adoption more rational for potential enactors, but also more difficult, since there would be so much more information available. Extensive elaboration and development also would increase work, time, and costs, and revise innovators' role, pushing it beyond design toward teaching innovations, and perhaps more responsibility for enactment. That could deter many innovators, and may be why most limit themselves to "presenting the material", and letting enactors do what they can.

B.3. Innovation in environments. The central problem of instructional innovation is to improve teaching and learning, but such improvement must occur in, and partly be constructed from, environments. We already discussed how instructional designs may deal with environmental influences within instruction. But innovators also operate in environments as they move from design to practice; doing so includes

[20] Elaboration without development leaves it to enactors to learn how to bring the intervention to reality. Development without elaboration provides enactors with resources for improvement without much guidance as to how or to what end they should be used.

recruiting adopters;
supporting enactment of the innovation;
mobilizing fiscal and human resources;
managing knowledge about the innovation;
dealing with the innovation's spread, or "scale-up".

Each can be difficult. Solving the problems of instructional design, elaboration, and development are no small task, but doing so in ways which also enable recruitment of adopters, support for enactment, raising money, and producing useful knowledge about and scaling up an innovation, brings innovators into contact with an additional range of problems. In addition the issues interact. The better designed and more elaborated an innovation is, the more likely it will be instructionally effective. But such innovations also are likely to depart from conventional practice, and thus increase the burdens of enactment -- including time, cost, instructional change, learning, and role re-definition. Instructional designs also bear on recruitment, since educators' appetites for ambitious change varies. Ambitious plans to scale up also may provoke adjustments in instructional designs, as innovators contemplate work with hundreds or thousands of schools or teachers. If instructional design is essential, it is not enough.

In a different world, decisions about these problems might be shaped only by the fit between educators' aims and innovation designs. But in this world, schools and innovators encounter each other in very particular environments, which help to shape innovators' work with adopters. Weakly constrained mutual choice has been the chief means by which government and private innovators met schools. Schools operated in weakly regulated markets, in which private innovators worked with those who chose to work with them, and governments worked with localities which had more authority and power than the innovators. There was little knowledge of innovations' effects, and, with the exception of textbook adoption in some states, weak government regulation of what schools and teachers did. There were few incentives for dramatic change, and little support for enactment. Independent knowledge on enactment and results was scarce, and monitoring of enactment and performance were weak at best. The environments of instruction did not support ambitious and sustained improvement; they have been characterized by fragmented organization, weak coordination of guidance for instruction, weak professional knowledge and norms, and mostly weak incentives for performance. The resources to support fruitful intervention, including a shared professional language concerning teaching and learning, traditions of common work, opportunities for professional learning, and social and economic support, were in short supply. Innovators had a good deal of independence to define what they would do, and schools and teachers had similar independence to decide how they would respond, but everyone operated without much knowledge about change processes or their effects.

A few states and localities recently began to take a somewhat stronger role in school improvement. Texas, New Jersey, Maryland, and Kentucky, and localities like New York's District 2 and Chicago, have undertaken reforms which expand state and local roles in school affairs. They have begun to restrict permissiveness, and some have begun to increase knowledge about the effects of innovation. These developments have begun to change the strength of incentives for improved performance, though they have been much less effective in changing the support for change. There is continuing controversy about these efforts, and there still are strong elements of voluntarism in many of these places. For example, if they mandate improvement, states and localities typically permit choice among innovations, and often monitor enactment weakly. That is what one would expect in a decentralized system with strong markets and weak government. Thus it remains to be seen how effective and sustained the new local and state roles will be.

This situation has influenced how innovators address problems of recruitment, support for enactment, managing knowledge, fund-raising and scale-up. Educators were able to define adoption in ways that gave them access to the resources that innovations bring, while making little change in core instructional operations. For schools operate in the grants economy and have relatively stable funding, while private innovators' funding is less stable. Thus while in theory innovators have incentives to define the choice process in ways that would deliver enlistees who wish to improve and are willing to do as the innovator proposes, they must not only recruit schools but also show evidence of adoption and scale-up in order to remain legitimate, or even stay in business. Thus there have been reasons for innovators to do as schools and teachers prefer.

Innovators' and enactors have long operated in this situation, and most still do. We briefly summarize how these features of the environment bear on innovators' and adopters' solutions to each of the problems of operating in environments.

Recruitment. Most innovations have reasons to recruit selectively, but the content and stringency of selection varies. Other things being equal, the more comprehensive, explicit, coordinated, and focused on instruction innovations are, the more likely they are to recruit schools which are disposed to improve. Such schools are appealing recruits precisely because their wish to improve means that they already have some of the required resources in place to enact innovations. More elaborated and developed interventions thus are more likely to recruit schools selectively, based not simply on general preferences but on these more focused considerations. By the same token, less elaborated and developed innovations are more likely to recruit unselectively, or to select in less focused ways.

But environments vary, and recruitment is likely to vary with them. If ambitious innovations operate in environments that offer weak incentives for improvement, or strong incentives and weak support, or neither, they are more likely to be limited to recruits with a strong preference for the innovation. Indeed, ambitious interventions operating in environments with weak incentives and support for improvement could have difficulty in recruitment. That could create incentives to reduce the ambitiousness and specification of their designs.

Support enactment. Innovators have incentives to assist schools to enact their designs, for intervenors' standing, funding, and professional success depend partly on the adopters' success.[21] Since schools' success requires some departures from conventional practices, it would be in innovators' interest to offer school professionals help to make those departures. But there also are reasons for innovators to limit such assistance. They cannot control schools' success; innovations are enacted only as they are recognized and used by teachers, students, and parents, and they may have other priorities than high-fidelity enactment. Lacking unusual pressure, schools would continues to treat innovations as opportunities to gain useful resources without changing instruction, and would respond negatively to intrusive assistance. Schools operate in complex and often difficult environments, over which they have limited influence. Educators commonly believe that schools' and teachers' autonomy is sacred, and many

[21] Intervenors' approaches to managing enactment include all their efforts, whether deliberate, tacit, active, or inactive, to support the effective enactment (recognition, interpretation, and use) of the intervention design in schools.

educators would reject highly elaborated innovations or close oversight of enactment, on the ground that they restricted autonomy. The more innovations depart from conventional instructional practice, the more likely such perceptions would be.

Innovators also might limit assistance because of its burdens and costs. The more ambitious an innovation, and the greater an innovator's effort to support enactment, the more money, people, and organization would be needed. Support could create costly and extensive infrastructure, increasing demands on management and funds. More intensity in operations could limit the number of enactors with which innovators had time and other resources to work, thus reducing the scale of operations.

Manage knowledge. Innovators have reasons to produce and use knowledge, since it is helps with recruitment and fund-raising. But not all innovators have incentives to produce and use knowledge to improve enactment. One influence on knowledge production and use is the innovation. Better designed and elaborated innovations are more likely to collect and use such evidence, since they will have identified the key domains for enactment, and perhaps indicators of performance. Design and elaboration can be viewed as ways to identify the domains in which educators would have to learn about their work, as they tried to enact an innovation.

Environments are a second influence on innovators' knowledge production and use. Though most states and localities impose extensive requirements for data collection, only a few focus these requirements on improving performance. In most cases, well designed and elaborated innovations would find little support for extensive knowledge production and use, but no strongly opposed requirements. In the minority of places which do have relatively strong requirements, innovators' decisions about where to operate could be influenced by the fit between their designs and state or local requirements. Well designed and elaborated innovations might avoid environments whose knowledge production requirements conflict with their own, while others would either be less likely to operate in environments which demand such knowledge, or to generate but not use the required knowledge.

A third influence on knowledge production and use is both technical and organizational. The challenges of such work would include the definition of relevant knowledge, invention or adaptation of instruments, and the creation of opportunities to collect and process the ensuing data. These could include evidence with which to link evidence of student performance and teaching on the one hand, to means of improvement on the other, so that weaknesses in enactment and means to correct them could be identified. That could require regular monitoring, data collection, analysis, and reporting back to educators, and the capacity to generate and use such knowledge in innovations, schools, and district offices. Innovators might have to both devise the schemes and help educators learn to enact them.

These would create significant demands on innovators and schools, and add to the costs of innovation and enactment. Using the evidence would be even more challenging, since that would require changes in instructional decision-making to focus on evidence of teaching and learning. That would require incentives to support knowledge generation and use, and change in professional roles to make evidence about teaching and learning public.

Mobilize resources. Interventions which are more likely to be instructionally effective also are likely to cost more. For better design, elaboration, and development are likely to increase the difficulty of innovation design and enactment. If so, the intervenors most likely to improve teaching and learning would have to have more funds to do their work. Since no innovator could raise the funds to support many schools' enactment, operating at any scale would require capturing as well as raising funds.[22]

That would be difficult to arrange. The approach most likely to succeed in our system of weak government and voluntarism would be to use inclusive criteria to determine schools' or intervenors' access to subsidies. Title I is a prime case in point. But such subsidies would have no strong criteria of instructional effectiveness, and would support more and less effective innovations, and more and less responsive schools.[23] The schools that need improvement the most would have the least capacity and incentives to improve, and most would use subsidies to add projects and resources without much changing instruction. And the innovations which need most support would compete for funds and adopters with less effective and demanding innovations, under conditions in which greater effectiveness had no fiscal benefit.

That is important, for subsidies which cover schools' expenses do not cover the costs of design, elaboration, and development. It would be difficult to raise private funds for that work, and to offer continuing support for enactment, for private foundation agendas change frequently. This could create disincentives to operate at much scale, or incentives for innovation designs that were simple enough to hold down costs.

These comments are preliminary, for we are only at the beginning of efforts to systematically improve instruction. Further design and research might make it possible to improve instruction through better use of existing materials, assessments and standards. If so, the difficulty of school improvement, and the associated resource demands could be more modest. But that would depend on innovations which made much more effective use of existing resources within a conventional instructional framework, and that is not a task with which many innovators appear to be engaged.[24]

Scale-up. Innovators have reasons to spread their products widely, for broad adoption and enactment offer legitimacy, opportunities for influence, access to funds, and other signs of success.[25] But expanding the scale of operations can pose serious problems for intervenors and schools, since there are complex trade-offs between scale and the other problems discussed just above. Increased

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[22] Many innovations have tried to deal with this by working largely or entirely in high-poverty Title I schools, for the Obey-Porter amendment subsidizes such work.

[23] At this date only a few states and localities have adopted arguably strong criteria. Hence we expect that the most likely short-term result of using Title I and Obey-Porter grants to subsidize adoption of "whole school models", will be to ease intervenors' problems of resource mobilization without broadly increasing schools' instructional effectiveness. For both subsidies would tend to increase demand for less effective interventions in states and localities which did not have aggressive school improvement practices already operating. Though researchers and policymakers might learn, and encourage more stringent criteria, Congress finds it difficulty to repeal grant programs.

[24] One explanation is the persistent fascination with novelty in teaching and materials, and another is the lack of well developed knowledge about instructional improvement: lacking substantial theory, evidence, and experience, most intervenors are guided by other things, including leaders' experience and preferences, ideology, and climates of opinion. Many of these could lead them away from a search for more conventional approaches to effective instruction.

[25] Scale conventionally refers to the quantitative extent of operations of an innovation, including chiefly the number of participating schools, districts, communities, states, or teachers, but perhaps also the types of participants across grade levels, subjects, demographic attributes, and geographic, political, or economic contexts.

scale could, for example, increase the variation in enactors and environments, thus increasing the complexity and burdens of managing innovations, fund-raising, and quality control. For example, the increased burdens of managing the environment created by comprehensive innovations will be multiplied as they expand in number across environments. Supporting the enactment of such interventions could require the creation networks of adopting schools in which professional support and association, information exchange, and social connections were sufficiently rich and frequent as to become an alternative system which bridged among existing formal systems. The burdens of maintaining such networks could be appreciable, and could impede quantitative expansion.
But those burdens would depend on innovations' design, elaboration, development, and the extent to which they departed from conventional practice. Though most previous discussions suggest that "scaling up" is a quantitative matter of getting broader adoption and implementation, our analysis suggests that quantitative scale would depend on crucial qualitative features of instructional innovations. We hypothesize that their qualitative features would shape their potential for quantitative scaling up, that the very nature of scaling up would vary with these four attributes.

Innovations can be designed to deal only with one aspect of instruction, like curriculum, or to deal with instruction as a complex system. The former design is much easier to accomplish than the latter, and scaling up a curriculum could be -- has been -- seen as a simple matter of adoption. But scaling up more complex and comprehensive designs would be much more taxing, for it would require explicit attention to such matters as solving the four problems of instruction which we discussed earlier. That would require extensive and complex designs, which would be commensurately difficult to enact.

Elaboration is a second qualitative feature of innovations' potential for quantitative scale. It is not deeply difficult to elaborate a simple change like extending the school day by an hour, but it would be quite difficult to elaborate a complex and comprehensive design which sought to promote intellectually ambitious instruction. Such a design would require complex and detailed planning, the identification of key areas of instructional change, considering the sorts of materials which would be suitable, and more. Such a well elaborated complex design would imply not only extensive qualitative work in devising the innovation itself, but also much more work for educators as they consider and try to enact the design.

Development is a third qualitative feature of innovations' potential for quantitative scale. Devising the materials and social processes required to extend the school day by an hour would be quite modest; but doing so for a complex and comprehensive design, which sought to promote intellectually ambitious instruction, would be a very different matter. For that would require extensive development of materials and processes that would support professional learning and change, which likely would extend over many years. Scaling up a well elaborated and developed design for a complex and ambitious innovation would require a great deal of qualitative work on the innovation itself, and it would entail commensurate work for enactors, as they tried to learn the innovation.

Innovations' distance from conventional practice is a fourth qualitative element of the potential for quantitative scale. Even comprehensive and complex designs which were well specified and developed would be more difficult to enact, and thus to scale up, in proportion to the extent of their departure from conventional practice. For example, a program to intensify and deepen mathematics learning could be designed in ways which only changed the mathematical content. It could also change the approach to learning, so that students were expected to discover or reinvent mathematics. It could also change classroom discourse, so that students were expected to construct solutions in small groups. Each of these elements increases the distance from conventional practice, and thereby increases the difficulty of both design and enactment.

This discussion leads us to several additional hypotheses about scale in innovation.

> More elaborated and developed innovations offer some advantages for growth in scale, because better elaboration increases the potential for more precise adoption, assistance with enactment, and monitoring, quality control, and more development increases the support for enactment. For such innovations, large-scale work could simplify some tasks and reduce unit costs,[26] and enable innovators to capitalize on economies of scale and to sustain operations with many schools in varied locations.
>
> But these advantages of elaboration and development are a function of innovations' distance from conventional practice. The more distant they are the more complex and difficult enactment will be, even with extensive elaboration and development. By the same token, the more distant they are the less the potential to expand scale by simplifying tasks and reducing unit costs.
>
> Less elaborated and developed interventions are better able to grow in scale in quite a different sense. Because they are weakly elaborated they can be easily adapted to local needs, and because they have less clear criteria of quality in enactment, clear judgments about enactment would be much more difficult. Thus one would expect extensive adoption, high quality enactment at a relatively low frequency by adopters who brought relatively rich resources to the innovation, and either rapid drop-outs or superficial enactment at much higher frequencies.

Different approaches to the qualitative features of innovation thus imply different conceptions of enactment, and very different versions of what scale-up would entail. Solutions to the quantitative problems of scaling up would depend on how the qualitative problems were solved. Design, elaboration, and development can be thought of as the intellectual and social infrastructure of innovation. The more well developed the infrastructure, the more the potential for scaling up at high levels of quality in enactment, and high frequencies of sustained adoption. But such infrastructure is more difficult for innovators to build and for enactors to use, as innovations depart further from conventional practice.

These points imply that consideration of scale in innovation would be improved by attention to the qualitative as well as the quantitative features of scale. They also imply that scale cannot usefully be considered apart from quality in enactment. They imply that, at any distance from conventional practice, quantitative scale at high frequency of sustained adoption and high quality enactment would depend on the extent of qualitative scale in the innovations. And they imply that innovators face difficult decisions about trade-offs between the ambitiousness of the improvements in teaching and learning they seek, their ambitions for quantitative scale, and their capacity to design, elaborate, develop and sustain instructional change efforts.

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[26] Innovations may achieve economies of scale, or be able to control more elements of the environment (vertical and horizontal integration, market power), or to attract more resources.

Instructional innovation is a complex enterprise, requiring the solution of several sets of connected problems. One is instructional design: improving instruction is not simply a matter of devising better curriculum or professional development, but of doing such things in ways that support use of the new resources, mobilize and sustain incentives for performance, coordinate instruction, and manage environments. That greatly complicates the task of instructional design. Additionally, innovations would be more likely to succeed if they addressed the organizational problems which are critical to effective teaching and learning, including organization of teaching and learning within instructional units, over time, and among classrooms within schools. Designs for improved instruction are unlikely to solve those problems without some sort of general leadership, whether embedded in the knowledge structure of instruction and professional norms or in positional authority, or both.

A second set of problems concerns the elaboration and development of instructional designs. The more fully innovations are elaborated and developed, the more likely adopters will be to make intelligent decisions, and the greater the probability of both high quality enactment and sustained adoption. But elaboration and development can
be very costly, and may inhibit adoption in the individualistic culture of U.S. education.

A third set of problems arise as innovators operate in the educational environments, solving problems of recruitment, resource mobilization, and scale. With a few recent exceptions, those environments offer schools and teachers weak incentives for sustained efforts at serious improvement. There are few political incentives for policymakers to carefully design and elaborate innovations, and few financial or professional incentives for innovators outside government to do such work. The more ambitious innovations' design and the more extensive their elaboration, the more difficulty they are likely to encounter operating in these environments.

The solutions to these problems interact. The more ambitious an effort to improve instruction is, the less support it is likely to find in the environment. Such innovations may promise greatly improved teaching and learning, but they also make it more difficulty for innovators to find broad adoption and high quality enactment.

III. RESULTS OF THE THEORETICAL WORK

We conclude by calling attention to several results of our theoretical work. Most
generally, it implies that the enactment of instructional innovation is itself instructional in certain crucial respects. Innovation designs depend not only on new knowledge, such

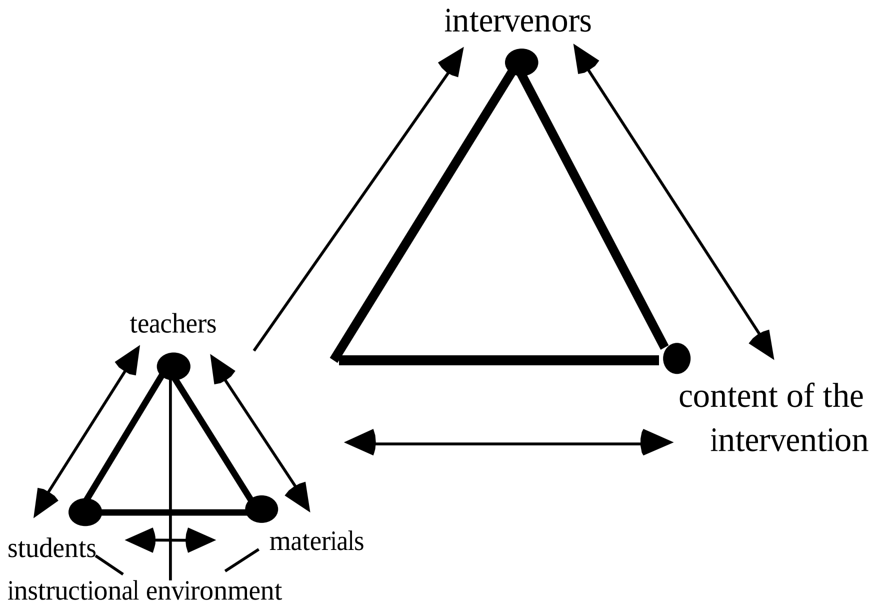

FIGURE II: INNOVATION AS INTERACTION

as better curricula and teacher education, to change instruction, but also on the knowledge, skills, and norms needed to make the designs usable, and to enable those within instruction to use them well. Figure II depicts those relations, by situating instruction as one point of an "innovation triangle", in which innovators and the content of innovations are the other two points. To innovate in instruction is to operate on and with learners, teachers, and materials, just as to teach is to operate on and with learners and content.

This representation implies that teaching, learning, and other means of knowledge use can be seen as the "core technology" of instructional innovation.[27] Knowledge alone is of course insufficient, for innovation occurs in and with environments. But knowledge and its uses are critical instruments of innovation, and environments count partly because of their bearing on knowledge and its uses.

A. TASKS OF INSTRUCTIONAL INNOVATION. Our analysis also throws quite a different light on the critical tasks of innovation. We hypothesize that successful enactment depends on:

- Innovation designs which are grounded in instruction, address its core problems, and operate comprehensively on the elements of instruction.
- Elaboration of the designs, so that designers and enactors are able to understand innovations' likely operation, and their demands on innovators and enactors.
- Development of the elaborated designs, so that there are adequate materials and processes to teach and learn innovations.
- Designs for managing innovations' relations with its environments. This includes everything from designing innovations to deal with teachers' and students' work on the boundaries between instruction and its environments, to strategies for recruitment and assistance with enactment

[27] We are indebted here to the work of Janet A. Weiss, on ideas as instruments of policy.

which capitalize on environmental resources and/or buffer innovations from environmental problems.

If these hypotheses are roughly on the mark, the tasks of successful innovation are considerable, both because of the complex requirements of effective designs and because even with a fine design, managing recruitment, enactment, and related matters are quite demanding.

B. EXPLAINING INNOVATION. Our analysis also leads to a set of conjectures about explaining why innovations succeed or fail, which could help to improve knowledge in this area. Debates about innovation and its failures often have been grounded more in ideology than research and theory -- as, for example, in arguments between those who stress the need to elaborate instructional designs so as to insure high-fidelity enactment, and those who defend principles alone as guides to action, or between those who argue for rapid "scaling up" as against more deliberate work. These and other arguments resemble the ideologically charged reading wars, which have long been a feature of the U.S. educational landscape. We hope that the ideas sketched here will help to provoke new research, reanalysis of existing studies, and a more evidence-based approach to innovation. Recent research on reading has had a salutary effect in that field, and there is no reason to think that something similar cannot occur in instructional improvement. We organize our comments around the central categories in our theoretical frame.

Instructional design and elaboration. Our analysis leads us to the view that most innovations have been weakly designed and elaborated. Many were little more than general ideas and broad arguments for one new approach or another. The child- centered teaching which Larry Cuban studied is a leading case in point; there was no designed or elaborated innovation. There was a collection of appealing ideas, a few bits of student curriculum, and some modest, scattered efforts to invent new practices which embodied those ideas. Some other innovations -- The Coalition of Essential Schools is a recent case in point -- offer principles and rationales, but little more.
At best such appealing ideas and principles offer loose frames from which innovation designs might be built. Dewey's University of Chicago Laboratory School was an effort to create a working version of child- entered teaching, but it only began the work, and not even a developed curriculum for others to use, seems to have been left in usable form. Looking back some years later, Dewey wrote that the endeavor had been much more difficult than he had imagined, and quite incomplete (Mayhew and Edwards). Similarly, during the 1960s and 1970s, a few schools did create working versions of Open Education which innovators judged to be satisfactory, just as a few seem to have created such working versions of Coalition principles. One advocate of Open Education, Lillian Weber, had a well elaborated design, and offered some teachers extended opportunities to learn. But in the national movement for Open Education there seems to have been only one other such design.[28]

The most frequent instructional innovation in U.S. education has been curriculum. Many ingenious and challenging curricula were created in the 1950s and 60s, and many more were devised since, often funded by NSF. But our theory implies that in order to improve instruction and sustain the improvement, innovators would have had to enable students and teachers to use new materials well. Curricula are by definition somewhat elaborated for students, but not necessarily well. For example, few give much attention to helping students acquire new practices of learning which might be

[28] Charles Silverman, Crisis In The Classroom.

required for more ambitious work. Though they intend that students acquire new learning practices to advance their understanding, few unpack what it might take to learn those practices.

Moreover, few of the curricula were elaborated for teaching, despite the fact that most were quite distant from conventional practice, and would require teachers to do much more demanding work. Innovators did not try to either figure out how teachers might use the new materials, and design and elaborate for that. Some were more or less deliberately "teacher-proof", but others simply failed to consider what it might take for teachers to use better materials. They also rarely addressed incentives for performance within instruction, apparently assuming that if students were more interested in better materials, that that would be sufficient.

Additionally, few instructional innovations seem to have addressed interactions between instruction and its environments, especially concerning the likely consequences of departures from conventional practice. Most were created as if assuming that they would be used in a frictionless world, in which other teachers, schools, and parents did not exist or did not matter. Consider these examples:

> Dewey ran into problems with Laboratory School parents, who became uneasy with what was happening in the school's classrooms. He seemed not to have anticipated such concerns, but tried to deal with them in a series of public talks which became School And Society.
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> The New Math became infamous in the late 1950s and early 1960s for the hostility which it incurred among many parents, because their childrens' work differed so sharply from what they took to be mathematics. The innovators seem to have prepared not at all for this response, and had no organized way to deal with it.[29]
> Though MACOS was a self-consciously radical innovation in social studies, the innovators appear never to have considered how parents and policymakers would respond to a curriculum which so sharply challenged many conventional values, and conceptions of knowledge. On Peter Dow's account in Schoolhouse Politics, they were unprepared for teachers' reservations about the materials' ethical and cultural content, and were entirely taken aback by Congressional questions.[30] The developers apparently did not consider the likely interactions between their products and others with an interest in schools and social studies.
>
> Standards-based reform was launched on the apparent assumption that action by professionals, legislatures, and executives would carry the day. But in Kentucky, Oregon, California, and other states, public and interest-group responses have slowed, diverted, or crippled this reform. Only in response to these developments did reformers try to develop means to deal with public response.

In these cases and others, instructional innovators have attended very partially to the role which culture and politics play in and around practice. They gave little or no attention to teachers' role as boundary workers, and managers of environments and conflict. Few innovators designed means for parents or others outside classrooms to help them understand more adventurous approaches to

[29] Seymour Sarason, The Culture of Schools And The Problem of Change.
[30] Peter Dow, Schoolhouse Politics, Cambridge, Harvard, 1991.

teaching and learning. The sole known exception to this seems to have been Family Math, a curriculum for parents which was devised in connection with the recent California Math reforms. Similarly, few innovations have considered school leaders.

The same weak design and elaboration can be observed in innovations which focus on school structure and organization, rather than curriculum. This includes innovations in school organization, as with decentralization and restructuring, in school leadership, and in state standards or assessments. These innovations invested weakly or not at all in elaborating the instructional elements in change. Most seem to have assumed that changing structure or organization would cause changes in instruction, thus obviating the need for further design and elaboration. State standards-based reforms make only a modest pass at elaborating the elements of instructional change, for a similar reason; reformers appear to assume that assessments and standards will provide both the stimulus to learn and sufficient materials with which to do so.

The most striking feature of the instructional design and elaboration of instructional innovations, then, is how much has been missing. Most innovations have at best dealt with only one element of instruction among several, and that only partially. They have been designed and elaborated on what appear to have been naïve assumptions about instruction, chief among them that students learn what teachers teach, or materials offer, and that environments do not matter. Most innovations did not begin with a conception of instruction which improved their understanding of the practices into which they proposed to intervene. Most began instead with some ideas about learning or school organization, and tried to build materials or school designs which seemed to fit. Weak conceptualization of teaching and learning were a foundation of weakly designed and elaborated innovations.

Adoption. The effects of such designs play out in a chain of consequences. One concerns adoption and the role of knowledge in it. Lacking much design and elaboration, many innovators could not have well understood the operational features of their brainchildren, let alone what they or adopters might need to do. Without unpacking the designs and operations which could flow from their visions, goals, and ideas, there was a great deal that innovators could not see. One bit of evidence on this point is their frequent surprise that innovation turned out to be much more complex than expected. Dewey's surprise about the Lab School difficulties is the canonical case in this respect, but studies of innovation repeatedly report such experience.

More important, lacking detailed understanding of the operational features and demands of innovations, neither innovators nor potential adopters had good information about the fit between any innovation and particular schools, teachers, or districts. Adopters did not have much to go on to decide about innovations, and innovators did not know enough to make wise choices among potential adopters. One consequence was to tacitly delegate enormous problems to potential adopters, but another was that few noticed them. Weak designs and elaboration left the operations and demands of innovations ambiguous to all. That led to frequently uninformed adoption, and similarly weak knowledge about enactment. What many have seen as adopters' opportunistic behavior may be quite reasonable under conditions of weak design and elaboration. For given weak information, adoption and its immediate aftermath become the occasion to learn about the innovation, and then decide how or whether to engage with it.
Weakly committed initial adoption could be an exploratory move rather than a decision to seriously engage, and early drop-out or moving on to other innovations could be a result of learning. Imperfect information also meant that adopters would have very limited ideas about what they were

getting into, and would interpret innovations in ways which made sense in their inherited, mostly conventional, reference frames. That would help to explain the frequent reports from teachers and administrators that the adopted innovations were well and successfully enacted, despite researchers' reports that enactment was weak, fragmentary, and superficial.

Under conditions of weak design and elaboration, such results would be normal. The frequency distribution of adoption would be skewed sharply to the left: there would be a large proportion of initial, relatively uninformed adoptions, an ensuing high drop-out rate as adopters either learned more about the innovation or considered it fully enacted, and then moved on to others. There would be continuing enactment only from a much smaller number of adopters. But skewness in the distribution of adoption would vary with the nature of innovations, becoming more pronounced as innovations departed more sharply from conventional practice, since the imperfections of information and the shock of initial learning both would be more acute. Skewness would be less pronounced either with better elaborated innovations, with innovations which were closer to conventional practice, or both.

Development. Another consequence of weak design and elaboration, and the ensuing skimpy knowledge, was that innovators would create few opportunities for themselves to teach or enactors to learn innovations. In the past few seemed to have recognized that innovation was in good part an instructional process, and that teaching and learning new practices would be critical. They did not invest in creating materials and social processes which would support enactors' learning, which is what one would expect if innovators had only a modest grasp of the operational entailments of their designs.

Development certainly has mostly been ignored, or treated in very cursory fashion, in curriculum projects. Most of the 1950s and 60s curriculum reforms created only bits of opportunity for teachers to learn, and most of that was subject matter workshops for teachers. There is no evidence of any attention to creating opportunities to learn how to teach the subjects. MACOS added a bit of that for teachers as a modest afterthought, but never integrated learning to teach the innovation into MACOS. Researchers who studied the enactment of these reforms reported that most enactors responded weakly. Most innovations were either enacted quite superficially, as teachers added a few new elements onto a core of traditional practice, or were enacted more seriously in special and limited circumstances like AP classes.[31]

There also has been a paucity of development in innovations which focus on structure and organization. There has, for example, been little attention to devising means to teach and learn improved approaches to instruction in most efforts at decentralization and restructuring. But as we reported earlier, when Richard Elmore, Penelope Peterson and Sarah McCarthy tried to explain the difference between restructured schools in which teaching changed and those in which it did not, they pointed to development --
professionals who offered teachers opportunities to learn how to change instruction.

State standards-based reform is a structural innovation of a different sort, but these policies also have been accompanied by only modest efforts to devise materials and social processes from which professionals and others involved could learn how to respond constructively to standards or

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[31] See Sarason and Dow, op. cit. Se also Chapter V in A Powell, E Farrar, and D.K. Cohen, The Shopping Mall High School, Boston, Houghton Mifflin, 1986.

assessments. Barbara Neufeld reports on the lack of substantial opportunities for teachers to learn in schools in Texas and Kentucky, and Margaret Goertz and Diane Massell report similar things in more states. In a study of teachers' responses to the California math reforms, Cohen and Hill showed that when teachers did have opportunities to learn which were grounded in the new curriculum and assessments, their practice changed appreciably.[32] In fact, development there paid off not only for practice but also for students' learning; students in schools with more teachers who had such opportunities to learn had higher average scores on the state math assessment in 1994 (Cohen and Hill, 2000). Though there has been growing recognition that professional learning is an important element in the success of such innovations and structural policies, most state standards-based reforms are so weakly designed and elaborated for instruction that they contain little guidance for professional development. Since most professional development is weakly related to serious instruction, the majority of the opportunities for professional learning appear to be only marginally relevant to improved teaching and learning, at best.

These ideas imply further consequences for both innovators and enactors. Given weak elaboration and under-development of innovations, innovators would be likely to misperceive the ease with which educators might enact innovations. Their lack of knowledge about what enacting innovations actually might take would deprive them of guidance for estimating the nature and difficulty of the work. That may help to explain the persistent idea, held by many innovators, that mere principles or organizational change alone are sufficient to improve instruction. Three recent cases in point arise from the School Development Program, The Coalition of Essential Schools, and Accelerated Schools. The designers of these three programs are extraordinarily capable, and would have been unlikely to have taken this position unless they were unaware of the weak links between schools' goals, principles, and organization on the one hand, and teaching and learning on the other. For to persist in their devotion to the idea that principles or organization would be adequate guidance for enactment, in the face of evidence to the contrary, would be to condemn their efforts to an early demise. Another bit of evidence for our view is that, as evidence began to accumulate, all three revised the designs to include more explicit elaboration of instruction, and more development.

Something of the same sort holds for enactors. In most cases they have been deprived of anything approaching adequate opportunities to learn what they would have needed to know in order to enact innovations well. That ignorance would have led them to mis-estimate their effectiveness in enacting innovation; lacking many reference points against which to judge their performance, they would have over-estimated enactment, and reported illusory fidelity. That would help to explain the frequent collisions between researchers' reports that innovations have been weakly enacted and teachers' reports that they have fully enacted the innovation in question. It also would help to explain why teachers see little or no conflict between very ambitious innovations and their inherited conventional practice. For lacking much knowledge about the innovations, owing to weak elaboration, and many opportunities to learn, arising from underdevelopment, teachers would be unable to see far beyond the surface features of an innovation.[33]

So there are cognitive consequences when innovations are not designed and elaborated as though knowledge use was the core technology of change, and are not developed as though teaching and learning would be critical to enactment. The entire enterprise lacks the understanding and orientation which knowledge could supply, and ill-informed action becomes normative. Innovation

[32] "Policy, Practice, and Performance", Teachers College Record, April, 2000.
[33] D.K. Cohen, "Revolution In One Classroom, EEPA, 1990; Cohen And Ball, same volume.

occurs in a system of self-sealing ignorance, which supports superficial design and enactment, and insufficient explanations of the results.

A more detailed example of how these ideas can be useful in explaining innovation arises in Larry Cuban's pioneering book, How Teachers Taught.[34] He argued that the classroom enactment of child-centered instruction was appreciably greater in Denver than in Washington, D.C., or New York City. He attributed the difference to the extensive effort which Jesse Newlon and his successor in the Denver superintendancy made to involve teachers in the process of implementation, and to the longevity of their leadership. Teacher involvement in implementation is important, but the evidence which Cuban presents leads us to think that their involvement in Denver had very special content. We hypothesize that Newlon created processes in which teachers actually turned ideas about child-centered teaching into some sort of instructional design, which they then elaborated somewhat, and developed. The committees of teacher leaders and teachers which the Denver schools' leaders appointed were to devise plans for changing teaching -- which is to say, design and elaborate the innovation. They also were to try their plans out, consult others in the schools, revise the plans, and report back. That looks very much like a process of practice-based, iterative, innovation planning. If our conjecture is correct, the effect was to create something much closer to an instructional innovation than was typical of efforts to enact child-centered instruction anywhere else.

The work of design and elaboration in Denver would have given the teacher-designers many opportunities to learn about enacting the innovation, in or adjacent to practice. And it would have given them many opportunities to teach other teachers about enacting the innovation. That would have been useful, for the Denver teacher committees also were charged with figuring out how other teachers could enact their plans, and to take an active part in such enactment. Having devised the plans, and tried them out, the teacher-leaders were in a position to help others learn how to enact them. That looks to us like a considered development effort, which provided teachers with unusually rich opportunities to learn the innovation.

Our point is that the processes which Newlon enabled probably were more than what Cuban terms teacher involvement, and more than what other commentators call "buy-in". These were processes of designing, elaborating, and developing an instructional innovation: writing plans for instruction, revising and expanding them, learning about the plans' operation, revising, and teaching others how to enact it. Such things were not done in either New York or Washington, the other two cities which Cuban studied. We cannot tell from this book how much Newlon was aware that he deliberately sought to turn a loose body of ideas into an innovation which might be salient for teaching and learning, but the available evidence suggests that he could have been aware. Hopefully Denver records still exist with which to check our conjecture. Returning to the cognitive consequences of innovation cultures, if we could interview those Denver teachers today, we expect that they would also have a less elevated view of how well they were doing, in comparison to their colleagues in Washington and New York City, whom Cuban also studied. For we expect that the Denver teachers would know a good deal more about the innovation and what it took to do it than their colleagues in other cities, for whom elaboration and opportunities to learn had been much more constrained. Deeper knowledge, arising from elaboration and development, would inhibit teachers' tendency to mistake superficial for deep change, and it would also make them more aware of conflicts between innovation and inherited practice.

[34] Longmans, New York, 1984.

These ideas lead us to another, concerning collective cognition. Under conditions of weak elaboration and under-development a culture of innovation grows up in which innovators learn to expect casual adoption, and accommodate by accepting or even inviting it. In such a culture, more adoptions are better than fewer. It also is functional for many innovators, both because it saves them the burdens and costs of extensive elaboration, and because problems of enactment can be laid at enactors' doors. If we could have re-done studies of past innovations we would expect a species of the Lake Woebegone effect: a large fraction of persistent adopters would believe themselves to be above average while being below. They would enact the innovation weakly while seriously believing that they had successfully enacted it. The combination of weak development and modest opportunities to learn, taken with the therefore continuing power of inherited ideas and practices, would distort enactors' perception and judgment so as to overstate their view of their own accomplishments. Only unusually capable enactors can respond constructively, by re-inventing and thereby specifying and developing innovations themselves. In effect, they do the work of elaboration and development which we have sketched above. That suggests a further development of our hypothesis about Denver: the effort in which Jesse Newlon engaged teachers was a matter of enabling teachers to elaborate and develop an instructional design from a set of very general ideas.

D. RESEARCH: Our account also has some fall-out for research on instructional innovation. The chief point is that researchers mostly have been studying very weak cases of innovation, but drawing very strong conclusions. Very few researchers seem to have asked about the frequency distribution of innovations' design, and where the cases which they were considering fell on that distribution. A second conclusion is that one source of this difficulty was the lack of theory, which could have helped researchers to consider what might be expected, and how to understand the cases which they were studying. Lacking theory, they were not able to consider what sort of evidence should be considered in weighing the enactment of innovations, and from where it should be drawn. One consequence of that is that each study considers different sorts of evidence, and another is that there is no frame in which to cumulate results.

A third conclusion is that most researchers have focused mostly on one end of the problem, looking mostly at enactment and the surrounding conditions, and taking innovation designs for granted. We have argued that those designs were mostly quite pallid, and that the conclusions which have been drawn thus have make sense only for such weak innovations.

We offered a different approach to research, grounded in our theoretical work on instruction and instructional innovation. This provides both a broad frame for innovation and research on it, and more specific guidance for inquiry. For example, our ideas about design, elaboration, and development are useful for practice, but can also be used to frame data collection and analysis for research. As the last several pages suggest, there is no shortage of important work.

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We have argued that weak elaboration is the typical condition of instructional innovation in the U.S., and that it creates a linked set of "normal" conditions. One has been to tacitly delegate enormous problems to enactors, and to create great uncertainty about how to adopt or enact innovations. But another has been to shield innovators and enactors from that knowledge, leaving knowledge of the operations and demands of innovations ambiguous to all.. The lack of elaboration and ensuing uncertainty has made it easy for potential adopters to interpret innovations in their inherited and mostly conventional reference frames, and thus to overestimate the ease of adoption and enactment. It also has deprived enactors of guidance which might enable them to figure out whether their efforts to enact an innovation are at all reasonable. Lacking detailed understanding of the operational features and demands of innovations, innovators could not know much about the likely entailments for enactment. Without a good grip on that, they could not carefully consider what enactment would require from schools, teachers, learners, and others. And lacking that, innovators could not prepare very well to manage enactment, to figure out how to deal with its problems, or how to help enactors deal with them.

In explaining enactment our analysis can be summarized in a blunt claim: weaknesses in the instructional features of most innovations alone are sufficient. Even if all of the organizational problems to which scholars have directed attention had been solved, patterns of enactment would have remained substantially the same. For the innovations did not offer much to enact, even under the best conditions.

But ignorance has rewards: it enables the very common claim by practitioners that innovations which they had adopted and enacted were entirely compatible with conventional practice. For weak elaboration deprived enactors of guidance which might enable them to figure out whether their efforts to enact an innovation were on a reasonable track. That made it easy for enactors to interpret innovations in their inherited, mostly conventional, reference frames, and to hold very limited views of what enactment required of them. The result has been a culture of innovation in which very imperfect information has been self-sealing, protecting most participants from deep awareness of the skimpiness of what they do.

Nothing but fragmentary and superficial enactment could be expected from weak innovations in such a culture of change. One does not need to resort to elaborate explanations. The story thus far Is largely one of the failure of innovation design -- we are only beginning to see innovations which would enable us to probe reasons for success and failure in enactment. It has not only made fragmentary and conventional enactment a virtual certainty, but it has created two very different ways of thinking about innovation. Researchers seem mostly to agree that most innovations fail and that failure is inevitable, while many practitioners report that their efforts to innovate have been reasonable and successful.

Adoption or enactment cannot be predicted and then planned in detail, for the world is awash in uncertainty, no less for instructional innovation than for polar exploration. But explorers who learn what they can about the terrain and conditions, the experience of others who have gone before, the performance of their equipment, and its suitability for the expected conditions, can make more informed choices, and have a better basis to deal with uncertainty than those who make no such preparation.