How Should Research Contribute to Instructional Improvement? The Case of Lesson Study

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Lesson study, a Japanese form of professional development that centers on collaborative study of live classroom lessons, has spread rapidly in the United States since 1999. Drawing on examples of Japanese and U.S. lesson study, we propose that three types of research are needed if lesson study is to avoid the fate of so many other once-promising reforms that were discarded before being fully understood or well implemented. The proposed research includes development of a descriptive knowledge base; explication of the innovation's mechanism; and iterative cycles of improvement research. We identify six changes in the structure and norms of educational research that would enhance the field's capacity to study emerging innovations such as lesson study. These changes include rethinking the routes from educational research to educational improvement and recognizing a "local proof route"; building research methods and norms that will better enable us to learn from innovation practitioners; and increasing our capacity to learn across cultural boundaries.

Lesson study, the professional development approach credited for Japan's steady improvement of elementary education, has recently emerged in hundreds of locations across the United States (Lesson Study Research Group, 2004; Lewis, Perry, & Hurd, 2004). Its emergence provides an opportunity to see whether recent visions of education research as "science" (see *Educational Researcher,* November 2002, special issue) and as "design-based science" (see *Educational Researcher,* January/February 2003, special issue) offer the tools needed to study a rapidly emerging, locally initiated innovation.

After providing a brief background on lesson study, we build a case that three types of research on lesson study are critically needed: (1) expansion of the descriptive knowledge base on lesson study; (2) explication of lesson study's mechanism; and (3) iterative cycles of testing and refinement of lesson study. Our arguments are induced from analysis of current knowledge about lesson study and about innovation more broadly, rather than deduced from a particular theoretical vision of research. The final section of the article suggests six changes that are needed in the education research environment if lesson study—and other locally initiated innovations—are to be studied effectively.

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Brief Description of Lesson Study

Lesson study is a translation of the Japanese words *jugyou* (instruction, lessons, or lesson) and *kenkyuu* (research or study). The term *jugyou kenkyuu* encompasses a large family of instructional improvement strategies, the shared feature of which is *observation of live classroom lessons by a group of teachers who collect data on teaching and learning and collaboratively analyze it* (Lewis, 2002a, 2002b; Lewis & Tsuchida, 1997, 1998; Wang-Iverson & Yoshida, 2005). The observed lessons, called "research lessons," are regarded not as an end in themselves but as a window on the larger vision of education shared by the group of teachers, one of whom agrees to teach the lesson while all the others make detailed records of the learning and teaching as it unfolds. These data are shared during a post-lesson colloquium, where they are used to reflect on the lesson and on learning and teaching more broadly (Lewis, 2002b, p. 2).

Figure 1 graphically depicts the lesson study cycle. Lesson study shares certain characteristics with various North American professional development approaches. For example, lesson study shares with analysis of student work a focus on evidence of student thinking, and it shares with video cases the analysis of actual instruction. However, no other approach has exactly the constellation of characteristics found in Figure 1, with a live classroom lesson as the centerpiece of study (Lewis, 2002b; Perry & Lewis, 2004). In fact, the simple practice of observation in colleagues' classrooms for the purpose of professional learning is rare in the United States (Darling-Hammond, 1997; Darling-Hammond & Ball, 1998).

Brief History of Lesson Study in North America

In 1999, the Third International Mathematics and Science Study brought existing ethnographic accounts of lesson study to a broad public audience (Stigler & Hiebert, 1999). In the space of just over 4 years, lesson study emerged at more than 335 U.S. schools across 32 states and became the focus of dozens of conferences, reports, and published articles (Brown, McGraw, Koc, Lynch, & Arbaugh, 2002; Chokshi & Fernandez, 2004; Fernandez, 2002; Lesson Study Research Group, 2004; National Research Council, 2002; North Central Regional Educational Laboratory, 2002; Perry & Lewis, 2004; Richardson, 2004; Stepanek, 2001, 2003; Wang-Iverson & Yoshida, 2005; Watanabe, 2002; Wilms, 2003). Despite these numbers, the whole edifice of U.S. lesson study actually rests on just two examples of full Japanese lesson study cycles: Yoshida's (1999) dissertation case of mathematics lesson study in a Japanese elementary school (which formed the basis for Stigler and Hiebert's chapter on lesson study and is now available in Fernandez & Yoshida, 2004); and a case of science lesson study in a Japanese elementary school, captured on the videotape "Can

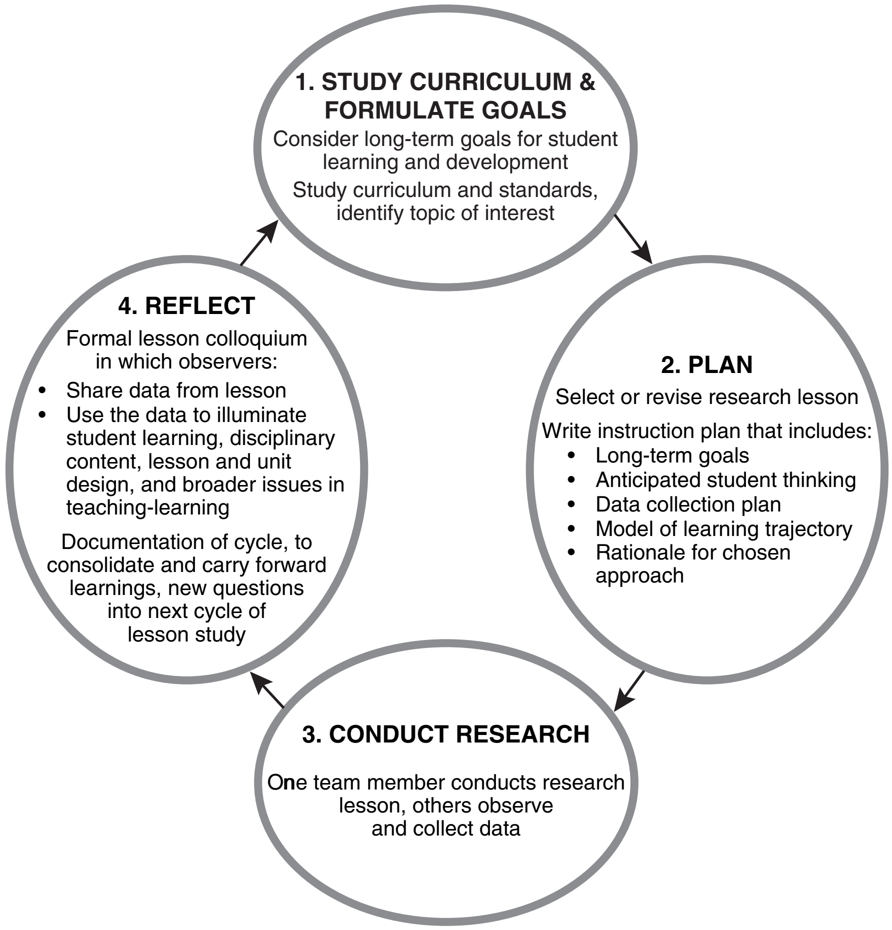


FIGURE 1. *Lesson study cycle.*

You Lift 100 Kilograms?" and in two written works (Lewis 2002b; Mills College Lesson Study Group, 2000). Both accounts come from elementary schools, only one of many contexts for lesson study in Japan.

Critical Research Need 1: Expansion of the Descriptive Knowledge Base on Japanese and U.S. Lesson Study

The first pressing research need, therefore, is to expand the descriptive knowledge base on lesson study beyond the two cases currently available, in order to provide a fuller view of lesson study, reveal its constant and varying features, and identify adaptations relevant to needs in diverse U.S. settings. In Japan, lesson study is initiated by teachers and may be sponsored by a variety of organizations, including schools, districts, professional organizations, and independent study groups; it takes on somewhat different characteristics under each type of sponsorship (Lewis & Tsuchida, 1998; Lewis, 2002a, 2002b; Murata & Takahashi, 2002; Takahashi, 2003). For example, research lessons sponsored by university elementary schools and national professional organizations often attract thousands of educators eager to visit schools where educators are forging new approaches to help students write poetry, think scientifically, reason about proportions, understand community problems, sing choral music, or engage in myriad other kinds of learning. In contrast, research lessons sponsored by local schools may involve only teachers within a single school who carefully study their own students, often focusing on a schoolwide research theme. Likewise, the features of lesson study differ across settings. For example, a Japanese school reform network modeled on the Coalition of Essential Schools eschews the carefully written lesson plan that is a hallmark of most lesson study (Fernandez & Yoshida, 2004; Lewis, 2002b; Stigler & Hiebert, 1999), preferring instead for observers "to experience the lesson as the students do, without knowing what it is *supposed* to be about" (Sato & Sato, 2001). Over the past century, lesson study has evolved in tens of thousands of sites across Japan, resulting in great variations with respect to lesson study goals, practices, norms, scheduling, governance, and other dimensions of great practical and theoretical interest to U.S. educators. Knowing about more of these sites might substantially enrich or alter our picture of lesson study.

Descriptions of U.S. lesson study will not provide an adequate substitute for Japanese examples, since early evidence suggests that U.S. lesson study practitioners may alter key features of Japanese lesson study. For example, U.S. practitioners may focus on teacher moves rather than on student learning; make impressionistic notes rather than thorough observational records; and engage in discussions that emphasize debate rather than listening and reflection (Fernandez, Cannon, & Chokshi, 2003; North Central Regional Educational Laboratory, 2002; Perry & Lewis, 2004). While a descriptive knowledge base may be particularly critical for an innovation of foreign origin like lesson study, many home-grown innovations also suffer from inadequately formulated or shared knowledge about what actually constitutes the innovation (Cremin, 1961; Fullan, 2001).

Critical Research Need 2: Explication of the Innovation Mechanism

A second need is to explicate the mechanism by which lesson study results in instructional improvement. Innovations often fail when educators focus on the surface features of the innovation rather than on the underlying mechanism that will enable it to work (Fullan, 2001; McLaughlin & Mitra, 2001). For example, a focus on surface features of "reform mathematics," such as hands-on activities and discussion, may prove a lethal substitute for attention to the underlying mechanism of developing students' mathematical reasoning through problem solving (Spillane, 2000; Cohen, 1990).

Figure 2 illustrates two alternative ideas about the mechanism by which lesson study improves instruction. The view of lesson study labeled as Conjecture 1—that lesson study improves instruction primarily through the refinement of lesson plans—appears to be widespread, judging from how frequently we are asked questions such as "If Japanese teachers spend so much time on one lesson, how do they ever get to all the lessons in the curriculum?" The teachers of one U.S. school district initially called their lesson study work "Polishing the Stone" and planned to disseminate "polished" lesson plans on the district intranet as their final product. However, the teachers later dropped the name and redefined their work as teacher-led research on practice, disseminating it not through lesson plans but through public research lessons where visitors engaged in joint lesson observation, data collection, and discussion. Conjecture 2 (outlined in Figure 2) represents our current thinking about the mechanism of lesson study (for further discussion, see Lewis, 2002b; Lewis, Perry, & Hurd 2005).

Models that specify the connections between lesson study's observable features and instructional improvement, even in a tentative, emerging fashion, can be useful in several ways. By forcing a conversation about the essential features of lesson study, a model can make the innovation mechanism more visible, focus data collection, illuminate "zones of wishful thinking" in the innovation design (Hill, Campbell, & Harvey 2000), increase the likelihood of data and model sharing across sites, and stimulate model improvement. Models may also enable innovators to avoid rote implementation of surface features and to adopt a more thoughtful and flexible—less recipe-like—approach to innovation and accompanying research. Conjecture 2 may enable educators to approach lesson study much more thoughtfully than Conjecture 1.

Critical Research Need 3: Design-Based Research Cycles

Design-based research cycles enable researchers to progressively hone an innovation while also building theory about how it works—"to develop theories, not merely to empirically tune 'what works' " (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003, p. 9; Barab & Squire, 2004; Linn & Hsi, 2000). For example, teacher–leaders from "Bay Area School District" have worked with us on repeated "cycles of design, enactment, analysis, and redesign" of lesson study (Design-Based Research Collective, 2003, p. 5), drawing on data including lesson study meeting transcripts, lesson video-recordings, and periodic "theory of action" interviews. Design-based cycles may produce "usable, actionable, and adoptable" artifacts that "leverage learning" in other sites (Bannan-Ritland, 2003, p. 24.).

The appendix excerpts one such usable artifact, a video that traces the learning of a group of teachers during a lesson study cycle, in order to make visible some of the pathways by which teachers may learn during lesson study. The mathematics problem under consideration is to find the relationship between the number of "tables" and the number of "seats" when the (triangular) tables are arranged contiguously in a row with one seat per exposed side, as Figure 3 illustrates. Teacher 1 initially cannot describe the "plus-two"

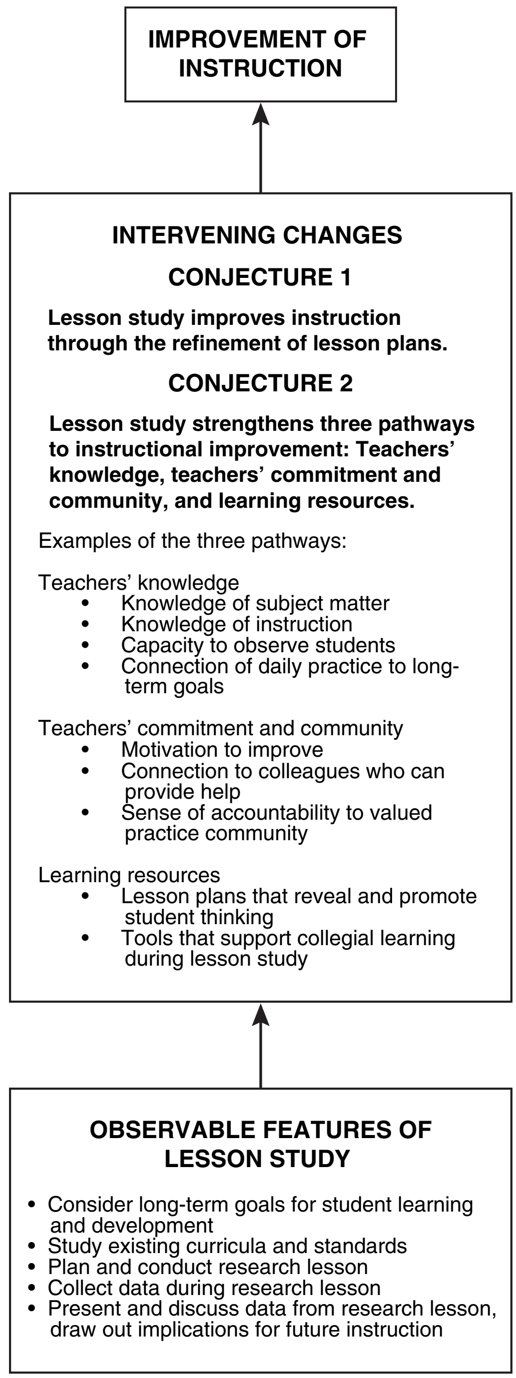
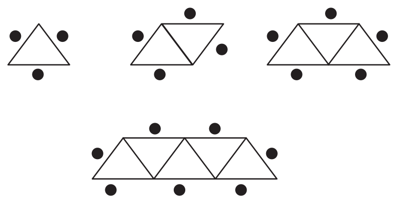


FIGURE 2. *How lesson study results in instructional improvement: two conjectures.*

We have a long, skinny room and triangle tables that we need to arrange in a row with their edges touching, as shown. Each side can hold one "seat," shown with a black dot. Is there a pattern that helps you figure out how many seats any given number of tables will hold?



INPUT Number of triangle tables	OUTPUT Number of seats
1	3
2	4
3	
4	
5	
6	

FIGURE 3. *Lesson task and worksheet.*

pattern that relates the number of triangles to the number of seats (August 7, 2002), but can later clearly describe the pattern (August 9, 2002) and the geometric reason for it (August 14, 2002).

Video like that transcribed and excerpted in the appendix may build the practice and theory of lesson study in several ways. First, it can enable researchers to identify, test, and refine key features of lesson study, such as having teachers solve and discuss the task to be given to students. (It was in the course of such a discussion that Teacher 1 puzzled aloud about the mathematics.) In this way, lesson study can be used to test and expand our theories of professional learning (Cochran-Smith & Lytle, 2001; Grossman, Wineburg, & Woolworth, 2001; Loucks-Horsley, Love, Stiles, et al., 2003; National Research Council, 2002; Schorr & Lesh, 2003; Shulman & Shulman, 2004). Further, video and other "actionable artifacts" may capture important elements of an innovation, enabling it to be enacted and studied more easily at new sites. Teachers who view the video excerpted in the appendix commonly draw many implications for their own lesson study work, such as the value of carefully recording student solution methods (see appendix, August 12 colloquium), of enabling team members to raise questions about subject matter, and of formulating written plans and reports that require group consensus.

Implications for Education Research and Policy

The three research directions that we propose for lesson study—expansion of the descriptive knowledge base, explication of the innovation mechanism, and testing of design-based improvements—may seem commonsensical. Who would argue that we should characterize an innovation based on just a few examples, ignore the mechanism underlying an innovation, or summatively evaluate an immature innovation without first doing all we can to improve it? Yet we believe there are strong pressures to do all of these things. Following are six changes that would enhance our field's capacity to effectively study locally emerging innovations such as lesson study.

1. Recognize "local proof" as a legitimate route to educational improvement.

Table 1 grew from an interesting paradox. Lesson study has been known in the United States for just a few years, and U.S. researchers are already proposing randomized controlled trials, horse-race style comparisons, and other summative research designed to find out "whether lesson study works." This eagerness to conduct summative research contrasts remarkably with the situation in Japan, where lesson study has been used for a century without summative evaluation (Akita, 2004). We speculate that this is because much education research in Japan follows the "local proof" path described in Table 1, in which instructional knowledge accumulates through progressive advances in research lessons taught in various local contexts across Japan, rather than through large-scale or centralized studies.

Using lesson study, Japanese educators make public their ideas about instructional design in the form of research lessons that are observed and discussed by local and outside educators (often including university-based educators; Bjork, 2004; Fernandez & Yoshida, 2004; Lewis, 2002b; Lewis & Tsuchida, 1998, 1999; Tam, 2004; Tsuneyoshi, 2001, 2004; Yoshida, 1999). Observing educators closely scrutinize both the teaching-and learning process and its rationale, and they make sense of these through discussions, sometimes reshaping their own practice and research lessons as a result. As they do so, widely shared norms about teaching and learning may begin to change, as was the case in the shift from "teaching as telling" to "teaching for understanding" in Japanese elementary science instruction over a period of several decades (Lewis & Tsuchida, 1997). In the United States, the National Writing Project has followed a somewhat similar trajectory of reform informed by university-based research but initiated and spread, in large part, by teachers engaged in shared observation and discussion of lessons and student work (Lieberman & Wood, 2002). In both the Japanese lesson study context and the National Writing Project, school-based teacher–researchers and university-based researchers collaborate closely; in the local proof route, both are "researchers."

The Japanese Ministry of Education, Culture, Sports, Science and Technology supports the local research route through research funding to schools across Japan that apply to be "designated research schools" for curricular innovations under consideration. Over a period of several years when an innovation is being considered or initiated, teachers at designated research schools engage in repeated cycles of lesson study, often inviting observation by university-based specialists and nationally known teachers interested in the particular innovation (Bjork, 2004; Lewis & Tsuchida, 1997, 1998; Tam, 2004; Tsuneyoshi, 2004). Teachers at the designated research schools study existing curricula and materials (often including approaches from abroad), adapt or develop approaches they think will work in their own settings, and study students' responses to the new types of instruction. After cycles of internal lesson study, teachers conduct public research lessons that bring to life the local vision of the innovation, enabling visiting educators to observe the instructional approach and the students' learning and development, and providing a public forum for lively discussion of the local theory of the innovation.

"Local theory" of an innovation may include, for example, the idea that science units should begin with a challenging and mem-

Table 1
Two Routes From Research to Spread of Instructional Improvement

Route Characteristics	General Proof Route	Local Proof Route
Description	Innovation is proved effective through controlled study. Planned dissemination follows.	Innovation is built or rebuilt locally. Local data are used to assess and improve innovation effectiveness. Spread may be organic or planned.
Research products and warrant	Innovation is well-specified, designed to be transportable across sites. Causal evidence of impact is strong at original sites.	Innovation may differ across sites and over time. Evidence of causality may be weak.
Interaction between innovation and site	Low or predictable. Innovation is designed to be transportable, and to have reliable effect across sites and across time.	Innovation may depend on local capacity and be designed to build it. Innovation may transform and be transformed by sites over time.
Dissemination	Dissemination is centrally planned to maintain effective features. Dissemination occurs after innovation is proved effective in controlled trials.	Locally initiated spread may occur at any time.
Flexibility of innovation	Flexibility is limited at initial stage of controlled research in order to avoid poor implementation. "Fidelity" of implementation may be a major emphasis at dissemination sites.	Continuous adaptations are possible. Local adaptations are expected and studied as sources of potential improvement to innovation design and theory. "Lethal mutations" may also occur.
Institutionalization	External controls that are needed to maintain fidelity may initially reduce local buy-in. Institutionalization is fully visible only after external controls and incentives associated with dissemination are withdrawn.	The innovation and the local structures may adapt to each other from the start, thus beginning the institutionalization process early.
Knowledge base	Knowledge base must be held centrally and include knowledge relevant to all cases in the study.	Knowledge base may be held locally, be embodied in local structures (rather than "known"), and include only the knowledge needed locally.
Major strengths	Strong causal inferences possible. Innovation is well defined and can be used across various sites.	Local adaptation, ownership, improvement, and spread are possible. Local data can be used to warrant effectiveness.

orable real-world problem (such as lifting a 220-pound weight) rather than a simulation or small desk-top investigation; or the idea that daily mathematics journals can be used in specific ways to increase the quality and quantity of discourse among students during class time. Visitors can ask about the lesson and the broader local context of instruction and suggest competing explanations or approaches. Lesson study thus provides a professional knowledge base for teaching that is public, shareable, and verifiable (Hiebert, Gallimore, & Stigler, 2002). Over time, local practice and theory that are persuasive to visitors may spread widely and breed changes in widely shared norms about teaching and learning, in textbooks (which are written by practicing teachers), and even in national policy (Hashimoto, Tsubota, & Ikeda, 2003; Lewis & Tsuchida, 1997; Lewis, Tsuchida, & Coleman, 2002; Watanabe, 2002).

Lesson study generally fits the definition of scientific inquiry laid out by the National Research Council (2002; see also Feuer, Towne, & Shavelson, 2002), with two possible shortcomings. (As noted below, the shortcomings may actually provide strategic advantages with respect to dissemination.) The first shortcoming concerns data collection: The data are fine-grained and collected from very small samples and without formal attention to inter-observer reliability. For example, observers might record how many students in a class progress from counting by ones to flexibly decomposing 10 over the course of a lesson on addition or subtraction, and, as evidence for student thinking and motivation, what students are murmuring under their breath as they devise ways to lift a heavy sack (Lewis & Tsuchida, 1998, 1999; Murata, 2004; Yoshida, 1999). It is expected, in fact, that different lesson observers will notice different things and that the resulting discussion will foster teachers' development. Indeed, Japanese teachers describe "developing the eyes to see children" as a primary benefit of lesson study (Lewis, 2002a, 2002b). To draw on the example of seats and tables presented above, only one teacher initially took note of student counting methods, but other team members subsequently recognized the value of observing how students counted. Fine-grain measures of student behavior such as counting by ones or murmuring may not seem "scientific" in comparison with distal measures (e.g., achievement tests) commonly found in U.S. educational studies. In both cases, however, researchers use some combination of theory, empirical study, and logical analysis to establish the validity of the measure, whether it is flexible decomposition of 10 as a step toward multi-digit addition (Fuson, 1992a, 1992b) or standardized tests.

A second possible shortcoming of lesson study as scientific inquiry is the lack of a clear causal warrant (see Table 1). Essentially, educators may be able to craft a set of practices that work locally (e.g., that reduce truancy or increase students' persistence in solving novel mathematics problems), whether or not they can define precisely the causal set of practices or separate them from other elements of the local context. Knowledge about how to adapt the innovation to local circumstances may be embodied in local structures (e.g., collaborative habits) rather than consciously "known" (Cobb, McClain, et al., 2003; Rogoff, 1990, 1995). Causal attributions to the innovation may not be possible, but the innovation may nevertheless spread in a grassroots fashion if other individuals have opportunities to see it in action and are persuaded by what they see (Rogers, 1995). While the "general proof route" described in Table 1 is more rigorous in terms of causal warrant, the local proof route can result in rapid, locally tailored instructional improvement if local innovators gather valid and important data on students and use it to reshape instruction. That is what the teachers represented in the appendix did when they revised their instruction so that students could learn from one another's counting methods. Practitioners adapt and spread innovations that they perceive to be valuable, regardless of research findings (Lieberman & Wood, 2002; Rogers, 1995). Researchers may be able to add significant value to practitioners' efforts by illuminating the innovation's mechanism and design. But for this to occur, the local proof route must be recognized as a legitimate route for research contributions to educational improvement—with all that such recognition implies for funding, publication, and investment in research methods.

The general proof section of Table 1 illustrates a research approach that is more familiar to U.S. researchers: controlled trial of an innovation's effectiveness followed by planned dissemination. The general proof route is often regarded as the ideal path enabling research to contribute to educational improvement, because causal inferences and centrally planned dissemination are possible (e.g., U.S. Department of Education, 2003; Mosteller & Boruch, 2002). However, as the next section highlights, this route also has drawbacks.

2. Recognize the trade-offs of "local" and "general" proof.

As Table 1 suggests, an innovation is well suited to general proof if it is easily specified, interacts little (or in predictable ways) with local contexts, and can be neatly separated from those local contexts. (Aspirin is often used as an example of such an intervention.) A National Research Council report notes, "Experiments are especially well-suited to situations in which the causal hypothesis is relatively simple" (2002, p. 109). However, the very qualities that suit an innovation to controlled trial may handicap it at the later stage of broad dissemination. Those qualities include, for example, external specification that limits local sense of ownership; simplification that enables easy transport and wide usability but compromises quality; creation of a compromise "Swiss Army Knife" version that contains features for many sites but is not well adapted to any one; and emphasis on fidelity to the original design that stifles continuing improvement. Conversely, the very characteristics that make an innovation (such as lesson study) difficult to study in a well-controlled fashion—adaptation to local circumstances, reliance on local teacher leadership and commitment, and transformation of the local users and of the innovation over time—may foster local institutionalization and grassroots spread. Teachers have been key players in lesson study's rapid spread in the United States and its widespread voluntary use in Japan. When confronted with an innovation "with legs," as one educational administrator described lesson study, researchers have two choices: We can specify and freeze in time a particular version of lesson study in order to apply summative research methods, or we can adopt research methods suited to a rapidly evolving and locally adapted innovation. Each approach has trade-offs, but we think the disadvantages of the general proof route are much less widely recognized among U.S. researchers than those of local proof. In part, this is because we often choose the wrong endpoint for research: causal proof of an innovation's effectiveness under controlled circumstances at initial sites, rather than "legs" and effectiveness at subsequent sites of spread. Too often, spread of a "proven" innovation is regarded as a separate research phase and a mere technical chore, despite the overwhelming evidence of the difficulty of the dissemination phase and its intimate relationship to the initial characteristics of the innovation as an externally designed entity (Burkhardt & Schoenfeld, 2003; Fullan, 2001; McLaughlin & Mitra, 2001).

In summary, it should be incumbent on researchers to justify their choice of research methods based on the endpoint—*instructional improvement at sites of spread*—not just the premature stopping-point, *proof of innovation effectiveness under controlled conditions.* The seeds of dissemination success or failure may well be planted at the outset of innovation. Our metric for judging innovation research design should therefore consider not just whether a design allows causal inferences (National Research Council, 2002), but also whether it is likely to promote or to undermine effective local adaptation and grassroots spread of innovation.

3. Ask whether it is reasonable and ethical to conduct summative research.

One downside of the general proof route is that "the use of randomized trials may hinder innovation studies by prematurely judging the efficacy of an intervention" (Design-Based Research Collective, 2003, p. 6). Given the variety of lesson study models emerging in the United States, conclusions drawn about one model of lesson study may have little relevance to other models (compare, for example, the two conjectures in Figure 2). Nevertheless, a single randomized controlled trial showing that lesson study "doesn't work" might foreclose lesson study's future in the United States, sending it to the graveyard that holds so many once-promising educational innovations, many of which were never fully understood or implemented (Fullan, 2001). When is it reasonable and ethical to subject an evolving innovation such as lesson study to summative research? It seems reasonable to ask that an innovation be highly developed (i.e., unlikely to benefit substantially from further design-based research and refinement) and transportable before subjecting it to summative trials (Cobb et al., 2003; Design-Based Research Collective, 2003). A National Research Council (2002) report notes that, prior to summative research, "ideally, a strong theoretical base as well as extensive descriptive information are in place to provide the intellectual foundation for understanding causal relationships" (p. 108).

4. Define lesson study productively.

For the purpose of conducting controlled summative research, a productive definition of lesson study would be a checklist of observable features, such as those listed in Figure 2. Were lesson study like aspirin—an intervention that is changed little by local settings—the features listed in Figure 2 might be sufficient to define lesson study. However, these features do not automatically result in the changes shown in the center of Figure 2. Many local factors intervene. For example, the study of curriculum and standards fosters teachers' knowledge only to the extent that local curricula and standards support rich disciplinary and pedagogical discussions. Pervasive local competition and hierarchy may make it very hard for teachers to build a valued practice community in some settings. Lesson study is both intimately dependent upon and designed to build local teachers' knowledge, their commitment and community, and learning resources (see central portion of Figure 2).

One solution to the interactivity of lesson study and local characteristics could be to specify the characteristics of lesson study in great detail—for example, to specify that teachers must study certain excellent curricula, or that group interaction must meet certain quality criteria. However, the work of compiling such a list of observable features (and proving they can be reliably observed) seems much less productive than the use of video and other actionable artifacts that capture some of the growth pathways in the center box in Figure 2, showing how teachers deepen content knowledge, warrant instructional views with evidence about student learning, build productive collegial connections, and so forth. In this way, aspiring innovators may see not just the short list of observable features of lesson study, like study of existing curriculum, but the transformations of local capacity (Rogoff, 1995) that lesson study is designed to create. However, we are sometimes accused of "tautological" thinking when we define lesson study in part by the changes that it is expected to create.

We think the most productive definitions of lesson study with respect to the larger endeavor of instructional improvement will take a form something like that outlined in Figure 2—they will be models that lay out both the observable features of lesson study and the intervening pathways that it is expected to build. A productive definition for the purpose of a controlled experiment (where faithful reproduction over multiple sites is paramount) may be quite different from a productive definition for the purpose of building capacity for local use and adaptation of the innovation (where building the judgment to understand and wisely adapt an innovation is paramount). As Linda Darling-Hammond noted in 1997,

> For most of this century, policy-makers sought knowledge that would aid them in the remote control of teaching—generalizable dicta that would shape the design specifications for teaching via texts, curriculum packages, and teaching procedures. This trickle-down theory of knowledge envisioned that teachers could get all that they needed from these tools and their teachers' manuals: five rules for a foolproof classroom management system or seven steps to a perfect lesson. When these directives and materials proved inadequate to the real complexities of teaching, teachers were left with whatever knowledge they had managed to accumulate on their own, largely from personal experience. (p. 323)

5. Encourage refinement.

In the United States, policymakers and university-based researchers frequently ask *whether* lesson study works. To us, the question "Does lesson study work?" is a lot like the question "Does teaching work?"—the answer always depends on the details of how it is done. The specific processes that make lesson study work—choosing tasks that reveal student thinking, designing tools that support effective data collection by teachers, crafting discussion protocols that keep the focus on student learning—are only beginning to be understood. Novice U.S. lesson study groups may lack these elements (Chokshi & Fernandez, 2004), making it critical to identify and test the tools and processes that make lesson study effective. Some research suggests that the effectiveness of an innovation may be increased several hundredfold through cycles of refinement and testing (Linn & Hsi, 2000). Yet several factors may discourage education researchers from the important and intellectually demanding work of refinement.

First, generating and testing big new ideas—not the refinement of familiar ideas—may be seen as the primary work of education researchers, and the work most deserving of attention, funding, and status. As a group, education researchers may be addicted to new ideas, and ignore the considerable intellectual challenges entailed in refining old ideas so that they work in various settings (Burkhardt & Schoenfeld, 2003). Second, journals generally prefer summative results; there are few publication outlets for exchange of in-progress models such as Figure 2. Finally, the design-based research methods used to refine and adapt big ideas to varied real-world settings are less familiar to many researchers and less developed than their summative counterparts, and fraught with many disagreements about what constitutes reliability, evidence of causality, and so forth (Barab & Squire, 2004; Kelly, 2003, 2004; Shavelson et al., 2003). For example, there are no agreed-upon standards for selecting, from hours of videotapes, examples of teachers' learning such as that provided in the appendix; or for making inferences about what enabled Teacher 1's change in thinking; or for figuring out how many incidents of learning like that in the appendix qualify an innovation as "effective" or how many counter-examples qualify it as "ineffective."

Japan's elementary education system provides a provocative example of the power of a systemwide focus on refinement of ideas. While the Japanese criticize themselves for borrowing so many ideas from abroad, we might want to notice how profitably they have refined and spread many big ideas that came from the United States, including the ideas of John Dewey, George Polya, and post-Sputnik U.S. mathematics and science reforms. All of these have been systematically refined by Japanese practitioners through the lesson study process and have contributed to Japan's elementary education achievements (Lewis, 1995; Lewis & Tsuchida, 1997; Linn, Lewis, Tsuchida, & Songer, 2000; Stevenson & Lee, 1990).

6. Learn across boundaries.

As education researchers, we often encounter the assumption that educational sites must be similar to allow educators to learn from one another's practices: that U.S. schools cannot learn from Japanese schools, that schools serving low-income students cannot learn from schools serving middle-income students, and so forth. Similarity no doubt supports some processes of learning, but dissimilarity may support other processes of learning, such as becoming aware of our own values and assumptions, seeing practices that follow from different assumptions, changing our view of what it means to learn a particular subject, or revising our expectations about what is possible in schools.

The distance between the U.S. and Japanese educational systems is presumably the same whether it is viewed from the Japanese or the U.S. side of the ocean. Yet Japanese education researchers have drawn much more extensively on U.S. practice and theory than have we on theirs. While one is tempted to dismiss this as a problem of the Japanese language, it is worth noting that some disciplines (e.g., history, economics, anthropology, law, business) routinely recruit scholars with expertise in Asian languages and area studies because their perspectives are considered essential to a full disciplinary understanding.

A second type of learning across boundaries is the capacity of researchers to learn from practitioner-initiated innovations. Current education research methods, norms, and professional rewards make it easier for a researcher to dismiss locally initiated innovations ("I heard that lesson study doesn't work in the U.S."), or to subject them to premature (and likely fatal) summative study, than to add something of value through research that explicates and refines the innovation theory. The methods that are needed if we are to follow, learn from, and add something of value to locally initiated innovations are poorly developed and poorly agreed upon in comparison with the methods used to conduct and evaluate researcher-controlled interventions (Shavelson et al., 2003; Kelly, 2004).

Conclusion

Faddism has been identified as a pressing problem of U.S. education (Burkhardt & Schoenfeld, 2004; Paige, 2002). Will lesson study be one more fad? The root cause of educational faddism, in the view of some policymakers, is adoption of educational practices that have not been tested through controlled trials (Paige, 2002). In contrast, we suggest that summative trials of lesson study—given how little is currently known about its nature and mechanisms—might actually contribute to making it a fad. Controlled experimental research on immature versions of lesson study could lead us to conclude that it doesn't work, and to move on to the next promising idea.

We have argued that three types of research are needed at this stage to vigorously explore lesson study's potential as a tool of instructional improvement. These include the creation of a broader knowledge base about lesson study (as practiced both in Japan and in the United States) so that we can develop sound ideas about its central features; the explication of lesson study's mechanism; and cycles of design-based research that test key design features and create "actionable artifacts" to leverage learning at new sites. We have noted substantial barriers to such research, however, including a reward structure within education research that emphasizes new ideas and provides little incentive to share in-progress models, refine existing approaches, or study practitioner-initiated innovations. We identify six changes in education research norms that would make it easier for the U.S. education research community to add something of value to lesson study and other locally initiated innovations. Foremost among these is the recognition of a "local proof route" whereby locally initiated innovations can contribute to broad instructional improvement, with education researchers supporting the explication, development, and testing of such innovations. We have argued that, for the most part, lesson study and the "local proof route" meet the criteria of "scientific" education research (National Research Council, 2002; Shavelson et al., 2003) and that design-based research methods will be important to lesson study's adaptation and testing in North America. We suspect that our field's willingness and capacity to study locally initiated innovations, to invest in repeated cycles of principled adaptation and study, and to accumulate and spread knowledge in ways that enable active *local* adaptation and ownership of innovation will be the keys not just to the fate of lesson study but to the efficacy of education research in general.

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APPENDIX
Excerpts From Transcript of a Videotaped Lesson Study Cycle

The following transcript excerpts highlight the learning of a group of teachers during a lesson study cycle. The teachers are considering the mathematics problem illustrated in Figure 3.

August 7, 2002

Evidence: Planning Meeting

Teacher 1: I thought when we added a triangle we were adding two, but the output chart here is adding one, and I'm not, I don't understand why that is. . . .
Teacher 6: Because the third one is now a combined one.
Teacher 2: One plus two. It's plus two *this way* [moves finger horizontally across Teacher 1's chart, to show comparison between seats and tables].
Teacher 1: Oh. Wait a second [studying triangles].
Teacher 5: So maybe it would be a good time for us to do the activity?
Teacher 1: [Laughing] Yeah, maybe! [the teachers work the problem with manipulatives and discuss]. . . .
Teacher 6: Because if you have one triangle you have three [sides], but then when you have two [triangles], one of those three [sides] becomes a combined.
Teacher 1: *Two* of them become combined, that's why you don't have five. 'Cause I'm thinking, how come I don't have three plus two?
Teacher 6: I just did the same thing!
Teacher 4: You don't count the shared side.
Teacher 5: It's the number of triangles plus two.
Teacher 2: It's all plus two. It's plus two *this* way [gesturing across Teacher 1's chart, comparing triangles and perimeter units]. . . .
Teacher 1: But, now, why is that? . . . I'm still, though, why isn't it if I add a triangle, . . . why am I not . . . [continues to work with the triangles, initially with puzzled tone of voice, then increasingly matter-of-fact as she tries different numbers of triangles]. Three. So there's the two. . . . [with confidence]. This does not fit for zero triangles. This formula is not an *n* formula, it is not like "in any case," 'cause it has to fit for zero stage, right?
Teacher 2: I don't know. I'd have to ask.
Teacher 1: If the number of triangles is zero, you do not have two sides when you have no triangles.

Researcher's Inference

Teacher 1 is trying to understand the meaning of the "plus-two" pattern in the chart. She initially merges the plus-one pattern (each additional triangle adds one perimeter unit) and the plus-two pattern (the number of perimeter units is two more than the number of triangles). By trying different numbers with the manipulatives, the teacher distinguishes the plus-two numerical pattern.

Design Principle

- Teachers should solve and discuss the mathematical task to be presented to students. When they do, teachers' mathematical thinking becomes visible and available for challenge, elaboration, and development.

August 9, 2002

Evidence: Planning Meeting

Teacher 1: [Reading from group's instructional plan goals] Students will discover a pattern and they will represent the pattern as a rule. They will understand what a mathematical rule is and will be introduced to the idea of representing the rule as an equation.

Teacher 2: So, representing the rule as an equation, that's a little bit . . .

Teacher 3: Going in another direction.

Teacher 1: But it is an equation. We're saying: Number of tables plus two equals the number of . . . seats; that *is* where we want to get them to at the end of the easel time.

Researcher's Inference

Now, Teacher 1 clearly describes the plus-two pattern in her own words as she advocates for it in the lesson goals.

Design Principle

- Teachers should write a shared instructional plan that becomes the basis for the research lesson and that publicly represents their thinking. Such writing requires teachers to articulate and agree on goals for student learning, making their thinking visible and available for challenge, elaboration, and development.

August 12, 2002

Evidence: First Teaching of Research Lesson

Teachers record the activities and speech of selected students, trying to create a complete record of what each selected student heard, saw, and did during the lesson.

Design Principles

- The chosen mathematical task should reveal students' thinking.
- Teachers should conduct live research lessons and make detailed records of learners' activities. Live lessons allow discovery of unanticipated but relevant conditions; detailed records enable the lesson and learners' experiences to be reconstructed and analyzed.

August 12, 2002

Evidence: Colloquium on First Teaching

Teacher 2 recalls teaching the problem to students: "I noticed kids counting the seats different ways, and this was a kind of a big aha for me. . . . When I've done the problem myself I've always counted [shows counting around the edge], and it didn't occur to me there was another way of counting it. . . . But [student name] had laid out 20 triangles . . . and she was counting [demonstrates counting top and bottom alternately, followed by ends], and then it looked totally different to me; I could see there's 10 triangles on top, 10 on bottom, and a seat on either end. Now I was seeing the pattern a different way. Up until then, I had always seen it as you're taking away a seat and adding these two, taking away a seat and adding these two [shows adding a triangle and subtracting the side that is joined]. I was seeing a pattern from somebody else's perspective. That's why I thought it might be helpful to have kids talking about how they're counting it. How are you seeing the seats, and the numbers, and the increases, and where does that come from? So I think definitely having the kids use the manipulatives is important, and watching how they use them is going to tell us a lot about how did they see the pattern."

Researcher's Inference

Observation of student counting methods enables Teacher 2 to understand the mathematics of the problem in a new way: that the two ends contribute the plus-two pattern.

Design Principle

- Colloquium protocol should allow data presentation and discussion by team members. These activities enable teachers to strengthen their knowledge of diverse learners in the classroom, their observation strategies, and their thinking about the connections between lesson design and learning.

August 12, 2002

Evidence: Planning Meeting

Teacher 2: So the way they count it kind of identifies how they see the pattern. . . .

Teacher 4: [Next instructor of research lesson] . . . How could I use that information?

Teacher 2: Having kids share their strategies is going to help them understand *why* it's plus two. . . .

Teacher 4: From sharing each of those experiences with counting, they'll see *where* the two is coming from.

Following this exchange, the group revises the research lesson plan to have "kids come up and talk about how they are counting."

Researcher's Inference

Teacher 4 does not initially understand why it would be valuable to have students share counting, but gains the idea that student counting methods may reveal their thinking.

Design Principles

- Teachers should write a shared instructional plan, as discussed in the section for August 9, 2002, above.
- Revising the research lesson enables teachers to examine closely the knowledge they gained during the first teaching.

August 14, 2002

Evidence: Second Teaching of Research Lesson

The lesson plan is revised for the second teaching. Among other changes, some students are invited to show the class how they counted.

Design Principle

- The lesson plan for the second teaching should be revised on the basis of data from the first teaching. Revision enables potential improvements to be tested and builds a view of instruction as something to study and improve.

August 14, 2002

Evidence: End-of-Cycle Reflection Meeting

Teacher 1 offers reflections on her own thought process: "When you said . . . in the first debrief that we should spend some time having [students] share their counting, . . . I did not see that as an important thing, because I personally did not see the pattern that the two ends are the plus-two. I never saw that. So it just shows that in all this math, well, in everything we teach, we're only as effective as our own level of understanding. So we have to always keep pushing ourselves to delve into . . . the why, the how come, that's the challenge."

Researcher's Inference

Teacher 1 has increased her mathematical understanding (i.e., the geometrical reason for the plus-two numerical pattern) and her knowledge of students (i.e., that the way they count may reveal their thinking). Her final comment suggests deepened commitment to professional learning.

Design Principle

- Teachers should meet at the end of the lesson study cycle to document the work they did and what they learned from it, with discussion prompts such as "What did we learn by revising and teaching the lesson again?" Summarizing what was learned from the lesson study cycle may build a sense of efficacy and may improve future lesson study work by identifying features that supported student and teacher learning.