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ABSTRACT

This paper describes research lessons, which form the core of a larger process called lesson study within Japanese elementary science faculty development. Research lessons are actual classroom lessons with students which are: observed by others; planned for a long time, usually collaboratively; designed to bring to life particular goals of education; recorded; and discussed. Types of research lessons include within-school lessons, lessons open to teachers outside the school, and lessons as part of national conferences. After presenting an example, the paper discusses the impact of research lessons, examining how they contribute to the improvement of education. The strengths of research lessons are: individual professional development; learning to see children; spreading new content and approaches; connecting individual teachers' practices to school goals and broader goals; competing views of teaching bump into each other; creating demand for improvement; shaping national policy; and honoring the central role of teachers. Several features of Japanese education support research lessons: a shared, frugal curriculum; established collaboration; belief that teaching can be improved through collective efforts; self-critical reflection; stability of educational policy; instructional improvement time focused on instruction; and focus on the whole child. The paper concludes by discussing lesson study's future role in the United States. (Contains 25 references.) (SM)

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Lesson Study: The Core of Japanese Professional Development[1]

Invited Address to the Special Interest Group on Research in Mathematics Education

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Introduction

My interest in lesson study -- also called "lesson research" -- came about in an odd way. In 1993, I was sitting in Japanese elementary classrooms for months on end, finishing up my book *Educating Hearts and Minds: Reflections on Japanese Preschool and Elementary Education* (1995), which focuses on students' social development and attachment to school, and particularly on the classroom practices that build Japanese students' basic motivation. Although I was not focused on science instruction, I discovered that, without any intention to do so, I was learning much science. Suddenly, I was seeing levers and pendulums everywhere. Because of the way science is taught in Japanese elementary schools, I was noticing the science in daily life. Across the more than 50 varied elementary schools I studied in the course of writing my book, there were considerable similarities in how science was taught: teachers used a compelling problem or activity to "hook" students on a topic (such as magnets or levers), which students then explored through hands-on experiments coupled with intense, critical discussion of their findings, progressively honing their understanding over 10-12 lessons on a single topic (Linn, Lewis, Tsuchida & Songer, 2000).

When I mentioned to Japanese teachers how much I was learning from their science teaching methods, they told me, with surprise, that they thought many of their science teaching techniques came from the United States. Indeed, many techniques probably did come from U.S. model programs, but had spread much more broadly in Japan, substantially changing Japanese science education from teacher-

centered "telling" to a problem-solving approach (Lewis & Tsuchida, 1997). When asked to compare his own science education as an elementary student with current practice, an assistant principal and 25-year veteran of Japanese elementary teaching made clear that the changes in science have been part of larger changes in pedagogy:

> The changes that have occurred since I was a child are changes in the whole elementary system, not just in science: increasing students' autonomy, emphasizing "learning how to learn," taking initiative to learn rather than just memorizing what one is told. These are the changes that have shaped not just science but other subjects as well in the 25 years that I've been teaching.

In 1995, I was fortunate to obtain funding from the National Science Foundation to study the shift to "teaching for understanding" in Japanese elementary science instruction, and the role of research lessons in this change. When I started out this research, some colleagues on both sides of the ocean said there was nothing *to* study. As one put it, "Japan has a centralized education system; you just tell teachers to change and they change." But much research in U.S. classrooms suggests that it's difficult to shift from "telling" to active problem-solving-- for example, that teachers "domesticate" new approaches to fit a more familiar instructional model, in the process losing innovative features such as discussion (Cohen & Ball, 1990; Olson, 1981).

When I asked Japanese teachers how they actually learned to teach science, the answer I heard again and again was "kenkyuu jugyou" -- research lessons. At this point it may be helpful to introduce two words of Japanese: *kenkyuu*Åiå§ãÜÅjand *jugyou*(éˆãΔÅj*Kenkyuu* means research or study; *jugyou* means lesson(s) or instruction. So, *kenkyuu jugyou* means research lesson (or study lesson), and refers to the lessons that teachers jointly plan, observe and discuss. *Jugyou kenkyuu* --using

the same two words in the reverse order -- means lesson research (or lesson study), and refers to the process of instructional improvement of which the research lesson is the core piece. Makoto Yoshida has written a fascinating ethnography of lesson study in mathematics in a Japanese elementary school, which I recommend to anyone who wants to understand how lesson study unfolds over time (Yoshida, 1999, 1999 April). Today, I'll focus on the research lessons themselves, which are at the core of the larger process known as lesson study.

Overview of Research Lessons

The overview that I will provide is based on approximately 75 interviews with Japanese elementary classroom teachers and administrators, and 40 observations of research lessons at more than 30 schools in different regions of Japan, including many ordinary public schools in both low-income and middle-income neighborhoods, and six national public schools. I videotaped many of these lessons for analysis. I speak and read Japanese, so the interviews were conducted in Japanese.

Research lessons are actual classroom lessons with students, but typically share five special characteristics.

1. *Research lessons are observed by other teachers.* The observing teachers may include just the faculty within a school, or a wider group; some research lessons are open to teachers from all over Japan.

2. *Research lessons are planned for a long time, usually collaboratively.* For example, Makoto Yoshida's ethnography followed lower-grade teachers as they focused on the specific topic of how to introduce subtraction with borrowing. These teachers talked about how to shift toward a "problem-solving" approach in mathematics, refined the

problem they would use to introduce subtraction with borrowing, designed new manipulatives that provided a better window into student thinking, and taught research lessons observed and discussed by the entire faculty.

3. *Research lessons are designed to bring to life in a lesson a particular goal or vision of education*. The whole faculty chooses a research theme or focus. Typically, it is a broad goal or vision of education that goes beyond a specific subject matter and lesson. A principal described one common way to choose the research theme: "As a faculty, you identify the biggest gap between the qualities your students have now and your ideals for them -- when you focus lesson study there, it will be successful." School research themes include, for example, for students to "take initiative as learners," "be active problem-solvers," "be active problem-seekers" and "develop individuality" -- all issues central to Japan's current national educational debate. The research lesson is not a finished product that is expected to be used *in toto* elsewhere, but an example of a goal or vision of education in action. This point was brought home to me when I saw a research lesson on pendulums that was described as "practice" for a research lesson on a completely different content (levers) that would occur six months later. This did not seem odd to the teachers, because what was "practiced" was not the content of the lesson but the philosophical approach of having students "immerse themselves in nature and develop scientific ways of thinking."

4. *Research lessons are recorded*. Usually teachers record these lessons in multiple ways, including videotape, audiotape, observational notes, and copies of student work. The particular data gathered depend upon the issues of interest to the teachers

planning the lesson. Often other teachers within the school are asked to collect particular types of data.

5. Research lessons are discussed. A colloquium follows the lesson. Typically, such a gathering begins with presentations by the teachers who taught and co-planned the lesson, followed by free or structured discussion; sometimes an outside educator or researcher also comments on the lesson.

Research lessons are conducted in all subject areas, and in non-subject areas as well -- for example, class meetings, and special school-wide activities designed to build community. A photo from a general bookstore in a small city shows thousands of books about lesson study that span all subject areas and many topics (for example, lesson study etiquette).

Types of Research Lessons

1. Within-school research lesson

The most common research lesson is the "within-school research lesson" (*kounai kenkyuu jugyou*); these take place regularly at ordinary elementary schools throughout Japan. As one Japanese elementary teacher said:

> The research lesson system is valued very highly by Japanese teachers. You find it even in very isolated mountain schools, where there are fewer than 20 students. You won't find a school without them. That's one reason why the education throughout Japan is fairly standard, whether you're talking about Tokyo schools or the remotest mountain school.

Another teacher said: "Why do we do research lessons? I don't think there are any laws [requiring it]. But if we didn't do research lessons, we wouldn't be teachers."

Teachers decide the theme and frequency of research lessons; frequencies varying from every month to several times a year are common.

2. Public research lesson

A second type of research lesson is the public research lesson (*koukai kenkyuu jugyou* or *gakushuu kenkyuu happyoukai)*. These research lessons are open to teachers from outside of the school; invitations may be sent to educators in the local district, the region, or even the whole of Japan. When schools receive grants to develop some part of their educational program -- such as computer instruction or international education -- they are often expected to culminate their work in a public research lesson. Research lessons are a popular place to see new subjects or approaches in action. For example, when a new subject -- life environment studies -- replaced science and social studies for first and second graders, teachers flocked to research lessons showing the new subject.

Perhaps the largest and best-known public research lessons are those conducted several times a year at national elementary schools, the 73 selective-admission public schools throughout Japan where new educational approaches often originate. Emerging from a Tokyo subway station in 1996 to attend a research lesson at a national elementary school, I found the broad walkways leading to the school were jammed with educators from all over Japan, in a scene that reminded my colleague Ineko Tsuchida of the huge crowds that pay homage at Japanese shrines on New Year's Day. The elementary school attracted nearly 5000 educators over its two days of research lessons. As lessons went on throughout the school, dozens of teachers crowded inside each classroom, and dozens more looked in from the hallways,

through large sliding windows opened to afford a view of the classroom. Each visitor received a packet that included lesson plans, unit plans and background on the teachers' research. During panel discussions following the lessons, visiting teachers had a chance to question the teachers about their lessons, to exchange views, and to hear the teachers' own assessments of what went well and poorly.

3. Research lessons as part of national conferences, teachers' circles, etc..

Research lessons also occur in many other contexts. For example, the national conference of Japan's Elementary Science Education Association occurs largely in a cluster of elementary schools that volunteer to host research lessons; conference attendees spend most of their time in these schools, observing and discussing research lessons, and only at the end of the conference do they assemble in a single location for a plenary session. Research lessons are also central to the work of many teachers' study circles and to school districts' professional development (for example, the required professional development that is often provided during the first, fifth, and tenth years of teaching).

When the various types of research lessons are added together, teachers have many opportunities to see others teach. The teachers surveyed by Makoto Yoshida in 35 schools in Western Hiroshima Prefecture observed a total of about 10 research lessons per year (including those within and outside their school; Yoshida, 1999).

Example: An Upper-Grade Research Lesson on Levers

To ground the discussion of research lessons, we'll start with an example (both this example, and a second example, "The Secret of Trapezes" are available on video). The example comes from Komae School #7 in Tokyo, the sort of ordinary public

school that 99% of Japanese children attend. As in all ordinary schools, teachers are generalists who teach all or most subjects during a teaching day that lasts from 8:30 through early or mid-afternoon, so most meetings to plan or discuss research lessons take place at 3:30 or 4 p.m. Research lessons generally take place during the school day, and classes that are not participating may be dismissed early or may work independently while the teacher is out of the room.

The whole faculty of Komae school has chose as their school research focus "For students to value friendships at the same time that they develop their own perspectives and ways of thinking -- Toward enjoyable science and life environment studies" Amid great national discussion and media attention arguing that Japanese students are pressured, conformity-oriented learners, many schools across Japan are choosing school research themes that focus on helping children "develop individuality," and "take initiative." Komae's research theme blends the emphasis on students' individual thinking with an emphasis on valuing friendships and enjoyment of school life, which are traditionally strong concerns of Japanese elementary education (Lewis, 1995). Teachers chose the research focus, which is likely to be maintained for several years, "by asking what is the biggest gap between our ideals and our actual students."

In planning meetings before the research lesson, the upper-grade research group discusses how the school's research focus applies specifically to upper grade students, concluding that fifth and sixth graders need to derive enjoyment not just from the activities and from working together with friends, but also from "understanding and figuring out". (Planning meeting 9/2/99). Although any content area could be used

as a window for pursuing their research theme, Komae's teachers have chosen science, in part because they would like to take advantage of the recently-arrived principal's expertise in science. Ms. Omasa, a fifth grade teacher, has volunteered to teach the research lesson. She recommends that the levers unit normally taught at the time of the research lesson "has a natural flow that fits with how students learn, so let's use it." The teachers then decide that the major point of their research lesson will be to introduce the levers unit in a way that really motivates students' desire to learn, and that encourages and emboldens students to develop their own perspectives. The teachers share various introductions to the study of levers that they have tried, read about, or seen others use, and agree that the best idea is to introduce the unit by challenging students to lift a 100 kilogram (220 pound) bag of sand. To promote individual thinking, they will ask students to devise plans individually for lifting the bag; students with similar ideas will then be grouped together for the following lesson (the research lesson itself) and provided with the materials needed to carry out their plans. Ms. Omasa has never before grouped students by their ideas, and wants to try it as a way of supporting students' individual thinking.

On the day of the research lesson, students work in seven groups according to the strategies they have devised: pushing the sack onto a tilted, wheeled platform; using a rope to lift it (with a person or countervailing weight on the other end of the rope); or using a lever (to pry, or to lift using a fulcrum). During the lesson, each group struggles to make its method work, first on a 30 kilogram (66-pound) sack and then on the 100-kilogram (220 pound) sack. Komae's teachers are assigned in grade-level teams to record the activities of each student group, information they report at the

whole-school research colloquium that follows the research lesson. The agenda for the 2-hour colloquium is typical of meetings that follow research lessons:

- Comments by the Instructor
- Comments by the Research Group Collaborators
- Discussion
- Invited Commentator's Remarks

Typically, the teacher(s) who taught the lesson have the first chance to speak, in order to explain their aspirations for the lesson, and what they feel went well (or poorly). This primacy enables the instructor to mention any disappointments with the lesson, rather than having them pointed out by others. Next, the collaborating researchers explain why the lesson was designed as it was and how it furthers the school's research focus. After this background, the lesson itself is discussed. This may be done in an open-ended or structured way, according to the preferences of the research team. The Komae team chose a structured approach, designating teachers to observe and describe the activities of each student group, reporting on what students did within each group, their persistence and engagement, their changes in thinking, and any evidence of learning. Most of the discussion period focused on these reports; one example follows:

> The group I observed never thought about what would make it easier to use the lever; they just thought about whether it worked or didn't work, and why. All their thinking focused on things that weren't relevant -- the height of the lever, or adding a log at the fulcrum, or the position of the rope. ...Because the requirement was that everyone had to lift the sack, the quiet students also spoke up. When it lifted easily on their turn they talked about why , so I thought the requirement that everyone lift the sack led even the quiet students to speak up. The revisions of thinking in this group seemed to come from looking at other groups. I don't think they would have refined their thinking

if they'd just been looking within their own group. They really scooted here and there checking out the other groups.

The teachers' lively, and sometimes humorous descriptions often focused on figuring out what students were thinking:

Teacher 1: They used a rope, and extended it across many beams; on one end was the sack, and on the other, they put a weight...

Teacher 2: Why did they extend the rope across so many beams? They extended it a long ways.

Teacher 3: They were saying "If we extend the rope, the sack will be lighter to lift." And then when it didn't get lighter, they said "We must have extended it too far." (Teachers all laugh.)

The observations often led naturally to suggestions like the following:

The group that I was watching completely erased their initial plan. I thought it was a shame for them to erase all their work. So it would have been good to give them a second worksheet to draw their new plan. To help them think about why their initial plan didn't work, it would be good for them to be able to look back at their initial plan. I felt it was a loss.

The final portion of the whole-school research meeting was devoted to remarks by an invited commentator (usually this role is filled by an outsider, but in this case, the teachers requested that the principal serve as a commentator). The principal thanked the teachers for providing a lesson that helped the whole school think about "lessons that don't just provide knowledge in isolation, but provide real experiences that make a lasting impression on students." He also suggested that lively interchange of viewpoints had occurred within students' groups, but there might be a need to think about whether information interchange among the groups could be supported systematically in the next lesson. Further, he expressed the hope that

every student would have the chance to experience the power of the lever firsthand, since some groups had been intent on their own solutions, and had not discovered the ease of using the lever.

The Impact of Research Lessons

Based on the interviews and observations, I would like to suggest nine ways in which research lessons contribute to the improvement of Japanese instruction.

1. Individual Professional Development

Japanese teachers mention many effects of research lessons on their own professional development, including feedback on their own teaching and new ideas gained from watching others teach:

> As a brand new teacher, my colleagues who saw my research lesson told me I talked too fast. They were right. My students were having a hard time keeping up with what I said, and I didn't even know it!
>
> Something I learned from seeing a research lesson is finding out how teachers deal with certain common problems in the classroom, such as how to get a debate going when there's just one point of view held by most of the children in the class. For example, if there's just one child holding the "B" point of view, and the rest of the class holds the"A" point of view, the child holding "B" may feel bad if you stimulate a debate between views A and B. The "B" child may feel alone, and want to switch to be with the majority. That's a kind of torture for children. One thing many teachers will do in that situation is to take the "B" point of view themselves. But then the teacher is talking alot, instead of the students. What I learned is that you can ask children how sure they are of the viewpoint they espouse. Are they 100% sure, or 80% sure, or half sure? Then you can ask what their doubts are about the idea, and have a debate between people who do and don't have doubts of a certain kind. ...That's a technique that I learned from research lessons that I apply in my classroom lessons when there's not enough difference of opinion to sustain a debate.
>
> Another example of something I learned from research lessons is to use magnets with children's names on the blackboard. For example, you can...use them to keep track of how children's opinions about something changed over the course of a lesson or unit. Or you can put the name-magnets next to ideas, and children can look at them and be conscious of their own ideas.

The data gathered by one's colleagues during a research lesson provide an external reference point on one's practice. In one research lesson, an observing teacher told her colleague: "Only 47% of the children spoke up today during your science lesson. To increase participation, you might have quickly polled all students, especially since you already had their names on magnets."

In addition to seeing research lessons as a source of feedback and of new techniques, teachers described influences on their philosophy of teaching:

> I had always seen education as teachers giving knowledge to children, as a top-down process. Through my work with the elementary science research group, I came to see education not as giving knowledge to children but as giving them opportunities to build their own knowledge. Initially, that was not what I believed. Even when I saw it in practice, I couldn't believe in it at first. When I first saw lessons in which children were building their own knowledge, I thought 'Is this kind of instruction really OK? It takes so much time.' But then I began to realize that if children don't experience something, they don't understand it. They can memorize it but when the time comes to use it, they can't.

2. Learn to See Children

When I asked Japanese educators what they learn from research lessons, I often heard answers like "You develop the vision to see children." Research lessons facilitate such vision in several ways. First, student data are systematically gathered during the lesson (and often the larger unit of which it is part) and provided to all participants. For example, in the levers lesson these data included students' illustrated plans for lifting the 100 kilograms, their revised plans, and the teachers' observations of what each group actually did during the lesson. For in-school research lessons, members of the research group and other faculty members often gather data on particular issues of interest, for example:

- The comments and involvement of three students (selected for their very different personal qualities and levels of scientific knowledge)
- All teacher interaction with the small groups (so that the teacher could later study the nature of his interventions and student responses to them)
- Students' drawings and explanations of what happens when air is heated, collected at the beginning and end of the unit
- Whether students eagerly investigated the characteristics of water when it boils, had interest and questions about it, and grasped that white steam and large bubbles appear
- The number of boys and girls who raised their hands to volunteer their ideas
- Students' *tsubuyaki* (their exclamations under their breath). Do these indicate students are surprised by how light the bag feels when lifted with a lever?
- Students' initiative in pursuing the problem. Are their eyes shining?

In addition, lesson plans given to observers suggest what to look for in the lesson (for example, are the students actively engaged, do they exchange information in a friendly and effective way, do they think about controlling variables, do they bring to bear prior knowledge)?

3. Spread of New Content and Approaches

When a new topic -- such as solar energy -- is added to the curriculum, it becomes a popular focus for research lessons. Research lessons give teachers the opportunity to ask questions about the new topic. In the discussion following a fourth-grade research lesson on solar energy, a teacher asked:

> I want to know whether the three conditions the children described -- "to put the battery closer to the light source," "to make the light stronger," and "to gather the light" -- would all be considered the same thing by scientists. They don't seem the same to me. But I want to ask the teachers who know science whether scientists would regard them as the same thing.

It also gives teachers the chance to make sense, collectively, of topics or approaches newly added to the national curriculum. At the same research lesson, a teacher said:

> I haven't taught fourth graders for awhile, so I have no idea how and why solar batteries were added to the curriculum. I'm only guessing that including solar batteries reflects adults' hope that children will become the next generation of scientists who will become interested in solar energy and thereby help Japan. Science education specialists might be concerned about children using the proper vocabulary or setting up certain experimental conditions, but if the goal of including solar batteries in the curriculum is to get children interested in the fact that electric current can be changed by light, then Mr. Hori's lesson fulfilled that. So I'd really like to know the reason why solar batteries were included as a new curriculum material for fourth graders.

In other words, teachers had the benefit of colleagues' ideas as they sought to understand new science and why it had been added to the curriculum.

Administrators mentioned research lessons as a critical element enabling teachers to the new Life Environment Studies curriculum:

> The way to improve Life Environment Studies is to see many good actual examples. We can do that by going to lots of schools that are doing presentations and research lessons on Life Environment Studies. Many people from this school have gone. Each school has its own way of approaching the new subject. Some are appropriate for your school, some aren't. What works elsewhere might not work at your school because the children are different. So you need to see lots of examples.

Liping Ma (1999) documents a striking difference between Chinese and U.S. teachers in their capacity to give concrete examples of abstract mathematical ideas such as dividing a fraction by another fraction. Whereas most Chinese teachers could give such concrete examples, few U.S. teachers could. I was struck by this example, because -- although there's often a cry for U.S. teachers to take more college mathematics courses, I wonder how likely teachers are to develop such understanding in traditional college mathematics courses, in contrast to how likely

they would be to develop it as part of lesson study, when colleagues actively discuss students' understanding and share concrete examples of how they promote understanding of abstract ideas. For example, when I read Makoto Yoshida's work, I understood for the first time that there were several different ways to represent the problem 12 -7; and I learned this "content" from watching the teachers anticipate and analyze student solutions. So I think it would be very interesting to look at research lessons as a potential influence on teachers' content knowledge development. Ball and Cohen have written about the (largely unrealized) potential of curricula to build teachers' content knowledge; research lessons exemplify a meaningful, motivating, high-fidelity context in which teachers can build their content knowledge.

4. Connect Individual Teachers' Practices to the School Goals and Broader Goals

When I asked teachers at Japanese schools how they chose their school research theme, invariably, the answer was that they looked carefully at their students, and compared this reality with their ideals. Research lesson plans typically have sections labeled "the current situation of our students" and "the ideal profile of our students." Nevertheless, school research themes show trends over time that clearly relate to national education priorities -- for example, problem-solving, autonomy and initiative, individuality, internationalization, enjoyment of daily life. Not surprisingly, teachers connect their own school research themes to key themes in national educational policy.

5. Competing Views of Teaching Bump Against Each Other

The following discussion occurred as part of the "trapezes" research lesson on pendulums:

Host Teacher: We have the feeling that recently in science education the process has been over-emphasized, and the results and conclusions underemphasized. We feel that the conclusions -- what you might want to call children's knowledge -- have been underemphasized of late. Why is a lesson good simply because children are active?

Visiting Teacher: If children are making connections with daily life, then that's science. [Reads a quote to that effect from the science Guidelines.]

Host Teacher: Not just any kind of experience qualifies as science. If children leave here thinking that weight makes a difference in pendulum swing, then there's something wrong with the scientific process that's going on here.

Visiting Teacher: Do you call it scientific reasoning if they get the right answer, but not if they don't? When does it suddenly become unscientific thinking?

In this conversation, two views of science education bump up against each other. Is it more important to have students gain the factual knowledge that weight does not influence pendulum cycles? Or to be active, independent scientific experimenters, and through this to learn how to design controlled experiments? Both seem to be worthy goals; the research lesson system increases the likelihood that teachers will hear opposing points of view, rather than hear only from like-minded colleagues.

In the discussion following a research lesson on solar batteries, several teachers suggested that the teacher who taught the lesson should have used students' words, rather than his own words, in the lesson summary. "I felt sorry for the students when the teacher concluded the lesson with his own summary statement," said one teacher. The teacher "forcibly" pushed students' results into his own summarizing statements, commented another. Yet other teachers disagreed:

I don't agree with several teachers who think that students' ideas were somehow stifled by the teacher's summary. As someone who doesn't know much about electricity, I found the teacher's summary helpful. Students who,

like me, have limited knowledge about solar cells may have found the teacher's statement helpful, after hearing such a wide variety of opinions.

U.S. education is often plagued by extreme shifts: No sooner is a hands-on, conceptual approach to mathematics advocated and tried than a backlash sends teachers scurrying for cover under math facts and skills. As I listened to conversations like the one above -- in which Japanese teachers debated whether it was more important for students to acquire correct scientific knowledge or to practice scientific processes -- I imagined how different the situation would be in the U.S. if teachers with opposing viewpoints planned, viewed, and discussed lessons together. The more frequently different views of science education come into contact around a shared, concrete lesson, the more likely teachers are to find ways to see and combine the strengths of content-centered and process-centered approaches -- and the more likely they are to notice the benefits that students can derive from each. An American teacher who saw our videotape of a Japanese research lesson commented: "How different American mathematics education might be if we actually saw each other's lessons and found out what other teachers actually meant by terms like "constructivism."

6. Create Demand for Improvement

Richard Elmore has made the case that education in the U.S. suffers not from a low *supply* of good educational programs, but a low *demand* for those programs. Demand occurs when educators want to improve their practice. Research lessons may be seen as a way of creating demand.

One teacher recalled how, early in her career, she burst out into tears after seeing a wonderful research lesson by her fellow first-grade teacher:

> I felt so sorry for my own students. I thought their lives would have been so much better if they'd been in the other teacher's class. You realize you have had a big impact on your students. You see how authoritarian teachers have very quiet classes. Teachers who value students' ideas have very active classes. You see how teachers are creating a class, not just teaching a lesson. The teacher's way of speaking and the teacher's way of getting angry are all passed on to the students.

7. Shape National Policy

Research lessons may help shape national educational policy. One way this happens is that ideas pioneered by classroom teachers at research lessons may spread to other teachers, and, eventually, be made part of the national curriculum. Solar energy entered the national curriculum in this way, after being demonstrated in research lessons.

A second route of policy influence is through the outside commentators invited to research lessons; often these individuals have been active in the development of a new topic or approach. They may be classroom teachers, district resource teachers, university professors, or policymakers. When they attend research lessons, they see how students and teachers are grappling with new subject matter, or with goals such as "initiative" and "autonomy." For example, one invited commentator at the solar energy lesson was a principal who had served on the Ministry of Education committee that added solar energy to the national curriculum. At the research lesson, he could see how this new content area was actually brought to life in the classroom, how students reacted, and what questions teachers had. He

could take this information to the Ministry of Education Curriculum Committees. Well-known science teachers may be invited to dozens of research lessons every year; they see how new approaches and topics are being implemented and understood in many different schools. In effect, this amounts to a system of "formative research" on policy. Figure 2 illustrates how research lessons provide feedback to policy, high-fidelity professional development, and authentic assessment. In contrast, U.S. instruction is a thick-walled black box; most assessment and professional development are hurled against it from the outside.

8. Honor the Central Role of Teachers

Finally, research lessons honor the central role of teachers. Japan's national educational guidelines are remarkably terse, underscoring the idea that policy is brought to life in the classroom, not on paper. The entire Japanese *Course of Study for Elementary Schools* spans just 122 pages of a half-letter-size booklet. The additional volume provided for each subject area is, like the *Course of Study* itself, small and thin, and does not specify the particular teaching materials to be used. (The volume for all of elementary science, for example, covers 116 half letter-size pages.) The changes made to these documents (about once a decade) are often brief, abstract descriptions of new goals: "autonomy," "initiative", "desire to learn" "problem-solving capacity". Although I initially found these vague goals -- provided without accompanying concrete examples -- frustrating, they may reflect an underlying assumption that policymakers cannot define good classroom practice. Instead, research lessons provide a systematic way for teachers to bring policy to life, thoughtfully and collaboratively, in the classroom.

Research lessons also provide a way for Japanese classroom teachers to rise to national stature while remaining in the classroom. Though teachers do not receive increased salary or position by conducting research lessons, they do, in some cases, become known throughout Japan, often publishing books and articles about their lessons. The research lesson system provides a route to become nationally known that does not lead inexorably out of the classroom.

Research Lessons: What Are the Supporting Conditions?

Several features of the Japanese educational landscape seem to support research lessons.

1. A shared, frugal curriculum

By U.S. and world standards, the Japanese curriculum is very spare. The TIMSS (Third International Mathematics and Science Study) documents, for example, that Japanese eighth grade science textbooks cover just eight topics, compared to an average of more than 65 for U.S. eighth grade textbooks (Schmidt et al, 1997). To return to the levers lesson that we saw, Japanese textbooks suggest 12 periods to study levers (14 periods are allocated by the Course of Study, so the textbook does not completely fill the allocated periods). The Course of Study lists just the following items that students must learn about levers during those 12-14 periods:

> Use a lever, and study its structure and function by varying the amount and placement of force. [Learn that]:
>
> a). When the location of the weight is changed, the lever's functioning changes, even thought the amount of weight doesn't change
>
> b) That a lever has a fulcrum, point of effort, and point of resistance

c)When a lever balances, the amount of effort and the placement of the effort are related by a fixed principle (Monbusho, 1991, p.64; author's translation)

Since Japanese teachers have 12-14 class periods to help students master this relatively small amount of science content, the teachers at Komae could devote time to studying the most effective ways to present it -- rather than to wading through massive textbooks to figure out what's really important to teach (Lewis & Tsuchida, 1997, 1998, under review; Tsuchida and Lewis, under review; Stigler & Hiebert, 1997).

In the levers research lesson at Komae School, a fourth grade teacher commented that, although the students had studied balance scales in her class the year before, and should have learned that a given weight has a larger effect the further out from the fulcrum it is placed, she saw no evidence they brought this understanding to the study of levers. "It really makes me think about how I can teach the balance scale so that students bring this understanding to levers," she commented. Because the content is set by the national *Course of Study*, Japanese teachers do not spend time at the district or school level in what U.S. teachers often call "articulating" what should be taught at each grade level; but they do, through research lessons, actually see how information from prior grades is being brought to bear (or not) by children.

Japanese teachers typically teach the same class for two years, and over time rotate through all grade levels. So the content taught to other grade levels is likely to be content you have taught or will teach in the future.

2. Established collaboration

The first time I asked a Japanese principal how to build a good climate for lesson study at a school, he mysteriously answered "beach volleyball." It was the kind of answer that eventually became very familiar; teachers developed good working relationships in many ways -- practicing for a beach volleyball game against the parents, planning the teachers' skit for the school festival, and planning the 30 days a year of school-wide activities such as hiking, school trips, sports day, and so forth (Lewis, 1995). Japanese elementary teachers routinely consult each other on lessons in the teachers' room (where teachers' desks are located, arranged by grade level), and they routinely take care of each other's classes, since substitutes are not hired for short-term absences (Bjork, in press; Sato, 1996; Sato & McLaughlin, 1992; Rohlen & LeTendre, 1996; Shimahara & Sakai, 1995). Accounts of Japanese elementary school life suggest that collaboration among students is emphasized, competition avoided, and every student is regarded as having a valuable contribution to make (e.g.,Lewis, 1995); this may be true for teachers as well. Japanese elementary teachers are generalists, but typically each teacher specializes in a particular area (such as mathematics, Japanese, class meetings, physical education) and takes responsibility for attending outside meetings of that specialty, and for acting as a resource to other teachers within the school for that subject.

Attitudes toward borrowing may support routine collaboration, as two Japanese teachers suggest:

> Even if you copy someone else or are copied by someone else, I don't think anything can be absolutely the same. So, I think it is all right to copy others.
>
> If you shoot for originality too early in your development as a teacher, you're likely to fail. Initially, you must take a lot from others. But ultimately, to move to a higher level of teaching, your lesson must become your own

> original thing, not simply imitation of others. But it's through imitating others' lessons you create your own authentic way of teaching.

It is *not* the case (despite accounts to the contrary) that Japanese elementary teachers have more time for collaboration than their U.S. counterparts; daily time with students is comparable or longer in Japan (see Lewis, 1995). However, general support for teachers and for their professional development activities may be greater in Japan (U. S. Department of Education, 1985).

3. A Belief that Teaching Can Be Improved Through Collective Effort

I was once stopped in my tracks by an American school board member who said "Don't you think that good teachers are born, not made?" I don't know whether this is a common point of view in the U.S., but Japanese educators certainly act as if good teaching is created through continuous effort (just as they attribute student achievement to effort; Stevenson & Stigler, 1992). As one Japanese teacher said:

> Our textbooks are very thin with few explanations....Teachers have to fill the blanks between the lines in the textbook. That is why we have to study about lessons. . . Unless you improve your own skills, you can't do a good lesson even with a good lesson plan or good textbooks. Precisely because of this belief, we all do research lessons and try to improve our teaching skills. If you isolate yourself and do whatever you wish to do, I don't think you can ever conduct good lessons.

The teacher just quoted points up another belief about teaching: that *collective* effort is needed to improve it -- that you cannot ever conduct good lessons if you "isolate yourself and do whatever you wish to do." This recalls the distinction made by Westheimer (1998) between "collective" and "liberal" teacher communities within U.S. schools. In the collective teacher community, teachers believe they need to forge a common vision of good practice; in the liberal community, vision and practice are ultimately matters of individual conscience. This raises an interesting issue: what

elements of educational vision and practice can productively be left to individual teachers, and what need to be approached coherently by an entire school? For example, is it fair to ask students to move back and forth over during the elementary years among classrooms where mathematics is defined in radically different ways, and requires utterly different skills, learning strategies, habits of mind, and personal qualities? The downside of *individual* teacher autonomy is potential lack of coherence in children's experience. Japanese teachers have what might be called "collective autonomy".

4. Self-critical Reflection

Within Japanese schools and perhaps within Japanese culture more widely, *hansei* -- self-critical reflection -- is emphasized and esteemed (Rohlen, 1976; see also Lewis, 1995). Both teachers and students set goals for self-improvement in a "quest for character improvement [that] is close to being a national religion" (Lewis, 1995; Rohlen, 1976, p.128). De-emphasis of external evaluations (merit reviews, checklist evaluations, etc.) of teachers may create safety to reveal one's weaknesses (Bjork, in press). Self-critique may have a decidedly different emotional meaning when it is established and valued as it seems to be in Japan; identifying one's shortcomings and soliciting and gracefully accepting criticism may be ways of showing competence, not failures to be avoided. Nor is critique typically focused on a single individual; collaborative planning of research lessons means that criticism is generally shared with several colleagues.

5. Stability of Educational Policy.

Although some Japanese educators complain that Japanese education is slow to change, (Shimahara & Sakai, 1995; Horio & Platzer, 1988), general stability may enable educators to concentrate on policy changes that do occur. The comments of a Ministry of Education official suggest a surprisingly long timetable for change:

> We change the *Course of Study* about every ten years. But the truth is that ten years is too short a time to change classroom education. If we greatly changed the *Course of Study* every ten years, teachers would be turning their heads this way and that so often that their necks would break. So we make major changes in the *Course of Study* only every twenty years or so, and in between it's just fine tuning.

6. Instructional Improvement Time Focused on Instruction

Figure 1 is a schematic that suggests how Japanese and U.S. teachers spend their instructional improvement time. Japanese teachers spend relatively little time at the top of the pyramid, in developing or aligning curriculum, or translating national standards into local practice. They have a frugal national *Course of Study* and a number of nationally approved textbooks from which to choose. Although Japanese teachers as a whole spend little time developing or aligning curriculum, it's important to note that elementary textbooks are written by elementary teachers, based on their actual lessons. Because Japanese teachers start with texts that are teacher-written and lesson-based, they can afford to spend considerable time at the bottom of the pyramid, planning, observing, discussing and refining actual classroom lessons.

In contrast, think about the time many U.S. teachers spend selecting and adapting curricula, articulating what will be taught at each grade level, aligning curricula with state or district standards, and finding or writing lessons to fill the

resulting holes. To take the example of levers, all five Japanese fifth grade textbooks devote about $1/12^{th}$ of the entire fifth-grade textbook to the study of levers. While there are 24 illustrations and 23 photographs in the average 11-page Japanese unit on levers (most of these illustrating the activities children will do), there are just 22 sentences describing levers, in contrast to 131 sentences in U.S. texts (Tsuchida & Lewis, under review). American elementary science textbooks are designed for students to read about science; Japanese textbooks to do science (Tsuchida & Lewis, in press). So U.S. teachers must first decide whether to teach levers -- one of many topics related to simple machines that appear a multiple grade levels. Then, within the levers unit, they must deal with about six times as much text. In other words, several factors conspire to make American teachers invest considerable time at the top of this pyramid -- decentralized decision-making, multiple levels of policies and requirements, and perhaps most of all, the fact that available curricula are jam-packed with information typically meant to be read, not done, whereas the Japanese textbooks are lesson-based, containing fewer lessons than the number of periods actually allocated for the subject. Hence the upside-down U.S. triangle stands precariously on its tip, without a large enough basis of classroom practice, observation, and discussion to support it in a stable fashion.

7. Focus on the Whole Child

The final support for lesson study that I would like to mention is the focus on the whole child in Japanese elementary schools. Japanese elementary teachers see their job as "raising" children -- as promoting children's social, ethical, emotional, aesthetic, physical, and intellectual development. As a Japanese elementary teacher

summed it up "My most important job is to create happy memories"(Lewis, 1995). How Japanese teachers do this -- through family-like small groups, use of many unity-building activities, 30 days a year devoted to school-wide festivals, emphasis on students' own personal goal-setting and reflection rather than adult-imposed rules and rewards -- is beyond the scope of this paper (see Lewis, 1995), but the fact of concern with the whle child may be an important instructional support. For example, Japanese science lessons depend for their success upon a particular social, motivational, and disciplinary infrastructure that is carefully built up during the years of elementary schooling (Linn, Lewis, Tsuchida, & Songer, 2000), and Japanese lessons may not transfer successfully to schools in other countries where students are used to extrinsic rewards, short-answer questions, and minimal responsibility for classroom management.

Analogously, the emphasis on the whole child in Japanese elementary schools may provide essential support for lesson study. Komae's goal that students value friendships at the same time that they develop individual ways of thinking and perspectives is typical of lesson study goals in its focus on the full development of the student. An interwoven emphasis on social and intellectual development may make lesson study deeply compelling to teachers, and heighten the willingness to collaborate. Compare two questions: "How should we teach mathematics?"; and "What are the biggest gaps between our students' current development and our ideals for them?" While many teachers are gripped by the question of how to teach mathematics, nearly all teachers are likely to see the latter question -- what is the gap between who are students are now and who we want them to be -- as at the very

heart of their work as teachers, and it is not a coincidence that this is the question at the heart of lesson study, a process driven by teachers. Further, the broad nature of lesson study goals means that teachers must truly work together over all the years of a student's elementary school life to achieve them. As Clea Fernandez has noted, if lesson study were only about teaching subtraction with borrowing, it might be possible for a single teacher to improve it; but all teachers must collaborate to move the school toward its ideals for students.

To illustrate the importance of thinking about the whole child in mathematics instruction, I'd like to tell a story about two U.S. fourth-grade classrooms where I saw "the same" probability lesson, in which students first draw 10 marbles from a large sack of marbles and individually make predictions about the proportion of black and white marbles in the sack based on their own marbles; next they look at the data from all the students and decide whether to revise their predictions. The lesson is designed to help students understand that many independent samples allow a better prediction than just one, and in one fourth grade classrooms it functioned just that way; students made remarks like "It's just like a baseball average. The more times someone has been at bat, the more accurate their batting average is likely to be." It happened that the teacher of that class had spent a great deal of time building a learning community in her classroom as part of the Child Development Project, and her students were very skilled at working together and very committed to helping one another learn and to treating others according to the class norms of responsibility and kindness they had together developed. In a demographically similar classroom just a few miles away, however, students never got the point of the lesson, because in

that very competitive milieu, students were too busy defending their initial predictions, and exchanging criticisms like "you probably chose all your marbles from one part of the bag." Although the same "lesson" was used in the two classrooms, it did not work in one because the commitment to finding the truth was weaker than the need to show you were smarter than someone else. This experience illustrates the importance of considering the whole student, if instruction is to be improved. At the outset, I said that the Japanese word "jugyou" refers to the whole of "instruction" as well to "lessons", and this example underlines the importance of thinking about the whole of instruction -- the diverse practices that influence students' qualities as learners -- rather than simply the lesson format itself.

Does Lesson Study Have a Future in the U.S.?

On February 28, 2000 I had the privilege to attend what I believe was the first day of public lesson study in a U.S. school; Paterson School Number Two, an urban school serving a student body 98% eligible for free lunch in Paterson, New Jersey. It was among the most extraordinary and inspiring days I have ever spent in a school. The lesson study at Paterson School Number Two grew out of a math research group at the school, which in turn grew from participation by the principal, Lynn Liptak, and several teachers in a conference on TIMMS. As part of an NSF-funded project conducted by Dr. Clea Fernandez and Dr. Makoto Yoshida of Teachers College, teachers from the Greenwich Japanese School, outside New York City, were able to collaborate with Paterson School #2 to support their development of lesson study. During the public lesson study day, four different lessons were taught, and School #2 teachers, Greenwich Japanese School teachers, and other invited educators went into

the classrooms to watch. In one lesson that I saw, Mrs. Heather Crawford taught a lesson planned and refined collaboratively with Mrs. Sandy Joseph, Ms. Marlene Hernandez, and Mrs. Roberta Wolff. Mrs. Crawford introduced multiplication to the 19 students of her second-grade class with the problem "I bought five Kit-Kat bars, and each one has four pieces. How many pieces do we have? Do we have enough for everyone to have a piece?" Students represented and solved the problem using various strategies, and the teacher asked students to share these on the board and explain them. Observers could see students actively grapple with the relationship between, for example, counting by 4's and adding 4+4+4... When a second problem was assigned, observers could gauge how students' thinking about multiplication had progressed over the course of the lesson.

I was struck during that lesson and the others I saw that day how much is communicated during a research lesson. Most obvious, of course, is the lesson itself -- a very motivating, carefully designed introduction to multiplication that had been planned by four second- and third-grade teachers, tried earlier in another second grade classroom, and refined by the four teachers working together over a period of time. Even more basic is the whole idea of instruction as something that can and should be progressively improved through consultation with colleagues, trial in the classroom and critique. The teachers described how they revised the lesson's visual aids (large laminated pictures of the front of four Kit-Kat bars and the inside of one). They redesigned the visual aids so that students would be clear on the numbers for the math problem -- that there were five candy bars and each contained four sections -- but would not be encouraged to use simple counting to solve the problem, as they

would if the inside of all five bars was visible. In their explanation of the redesign, the teachers were modeling another hallmark of lesson study -- anticipating students' reactions to the lesson and planning for them. Another important element was that observers were able to study students' representation and discussion of the problem, and to see a lesson from the student point of view in a way that is rarely possible in other forms of professional development -- even videos or written cases, though these certainly come closer than many forms of professional development. Finally, I was struck by another quality of research lessons -- the power of real, live students, deeply engaged in learning math, to renew and inspire adults. For many of us, the most astonishing moment of the lesson came when students postponed eating the Kit-Kat bars because they were eager to solve a second multiplication problem!

So my answer to the question of whether lesson study has a role to play in the U.S. is an emphatic "yes," though I think we will need to find the most effective ways to adapt it to our cultural settings. The graveyards of U.S. educational reform are littered with once-promising innovations that were poorly understood, superficially implemented, and consequently pronounced ineffective. If lesson study is to be any different, it will require a deep understanding of what it is and why it has been useful to Japanese teachers, and how it can be adapted to our very different setting.

I'd like to close with quotes from Japanese teachers that remind us of what it means to them:

> Research lessons are very meaningful for teachers because when they study and conduct demonstration lessons, they think hard and in a fundamental way about several critical issues, for example, "What is the basic goal of this lesson in this textbook?", "How does this particular lesson relate to my students'

learning and progress in this school year?", "How does this lesson relate to other curriculum areas?" Thus, it is very beneficial to teachers. Unless they think about all these things, teachers can't conduct research lessons. That is the purpose or significance of research lessons. Even if teachers do not think hard about the lessons they teach daily from the textbook, for research lessons, they should really rethink the fundamental issues.

What's a successful research lesson? It's not so much what happens in the research lesson itself that makes it successful or unsuccessful. It is what you learned working with your colleagues on the way there.

[After a research lesson]: The research lesson is not over yet; it's not a one-time lesson, but gives me a chance to continue consulting with other teachers. Other teachers can provide me with concrete suggestions and advice because they have seen at least one lesson I conducted. We teachers can better connect with each other in this way.

Research lessons help you see your teaching from various points of view. ... A lesson is like a swiftly flowing river; when you're teaching you must make judgments instantly. When you do a research lesson, your colleagues write down your words and the students' words. Your real profile as a teacher is revealed to you for the first time.

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WHAT IS A RESEARCH LESSON?

1. ACTUAL CLASSROOM LESSON, WITH STUDENTS, WHICH OTHER TEACHERS WATCH

2. PLANNED FOR A LONG TIME, USUALLY COLLABORATIVELY

3. BRINGS TO LIFE IN AN ACTUAL LESSON A GOAL OR VISION OF EDUCATION

4. RECORDED: VIDEO, AUDIO, STUDENT WORK

5. DISCUSSED BY FACULTY, AND SOMETIMES OUTSIDE COMMENTATORS: MIX OF FORMAL PRESENTATIONS AND DISCUSSION

TYPES OF RESEARCH LESSONS

1. IN-SCHOOL

2. PUBLIC

3. EMBEDDED: AS PART OF CONFERENCES, STUDY GROUPS, 5TH YEAR PROFESSIONAL DEVELOPMENT, ETC.

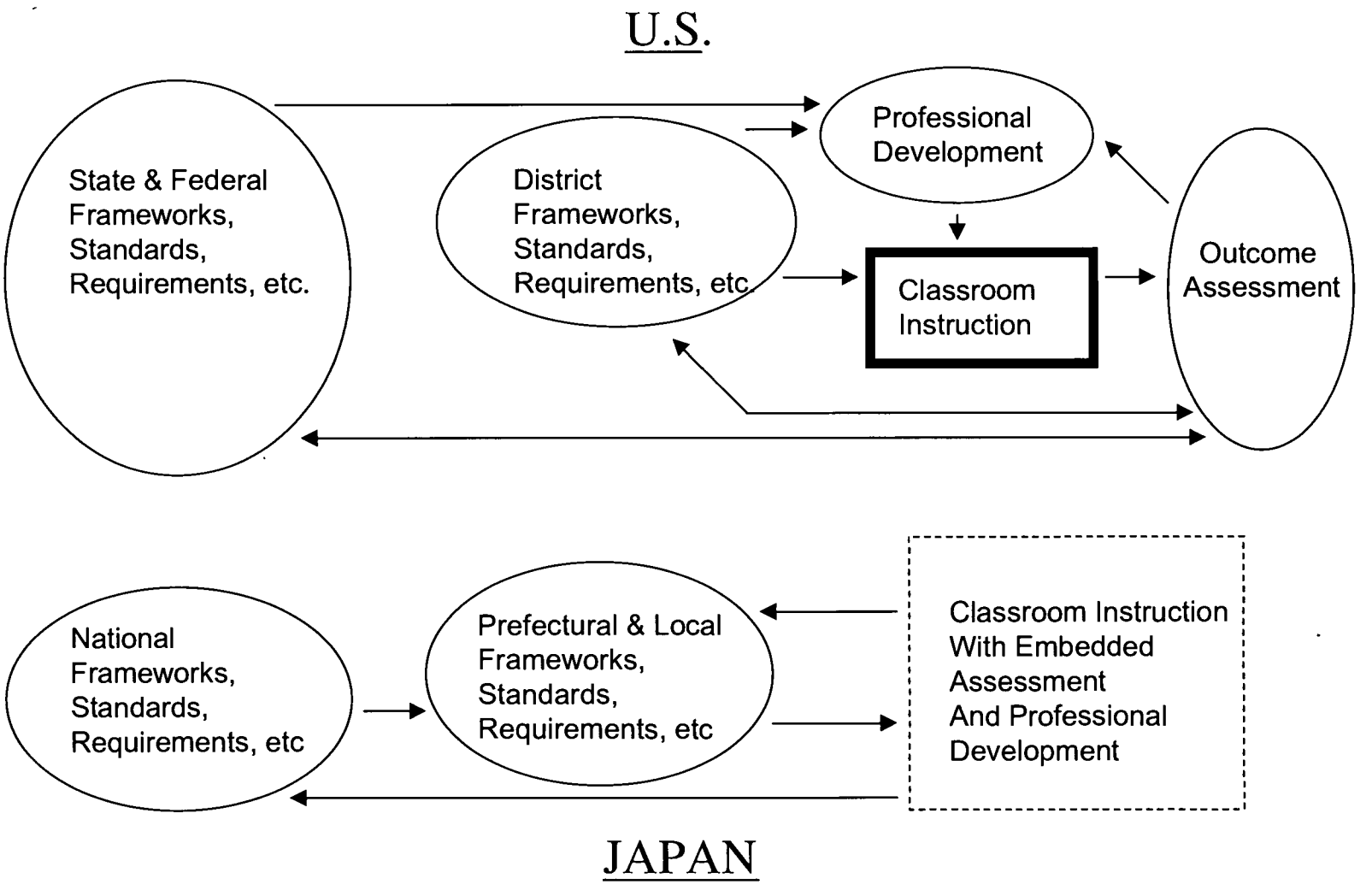
BENEFITS OF RESEARCH LESSONS

1. INDIVIDUAL PROFESSIONAL DEVELOPMENT
2. LEARN TO SEE CHILDREN
3. SPREAD OF NEW CONTENT AND APPROACHES
4. CONNECT INDIVIDUAL TEACHER'S PRACTICE TO SCHOOL GOALS AND BROADER GOALS
5. COMPETING VIEWS OF TEACHING BUMP AGAINST EACH OTHER
5. CREATE DEMAND FOR IMPROVEMENT
7. SHAPE NATIONAL POLICY
8. HONOR THE CENTRAL ROLE OF TEACHERS

SUPPORTING CONDITIONS

1. SHARED, FRUGAL CURRICULUM
2. COLLABORATIVE ETHIC
3. BELIEF THAT TEACHING CAN BE IMPROVED THROUGH COLLECTIVE EFFORT
4. SELF-CRITICAL REFLECTION
5. STABILITY OF EDUCATIONAL POLICY
6. INSTRUCTIONAL IMPROVEMENT TIME IS FOCUSED ON LESSONS
7. FOCUS ON WHOLE CHILD

Instructional Improvement



Professional Development

TRADITIONAL	*RESEARCH LESSONS*
• Begins with answer	• Begins with question
• Driven by expert	• Driven by participants
• Communication trainer -> teachers	• Communication among teachers
• Relationships hierarchical	• Relationship reciprocal
• Research informs practice	• Practice is research

By Lynn Liptak, Paterson School #2, New Jersey.

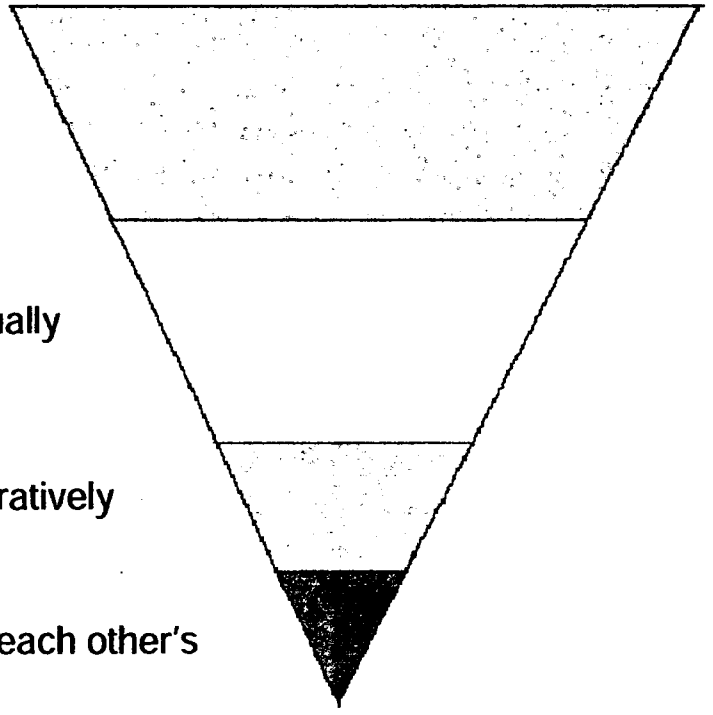
Teachers' Activities to Improve Instruction

Choose curriculum, write curriculum, align curriculum, write local standards

Plan lessons individually

Plan lessons collaboratively

Watch and discuss each other's classroom lessons



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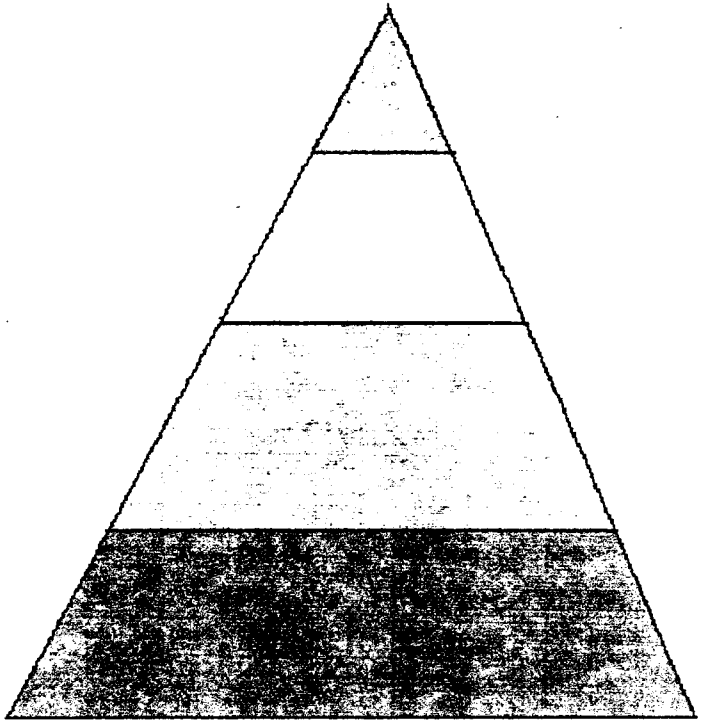

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