

## **How Do Japanese Teachers Improve their Instruction?**

### **Synergies of Lesson Study at the School, District and National Levels<sup>i</sup>**

**Catherine C. Lewis, Mills College**

#### **Origins of the Current System of Professional Learning**

Science teaching offers a particularly interesting lens through which to view Japan's system of professional learning, since science was not a subject in Japanese schools until the latter half of the 19<sup>th</sup> century – when U.S. gunboats abruptly ended centuries of self-imposed Japanese isolation and dramatically suggested the superiority of western science and technology. During the overhaul of Japanese education that followed, the teaching of science became a major priority, and foreign science instructors were invited to Japan to teach. Their demonstration lessons to Japanese students, simultaneously observed by hundreds of Japanese teachers, are considered by some Japanese scholars to be the starting point for lesson study and for large public research lessons in Japan–features integral to Japan's system of professional learning today (Isoda, Stephens, Ohara, & Miyakawa, 2007).

#### **Practice-Based Inquiry Cycles: A Core Feature of Japan's Professional Learning System**

A core feature of Japan's system of professional learning is “lesson study” (*jugyou kenkyuu*; 授業研究), collaborative inquiry cycles that revolve around planning, observation, and analysis of live instruction (Lewis & Hurd, 2011). As shown in Figure 1, at the heart of the inquiry cycle is a “research lesson” (*kenkyuu jugyou* 研究授業) that enacts teachers' ideas about the optimal teaching of a

particular subject matter to a particular group of students. Honing a single lesson is not typically the primary goal of lesson study as practiced in Japan (Isoda, et al., 2007; Lewis, Akita, & Sato, 2010; Lewis & Hurd, 2011; Nihon Kyouiku Houhougakkai, 2009). Rather, as highlighted in the middle rectangle of Figure 1, lesson study is expected to improve instruction by developing knowledge, beliefs, norms, routines, and materials that contribute to ongoing instructional improvement. The diagonally striped rectangles indicate the features of effective professional learning identified by (Desimone, 2009), connecting them to the features of lesson study. It may be useful to dispel at the outset the idea that Japanese teachers have a brief teaching day. In large-scale surveys, Japanese elementary teachers report a daily average of 11 hours and 12 minutes at school (Benesse, 2007). In addition to the time spent with students, close collaboration with colleagues in planning instruction and managing non-instructional aspects of school life is the norm (Cave, 2007; Lewis, et al., 2010; Sato, 2004; Tsuneyoshi, 2001a).

Lesson study occurs at several layers of the Japanese system—at schools, at the district level, and in national lab schools and subject-matter organizations—taking on somewhat different characteristics and purposes at each (Lewis, 2011; Lewis & Tsuchida, 1997; Shimizu, 1999). The different forms of lesson study work in synergy, enabling teachers to bring to bear local knowledge, cutting-edge research, and policy mandates, in live instruction that is viewed by other educators (Lewis & Takahashi, 2013).

The basic structure of lesson study is shown at the left of Figure 1. Western readers sometime equate lesson study with lesson planning, but lesson planning is just a small part of lesson study. The Japanese word “*jugyou*” always refers to *live* instruction, so lesson

study is the study of live instruction, not just the polishing of a lesson plan. The research lesson at the core of each lesson study cycle enacts and enables study of the teachers' hypotheses about good teaching and learning. It brings to life the teachers' long-term goals and vision of education (as well as their goals for a particular topic and subject matter) and is carefully planned (usually collaboratively), observed by colleagues and recorded, with a focus on understanding student thinking and learning, and on discerning the instructional elements that supported it or provided obstacles to its development.

Four different types of lesson study, illustrated in Figure 2, work together in Japan to support improvement of instruction and curriculum: school-wide, district-level, based at national lab schools, and association-sponsored (for example, sponsored by national subject matter associations). Together, these four types of lesson study can promote rapid development and spread of both the knowledge needed to implement and support a curricular reform and the commitment to do so.

### *School-wide Lesson Study.*

School-wide lesson study is nearly universal in Japanese schools; a recent survey found that research lessons are conducted at 99% of Japanese elementary schools, 98% of junior high schools, and 95% of public high schools (National Education Policy Research Institute, 2011). While it differs somewhat by school, region and level of schooling, at the elementary level it is common for each grade level or grade band to plan and conduct one to three research lessons per year, focused around a shared school-wide research theme, and observed and discussed by all the teachers and administrators in the school (Fernandez & Yoshida, 2004; Takahashi, in press). The school-wide research theme is

chosen by the whole faculty based on their aspirations for students' long-term development, and it joins the teachers together in thinking about how their daily instruction might support their long-term goals for students (Lewis & Hurd, 2011). For example, teachers at the school filmed in the science lesson study cycle "Can you lift 100 kilograms?" chose as their school-wide research theme "For students to value friendship, develop their own perspectives and ways of thinking, and enjoy learning" (Mills College Lesson Study Group, 2000). In research lessons, teachers tested modifications such as having students see a 100-kilogram sack of sand in the gym (rather than a smaller object as shown in the textbook) and had students themselves devise a way to lift it and ask for the needed materials, rather than giving students a pole and fulcrum (as they had in prior years)(Lewis, 2011).

#### *District-level Lesson Study*

Japanese elementary teachers are generalists, teaching all subjects. However, district-level lesson study (see also Murata & Takahashi, 2002a,b) generally asks all elementary teachers to participate in lesson study focused on a specific subject matter of particular interest to them—allowing them to become more knowledgeable about that area of teaching, so that they can support its improvement at their school. For example, teachers in one Tokyo district can choose from more than a dozen offerings, including mathematics, art, physical education, Japanese, science, social studies, music, school wide activities, etc..(Takahashi, 2003). These district-based lesson study groups meet during salaried after-school time once a month and conduct semi-annual research lessons open to all teachers within the school district, held on early release days when most students are dismissed early and the research lesson classes stay behind for an extra period.

### *National School Based Lesson Study*

Japan has a network of national schools spread across the country (with at least one in every state (Lewis & Tsuchida, 1997). Teachers at these schools take as their mission not just teaching their school's students, but also improving the current curriculum and instructional methods. As one national elementary school teacher commented, "When I taught in a regular elementary school, we teachers talked a lot about how to teach the science curriculum; here, we talk a lot about what Japan's science curriculum should be." Since the national schools are based at universities and typically have a university professor as the school principal, teachers at these schools have ready access to research and ideas from Japanese universities (and to the ideas that flow into universities from foreign countries). One or more times a year, they open up their practice in large public research lessons (*koukai kenkyuu jugyou*), sometimes attracting thousands of educators from across Japan (Lewis & Tsuchida, 1998). Such public research lessons may be projected to a large audience using a video projector and microphones. National schools are on the cutting edge of experimentation with new approaches and curriculum, and teachers at these schools often spread their ideas by writing, hosting visitors from other schools, traveling to other schools to serve as commentators on research lessons, and contributing to the writing of textbooks (Lewis & Tsuchida, 1997; Lewis, Tsuchida, & Coleman, 2002; Watanabe & Wang-Iverson, 2005).

### *Association-sponsored lesson study.*

Independent associations also sponsor lesson study. Japan has a variety of national subject-matter organizations which, on first glance, seem similar to their U.S. counterparts—voluntary membership organizations for pre-primary through university educators

interested in the teaching of a particular subject matter, such as science. However, lesson study plays a central role in these Japanese associations. For example, I was surprised when I attended the annual meeting of the national science education association that it occurred not in a hotel, but primarily in elementary and secondary schools across a city. Only after observing and discussing public research lessons across the city, all of them designed around a shared research theme, did the attendees all come together for a plenary session in a hotel. So the central focus of the conference was observing and discussing live research lessons designed to bring to life the research theme chosen by the association members.

### *Synergies Among the Four Types of Lesson Study.*

The different types of lesson study share certain commonalities: they all provide opportunities to observe teaching and learning, to analyze and discuss data collected during the research lesson, and to network with other educators and build professional learning community. However, each type of lesson study brings particular strengths into the mix. Looking at the arrows in Figure 2, what might be the contributions of each type of lesson study to the others? We can use a case of change in the Japanese national course of study to investigate this issue: the introduction of solar energy as a topic of study in Japanese elementary schools.

When the topic of solar cells was first added to the national curriculum in the 1990's, the course of study specified only the basic objectives for student learning, not the specific teaching methods. Even before teaching of the new topic was required, national and prefectural grant competitions invited applications from elementary schools that

wanted to become “designated research schools” for solar energy (Lewis & Tsuchida, 1997). Modest grants (on the order of \$5,000-\$10,000) were given to dozens of elementary schools across Japan that were interested in experimenting with the new subject matter in advance of the requirement to teach it. These schools used their funds mainly to work with well-known science educators (often based at national lab schools or universities, and often active in the national science education associations) who advised the school’s lesson study work by sharing high-quality instructional resources (often from the U.S.!), helping to clarify the underlying scientific concepts, passing on promising approaches from other innovating sites, and so forth. After a year or so of experimentation with teaching solar energy, the “designated research schools” opened up their instruction in large public research lessons. The tens of thousands of educators, researchers, and policymakers who attended these public research lessons across Japan saw and discussed live instruction designed to enact the new content. They had the opportunity to question the instructors about the rationale for the instructional design, scrutinize the entire unit plan and records of student learning across the unit, find out what the educators had tried that had not worked and offer their own ideas and critique.

As public research lessons were conducted across Japan, a shared knowledge base about how to teach about solar cells developed rapidly. This store of shared knowledge included practical aspects of instruction—for example, which solar toys were inexpensive and made important ideas visible—as well as knowledge about the kinds of student thinking to expect, how to handle it, and the subject matter itself. For example, one teacher observing a public research lesson asked during the public post-lesson discussion about the significance of three different student ideas about increasing the power of the solar cell:

moving the solar cell closer to the light source, adding a second light source, and using a magnifying glass to “concentrate” light:

I want to know whether the three conditions the children described–‘to put the solar cell 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.

The teacher’s question, asked in a public forum with elementary through post-secondary science educators present, illustrates how Japanese educators build a shared knowledge base about instruction, student scientific thinking, and even subject matter itself through lesson study. Elementary teachers who attend science lessons at designated research schools are often involved in local improvement of science education—for example, they work on science in district-based lesson study and are looked to for informal leadership when their school’s lesson study focuses on science. Also in attendance at the designated research school public lessons were district and regional administrators and the national policymakers responsible for the addition of solar energy to the national curriculum. So these public research lessons serve as formative feedback on the curriculum change, allowing policy-makers to see what sense students and teachers are making of solar energy. They also serve as way to help classroom educators and administrators develop a shared vision of what a reform should actually look like in a classroom.

With the example of the rapid scale-up of the solar energy curriculum in mind, we can revisit the bi-directional arrows in Figure 2 to think about the synergies among the four types of lesson study. The contribution of the national lab schools and national science associations is perhaps most obvious: their close connections to university-based science educators makes them important conduits for information to flow in from other countries and out to schools and districts (and from the university science faculty to the lab elementary school faculty in the case of national lab schools). Further, the advisors hired by designated research schools are often educators active in the national associations or national lab schools. As they travel to school sites across Japan to advise lesson study groups or serve as commentators on research lessons, they spread information on how other sites are implementing reforms (Watanabe, 2002). Even for a school that does not have funds as a designated research school, school funds typically allow a research lesson commentator to be hired once a year or so. Educators who are seen as providing useful lesson commentary that helps a school strengthen its improvement efforts develop a reputation across Japan, and are highly sought after as commentators. On several occasions, I have heard university faculty introduced with an accolade such as “he received 75 invitations from elementary schools last year to comment on research lessons.” On the other hand, since schools control the funds to invite commentators, educators who do not provide useful feedback and encouragement are unlikely to be invited back.

District-based lesson study provides a place for teachers within a district who have a particular interest in, say, science to work together over many years, constantly bringing back what they learn at the district level to the ongoing school-based lesson study work at their own schools (Lewis & Takahashi, 2013; Murata &

Takahashi, 2002; Watanabe, 2002). District-based lesson study also nurtures some of the educators who will go on to be nationally-known lesson commentators; these individuals may begin with district work and within the local or regional divisions of national subject matter organizations.

The contributions of school-based lesson study may be less obvious, but probably provide a critical link in widespread instructional improvement. Since elementary teachers are generalists, they may not have particular interest or expertise in science. However, school-based lesson study begins with a research theme developed by the whole faculty, based on close observation of students and on teachers' shared aspirations for them. Even a teacher who does not have a strong interest in science is likely to have a strong interest in the shared school research theme he or she helped to develop, such as helping students "to value friendship, develop their own perspectives and ways of thinking, and enjoy learning." So even teachers without an initial strong interest in science may see redesign of the unit on levers—to start with an imposing 100-kilogram sack of sand in the gym instead of a small object to be lifted from the desktop—as an important way to help students develop their own ideas and enjoy learning. Likewise, the human relationships within a school and routines such as grade-level planning are likely to draw teachers into innovations introduced by school colleagues. This may be especially true in Japanese schools, where many researchers have noted the strong emphasis on collaboration among teachers in Japanese schools. (Okano & Tsuchiya, 1999) note that, compared to the U.S., there is "stronger informal communication, interdependence and 'camraderie' among teachers in Japan" (p.173). Teaching in Japan has been described as a "communal" activity where teachers together identify their long-term goals for student development, and together

plan, observe and reflect on both instructional and extra-curricular activities in order to achieve their shared vision of student development (Tsuneyoshi, 2001b)

The arrows away from school-based and district-based lesson study denote the powerful formative feedback to from local users of an innovation to the educators at lab schools and national subject matter associations. University-based educators and policy-makers can see, for example, just how local educators are bringing to life the idea of “inquiry-based science” in the classroom.

### **Implications for the U.S.**

When I first began to write about lesson study in the mid-1990’s, I was often told that lesson study would never take hold or be effective in the U.S. because “the U.S. is not a collaborative culture” and because “U.S. teachers lack content knowledge.” Yet lesson study has now been flourishing for more than a decade in many regions of the U.S. (Chicago Lesson Study Group, 2010; Hart, Alston, & Murata, 2011b; Lesson Study Network, n/d)

Evidence is accumulating, also, that taking part in lesson study can *build* U.S. teachers’ content knowledge and collaborative culture(Hart, Alston, & Murata, 2011a; Lewis, Perry, & Hurd, 2009; Lewis, Fischman, Riggs, & Wasserman, 2013; Lo, Chik, & Pang, 2006). However, high-quality curriculum materials are likely essential to effective lesson study, and U.S. teachers may not have access to high-quality curricula—or they may be given such a volume of materials that their lesson study time is spent in sifting through the mile-wide curriculum, rather than in studying a particular topic in depth. One comparison of two U.S. and two Japanese science textbook units on levers found that Japanese fifth-graders are expected to read 22 sentences and engage in a series of hands-on experiments

that closely build on each other and on the written text; U.S. students are expected to read 130 sentences and are offered several activities that may or may not be hands-on and may or may not be related to levers -- such as figuring out how to use simple machines to move a piano into a truck and to move a roll of tape from floor to desktop (Tsuchida & Lewis, 2002).

During the first part of the lesson study cycle, teachers practice *kyouzai kenkyuu* (literally, study of teaching materials), examining what is currently known about the teaching and learning of a particular topic (Takahashi et al., 2005). In Japan, the teacher's manual is used for *kyouzai kenkyuu*. U.S. textbooks and teacher's manuals, in contrast, do not reliably support rich content discussions. A comparison of U.S. and Japanese (mathematics) teacher's manuals indicates that the Japanese teacher's manual devotes more space to features expected to support teachers' learning, such as providing a rationale for pedagogical decisions and information on student thinking. Anticipation of varied student thinking accounts for 28% of the statements in the Japanese teacher's units studied, but only 1% of the statements in the U.S. units (Lewis, Perry, & Friedkin, 2011). When lesson study in the U.S. is conducted with high-quality content materials, there is evidence (from a randomized, controlled trial of lesson study groups across the U.S.) that lesson study can increase not only teachers' content knowledge, but also students' learning (Perry & Lewis, 2013). The same randomized, controlled trial found that teachers who participate in lesson study report higher quality of professional learning, increase their perceptions of the value of collegial work, and increase their belief in student capacity to learn. Evidence from a cross-district U.S. lesson study network (the Silicon Valley Mathematics Initiative) indicates that U.S. teachers can also use lesson study to build and

spread instructional knowledge across a region (Lewis et al., 2012). Educators developed and spread an instructional strategy they dubbed “re-engagement,” in which they began class by presenting two contrasting examples of student thinking from the prior lesson, in order to help students think deeply about key concepts for which student thinking was fragile (Foster & Poppers, 2009). The strategy of “re-engagement” spread across classrooms, schools, districts, boundaries of subject matter, level of schooling and even foundation-school boundaries.

In summary, many pieces of lesson study have emerged in the U.S.: teachers who embrace lesson study and have continued it for a decade or more, and evidence that U.S. teachers find lesson study more useful than other available forms of professional learning, that they can build and spread instructional knowledge across regional lesson study networks, and that lesson study supported by high-quality content resources can build U.S. teachers’ content knowledge and students’ learning. So is it possible that the U.S., like Japan, can build a system in which lesson study is routinely used to build and spread rapidly the knowledge educators need to implement curricular reforms?

Despite its spread and longevity, lesson study in the U.S is typically an activity of volunteer champions. Lesson is rarely practiced school-wide, and rarely treated by administrators or policy-makers as a potentially powerful means to implement reforms or improve instruction (although there are some exceptions, like Florida, where lesson study has been part of the state’s Race to the Top effort (CPALMS, 2013). Schools have powerful routines (Sherer, 2011), and we know few schools where lesson study has become a school-wide core routine, displacing routines that are less directly connected to improvement of teaching and learning. Lewis & Hurd (2011), provide two examples of

school-wide lesson study schools, and a longitudinal study of one of these documents mathematics achievement gains three times that of other district schools over the three-year study period (Perry & Lewis, 2010). (The school focused its lesson study on mathematics during the research period.)

What systemic and policy elements in Japan support the growth and institutionalization of lesson study? Several elements of the Japanese environment are worth noting.

1. *Distributed Leadership for a Ubiquitous Routine*

In Japan, there are no formal requirements to do lesson study, yet it is ubiquitous. Responsibility for lesson study is distributed (Spillane, Diamond, & Jita, 2003), and educators in schools, in districts, in regions, and in national organizations see lesson study as a way to achieve their own educational visions, not as an imposed practice.

Advancement systems support lesson study, since it is unthinkable that a teacher could become an instructional supervisor or principal without a strong track record of lesson study. School structures (such as a research promotion committee) also support lesson study by creating a year-long lesson study calendar (Wang-Iverson & Yoshida, 2005) and plan (Takahashi, in press).

2. *Knowledge from Lesson Study Feeds Back into Policy and Textbooks*

Information from lesson study is consequential. Policymakers attend large public research lessons and may use what they learn to reshape policy. For example, an elementary science unit in which students hatched chicks was quickly withdrawn from the required course of study when Ministry of Education officials heard an earful from teachers

whose students were refusing to eat eggs. Likewise, commercial textbook publishers rewrite textbooks in response to lesson study, replacing less effective activities with more effective ones, such as a toy that uses brightness or color to show amount of energy, instead of one that shows just on or off (Lewis, et al., 2002).

### *3. Key Policy Supports*

As noted, a system of small, short-term grants allows schools to apply as “designated research schools” (*shitei kenkyuu kou*) to investigate proposed curricular and instructional innovations, and to share their learning in public research lessons. Often their funds are used to hire well-known educators who advise their lesson study work and comment on their research lessons. National elementary schools and secondary schools also conduct large public research lessons regularly (typically yearly) as a core part of their mission.

### *4. Other Institutional Supports*

Though not required, lesson study is a core routine in most educational settings, including school districts (which typically offer special lesson study programs after 5-years and 10-years of employment, in addition to the regular district-wide lesson study), preservice programs (in which aspiring teachers work together in a lesson study group with a mentor teacher and rotate classroom teaching responsibility, rather than an extended solo teaching experience), and subject matter associations(Shimizu, 1999).

## *5. Assumptions About Teachers' Learning & Instructional Improvement*

Finally, though less tangible than the institutional and policy supports just described, lesson study is supported by a set of assumptions about teaching and its improvement, such as the following.

- Collaboration among educators—not just in lesson study, but in the daily life of the school—is essential.
- Teachers' learning is multi-faceted, and includes development of knowledge, techniques, habits of mind, observation skill, beliefs, and habits of heart.
- Teachers' learning is never done; there is no such thing as a "master" teacher, because teaching is never mastered, and can always be further improved.
- Most important qualities of students can only be achieved through the efforts of many teachers working together over many years.
- Egalitarian treatment of teachers promotes learning; teachers' learning structures should assume that a first year teacher has something valuable to contribute and that a 40<sup>th</sup> year teacher has something important to learn.
- The students are never to blame.
- Instruction is the proving ground. The most carefully-designed policies and curricula are just starting points, mere splotches of ink on paper until teachers bring them to life in classrooms.

Figure 1: Lesson study cycle and impact on instruction

**Figure 1. Lesson Study: Theoretical Model of Impact on Instruction**

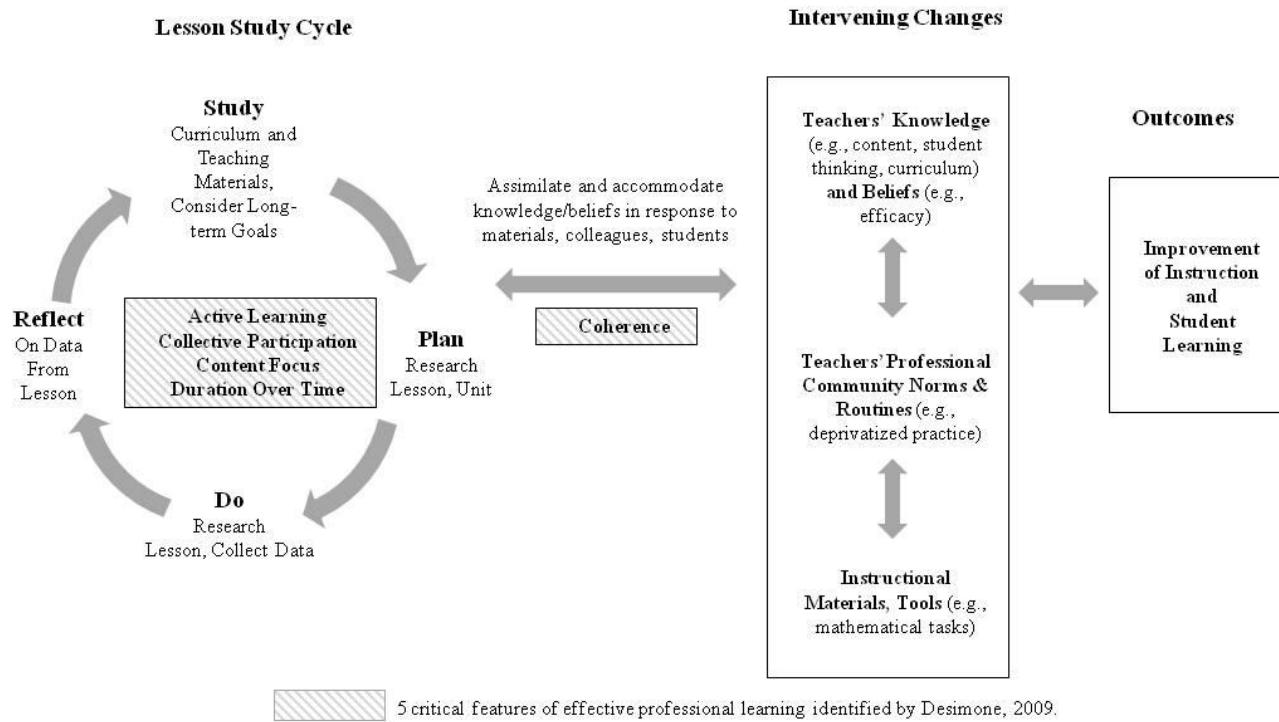
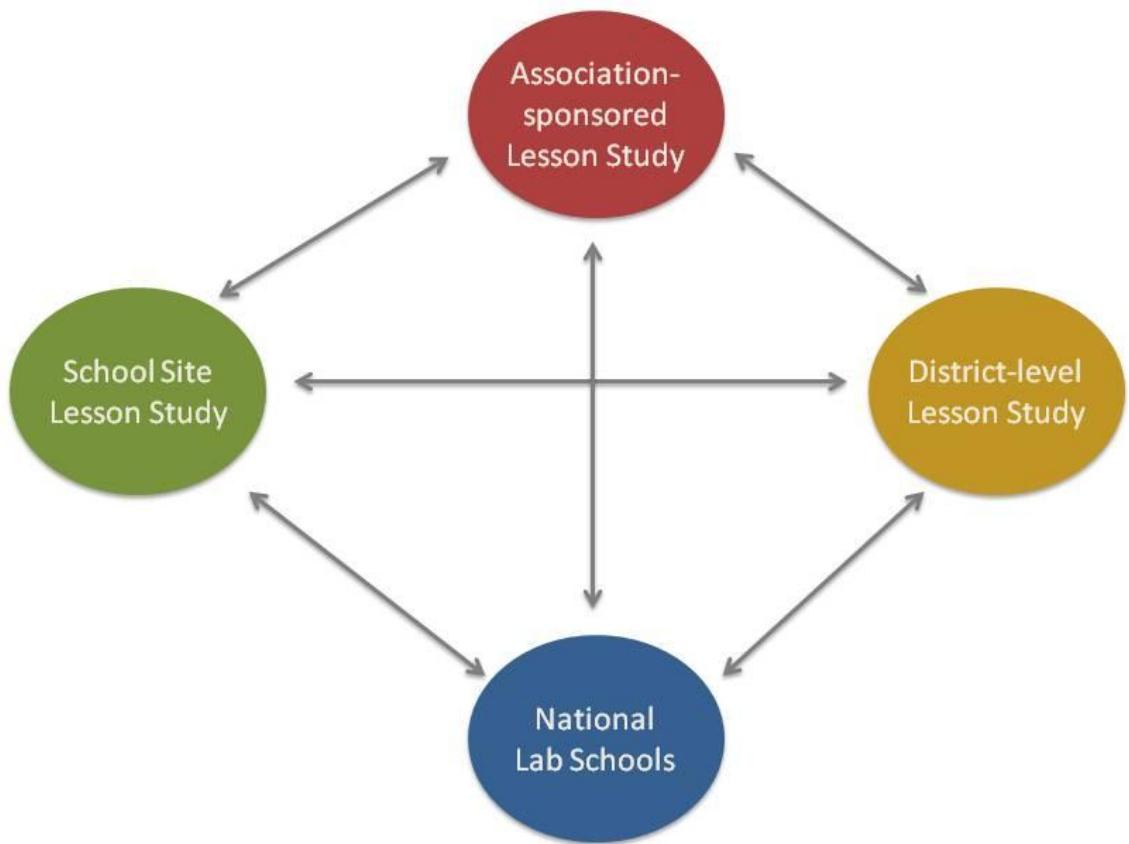


Figure 2: 4 types of LS



## References

- Benesse. (2007). Dai Yonkai Gakushu Shido Kiso Chosa (Fourth Basic Survey of Instruction). Retrieved June 10, 2008, from  
[http://benesse.jp/berd/center/open/report/shidou\\_kihon/soku/soku\\_0\\_1.html](http://benesse.jp/berd/center/open/report/shidou_kihon/soku/soku_0_1.html)
- Cave, P. (2007). *Primary school in Japan*. New York: Routledge.
- Chicago Lesson Study Group. (2010). Lesson Plans by the Chicago Lesson Study Group. Retrieved September 7, 2010, from  
[http://www.lessonstudygroup.net/lg/lesson\\_plans\\_table.php?clsg=1](http://www.lessonstudygroup.net/lg/lesson_plans_table.php?clsg=1)
- CPALMS. (2013). Lesson study support initiative. Retrieved July 26, 2013, from  
<http://www.cpalms.org/cpalms/lsss.aspx>
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181-189.
- Fernandez, C., & Yoshida, M. (2004). *Lesson study: A case of a Japanese approach to improving instruction through school-based teacher development*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Foster, D., & Poppers, A. (2009). *Using Formative Assessment to Drive Learning. The Silicon Valley Mathematics Initiative: A Twelve-year Research and Development Project*. CA: The Noyce Foundation.
- Hart, L., Alston, A., & Murata, A. (Eds.). (2011a). *Lesson-study research and practice in mathematics education: Learning together*. New York: Springer.
- Hart, L. C., Alston, A., & Murata, A. (Eds.). (2011b). *Lesson Study Research and Practice in Mathematics Education*. New York: Springer.
- Isoda, M., Stephens, M., Ohara, Y., & Miyakawa, T. (Eds.). (2007). *Japanese lesson study in mathematics: Its impact, diversity and potential for educational improvement*. Singapore: World Scientific Publishing.
- Lesson Study Network. (n/d). LS Network - Lesson Study Forum Network. Retrieved 8/17/2011, from <http://mailman.depaul.edu/mailman/listinfo/lsnetwork>
- Lewis, C. (2011). Teachers and teaching in Japan: Professional Mecca or pressure cooker? In Y. Zhao (Ed.), *Handbook of Asian Education* (pp. 231-246). New York: Routledge.
- Lewis, C., Akita, K., & Sato, M. (2010). Lesson study as a human science.. In W. R. Penuel & K. O'Connor (Eds.), *Learning research as a human science. National Society for the Study of Education Yearbook*. (Vol. 109, pp. 222-237). New York: Teachers College, Columbia University.
- Lewis, C., & Hurd, J. (2011). *Lesson Study step by step: How teacher learning communities improve instruction*. Portsmouth, NH: Heinemann.
- Lewis, C., Perry, R., & Friedkin, S. (2011). Using Japanese Curriculum Materials to Support Lesson Study Outside Japan: Toward Coherent Curriculum.. *Educational Studies in Japan: International Yearbook*, 6, 5-19.
- Lewis, C., Perry, R., Friedkin, S., Fisher, L., Disston, J., & Foster, D. (2012). Building knowledge and professional community through Lesson Study. In J. M. Bay-Williams (Ed.), *2012 NCTM Yearbook*. Reston, VA: National Council of Teachers of Mathematics.

- Lewis, C., Perry, R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal of Mathematics Teacher Education*, 12(4), 285-304.
- Lewis, C., & Takahashi, A. (2013). Facilitating curriculum reforms through lesson study. *International Journal for Lesson and Learning Studies*, 2(3).
- Lewis, C., & Tsuchida, I. (1997). Planned educational change in Japan: The case of elementary science instruction. *Journal of Educational Policy*, 12(5), 313-331.
- Lewis, C., & Tsuchida, I. (1998). A lesson is like a swiftly flowing river: Research lessons and the improvement of Japanese education. *American Educator*(Winter), 14-17 & 50-52.
- Lewis, C., Tsuchida, I., & Coleman, S. (2002). The creation of Japanese and U.S. elementary science textbooks: Different processes, different outcomes *National standards and school reform in Japan and the United States* (pp. 44-66). Columbia University: Teachers College Press.
- Lewis, J., Fischman, D., Riggs, I., & Wasserman, K. (2013). Teacher learning in lesson study. *The Mathematics Enthusiast*, 10(3), 583-620.
- Lo, M., Chik, P., & Pang, M. F. (2006). Patterns of variation in teaching the colour of light to primary 3 students. *Instructional Science*, 34, 1-19.
- Murata, A., & Takahashi, A. (2002). *District-level lesson study: How Japanese teachers improve their teaching of elementary mathematics*. Paper presented at the Research Presession of National Council of Teachers of Mathematics Annual Meeting, Las Vegas, NV.
- National Education Policy Research Institute, J. K. K. S. K. (2011). *Report of Survey Research on Improvement of Teacher Quality [Kyouin no Shitsu no Koujou ni Kansuru Chosa Kenkyuu]*. Tokyo: National Education Policy Research Institute.
- Nihon Kyouiku Houhougakkai. (2009). *Lesson Study in Japan* (Vol. 1). Tokyo: Gakubunsha.
- Okano, K., & Tsuchiya, M. (1999). *Education in contemporary Japan: Inequality and diversity*: Cambridge University Press.
- Perry, R., & Lewis, C. (2010). Building demand for research through lesson study. In C. E. Coburn & M. K. Stein (Eds.), *Research and practice in education: Building alliances, bridging the divide*. (pp. 131-145). Lanham, MD: Rowman & Littlefield Publishers, Inc.
- Perry, R., & Lewis, C. (2013). Improving the mathematical content base of lesson study: Summary of results. Retrieved July 25, 2013, from <http://www.lessonresearch.net/IESAbstract10.pdf>
- Sato, N. E. (2004). *Inside Japanese classrooms: the heart of education*. New York: RoutledgeFalmer.
- Sherer, J., & Spillane, J. (2011). Constancy and change in work practice in schools: The role of organizational routines. *Teachers College Record*, 113(3), 611-657.
- Shimizu, Y. (1999). Aspects of mathematics teacher education in Japan: Focusing on teachers' roles. *Journal of Mathematics Teacher Education*, 2(1), 107-116.
- Spillane, J. P., Diamond, J. B., & Jita, L. (2003). Leading instruction: The distribution of leadership for instruction. Retrieved December 17, 2004, from Northwestern University Distributed Leadership website: <https://http://www.sesp.northwestern.edu/dls/publications/papers/>

- Takahashi, A. (2003). *Lesson study overview: Three major types of lesson study*. Paper presented at the Global Education Resources Lesson Study Immersion Program, Japan.
- Takahashi, A. (in press). Supporting the effective implementation of a new mathematics curriculum: A case study of school-based lesson study at a Japanese public elementary school. In Y. Li & G. Lappan (Eds.), *Mathematics curriculum in school education*. New York: Springer.
- Tsuneyoshi, R. (2001a). *The Japanese Model of Schooling: Comparisons with the United States* (Vol. 27). New York: Routledge Farmer.
- Tsuneyoshi, R. (2001b). *The Japanese model of schooling: Comparison with the United States*. New York: Routledge Falmer.
- Wang-Iverson, P., & Yoshida, M. (2005). *Building our understanding of lesson study*. Philadelphia: Research for Better Schools.
- Watanabe, T. (2002). Learning from Japanese Lesson Study. *Educational leadership*, 59(6), 36-39.
- Watanabe, T., & Wang-Iverson, P. (2005). The role of knowledgeable others. In P. Wang-Iverson & M. Yoshida (Eds.), *Building our understanding of lesson study* (pp. 85-92). Philadelphia: Research for Better Schools.

---

<sup>i</sup> This material is based upon research supported by the Department of Education Institute for Education Sciences, Grant Nos. R308A960003, R305A110491 and R305A110500. Any opinions, findings, and conclusions or recommendations are those of the authors and do not necessarily reflect the views of the grantors. This material is also based upon work supported by the National Science Foundation under Grant No. 0207259. Any opinions, findings, and conclusions or recommendations are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.