

Implementing Japanese Lesson Study in Foreign Countries: Misconceptions Revealed

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This paper is based on data gathered during visits to Uganda and Malawi, conducted by the International Math-teacher Professionalization Using Lesson Study (IMPULS) project and the Japanese International Co-operation Agency (JICA). The author's observations and experiences highlighted misconceptions about lesson study. The paper concludes that some key factors can be viewed as either affordances, or constraints, on practice, while others are best understood against several misconceptions that seem to be common outside Japan.

Keywords: lesson study • mathematics education • teacher professional learning • structured problem solving • Africa

A Spreading Interest in Lesson Study

Since the TIMSS Video Study (Stigler, Gonzales, Kawanaka, Knoll, & Serrano, 1999) was brought to public attention, teaching activities in schools seem to have become one of the most interesting research targets in education studies. *The Teaching Gap* (Stigler & Hiebert, 1999), and particularly the seventh chapter titled "Japan's approach to the improvement of classroom teaching", which is based on Yoshida (1999) and is now available in Fernandez and Yoshida (2004), provoked enormous interest in lesson study as a process for professional development among non-Japanese educators and researchers. In fact, not only the United States but also other countries, including Asia-Pacific Economic Cooperation (APEC) countries, African nations, and European countries, have experimented with the introduction of lesson study. Many mathematics teachers and teacher educators are now involved in it, and many books and research papers have been written on various aspects of lesson study as well as the typical lesson pattern for Japanese structured problem-solving mathematics lessons (Groves & Doig, 2010; Hart, Alston, & Murata, 2011; Lewis, Perry, & Hurd, 2009; Lewis, Perry, & Murata, 2006; Perry & Lewis, 2009; Takahashi, 2006b; Watanabe, Takahashi, & Yoshida, 2008).

Outside Japan, however, it seems that many aspects of lesson study that are well understood by Japanese teachers have not transferred readily. For that transfer to happen, the Japanese model of lesson study needs to be more explicitly defined, including the beliefs and attitudes of Japanese teachers that underpin the process of lesson study.

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provided funds for the visit. The author's observations and experiences in Uganda and Malawi highlighted misconceptions about lesson study that are often found when it is implemented outside Japan. This paper describes these misconceptions and shows how they clarified, for the author, some of the key characteristics of Japanese lesson study.

Japanese Lesson Study

Lesson study is a teacher professional development approach. From the Japanese perspective, teaching is considered as a professional occupation with life-long goals to be accomplished, and therefore the aim of lesson study is not simply to improve teaching skills. The history of lesson study in Japan spans more than a century, as does the formal schooling system introduced in Japan during the Meiji era (Inagaki, 1995; Makinae, 2010). For Japanese educators, lesson study is like air, felt everywhere because it is implemented in everyday school activities, and so natural that it can be difficult to identify its critical and important features.

Lewis and Hurd (2011) described the lesson study cycle as shown in Figure 1.

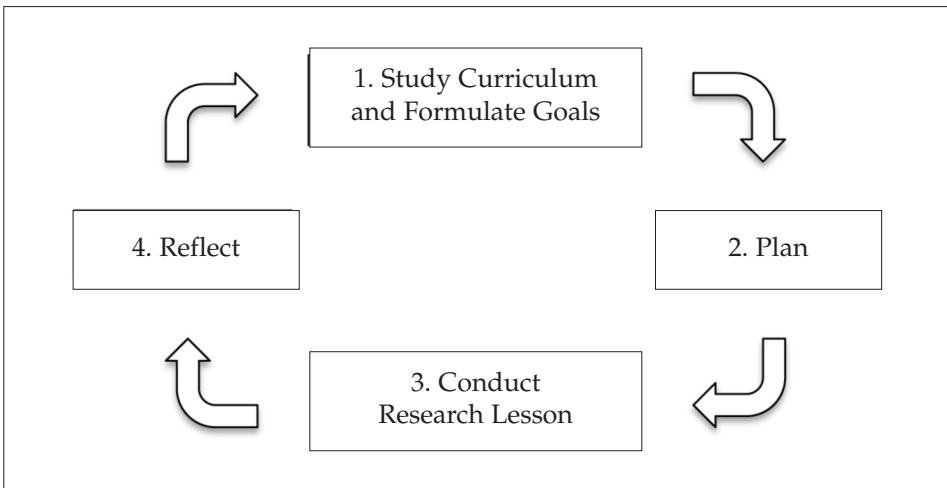


Figure 1. The lesson study cycle (adapted from Lewis & Hurd, 2011, p. 2).

Lewis and Hurd (2011, p. 2) characterised each phase of the cycle as follows:

1. *Study curriculum and formulate goals*: Consider long-term goals for student learning and development. Study curriculum and standards, identify a topic of interest;
2. *Plan*: Select or revise a research lesson. Write a lesson plan that includes: Long-term goals, anticipated student thinking, data collection, a model of a learning trajectory, and a rationale for the chosen approach;
3. *Conduct the research lesson*: One team member teaches the lesson, others observe and collect data; and

4. *Reflect*: In a formal post-lesson discussion, share data from the lesson to illuminate student learning, discrepancies in content, lesson and unit design, and broader issues in teaching and learning. Document the cycle to consolidate and carry forward learning as well as new questions into the next cycle of lesson study.

Lesson study in Japan takes place at three different levels: the individual school level; the district or regional level; and the national level (Takahashi, 2006a). The lesson study cycle is basically the same at each level and usually spans one year. At the school level, the typical lesson study cycle begins at the end of one academic school year—i.e., in February or March—when the faculty decides on a research theme for the next school year, which starts in April. Several research lessons are scheduled from, say, May to November. Each research lesson and its post-lesson discussion occupy only one day, but the teachers reflect on what they learned at the research lessons and usually write a booklet or long summary report by the end of the school year.

Although the lesson study cycle is the same at all levels, the purposes are different. National-level lesson study is usually research-orientated: an academic or veteran teacher may take primary responsibility for the lesson study and teach the research lesson. The research lesson emphasises the use of materials or tasks never seen before or difficult to teach, and the goal is usually to demonstrate that the materials, or task, have a good mathematical and educational value. The goal of school-based lesson study, on the other hand, is usually to accomplish the school's theme or mission. School-based teams usually use familiar tasks from a textbook, perhaps with slight modification.

Although Japanese teachers involved in lesson study spend time daily on it, along with their other professional duties, it sometimes takes more than half a year to design a task and plan a lesson. The lengthy period of planning a lesson crystallises into a detailed lesson proposal or lesson plan. This is considered to be one of the characteristics of the Japanese model of lesson study.

The Lesson Study Seminar for African Educators

Since 2008, the intensive three-week *Seminar for Mathematics Lesson Evaluation* for African educators has been designed and conducted by the Mathematics Education Department of Tokyo Gakugei University with the support of JICA. The seminar is implemented as part of the Official Development Assistance of the Government of Japan, based on a bilateral agreement between governments. The participants of the seminar (hereafter referred to as JICA participants) come from Ethiopia, Ghana, Kenya, Malawi, Nigeria, Sierra Leone, Tanzania, Uganda, and Zambia. In 2008 and 2009, one person from each country was invited, while from 2010 onward two people were invited. According to their *curriculum vitae* the JICA participants included: district and national trainers, teacher trainers, and mathematics facilitators at the national level; lecturers and teacher trainers at colleges and a regional training centre for in-service education; and a curriculum expert in mathematics from a regional Education Bureau.

The seminar is designed for the JICA participants to: learn about the Japanese model of lesson study; deepen and formulate viewpoints necessary for mathematics lesson evaluation; and contribute to lesson improvement in their countries. JICA participants have the opportunity to observe several mathematics research lessons in elementary and secondary schools, and discuss student-centred lessons through *kyozaikenkyu* (教材研究—the study or research of teaching materials) and post-lesson discussions. On return to their own country, JICA participants are expected to become leaders of lesson study. Since 2011, Project IMPULS has been housed in the Mathematics Education Department of Tokyo Gakugei University, as its staff took the initiative to conduct the seminar.

The Follow-up Study in Uganda and Malawi

For the follow-up study, four IMPULS project team members from Tokyo Gakugei University, including the author as leader of the project and one person from JICA, visited Uganda and Malawi for a period of two weeks in late 2011. The follow-up study consisted of interviews with former JICA participants of the seminar, together with observations of their role and function in their own countries, focussing on research lessons and the subsequent post-lesson discussions. In this way the follow-up study tried to evaluate the effectiveness of the seminar by observing how former JICA participants conducted research lessons and post-lesson discussions in their own countries, as key persons with first-hand experience of lesson study in Japan.

The organisers of the IMPULS project and JICA staff also needed to establish, through first-hand experience, former JICA participants' situation and difficulties in implementing and adapting lesson study in their own countries.

The Data and Methodology

Four research lessons were observed in Uganda, and two in Malawi. Details regarding these lessons are given in Table 1.

The total number of JICA participants visited was intended to be six from each country. In the case of Malawi, one of the JICA participants had passed away, so the number was five. At lessons #1 and #2 in Uganda, five of the six JICA participants were able to attend, but one was unable to attend because of now being in a higher-level position. For lessons #3 and #4 in Uganda, three of the six JICA participants were able to attend, but three were unable to attend because of other duties. In Malawi, for lessons #5 and #6, all five JICA participants were able to attend the research lessons.

Table 1
Summary of Research Lessons Observed in Uganda and Malawi

Lesson	School	Year	Topic	Students	Time (mins)	*African Participants
#1	Uganda 1	10	Bearings	89	80	15 (5)
#2	Uganda 1	12	Three dimension geometry: Angle between line and plane	63	80	23 (5)
#3	Uganda 2	12	The sine rule	53	80	14 (3)
#4	Uganda 2	11	Direct proportion	63	80	14 (3)
#5	Malawi 1	8	Expanding algebraic expression	68	50	10 (5)
#6	Malawi 2	10	The circle	50	50	15 (5)

* Indicates total number of African participants, including teachers from the school hosting the research lessons and teachers from nearby schools. Numbers in parentheses indicate the number of former JICA participants. In addition, six Japanese attended each lesson.

Thematic content analysis was carried out on transcripts of the post-lesson discussions and participants' comments were coded with appropriate keywords to track their views of the lessons. These comments were examined with respect to the misconceptions identified by the author when observing the lessons and post-lesson discussions.

Misconceptions Uncovered Through the Follow-up Study

The author noted that if lesson study is "A", then there should also be "non-A". Having been exposed to the Japanese form of lesson study naturally, the author had not previously given much thought to what this "non-A" might be until this follow-up study in Uganda and Malawi, at which point several misconceptions about lesson study became evident. Consequently, the author believes that these misconceptions merit attention and need to be addressed. These misconceptions are therefore listed below in the form of questions that are discussed, using evidence from the follow-up study.

Is Lesson Study a Workshop?

The lesson study cycle commences with goal setting and planning as the first and second components of the cycle. In a school-based lesson study, teachers discuss the educational goals of the school and the current situation of the students, and then set a goal for their lesson study. Therefore, lesson study is characterised as a teacher-led, or bottom-up, activity. In lesson study, the initiative is taken by teachers. This feature is different from traditional seminars or workshops. The author clearly learned in Uganda and Malawi that workshops or seminars seem to be one form of the non-A of lesson study. As early as 2002, just three years after *The Teaching Gap* was published, Lynn Liptak, the principal of Paterson School No. 2, New Jersey, who was one of the pioneers implementing lesson study in the United States, commented on the difference between lesson study and traditional professional development (Liptak, cited in Lewis, 2002, p. 12). In the United States, teachers are familiar with workshops or seminars. Upon the introduction of lesson study, it was contrasted with workshops or seminars. Liptak identified how a workshop begins differently from lesson study, with the former starting with an answer while the latter begins with a question.

In Malawi, teaching using structured problem-solving lessons was of interest, and conferences and demonstration lessons were conducted on this topic. However, as the author saw, these activities were treated as workshops. The evidence was revealed through an analysis of the lesson plans. The lesson plans for lessons #5 and #6 in Malawi made no mention of a "question", which is why the topics to be taught in the research lessons were only discussed in relation to students' current situation or curriculum issues, rather than in terms of how the lesson would address the participants' own research question, focussed on learning.

In Uganda, there were "science-clinic" activities, which were considered to be lesson study. These well-organised activities included observing live lessons and debriefing them. Good results seem to have come from these activities. This made the Japanese observers wonder whether these "science-clinics" were lesson study or not. On the surface, it looked like lesson study. However, on a closer examination of the details of the lesson plans for research lessons, particularly of the selection of the topic, one could see a deviation from one of the key points that lesson study holds to be important. In lesson study, the topic is chosen for a reason. The chosen topic could be one that is hard for teachers to teach; or for students it may seem to be too difficult; or it may seem easy, but important misconceptions arise; or the topic may be related to newly introduced content in the national curriculum; and so on. An analysis of the four lesson plans in Uganda found no evidence that such a "question" was stated, although there was a section for writing the "rationale". In the "rationale", the selection of the topic seemed to be based on the simplicity of the content, or it was chosen because it was the teacher's favourite topic to teach.

Also, through detailed analysis of participants' comments in six post-lesson discussions, the reason for choosing the topic was never questioned or discussed.

Considering Liptak's comparison above (cited in Lewis, 2002, p. 12), the demonstration lessons in Malawi and the "science-clinic" in Uganda, did not begin with a question, which appears to be a critical deviation from lesson study.

People may ask why it is important to begin with a question. A question is important for framing a specific and attainable aim of the lesson, an aim that should be clearly stated in the lesson plan. Starting lesson study without such a question would most likely result in beginning a lesson study without a lesson plan. Some former JICA participants and local teachers attending research lessons in Uganda and Malawi seemed not to have yet seriously considered the importance of such a question.

In Japan, the lesson plan is considered to be an important result of the goal setting and planning stages of lesson study. In the context of school-based lesson study, the beginning question of a lesson study should be connected to the mission of the school and the students' current state. It must then be broken down into an achievable lesson, one with coherent aims and methods. Therefore in Japan, having this shared idea of the necessity of a lesson plan in lesson study, the committee assigned to develop a research lesson provides copies of lesson plans for the observers. From the observers' points of view, the lesson evaluation depends on the aims stipulated therein and the lesson plan serves as a platform to see the mathematical and educational value of conducting such a lesson. These features of lesson study stem from the "question"; so lesson study begins with a question not with the answer.

In lesson study, to begin with a question is also related to the feature of lesson study that it is not a momentary activity. In Malawi, the continuity of lesson study was not evident. In Japan, teaching is a professional occupation with life-long goals to be accomplished. This is the reason why lesson study is a purpose-orientated and continuing life-long practice. Thus anyone, neophyte or veteran, gets involved in order to better his or her teaching. In Japan, teachers consider *kyozaikenkyu* inherent in a teacher's life so they are actively involved in this endeavour in the hope of improving their level of teaching. Teachers believe that the research lesson is a proving ground for teachers' theories about teaching. In Japanese lesson study, continuity is a fundamental feature. In the case of school-based lesson study, it is strongly connected with the educational pursuits of that school. Schools keep on trying to improve their educational activities, a self-imposed improvement function. In this light, one may see that continuity is inherent in lesson study. Continuity, and a desire to improve teaching are critical factors of lesson study that distinguish it from workshops.

Must the Lesson Plan be Followed Exactly?

At the research lesson, the third component of the lesson study cycle, the lesson plan is implemented. However, implementation of the lesson plan by teachers in Uganda and Malawi seemed to mean something a bit different from in Japan. The second misconception the author saw in these visits was in the participating teachers' interpretation of "lesson plan". In Japan, a lesson plan is called *gakushu-*

shidou-an (学習指導案), which when translated verbatim into English means "learning/teaching proposal". For this reason, if a lesson steers away a bit from what was written in the lesson plan, due to the actual classroom situation, this is never thought to be wrong. However, in Uganda and Malawi, a lesson plan seemed to be viewed as a script, so that if everything that was written on the paper was not accomplished, then that reflected badly on the whole enterprise.

In some lessons observed in Uganda and Malawi, the teachers taking the lesson found themselves in a situation where they felt obliged to follow the steps in the lesson plan, when instead they should have gone with the lessons' natural flow, based on the actual classroom scenario. For instance, in lesson #6 in Malawi, almost all students were trying hard to take an accurate measurement of the diameter of the circle by using the divisions of a scale, while according to the lesson plan the teacher had anticipated them using a compass and ruler. However he never tried to modify the lesson based on the actual classroom situation. This tendency was identified in other lessons as well. In fact, all six teachers who taught the research lessons said the lesson flowed well according to the lesson plan as written. For instance, in lesson #4 in Uganda, the teacher taking the lesson said "it was good for students to follow instructions" and one of the observers supported this comment in the post-lesson discussion, stating "The teacher used his authoritative approach to push the lesson to the end". This view may be the result of the English use of "lesson plan" as a sequence of tasks to be executed and accomplished in the allotted time. However, if "the lesson plan" had been seen as just a proposal—the way Japanese teachers see it—maybe teachers would have felt differently.

What then is a "lesson plan" in lesson study? Takahashi (2006a) claims that a lesson plan is equivalent to a research proposal in any research field. Table 2 shows the comparison between these two fields.

Table 2
What is a "Lesson Plan" in a Lesson Study?

General Educational Research Field	Lesson Study
• Research proposal	• Lesson plan
• Data gathering	• Observing the research lesson
• Interpretation and analysis of data	• Debriefing session

Adapted from Takahashi (2006a, p. 4).

Teachers who consider the lesson plan—as Japanese teachers do, as a research proposal—may not be so concerned when a difference occurs between students' reality and the lesson plan.

Undoubtedly writing a lesson plan is a vital part of the lesson study process. However, taking up Takahashi's (2006a) perspective more closely, it became clear that the writing of a lesson plan has three major functions. First, it brings the

ideas of the planning teachers together for a common purpose; second, it draws out the essentials of the teaching materials (which is in itself *kyozaikenkyu*); and finally, the lesson plan helps to keep a focus on teaching, not on the teacher. The last function is discussed later in this paper in relation to another misconception.

Is Structured Problem-solving Just Solving a Task?

Almost all research lessons in elementary school mathematics in Japan take the form of a "structured problem-solving" lesson, where the teacher poses a problem to the class without first demonstrating how to solve it (Becker, Silver, Kantowski, Travers, & Wilson, 1990). According to Stigler and Hiebert (1999) this is in marked contrast to most mathematics lessons in the United States. The aim of a structured problem-solving lesson is not for students to solve a problem, but through solving the problem to learn mathematical ways of thinking, and more generally, wisdom for becoming independent thinkers or intellectually independent human beings. Therefore the lesson is organised with a student-centred approach.

Teachers in Uganda and Malawi employed a "problem-solving approach" (PSA) that resembled some aspects of Japanese structured problem-solving lessons, because they too value student-centred teaching approaches. However, the author's observations of lessons in Uganda and Malawi suggest that teachers had grasped the Japanese approach superficially. That is to say, they had adopted the "present a problem and students solve it" feature, but other features of the Japanese structured problem-solving lesson were missing from their PSA lessons.

Japanese structured problem-solving lessons require what Sugiyama (2008) referred to as Level 3 teaching. Sugiyama distinguished three levels of teaching that Takahashi (2011) summarised as:

Level 1. The teacher can tell students important basic ideas of mathematics such as facts, concepts, and procedures.

Level 2. The teacher can explain the meanings of and reasons behind the important basic ideas of mathematics in order for students to understand them.

Level 3. The teacher can provide students opportunities to understand these basic ideas, and support their learning so that the students become independent learners. (pp. 201–202)

Level 1 teachers provide the "what and how", while Level 2 teachers provide "what, how and why", which corresponds to *instrumental* and *relational understanding* in Skemp's (1976) terminology. Level 3 teachers, however, provide students with the opportunity to explore, by themselves, mathematical ideas resulting from their own thinking and understanding. A Level 3 lesson is student-centred because students explore new concepts, relations, rules, etc., not through spoon-feeding or deliberate coaching by the teacher, but mostly due to their own efforts. Thus in a Level 3 teacher's lesson, the bulk of the concepts or

ideas originate from the students, and it is their voice that is mostly heard during the lesson. It is here that students, rather than the teacher, become the centre of the teaching-learning process. Therefore, teachers who can conduct student-centred and structured problem-solving lessons are Level 3 teachers.

It might be thought that Level 3 lessons make a teacher's life easy, since the students apparently do most of the work. This is a misconception, as Level 3 teaching clearly requires a lot of work from the teacher. So the question is, what specific "work" is done in Level 3 teaching, besides providing the exploratory environment for the students?

As an example, we will look at the topic "fraction divided by a fraction" that was given by Sugiyama (2008). This is located at sixth grade in the National Course of Study in Japan (Ministry of Education, Culture, Sports, Science and Technology, 2008). Important factors to consider include students' prior learning of equivalent fractions, introduced at fourth grade and used at fifth grade for addition and subtraction of fractions; the concept of division introduced at the third grade; and the rule of division introduced at the fourth grade. By the rule of division is meant

$$a \div b = (a \times c) \div (b \times c) = (a \div c) \div (b \div c), \text{ where } c \neq 0$$

So, for example,

$$\begin{aligned} 2/3 \div 4/5 &= 10/15 \div 12/15 && \text{(equivalent fractions)} \\ &= 10 \div 12 && \text{(the rule of division, } c=15) \end{aligned}$$

$$\begin{aligned} 2/3 \div 4/5 &= (2/3 \times 5/4) \div (4/5 \times 5/4) && \text{(the rule of division, } c=5/4) \\ &= (2/3 \times 5/4) \div 1 \\ &= 2/3 \times 5/4 \end{aligned}$$

Sugiyama (2008) claims that ordinary teaching is not sufficient to deliver a Level 3 lesson because it does not consider factors like these. To implement a Level 3 lesson, teachers must be able to choose a good task, to identify the pre-requisite knowledge, and, most importantly, must be able to nurture students to apply their knowledge to a new situation. Of course, the usefulness of the students' prior knowledge depends on the teaching that the students have previously received. In this respect, structured problem-solving lessons may also serve, to some extent, as an evaluation of the students' former learning experiences.

In one of the lessons the author observed in Malawi (Lesson #6), the teacher posed the task and let the students solve it by themselves. However, the teacher did not anticipate many of the responses from the students. This was most likely because the teacher was not able to study thoroughly the instructional materials beforehand, or because he did not know the scope and sequence of the curriculum well enough, or was unfamiliar with the students' prior knowledge.

Since structured problem-solving lessons require solving a task that requires pre-requisite knowledge and skills, participating teachers often think that when doing structured problem-solving lessons, it is necessary to develop a lot of concepts, treating all concepts as equally important. This is another

misconception. It should be possible to tell which concepts are more significant than the others, through a close study of the topic to be taught and the instructional materials, a process called *kyozaikenkyu* in Japanese. Level 3 teaching is based on a profound *kyozaikenkyu* by the teacher (see Doig, Groves, & Fujii, 2011).

Is the Focus of Consideration Teaching or the Teacher?

Immediately after the research lesson has been implemented, the post-lesson discussion follows as the fourth component of the lesson study cycle. In the follow-up studies in Africa, the author realised that, in these debriefing sessions, the participants focussed on the *teacher* who had demonstrated the lesson and not on the *teaching* that had just occurred. This practice was particularly apparent in the science-clinic in Uganda, where the object of diagnosis and treatment was clearly the teacher. The word "clinic" carries the medical connotation that someone needs treatment. As a natural result of this, in some of the lessons that the author observed, participants criticised the teacher during the debriefing sessions. Then the teacher strongly defended himself against any criticism. In fact, in Uganda Lesson #2, ten of the thirteen comments were about the teacher himself. These were quite critical such as "There is a need for the teacher to do ...". Not surprisingly, there were five refutations made by the teacher in response to the ten comments. The post-lesson discussion records were made by three former JICA participants, and contained comments such as "Demo-teacher defended by saying ...", "Demo-teacher counter-defended that he was aware of ..." and so on. This was not productive. It was clear to the author that the implicit purpose here of lesson study was to improve teachers' behaviour, not to improve teaching.

Further evidence of the focus being the teacher, and not teaching, is that observers used checklists at research lessons. In those checklists, the object of analysis and evaluation was the teacher. The use of a checklist is not wrong, depending on the context. In Japan, school principals also use a checklist in evaluating teachers for purposes other than teaching. But the purpose of checklists in lesson study needs to be reconsidered.

When the teachers in Uganda studied the lesson plan before observing a lesson, as happened in Lessons #3 and #4 in Uganda, the nature and quality of the post-lesson discussion changed significantly from what it was when the teachers did not study the lesson plan ahead of time (Lessons #1 and #2 in Uganda). In fact, in the post-lesson discussion of Lesson #3 in Uganda, only one comment out of a total of 23 comments was about the teacher. After Lesson #4 in Uganda, there were 21 comments by observers, none of which were a comment on the teacher himself. It should be noted that, at the very beginning of the post-lesson discussion of Lesson #3, the chairman made it clear that participants needed to focus on teaching not the teacher. Even so, the fact that the "demo-teacher" at no stage tried to bring a counter-argument against negative comments from observers shows that the entire atmosphere and attitude of participants

changed through studying the lesson plan before the research lesson was implemented. This confirmed the author's belief that one of the functions of the lesson plan is to shift the focus from *teachers* to *teaching* during lesson observation and post-lesson discussion.

Should a Research Lesson Always be Re-taught?

In Uganda and Malawi there seemed to be no hesitation in re-teaching the research lesson. This practice evaluates the teacher's performance and the feasibility of the lesson plan. The author believes the possible roots of this misconception may stem from the steps in lesson study described in *The Teaching Gap* (Stigler & Hiebert, 1999, pp. 112–113). These include: *Step 3*: Teaching the lesson; *Step 4*: Evaluating the lesson and reflecting on its effect; *Step 5*: Revising the lesson; and *Step 6*: Teaching the revised lesson. This suggests a practice of revising a faulty part and replacing it in the revised lesson. An inorganic system, such as a car, is composed of parts that may be easily replaced. However, in organic systems like a lesson or like lesson study, each part is systemic, not systematic.

But what does it mean to state, "A lesson is an organic system" and "Lesson study is an organic system"? A possible conceptual model for lesson study is that key factors or parts of lesson study, including factors identified in this paper, are located on a plane. These factors or parts could function as an organic system with one additional part: the heart of lesson study. The heart is located in a third dimension, or at a meta-level. The heart of lesson study is found in its consideration of educational values, the most important factor in lesson study. With the consideration of educational values, lesson study could be interpreted as an organic system.

Another problem with re-teaching is that it reinforces the idea that the same lesson plan can be used with different students. In this kind of thinking, the students are not an important consideration. This is in outright opposition to a core value of lesson study. Consideration of students is not special in structured problem-solving lessons, but it is a focus of lesson study. Finally, re-teaching is disrespectful of students' right to the best education one can provide them. Having the thought of re-teaching at the back of one's mind is like making the first class a pawn in order to improve classroom teaching. This benefits teachers and lesson plan makers at the expense of students.

In some countries, such as Zambia, it is clearly stated that the lesson study cycle includes re-teaching. The steps of lesson study in Zambia are: (1) Defining problem or challenge; (2) Collaboratively plan a lesson; (3) Implementing demo-lesson; (4) Discuss lesson and reflect on its effect; (5) Revise the lesson; (6) Conduct the revised lesson; (7) Discuss the lesson and reflect; and (8) Reflections compiled and shared (Ministry of Education, Science, Vocational Training and Early Education, Republic of Zambia, 2013). The fifth step is further explained as "Changes and adjustments are made and a modified lesson plan is prepared for presentation to another class by the same teacher" (p. 3); and the sixth step as

"The lesson which was discussed together with reflections by the group is conducted by the same teacher but in a different class" (p. 3). This is a fixed cycle and it seems to be difficult to change.

An alternative to keeping the eight steps as they are would be to modify the fifth step to plan the *following* lesson to be taught to the *same* class by the *same* teacher. Thus the sixth step would then become "Conduct the following lesson" for the *same* students, taught by the *same* teacher, with insights from the first lesson. This modification would be more productive, since the planning team would be taking care of the class responsibly without abandoning the students, as they would discuss how to move on from the first lesson to the following lesson. By doing this, teachers could see students' potential more clearly, as Lewis and Tsuchida (1998) fortunately experienced. They observed two consecutive research lessons in science in an elementary school, with the same class and the same teacher. They described their experience: "For us observers, the second day's lesson was stunning. Believers though we were in the power of student-centred instruction, we never imaged that the sloppy experiments of the prior day could be salvaged, let alone turned into such a powerful 'Aha'" (p. 51). We should note that here the teacher did not repeat the same thing to the same students, but moved on and brought students to the "aha" moment eventually. The cycle of planning and implementing the first lesson, reflecting on it, and planning and implementing the following lesson, is surely beneficial for teachers in terms of gaining richer pedagogical content knowledge and deeper understanding of students.

In Japan, in situations such as huge, nation-wide research lessons, where observers come over from all over Japan, or even in school-based lesson study, a trial lesson just before the research lesson might take place, simply because a demonstration teacher feels that it is too risky to implement a lesson plan for the very first time in front of so many outside observers. The demonstration teacher may expect to fine-tune the initial plan in light of students' actual responses. However, even in this case, the demonstration teacher needs to consider the students' responses at a research lesson as they would differ from the trial lesson. More importantly, the demonstration teacher needs to understand that the lesson plan is considered to be the best or ideal one that the planning team could create. The lesson plan should be the result finally reached after extensive and enormous effort. In other words, Japanese teachers' attitude towards research lessons and lesson plans is that the best lesson plan should be implemented at a research lesson, and that a research lesson is the proving ground for teachers.

Discussion

Some key factors of lesson study can be viewed as either affordances or constraints on the practice, while others are best understood against several misconceptions that seem to be common outside Japan, as described in this paper.

Diagrammatically, the key features of lesson study could be located at the

vertices of a square in the plane using Lewis and Hurd's (2011) lesson study cycle model, with one more distinguishing feature, the heart of the organic system, being located in a third dimension (see Figure 2).

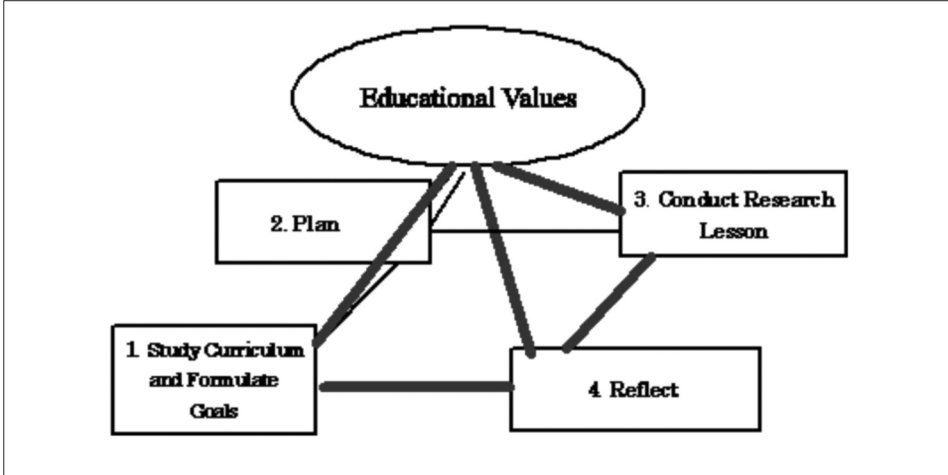


Figure 2. Pyramid model of lesson study

With values being at the apex of the pyramid, this model of lesson study intends to show that the consideration of educational values is always tied to, influenced by, and reflected in, the key features of lesson study.

The pyramid or three-dimensional model could assist in explaining other important aspects of lesson study. For instance, the statement "Lesson study begins with a question" could be explained by the simple reason that the question is related to an aim or educational value. In any type of lesson study—school-based, district-wide, or cross-district—one begins by identifying a long-term goal, or goals; a research question, or set of questions; or a theme (Takahashi, 2006a). Goals are identified through analysing the situation of the students or school, recent educational trends, or a serious educational problem to be solved. The educational goal or goals could be accomplished using several different forms. As described by Lewis (2002), lesson study is one form of showing the answer to the problem as an actual classroom lesson, with lesson study being a way to bring educational goals to life in the classroom. For instance, a school might be concerned that, while students can do calculations, they are struggling to understand why the procedures work. They know how to calculate but they don't know why it works. Teachers discuss what they can or should do to change this situation. They are indeed starting with a question. They conclude that they need to nurture mathematical thinking through lesson study. They then plan a lesson to accomplish this goal. Teachers may decide on the topic — for example, fractions divided by fractions—that is a typical topic where students can easily understand how to do it, but do not understand why

the procedure works. Mathematical thinking, such as applying former knowledge to a new topic, is important here and so, in a structured problem-solving lesson, this would be discussed in the comparison and discussion part of the lesson and then summarised. Promoting students' mathematical thinking is educationally valuable of course, and is the answer to the question the planning team posed at the very first stage of the cycle. Therefore lesson study needs to begin with a question. Lesson study could be constructed as an organic system with a "question", in line with Liptak's insight into this being a necessary factor in lesson study (as reported in Lewis, 2002).

When teachers start lesson study with goals they have identified themselves, they are likely to evaluate the activity in terms of the goals, and then lesson study can continue in order to improve lessons. Eventually, lesson study becomes a lifelong activity as a form of teacher-led professional development. This contributes to "Lesson study is a life-long continuing activity".

"Educational and mathematical values are taught through structured problem-solving lessons" is the converse of the misconception "Structured problem solving is just solving a task". This misconception is related to the tendency of some people to think that completing the task is the aim of a lesson, resulting in them being keen to get the answer to the task. These people are concerned only with "Students can do this" or "Students understand that". However, if students can do a task, completing the task should contain some value. In other words, it is meaningless for students to be able to complete a task if the task itself is not a valuable thing. What constitutes a valuable thing needs to be considered. Therefore, Japanese teachers distinguish between "teaching the textbook" and "using the textbook to teach mathematics", when they use a task from the textbook. (Takahashi, 2011, p. 198). Examining and investigating values through *kyozaikenkyu* is an important activity for teachers. Here again the consideration of values is a key factor of lesson study.

Structured problem-solving lessons aim further: they are to teach students general values. If the task is mathematically and educationally rich, then mathematical and educational values become evident during the comparison and discussion phase of the lesson (Fujii, 2009). Therefore considering the value of the task used in a structured problem-solving lesson is a critical factor in lesson study.

However, it is hard for us to actually implement an ideal lesson, with a rich task and discussion, leading to a rich summary with educational value. Therefore teachers keep trying to implement an ideal lesson throughout their lives with a value-orientated attitude, so "lesson study is a life-long continuing activity", and a "lesson is the proving ground for teachers". Here again values are located at the heart of lesson study. In fact, the teachers' attitudes may relate to the Japanese educational landscape identified by Lewis (2002) as containing established norms of collaboration, a belief that teaching can be implemented through collective effort, as well as norms of self-critical reflection. To the extent that these features might not exist in other countries, they act as constraints on the implementation of lesson study elsewhere.

The most stunning experience in the follow-up study in Uganda and Malawi

was to observe that examination of the lesson plan made the focus of the post-lesson discussion change from the *teacher* to *teaching*. This fact could be explained again using the pyramid model of lesson study. Investigating the lesson plan before the research lesson enabled participants to understand the aim and value of the lesson, or more precisely the reason why the task was chosen in relation to the aim of the lesson. The consideration of educational values or aims is a core factor in lesson study, and this factor made participants' attitudes change in an appropriate way in terms of lesson study.

More precisely, what participants need to do to get a better understanding of the value of the lesson is to solve the task. In the structured problem-solving lesson, a Japanese style of problem-solving approach, the task is critical (Doig, Groves, & Fujii, 2011; Fujii, 2010). Therefore, reading the lesson plan, understanding the position of the content to be taught in the lesson within the curriculum and the reason for choosing the task, and so on, are not the top priority activity for the pre-lesson briefing sessions. Instead, the author strongly recommends that pre-lesson briefing sessions should include time for the participants to solve the task themselves. They should try to solve it straightforwardly, as a student without pre-judgment or prejudice, and then they may find possible solutions or misconceptions, or maybe a pitfall in the task, or possible misinterpretations. Then finally they may realise the potential of the task: its educational and mathematical value.

Solving the task by yourself is critical if you want to understand the value of the structured problem-solving lesson itself. Structured problem-solving lessons are composed of many factors, just like lesson study. So people tend to try to understand each factor or part at first. However this is not a productive strategy. Because a structured problem-solving lesson is itself an organic system, it is not like a machine. The heart is again the educational value located at the meta-level. In order to know the educational value contained in the task you have to solve it by yourself. This recommendation itself may be a tacit axiom of Japanese lesson study embedded in Japanese culture.

Final Remarks

Lesson study in Japan is like air. Lesson study is so natural that it is difficult for Japanese educators to identify its critical and important features. This is true for researchers as well. Takahashi (in press) argues that despite the long history of lesson study in Japan, Japanese mathematics education researchers and other researchers have not been interested in studying lesson study itself until recently. As evidence he notes that the recently published *Handbook of research in mathematics education* (Japan Society of Mathematics Education, 2010) does not include any research that focuses on mathematics lesson study under the section for mathematics teacher education and professional development.

When there is a call for us to introduce something of Japanese origin, like lesson study, to other countries, we have to grasp its fundamental nature and describe it carefully, with due consideration of cross-cultural differences.

Through writing this paper, the author has realised that the heart of lesson study is the consideration of the educational value or aim. In fact, we always see things in lesson study from the educational value viewpoint. This proposition is not to be proved. It may be an axiom of Japanese lesson study. People outside Japan have made us realise the critical features and value of lesson study. This lack of awareness is to some extent a flaw. When people do good things without awareness, the most regrettable case is that people lose it without hesitation. Therefore it is of benefit to both Japanese and foreign educators for us to identify the authentic nature of lesson study.

Some non-Japanese researchers have identified social, cultural, and educational aspects that make lesson study possible in Japan. Focussing on the structured problem-solving lesson, there are critical factors making such lessons possible in lesson study. These factors include a *focus on the whole child*, identified by Lewis (2000) as one of the seven features of the Japanese educational landscape that support the effectiveness of research lessons. Also Groves and Doig (2010) identified and examined some of the affordances and constraints in the adaptation and implementation of Japanese lesson study outside Japan, based on their experiences in Australia, Japan, China, and the Czech Republic. They categorised the affordances and constraints under three headings: Cultural issues, School contexts, and Research lessons. From the viewpoint of the structured problem-solving lesson, some factors they have identified are: *teaching as a public activity and a focus on learning as a community rather than an individual activity*. This is a social norm of classroom culture in Japan, but may be a constraint in other countries with different norms. A further study is needed to investigate the relationship between such constraints and misconceptions as revealed in this paper, so that misconceptions can be examined in terms of cultural, social, and historical differences between countries.

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