The Role of the Knowledgeable Other in Lesson Study: Examining the Final Comments of Experienced Lesson Study Practitioners

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Lesson study, originating in Japan, has been implemented in many different countries as an approach to improve teaching and learning. But some mechanisms of lesson study are not fully understood. In particular, researchers and educators trying to implement lesson study in their own schools often ask about the role of knowledgeable others who provide final comments at the end of a post-lesson discussion. A study was conducted in Japan to learn about the nature of such final comments and how knowledgeable others prepare for them. The author examined the actual final comments of three highly respected knowledgeable others, and conducted interviews with them, to reveal the structure of effective final comments, the considerations that go into planning and making the final comments, and the skills and expertise that the role of knowledgeable other requires.

Keywords: lesson study • professional development • mathematical knowledge for teaching • curriculum implementation

Background

Since the launch of universal public education in Japan in the late 1800s (Makinae, 2010), lesson study has been a fundamental driver of improvement in teaching and curriculum. The publication of *The Teaching Gap* (Stigler & Hiebert, 1999) brought lesson study to the attention of a wide audience, and since then educators around the world have recognised its power for helping teachers improve their instruction and have sought to implement lesson study in their own countries.

Lesson study embodies many features associated with effective professional learning, such as being intensive, continuing, and connected to practice (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Stigler & Hiebert, 2009). But outside Japan lesson study has not always been as effective as it could be (Takahashi, 2011). Ineffective implementation may be due in some cases to a lack of understanding of how the lesson study process is supposed to help teachers deepen their understanding of content and of new pedagogical ideas (Meyer & Wilkerson, 2011; Murata, 2011). But its lack of effectiveness is also likely to be due to a lack of effective support from outside the lesson study team.

Researchers have noted the importance of outside expertise provided by the so-called "knowledgeable other" in making lesson study effective (Lewis, Perry, Hurd, & O'Connell, 2006; Lewis & Tsuchida, 1998; Takahashi, 2011; Takahashi & Yoshida, 2004; Yoshida, 1999). Japanese schools customarily invite a knowledgeable other to their research lesson and ask the person to provide "final comments", lasting sometimes over 30 minutes, at the end of the post-lesson discussion. The Lesson Study Research Group of Teachers College, Columbia University identified three major reasons to have knowledgeable others provide comments at research lessons: "(1) to provide a different perspective on the lesson study work of the group; (2) to provide information about the subject matter content, new ideas, or reforms; and (3) to share the work of other lesson study groups" (Fernandez, Yoshida, Chokshi, & Cannon, 2001, p. 18). These reasons help explain why schools and teachers doing lesson study would choose to enlist a knowledgeable other to make final comments (Watanabe & Wang-Iverson, 2005).

Educators outside Japan who wish to support lesson study in their country have asked about this practice: about who these experts are, what their preparation is, what they talk about in their comments, and what they try to accomplish through their comments. But because this practice developed organically in Japan and has never been studied, answers to these questions have been hard to find, and this absence of explicit information about the work of knowledgeable others is an impediment to developing effective support for lesson study outside of Japan.

In an attempt to partially fill this gap in knowledge about supporting lesson study, the author conducted a study in Japan to learn about the nature of final comments at post-lesson discussions, and how knowledgeable others prepare for them.

About the Study

The study focused on three educators who had been providing final comments for a public elementary school in the Tokyo area as part of a two-year lesson study research project conducted by that school. The school is a typical neighbourhood school with an economically diverse student population, comprising about 760 students from Grades 1 to 6, and 64 teachers and staff. Starting in the spring of 2010, the school conducted a two-year research project, using lesson study to address issues around implementing the new national curriculum, known as the Course of Study (CoS). As is usually done in Japanese schools, the school set up a research steering committee to co-ordinate and focus the collaborative work on the school's research theme. That theme was the development of individual thinking and the expression of these thoughts, with the school seeking effective ways to support students' individual problem-solving skills and better facilitation of whole class discussion.

During the second year of the school's research project, the author visited the school from April to December 2011 to observe and document the lesson study activities. These activities included six research lessons and post-lesson discussions, lesson planning sessions during the summer break, and the school's open house at the end of the research project (Takahashi, 2014).

About the Subjects

As part of its project, the school enlisted the assistance of several knowledgeable others. The author selected three of these knowledgeable

others who were among the most popular for school-based lesson study in the Tokyo metropolitan area, as the subjects of this study. Through careful observation and analysis of what they said during the final comments, and through interviews with each individual, the author intended to learn the reason for their popularity among teachers and gain insights into how they developed their knowledge and expertise.

Although none of the three subjects had completed a post-graduate degree program, each of them had many years of experience as an elementary school classroom teacher and had achieved recognition as a leader in mathematics education. At the time of this study all three were working with several schools simultaneously, giving lectures on improving mathematics teaching and learning, and providing final comments at research lessons. They work primarily in the area, but one of them was often invited by schools in other prefectures and was known nationally as a leader in mathematics education. All three are currently working as consultants or university professors. Specific details about each knowledgeable other follows.

Subject #1: Mr S. Mr S worked for 16 years as an elementary school classroom teacher, 12 years as a district administrator, and nine years as an elementary school principal. He retired from public schools four years ago and currently serves as a visiting professor at a private university.

Schools began inviting him to serve as a final commentator when he was still a classroom teacher. Later, when he was a principal, he provided final comments at other schools about 20 times a year. After becoming a district administrator, he served as a final commentator at research lessons conducted by schools in his district about 20 times a year on average, and sometimes as often as 30 times a year. In the four years since his retirement from the public school system, he has been visiting schools about 70 times each year. While he was a classroom teacher he served as the chairman of the school research steering committee for the school's research project.

Subject #2: Mr Q. After 15 years as a classroom teacher at two public elementary schools, Mr Q moved to an elementary school attached to a national university. He spent 22 years there, 19 as a classroom teacher and three as an assistant principal. He then became a professor at the university. At the time of this study he was in his fourth year as a professor. While in the classroom, Mr Q taught between 200 and 300 mathematics research lessons, most of them public research lessons. He also served as school research steering committee chairman both at the public schools and at the national school. He began to be invited as a final commentator while he was a classroom teacher at a public school, and the invitations became more frequent after he moved to the national elementary school. He is now one of the most popular final commentators in Japan and is invited by schools throughout Japan.

Subject #3: Mr U. After 18 years working as a classroom teacher at three public elementary schools, Mr U became a district mathematics curriculum co-ordinator in the Tokyo area for nine years, and then became an elementary school principal, first at a public school for nine years and then at a private school for six years. Currently he is superintendent of a small school district in the Tokyo area. He has been invited, and served, as a final commentator about 300 times: about 90 times while he was a district curriculum co-ordinator, about 100 times while a principal, and about 100 times since then.

Although they were not formally trained as educational researchers or mathematicians, all three subjects had developed a reputation as leaders in

mathematics education while they were still classroom teachers and had led formal and informal professional development for other classroom teachers. Today, they regularly publish articles in journals of mathematics education, and one of them has published several dozen single-author books for practitioners. Each of them has contributed as an author to government-approved elementary mathematics textbooks.

Data Procedures

In this study, the data came from two major sources. The first set of data came from the actual final comments by the subjects at three research lessons at the school. The author observed these final comments first-hand, as well as the preceding lesson and discussion. The lesson, discussion, and final comments were also audio-recorded and transcribed. The second set of data came from a questionnaire and interviews. The author submitted a written questionnaire (see the Appendix), which was completed by two of the three subjects. Following this, an interview lasting 60 to 90 minutes was conducted with each subject about their questionnaire responses in two instances, with similar questions being asked in the third instance. All the interviews were audio-recorded and transcribed. The transcripts were analysed, together with the written answers to the questionnaires and the author's field notes.

The Nature of Final Comments

As is common practice, all three knowledgeable others received a draft lesson plan at least a week before the research lesson and used this draft to prepare their final comments. They also prepared handouts ahead of time related to the theme of the school research, the development of individual thinking and the expression of these thoughts, and the topic of the research lesson. One handout, for example, included copies of pages from a textbook series other than the one used in the school. Another included articles from journals for teachers that Mr Q had published and a brief summary of the Japanese Ministry of Education's Course of Study teaching guide related to the topic of the lesson (Ministry of Education, Culture, Sports, and Technology, 2008b).

Among the three knowledgeable others' final comments, two of them (by Mr S and Mr U) had a similar structure (see Tables 1 and 2). These two comments had two major parts: one part discussing the content of the lesson in terms of the curriculum and the lesson plan, and another part discussing issues around the actual execution of the lesson. The final comments by Mr Q discussed several important issues regarding the teaching of the topic using various events from the actual lesson in chronological order. Table 1 and the following sections illustrate these two different types of comments, using final comments made by Mr S and Mr Q.

Final Comments by Mr S (Lesson plan followed by specific events). The research lesson observed by Mr S was about the introduction of subtraction in Grade 1 (six and seven year-old students). Students were shown three take-away situations as follows:

1. There are four cars in the car park. One car is going out. How many cars will be left in the parking lot?
2. There are four fish in a fish tank. One fish is going to be removed from the tank. How many fish will be left in that fish tank?

3. There are four pieces of cake. One piece is going to be eaten. How many pieces of cake will be left?

Table 1
Time Allocation of Final Comments by Mr S

Focus	Time	% of time
Introduction	1 min 45 s	4.2%
Summary of CoS and CoS teaching guide	5 min 10 s	2.2%
Issues around teaching and learning of the topic in general (using the textbook that the school uses)	3 min 0 s	7.1%
About the lesson plan	11 min 5 s	26.2%
About the research lesson	21 min 17 s	50.3%
Total	42 min 17 s	100%

After showing these three situations the teacher asked students to see what was the same about them. Through dialogue between the teacher and the students about the commonalities among the situations, the teacher introduced the concept of subtraction and the way to express subtraction situations using mathematical equations.

Following a post-lesson discussion by the school staff, lasting about 40 minutes, Mr S spent 42 minutes on his final comments. He used several slides that he had prepared before the lesson based on the lesson plan he had received a week earlier.

Immediately after the post-lesson discussion involving all the teachers at the school, Mr S began his comments with a brief summary of relevant sections of the recently released *Course of Study* (CoS) (Ministry of Education, Culture, Sports, and Technology, 2008a) and its *Teaching Guide* (Ministry of Education, Culture, Sports, and Technology, 2008b). Referring to the CoS, Mr S explained what it means to understand the concept of subtraction and how students develop such understanding through concrete manipulation.

One of the major emphases of the CoS is for students to learn mathematics through mathematical activities, so he explained why concrete manipulation is important both in this unit and in later grades. The lessons of addition and subtraction in Grade 1 are important, he said, not only for introducing addition and subtraction but also for establishing the skill of reasoning with manipulatives, diagrams, and equations, in order to determine what operation should be used to solve a problem. After he discussed the expectations of teachers and students in the CoS, he discussed how the school's textbook introduces subtraction: the context that the textbook uses, and unique characteristics of the textbook compared to other textbook series. (The Ministry of Education must approve textbooks, with six series approved for elementary school mathematics.) He highlighted the textbook's unique use of *tape diagrams*[1] in Grade 2. Thus the knowledgeable other discussed not only the topic of the particular lesson, but also how the textbook series supports students in earlier lessons and what students will be learning later in Grade 1 and beyond. He spent more than eight minutes, 9% of his time, discussing the CoS and the textbook.

Mr S then moved on to discuss the lesson plan that the team had developed. He highlighted some sentences in which the team's intentions were not clear, and suggested including in the lesson plan the reasoning behind the decisions that the team made while developing the plan. Since the school's research theme focused on students' ability to express their

thinking, he argued that the lesson plan should explain clearly the planning team's ideas to address the research theme and should include a plan for evaluating students' ability to express their thinking, including specific outcomes that the team expected. He noted that expecting students to interpret someone's idea by looking at an equation is important, but might not be realistic for first grade students.

Mr S also pointed our that the team's ideas behind the blackboard writing plan were not clearly communicated in the lesson plan. Although the teacher made skilful use of the blackboard for recording the students' ideas and the progress of the lesson, it was difficult for other teachers to understand the rationale behind the blackboard plan shown in the lesson plan.

Mr S then moved to the use of the manipulatives. Although many important mathematical ideas were raised through the students' use of counting blocks, the teacher did not highlight these important ideas. Since the use of the manipulatives was emphasised in this lesson as a way to help students visualise the concept of subtraction, the lesson plan should describe the progression from concrete to abstract more carefully. In particular, students were meant to recognise that the manipulation of the counting blocks is the same in the three subtraction situations. Thus the teacher should summarise the lesson by comparing the three situations to let students realise that the mathematical operation is the same because the manipulations are the same, and so the equations take the same form. The lesson plan, he said, should articulate this important summary of the lesson.

Finally, Mr S said that the map describing the scope and the sequence of topics in the lesson plan should be extended to other grades so that the reader could understand how topics are connected in the domain of numbers and operations.

All the above comments by Mr S regarding the lesson plan aimed to highlight the role of the lesson plan in lesson study. The purpose of writing a detailed lesson plan is to help others to understand the ideas behind the decisions made by the lesson planning team.

After his discussion of the lesson plan, Mr S turned his focus to important issues in the teaching of the lesson. He began with his overall impression of the lesson and the class, and commented that the classroom teacher who taught the research lesson had established an effective learning environment with the students since the beginning of the school year.

He showed photographs that he had taken during the lesson that highlighted what he observed and his interpretations. First, he shared his observations of the students' manipulation of the counting blocks on the board at the front of the classroom. He commented that a different teacher response to the students' work might have helped them learn more about the meaning of subtraction. For example, when students manipulated the counting blocks on the board to show the process of taking away, there was no trace of the movements of the blocks. It seemed difficult for the students to visualise the process, and some students seemed to have trouble following the whole class discussion about the commonalities among the three situations. He suggested that teachers draw lines, circles, and arrows to help students see the manipulation process on the board. This might have helped more students participate in the whole class discussion.

He also reminded listeners that students in Grade 1 need to experience concrete manipulation multiple times. He pointed out that the teacher provided multiple experiences during the lesson by asking several students to repeat the concrete manipulation after one student had come to the front and demonstrated it. This is something he said all the teachers at the school should practise when using manipulatives.

Second, he highlighted some of the places where the teacher successfully engaged students in the lesson. In the beginning of the lesson, the teacher's use of pictures to help students visualise the problem situation was effective, he said. It was nice, he said, to see the students' excitement about solving the problem. He also noted that the interactions among the students and with the teacher were lively. The class seemed to be a place for students to learn actively with each other. When students came to the board to explain their thinking to their classmates, the teacher encouraged them to use manipulatives while explaining what they were doing. Moreover, as mentioned earlier, the teacher asked other students to come and repeat the explanation. Mr S argued that this repetition of explanation using both concrete manipulatives and verbal explanation engaged more students in learning about subtraction.

Third, Mr S addressed an important general responsibility of classroom teachers. He noted some important routines that the first grade students had established already. The students in the class were able to prepare manipulatives, open their notebooks, and write equations in the notebooks without teacher prompts. He was impressed that the Grade 1 students could do all those tasks by themselves. He congratulated the teacher on having successfully established such routines with the students.

Regarding note taking, he suggested that the teacher might want to teach students not to erase their pictures of the cars that leave the parking lot. It is a good idea to keep a record of how many cars there were at the beginning, how many cars left, and how many cars remained. Instead of erasing cars, the teacher could encourage students to cross them out. Learning such techniques in the early grades would establish a foundation of good note taking.

Mr S also commented that the blackboard writing at the end of the lesson captured the students' learning beautifully. He thought that this showed that the school had established a shared understanding of the importance of blackboard planning, and that teachers at the school had developed the skills to use the blackboard effectively.

Mr S concluded his talk by commenting that the lesson plan was well written and the lesson successfully executed. The lesson would help students establish a strong foundation of understanding of the basic operations, including addition, subtraction, multiplication, and division. He concluded that he also learned practical ideas for fostering students' ability to express their ideas while helping them acquire a foundation for understanding subtraction.

Final Comments by Mr Q (Chronological Order of Events). The research lesson observed by Mr Q was on the introduction of the concept of multiplication of decimal numbers in Grade 5, for 11 and 12 year-old students. The lesson was designed to introduce the meaning of a whole number multiplied by a decimal number, using 80 x 2.4 as an example. The class spent one period to solve the story problem "Find the price of a 2.4m ribbon that costs 80 yen for 1m" and to discuss the meaning of multiplication of decimal numbers.

As shown in Table 2, after a 40-minute post-lesson discussion by the teachers, Mr Q gave final comments lasting 43 minutes. He used a blackboard to draw number lines and equations during his final comments.

Mr Q began by emphasising that the topic of the lesson, introducing the concept of multiplication of decimal numbers as one of the most important and challenging topics in the elementary grades. By referring to the *Course of Study* and *Teaching Guide*, he explained why the topic was so important and the possible challenges for students in developing the concept.

Table 2
Time Allocation of Final Comments by Mr Q

Focus	Time	% of time
Introduction	1 min 20 sec	3.1%
Summary of CoS and CoS teaching guide	4 min 10 sec	9.7%
About the topic (connection to the other grades)	7 min 25 sec	17.6%
Issues around teaching and learning of the topic in general	15 min 10 sec	35.3%
About the research lesson	14 min 45 sec	34.3%
Total	43 min	100%

Mr Q highlighted that the CoS emphasises three major points regarding teaching and learning basic operations in elementary grades. The first is to teach the meaning of each operation, the second is to teach how to carry out the calculation, and the third is to help students master the calculation. The CoS emphasises that teachers should not simply "tell" knowledge and procedures to the students but should instead provide opportunities for students to think mathematically to grasp these concepts and procedures, so that they will be fully comfortable later applying the procedures accurately to solve problems. Thus the topic of the lesson, introducing the meaning of multiplication of decimal numbers, is important because the students need to understand fully what it means to multiply by decimal numbers. But it is one of the more challenging concepts for students to understand, at least partly because ideas about multiplication as repeated addition do not apply easily to multiplication by decimal numbers. For example, in the students' previous experience, the product was always greater than or equal to the multiplicand. But with decimals, the multiplier can be less than 1, in which case the product will be smaller than the multiplicand.

Mr Q then explained how the CoS intends to lead students to understand the meaning of the operation, both before and after this grade level. He pointed out that the CoS includes teaching division with a decimal number quotient in Grade 4, the previous grade, in order that students are ready to learn this challenging concept.

From his explanation of the importance and challenging nature of the topic, Mr Q then went on to highlight what the major considerations should be in designing lessons to implement what the CoS emphasises. The proportional number line diagram, widely used in Japanese mathematics textbooks for elementary grades, is important, he said, for helping students visualise the abstract concept of multiplying by decimal numbers.

Mr Q continued to elaborate on how to help students gain the ability to use such number line diagrams as their thinking tool. He emphasised that lower grade teachers had the important task of helping students develop a secure foundation of understanding of both multiplication and division using such diagrams. He also discussed how the knowledge and understanding developed during this lesson would be the foundation for understanding multiplication and division involving fractions.

At this point Mr Q had spent nearly 30 minutes talking about the importance of a topic that required not only the teacher who taught the grade, but also teachers of other grades, to establish a shared view of the curriculum.

He then moved on to talk about what he observed during the research lesson. Using observations of student interactions during the lesson, he

discussed the importance of the teacher's selection of student responses, highlighting the following points. First, teachers should be conscious of the risk of misunderstanding students, because their expectations may prevent them from listening carefully to what students are saying. Even if what a student says does not seem to make sense, the teacher should listen carefully to understand the reasoning behind it, and use the student's understanding, or misunderstanding, to help students accomplish the goals of the lesson. Second, teachers should appreciate students' naïve or incomplete approaches. In an ideal classroom, students learn new ideas and procedures together, so crafting new ideas and procedures from naïve or incomplete approaches through collaboration should be appreciated. Although teachers tend to focus on ideal approaches, it is important for teachers to facilitate whole class discussion using some students' struggles, or misunderstandings. Developing a classroom culture that accepts struggle is one of the important tasks of classroom teachers.

Mr Q carefully chose specific events from the lesson to highlight pedagogical ideas that could be applied in other lessons. He concluded by emphasising that fostering students' ability to explain their ideas also helps crystallise mathematical concepts.

The Role of the Knowledgeable Other

The observations documented above illustrate the types of topics widely respected knowledgeable others talk about in their final comments. Results from the questionnaire and interviews can now shed light on why they say what they do, and on the expertise required.

The subjects in this study said that they did not receive any formal training to become final commentators on school-based lesson study. From their experience, they say that the best way to understand the role of knowledgeable other is through participating in lesson study with colleagues. Although they agreed that a formal training program might be necessary to improve lesson study in Japan, they are unaware of any such training available now.

Despite the fact that there is no formal training program, the three subjects shared a common view on the role of the knowledgeable other. According to them, the knowledgeable other is responsible for: (1) bringing new knowledge from research and the curriculum; (2) showing the connection between the theory and the practice; and (3) helping others learn how to reflect on teaching and learning. Compared with the roles identified by Watanabe and Wang-Iverson (2005) listed earlier, only one of those appears here: the role of providing information about subject matter content, new ideas, or reforms—which roughly matches the first of these. Each of the responsibilities is elaborated below.

Bringing New Knowledge from Research and the Curriculum

Since most Japanese elementary school classroom teachers have to teach all subjects, one of the important responsibilities of a knowledgeable other is to provide access to a deeper understanding of the content, the curriculum, ideas behind the textbooks, and pedagogical ideas. In doing so, they will usually draw primarily from the CoS and, especially, its companion *Teaching Guide*. More than just a list of topics, these two documents distil the latest ideas from research about how students learn into suggestions for how the content should be taught.

When teachers engage in developing a lesson plan in Lesson Study, they read these documents carefully, and their lesson plan generally represents their best effort to apply what they have learned. Occasionally, however, a lesson planning team will miss one or more important ideas that the knowledgeable other needs to address; and even when that does not happen, the knowledgeable other usually needs to help interpret the CoS for all the teachers at the post-lesson discussion, including the teachers who did not engage in planning the lesson.

All three knowledgeable others emphasised in the interviews that simply lecturing about such specialised knowledge is not enough. Teachers best learn important knowledge with concrete examples from the lesson that they have observed. And the final comments should be understandable by the entire school staff, including novice teachers.

Thus we see that all three knowledgeable others began their comments by providing new knowledge pertaining to the teaching and learning of the topic of the lesson, drawing from the CoS and from the textbooks. They then examined key ideas in the lesson plan. Finally, they reflected on the actual events of the lesson, bringing up specific evidence of what students had learned from the lesson, and made suggestions for future consideration.

In order to do so, the knowledgeable others prepared in advance some handouts for the teachers, based on the draft lesson plan they received a week earlier. These handouts mainly elaborated on that part of the CoS related to the topic of the lesson, so that the teachers other than the lesson planning team could understand the fundamental ideas involved. Although a similar curriculum investigation is often done by the lesson planning team as a part of their lesson planning research, any handout aimed to go beyond the investigation by the team. This is the first place where a deep understanding of the content and the curriculum is required of the knowledgeable other. One of the subjects said that the quality of the final comments should contribute to the quality of future lesson plans by providing a model of thorough lesson planning research.

Another important responsibility of the knowledgeable other is to elaborate on the ideas behind the textbook pages. The Japanese textbooks are thin, but contain rich content with a focused and coherent organisation (Watanabe, Takahashi, & Yoshida, 2010). The underlying rationale for the textbook content is sometimes subtle, and it can be difficult for teachers to see the connections between the problems on different pages, in different units, and from different grades. In their comments, the knowledgeable others elaborated on how the section of the textbook on which the research lesson was based was related to other units and other grades.

Based on a careful review of the lesson plan, the knowledgeable others also prepared a further elaboration of the lesson plan itself. This elaboration highlighted major ideas that the lesson planning team was trying to address and also how the ideas are related to issues and trends in mathematics education. Knowledgeable others view this as an opportunity for the teachers to see the connection between what they are doing and what is happening in the wider professional community.

All of the above aims to deepen teachers' knowledge and understanding of the content of the research lesson. As the three knowledgeable others emphasised, being able to show the theory behind the curriculum and research findings pertinent to the topic of the research lesson is important for making final comments effective.

Showing the Connection between Theory and Practice

Japanese teachers understand that they are responsible for implementing the CoS, using theory and research findings to improve students' attainment of the curriculum. Although there are plenty of materials available for teachers to help them implement the curriculum, reading these resources or listening to experts' lectures is usually not enough to develop the expertise to use them effectively in teaching. Lesson study is a type of "Phase 2" professional development that focuses on developing practical expertise (Takahashi, 2011). In Phase 2 professional development, teachers have the opportunity to plan lessons based on knowledge acquired by reading or listening, to teach the lesson based on a carefully-designed lesson plan, and to reflect on the teaching and learning using evidence from the lesson. Through this process, teachers can try out new ideas or practices, and evaluate the effectiveness of their lesson plan in the post-lesson discussion.

School-based lesson study almost always focuses on a school-wide research theme selected by the whole staff, and very often the research theme is about translating some aspect of the CoS into practice. Therefore, to help the school translate theory into practice, the three knowledgeable others connected many of their comments to the school's research theme. They tried to highlight concrete evidence from the lesson relevant for assessing the progress of the school toward its the research theme. For example, Mr S pointed out that some students in the class seemed to not understand fully the reason why all three situations can be represented with the same equation. Then he suggested that teachers use lines, circles, and arrows on the board to help students visualise the manipulation process so that the students could recognise that the manipulations of the counting blocks in the three situations are the same.

Knowledgeable others may suggest possible directions for pursuing the school's research theme, and offer a professional viewpoint and opinions about the school's research and the research lessons. Finally, they try to share observations from the lesson that may help the staff to find solutions for the school's issues. For example, Mr Q said that helping students gain the ability to use a number line is crucial for developing students' ability to represent their ideas. Without a shared tool such as the number line for thinking and for representing a situation, whole class discussions are less fruitful and students are less likely to understand each other and learn from one another. Thus he suggested that teachers at all grade levels should work together to help students develop the ability to use the number line, and similar tools, in order to make progress toward the school's research theme.

Helping Others Learn How to Reflect on Teaching and Learning

One of the knowledgeable other's roles is to help the school conduct effective post-lesson discussions. Thus the knowledgeable other should give the teachers the opportunity to reflect upon important lessons learned from the discussion and on what else they could learn if the discussion were improved. In order to do so, the knowledgeable other should be able to not only summarise the discussion but also contribute to the discussion by raising important issues that were not addressed during the post-lesson discussion. For example, Mr S remarked that the first grade students had already established some important routines. Although establishing basic routines is not a part of the lesson plan and was not discussed during the post-lesson discussion, he wanted other teachers to see that such routines are important for student learning and worthy of discussion.

Sharing what the knowledgeable other observed during the research lesson helps the teachers see what they can learn if they have good "eyes for observing students". In fact, all three knowledgeable others emphasised that observing lessons with experienced lesson study practitioners was the best way to develop good eyes for observing students.

Characteristics of Effective Final Comments

In addition to their common view of the purposes of the final comments, the three subjects in this study also agreed on the characteristics of final comments that helped accomplish these purposes.

To bring new knowledge from research and from the curriculum, as well as to show the connection between theory and practice, the knowledgeable others felt that it is important to frame the new knowledge in terms of the specific research lesson and use actual events from the research lesson as examples. All commentators, of course, focused their discussion of the CoS on those curriculum connected to the topic of the lesson. When Mr S talked about the need to draw arrows showing the movement of blocks, he was drawing from theory about helping students make connections between the concrete world (the blocks and their movement), semi-concrete representations (drawings and arrows), and abstract representations (number sentences). Mr Q spoke of the importance given in the CoS to teaching the meaning of operations, before teaching students how to carry out the calculations, and of why students have difficulty understanding multiplication by a decimal number.

Effective comments include ideas and concrete examples to help the school and the teachers advance the school's research. Mr S emphasised that repeating an explanation using both concrete manipulatives and verbal explanation engaged more students. This helped teachers see the importance of examining how many opportunities their own students have to practise representing and explaining their ideas. Unless each teacher deliberately helps each student develop the skill to represent his or her ideas, and ways of solving problems, it is hard to have discussion among the students to develop mathematical thinking. With this comment, Mr S tried to help the teachers see a step toward to accomplish the school research theme.

Effective comments highlight the joy of collaborative study and of making the school a place for the staff to work together on the research theme. In his comments after the subtraction lesson, Mr S congratulated the staff as a whole on their use of blackboard writing. Mr Q talked about the importance of work in earlier grades for preparing students to use the proportional number line, and how this work would be important again for multiplication and division of fractions later on.

Finally, the knowledgeable others said that comments should include suggestions for improving everyday lessons, as when Mr Q urged the staff to make use of student misunderstandings in classroom discussions.

All three subjects acknowledged that providing such final comments requires extensive knowledge, experience, and skill. To begin with, it requires a broad knowledge of mathematics related to the content for the grades, the goals of mathematics education, and the structure of the subject. One also needs knowledge about students' development of mathematics, characteristics of student thinking at particular developmental stages, and expectations of the curriculum, in order to assess student learning.

Then one needs an ability to collect, evaluate, and use observational data. Specifically, this includes the ability to judge if the teacher's questions address the goals of the lesson, if students' work helps them progress toward the goals of the lesson, and if the teacher provides students with the

opportunity to learn from each other. Then it requires the ability to select suitable observational data and use it effectively in the final comments.

One needs to be able to provide concrete examples of effective teaching practices as alternatives to improve the lesson. For example, both Mr S and Mr Q did not simply point out ways to improve, but always provided concrete examples of alternative approaches. To be able to provide good examples routinely, one needs to have had many opportunities to observe different teaching practices, and to evaluate their effectiveness, such as by observing many research lessons.

Finally, one needs to be able to communicate effectively with classroom teachers. This means knowing the audience and adjusting the talk depending, for example, on the participants' level of knowledge of the content, and explaining abstract theory and concepts in plain language, using concrete examples from topics and lessons familiar to the audience.

Beyond all of the above knowledge and skills, all three knowledgeable others emphasised the need to study the school's research theme and understand the lesson planning team's ideas before observing the research lesson in order to make comments fitting the school's and teachers' needs.

Recommendations

Among lesson study practitioners, it is commonly, if vaguely, understood that having a good knowledgeable other to provide final comments is important for effective lesson study. But the specific role of the knowledgeable other, the structure of the final comments, and the expertise required to give good final comments have not previously been made explicit. This case study begins to clarify the role of the knowledgeable other in lesson study, the nature of the final comments given at post-lesson discussions, and the expertise required of a knowledgeable other. But there is still the important question of how one develops that expertise.

Japanese experts argue that the best way to develop the ability to serve as a knowledgeable other is through participating in lesson study with colleagues. The subjects in this study learned how to provide effective final comments through years of experience as practitioners of lesson study and by observing many, many research lessons and final comments by colleagues and experts. From their perspective, it was difficult to imagine how one would develop such ability through formal training.

Outside Japan, where lesson study is still rare, there are not enough opportunities to learn how to provide effective final comments in the way that the three knowledgeable others of this study had learned. Yet for lesson study to be effective, the need for good final comments is perhaps greater outside Japan than it is within Japan. To overcome this challenge, certain steps may help inexperienced knowledgeable others provide effective final comments:

a) Send a list of expectations of the final comments when asking someone to be a knowledgeable other in a lesson study.

b) Send a draft lesson plan to the knowledgeable other at least one week before the research lesson so that they understand what the planning team hopes to learn from the lesson and discussion.

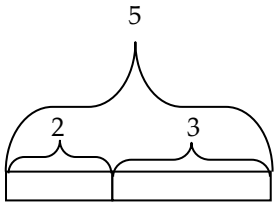
c) Conduct a meta-level discussion after the post-lesson discussion to analyse the discussion and final comments and consider how they could be improved.

Conclusion

Lewis (2006) has noted that lesson study is easy to do, but difficult to do effectively. Through their final comments, knowledgeable others play an important role in helping lesson study be effective. By examining the work of three respected knowledgeable others in Japan, this study has helped to clarify both the nature of effective final comments and the expertise required to make them. In Japan, such expertise comes from years of experience participating in lesson study. Outside Japan, where lesson study is still less common, it is difficult for prospective knowledgeable others to accumulate such experience. Additional research is needed to better understand how to develop the expertise needed to support effective lesson study.

Note

1. *Tape diagrams* are rectangular representations of numerical quantities. Thus, 2+3 would be represented as:



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Appendix

Questionnaire for the Knowledgeable Others

1. Please answer these questions about your teaching career.
   1.1. How many years did you teach as a classroom teacher?
   1.2. About how many times did you teach a research lesson while you were a classroom teacher?
   1.3. How many years did you work in education other than being a classroom teacher? (For example, as a school administrator, district administrator, or curriculum coordinator)
   1.4. Do you have experience leading other teachers' school-based lesson study, such as chair of a school research committee?
   1.5. When did you start being invited to other schools' lesson study as a knowledgeable other?
2. Please answer these questions about school-based lesson study.
   2.1. Japanese educators sometimes say, "Today's post-lesson discussion was effective" or "not effective". From your viewpoint, what is meant by "an effective post-lesson discussion"?
   2.2. What are the most important factors for making a post-lesson discussion effective?
   2.3. When you take notes during a research lesson, what are the important things that you take care to do?
3. Please answer these questions about the role of a knowledgeable other.
   3.1. Customarily, a knowledgeable other summarises the post-lesson discussion at a research lesson. What kind of summary is expected from the knowledgeable other to conclude the post-lesson discussion?
   3.2. How are a school's expectations different of knowledgeable others who are invited for only one research lesson versus knowledgeable others who are invited to work with the school continuously -- p for example, participating in several research lessons at the school?
   3.3. What are the criteria for effective final comments?
   3.4. In order to provide effective final comments, what kind of knowledge and expertise may be required?
   3.5. What training or experiences are required for becoming a knowledgeable other who can provide effective final comments?