



## How Do You Conclude Today's Lesson? The Form and Functions of "Matome" in Mathematics Lessons\*

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### Abstract

*This paper reports the analysis of form and functions of the particular lesson event "Matome", which means "summing up" in Japanese, in eighth-grade mathematics classrooms in Australia, Germany, Hong Kong, Japan, Mainland China, and the USA. First, the form and functions of the event are analyzed within the local contexts of Japanese classrooms. Then, the lesson event in the classrooms in other countries are identified and compared with those in Japanese classrooms. Particular attention is given to the commonalities in its form and the variation of its functions among different classrooms in different cultures. The analysis reveals, on the one hand, that there are commonalities among the events in Japanese classrooms in terms of associated observable teachers' behaviors, as well as differences in its functional roles. On the other hand, there are variations in both its form and functions across the data sets from classrooms in other countries. "Matome" which takes a similar observable form in different classrooms can be seen as internationally-recognizable event carried out with different functional roles. The student post-lesson interview data from Japanese schools are also analyzed for exploring the significance and the meaning that the students associated with the event type. The analysis shows that, not only the teacher who usually initiates the lesson event, but the students who seem to be audiences also perceive it as the event of significance to their learning.*

### INTRODUCTION

In the TIMSS 1995 Videotape Classroom Study, certain recurring features that typified many of the lessons within a country, Germany, Japan, or the United States, and distinguished the lessons among three countries were identified as "lesson patterns" (Stigler & Hiebert, 1999). The following sequence of five activities was described as the Japanese pattern: reviewing the previous lesson; presenting the problems for the day; students working individually or in groups; discussing solution methods; and highlighting and summarizing the main point. From a Japanese perspective, the final in the sequence of five activities described above, *highlighting and summarizing the main point*, seems to be an indispensable element in any successful lesson. How to end the lesson in accordance with its goals is the key question to those teachers who hope to conclude their lesson as a coherent and understandable learning opportunity to the students they teach. Japanese teachers traditionally share the term "Matome" for describing the corresponding teacher's activity at

the end of lessons.

Characterization of the practices of a nation's or a culture's mathematics classrooms with a single lesson pattern was, however, problematized by the results of the Learner's Perspective Study (Clarke, 2003a; Clarke & Mesiti, 2003; Jablonka, 2003; Mesiti, Clarke & Lobato, 2003; and Shimizu, 2003a). The earlier analysis suggested that, in particular, the process of mathematics teaching and learning in Japanese classroom could not be adequately represented by a single lesson pattern by, at least, the following two reasons (Shimizu, 2003a). First, lesson pattern differs considerably within one teaching unit or sub-units depending on the teacher's intentions. Second, elements in the pattern themselves can have different meanings and functions in the sequence of multiple lessons. Needless to say, it is an important aspect of teacher's work not only to implement a single lesson but also to weave multiple lessons that can stretch out over several days, or even a few weeks, into a coherent body of the unit. It would not be possible for us to capture the dynamic nature of activities in teaching and learning process, if each lesson was analyzed as "standing alone".

An alternative approach to the international comparisons of lessons was proposed by the researchers in LPS team. That is, a postulated "lesson event" would be regarded to serve as the basis for comparisons of classroom practice internationally. The "lesson event" is conceived as an event type sharing certain features common across the classrooms of the different countries studied.

This paper discusses the form and functions of the particular lesson event "Matome", "summing up" in Japanese, in eighth-grade mathematics classrooms in Australia, Germany, Hong Kong, Japan, Mainland China, and the USA. First, the form and functions of the event were analyzed within the local contexts of Japanese classrooms. Then, the lesson events in the classrooms in other countries were identified and compared with those in Japanese classrooms. Particular attention is given to the commonalities in its form and the variation of its functions among different classrooms in different cultures. The student post-lesson interview data from Japanese LPS schools are also analyzed for exploring the significance and the meaning that the students associated with the event type.

#### "MATOME" (SUMMING UP): THE LESSON EVENT

The earlier analysis revealed that multiple lessons are interrelated and that the structure of each single lesson looks differently when we locate it in the entire teaching unit (Shimizu, 2003a). It was suggested by the analysis that mathematics teaching and learning in Japan could not be adequately represented by the analysis of a set of distinct lessons. Also, the analysis showed that the students perceived the significant events in the lesson in a different way from the way the teacher perceived them (Shimizu, 2002; 2003b). The result suggests that the units of data collection and data analysis for the study of lessons are crucial for the international comparisons.

An approach to the characterization of classroom practices has been proposed as identifying the specific lesson event type and the practices through which it is constituted, such that, while not necessarily a consistent element of every or even most of the lessons being analyzed, the particular type of lesson event is frequent in occurrence, takes a consistent general form, but may be enacted with some variation at the level of actual classroom practices (Clarke, 2003a).

The author identified “Matome”, which means "sum up one’s main point in conclusion" or “pulling together”, as the specific lesson event type for characterizing classroom practices. Traditionally Japanese teachers share several pedagogical terms, “Matome” among others, which describe the teacher’s key roles at various phase of the lesson. Further, since Japanese teachers often organize an entire lesson around just a few problems with a focus on the students’ various solutions to them, they think that "summing up" is indispensable to any successful lesson in which students’ solutions are shared and pulled together in light of the goals of the lesson (Shimizu, 1999).

There are some findings of the international comparative studies on mathematics lessons that seem to be related to the function of this particular event. The TIMSS 1999 Videotape Study, among others, identified some characteristics of Japanese lessons (Hiebert, et al., 2003). One of the outstanding differences to the other six countries was the teachers’ behaviors for summarizing the problem solving activities to clarify the mathematical point illustrated by the problem.

*About one-quarter (27 percent) of mathematics problems per lesson were summarized by the teacher to clarify the mathematical point illustrated by the problem (table 5.4), more than in any of the other countries. (Hiebert, et al., 2003, p.136)*

These findings suggest that “Matome” would be a recognizable event in the classrooms in other countries and that by identifying and analyzing the event we would be able to identify certain characteristics of classroom practices in different cultures.

In this paper, "Matome" is defined as an event in which the teacher talks to the whole class to highlight and summarize the main point of the lesson. What students engaged and discussed in the lesson is reviewed briefly in the whole-class setting and what they learned during the lesson is highlighted and summarized by the teacher. In the following sections, we look into this particular lesson event with a focus on its form and functions.

### ***Three Examples from Japanese LPS Classrooms***

In this section, the author picks up three example of the event type. The following three

examples show how each of the Japanese teachers engaged in “Matome” in a consistent way with various purposes (*See Appendix*).

Example 1: JP3-L3, (00:43:08:15 to 00:43:35:18)

Example 2: JP1-L3 (00:24:43:06 to 00:27:17:26)

Example 3: JP3-L7 (00:34:05:16 to 00:40:20:14)

[Country, School, Lesson Number, Start and End Times]

Example 1: JP3-L3, (00:43:08:15 to 00:43:35:18)

In the first short excerpt of transcription from the JP3-L3, in which the students were learning to solve simultaneous linear equations, the teacher summarized and highlighted what they had done in the form of general comments. The comments were made at the final minutes of the lesson. He noted that the class had done “*something extremely important*” (00:43:08:15), emphasizing that the students “*would be able to solve tons of equation*” (00:43:22:13) and they “*should be able to solve everything*” (00:43:35:18). Also, he encouraged the students to “*check the calculation when you need to.*”

At the end of the lesson, after some discussions on two alternative ways of check the solution to the simultaneous linear equations, the teacher strongly emphasized that what they had done was extremely important. He then asked the students to jot things down on their notebook. In this case, the teacher appeared to promote students’ reflection on what they had done and on the importance of checking the results. The teacher pointed out the part of blackboard on which an important idea was described.

Example 2: JP1-L3 (00:24:43:06 to 00:27:17:26)

The lesson event in the third lesson in the school JP1, on the other hand, took place in the middle of lesson. The teacher introduced the term “linear function” as a formal mathematical term, by reflecting on several examples of linear functions appeared in the previous activities in the classroom; “*these are called linear function. Because they are all shown as a linear equation, they are called linear functions*” (00:24:43:06 -00:24:47:00 ). Then she asked the student to take a note.

She next tried to make a connection between the concept of linear function to the concept of direct proportionality, a special case of the linear function, which her students had learned in the previous year; “*And please look at this type of equations, in which B is zero. They are in the same group, but linear functions. What did we call this kind of equations in seventh grade?*” (00:25:05:12- 00:25:18:28). The event included the teacher’s explicit efforts of connection-making between the current topic and the one in the previous year.

After the introduction to the formal term, she asked the student to “*Draw an underline from ninth line*” and then wrote the point on the chalkboard using yellow chalk. Finally she

repeated main point by reading the corresponding page in the textbook; *“We can see what just we talked about in words; having two variables  $x$  and  $y$ , if  $y$  can be expressed with the linear equation of  $x$ , then we call it a linear function. And a linear function is expressed as  $y = x + b$ . Okay?”*(00:27:07:0-00:27:17:26).

The lesson event in Example 2 took place in the middle of the third lesson. The example shows that “Matome” can take place not only at the end of the lesson but also in the middle of the lesson for pulling together the students’ activities in multiple lessons. The event serves in setting the stage for introducing the new mathematical term based on the examples of linear functions examined in the activities in the three lessons including the current one. As Example 2 illustrates, “Matome” includes teacher’s effort to make connections among lessons. The next example from the school JP3 shows that “Matome” can encompass broader activities in more extended time periods.

Example 3: JP3-L7 (00:34:05:16 to 00:40:20:14)

This example shows that in the event the teacher and the students make connections between the current topic and previous ones in the same teaching unit. In the 7<sup>th</sup> lesson, after the extended efforts for deriving the “method by addition and subtraction” (Kagen-hou) through the 2<sup>nd</sup> lesson to the 6<sup>th</sup> lesson, the teacher introduced another method, “method of substitution” (Dainyuu-hou) by referring to the solution method proposed by a student in the 2<sup>nd</sup> lesson.

The teacher carefully repeated the method proposed by the student DOEN in the second lesson. *“Um, the question with the process of adding both of the expressions together, and then solving the expression with only  $Y$  as we can remove  $X$ . The way I was talking about was introduced by DOEN here”*(00:34:36:10). He finally referred to the summary sentences in the textbook. *“The answer is the same as the ones on the blackboard, and I think they are more in detail than the textbook. So, I don't need additional explanation, I think. The definition of Dainyu-hou, I mean the explanation, well, I'll read the sentence on page forty-four, the two sentences before question six. Uh, we have removed  $Y$  by substituting number one into number two. This way of answering, the way of leaving only one kind of letters by substitution is called Dainyu-hou”* (00:39:43:28-00:39:59:13).

The lesson event (Example 3) in JP3-L7 found in the Appendix to the paper is an example of “Matome” that encompasses broader activities stretched out among several lessons. The teacher had an intention of linking the new term “Dainyuu-hou” with students’ shared experiences in previous lessons.

*Commonalities in the Form of the Event*

Among the three examples described above, there are commonalities in the event type in terms of associated observable teachers’ and students’ behaviors.

### Teacher's Public Talk

Matome takes place in the form of teacher's public talk to the whole class. The teacher explicitly reviews what they have learned and what is the main point of the lesson in mathematical sense. Teacher may ask a few students to tell to their classmates what he or she learned in the lesson and the points appeared from the students' activities. In this way, Matome can take place in the form of interactive exchanges between the teacher and the students.

### Effective Use the Chalkboard

An important technique used by Japanese teachers during Matome is the particular use of the chalkboard, which is usually referred as "Bansho" by them. Whenever possible, teachers put everything written during the lesson on the chalkboard without erasing. By not erasing anything the students have done and placing their work on the chalkboard in an organized manner, it is much easier for them to compare the multiple solution methods proposed. Also, the chalkboard can be a written record of the entire lesson, giving both the students and the teacher a birds-eye view of what has happened during the lesson. All the three teachers of the Japanese LPS classrooms used the chalkboard in a similar way. The teacher can capitalize on these advantages by "moving" on the chalkboard.

### Reference to the Textbook

Another noteworthy characteristics with regard to the lesson event might be that both the teachers' and students' particular behaviors are observed during "Matome". At some points during the event, the teacher asked their students to take notes of the important points. Further, all the three Japanese LPS teachers often referred to the corresponding page of the textbook. Then the students opened the page and took notes or drew the underline.

In sum, as the three examples illustrate, the lesson event takes the following *form*. Typically at the final phase of the lesson, and sometimes in the middle of it, the teacher reviews what the students engaged and emphasize the main point of the lesson. Teacher may ask a few students to tell to the whole class what he or she learned in the lesson. She may also write on the chalkboard, by using a color chalk on occasions, the main points or key mathematical terms and then refer to the corresponding page of the textbook. Teacher's announcement follows, in some cases, of the start of practices for applying what has just highlighted.

The Japanese lesson pattern identified by the TIMSS 1995 Video Study included "highlighting and summarizing the main point" as the final segment (Stigler & Hiebert, 1999, pp.79-80). The above example shows that, however, "Matome" can take place not only at the end of the lesson but also in the middle of the lesson for pulling together the students' activities in multiple lessons. Also, when we look into sequences of consecutive lessons as embedded in the teaching unit, different functions of "Matome" for making connections among lessons can be identified. As Example 2 and 3 illustrates, "Matome" can encompass broader activities in more extended time periods.

There are four key aspects to the events from the teacher's perspective that emerge from the example cited above. For the Japanese teachers, the event "Matome" appeared to have the following principal functions: (i) highlighting and summarizing the main points in the lesson, (ii) promote students' reflection on their experiences by reviewing what they have done, (iii) setting the stage for introducing a new mathematical concept or term based on the previous experiences and for applying it, and (iv) making connections between the current topic and previous one.

### ***The Form and Functions of "Matome" in Other Countries***

By analyzing the data from three German LPS classrooms, Jablonka (2003) identified the activities observed in the classrooms that could not be characterized as part of one of the four components of the "typical pattern" of German lessons reported by Stigler and Hiebert (1999). Of particular interest in her analysis is concerned with "Reviewing" which is comprised of Checking results of students' work, including homework, *Summarizing previous work*, and Review before a test. Her analysis shows that the same event type can be observed in German data, which enables us to compare the lesson events between two cultures. In this section, the lesson event in the classrooms in other countries, which were identified by the LPS team members, are compared with those found in Japanese classrooms.

#### *Matome in Shanghai Classrooms*

The teachers in Shanghai quite often highlight and summarize the lesson mostly at the end of lessons. They begin "Matome" by reviewing what the class have done in the lesson and then emphasize the main points as follows.

*"So today we have talked about using the method of substitution to solve the linear equation in two unknowns"* (SH1-L06, 00:41:48:00).

*"These are the points which we should pay attention when we want solve the linear equations in two unknowns"*(SH1-L06, 00:43:17:11).

*"Good. Okay, today we've talked about some concepts of system of linear equations in two unknowns. System of linear equations in two unknowns, its solutions and how to solve the system, we've talked about one of the way to solve the system, basically it is to change two unknowns into one unknown. Today, we've used method of substitution, and we will talk about the other methods later on"*(SH2-L03, 00:41:49:27 to 00:42:16:16).

On occasions, they have interactions with their students while summing up. And they also sum things up with slide or on the blackboard to show the main points of the lesson. The teacher in the school SH3, in particular, quite often (in twelve lessons out of fifteen) used the slide or the blackboard while summing up.

The excerpt from the transcription of SH2-L03 (00:41:49:27 to 00:44:59:00) shows that the teacher summed up the lesson by recalling the topics and by asking the students some questions, and asked students to find out the answers by themselves in the textbook. The teacher asked, “*I want to ask, how many equations are needed as minimal, in order to solve the system?*” (00:42:24:17) In response to the student who answered to the question as “two”, he then asked another question, “*Two, we can find out the solutions only when there are two independent equations. Tell me, how many solutions are there for an equation?*”(00:42:35:05). The teacher summed up the lesson by asking his students questions to check their understanding.

In general, teachers’ behaviors, and the students’ behaviors in response to them, during Matome in Shanghai schools are very similar to those in Japanese classrooms. It is noteworthy that in all the examples examined the teachers in Shanghai highlight and summarize the lesson at the end of lessons.

#### *Matome in the US Classrooms*

The teacher from the school US2 often makes summary statements, similar to those found in the Japanese examples. However, they come both during and near the end of activities, rather than at the end of a lesson. It is also the case that sometimes students work on a problem in small groups and share their results, and the teacher does not summarize. In the following example, US2L05 (00:21:55:25 - 00:25:04:09), the teacher summarized and made connections via a vocabulary activity.

For about 20 minutes during Lesson 5, the teacher leads a type of review activity that she calls the “Vocabulary for Algebraic Representations” activity. During this activity, she engages in a lot of summing up and connection-making across the concepts addressed in Lessons 2-4. This vocabulary activity occurs after an activity called the “Algebraic Meaning for Representations” learning task, on which the students have worked for parts of Lessons 2, 3 and 4. In this activity, the students sorted 40 function cards into 10 sets so that each set would include the table, equation, graph, and verbal statement for the same function. The equations for the 10 functions were as follows:  $y = x^2$ ;  $y^2 = x$ ;  $2y = x$ ;  $y = x - 2$ ;  $y = 2x$ ;  $y = x + 2$ ;  $x + y = 2$ ;  $xy = 2$ ;  $y = 2$ ; and  $x = 2$ . During this summing up event, the teacher points and refers to the “posters” that the students created for each function.

The teacher had started the vocabulary activity by writing “Vocabulary for Algebraic Representations” on the board. She also mentioned several book pages (p. 421; p. 366; pp. 229-230; pp. 385-386; pp. 672) where the students could find definitions for the following list of vocabulary words: linear, non-linear, parabola, hyperbola, slope=rise/run,  $y$ -intercept, quadratic, direct variation, undefined slope, squaring function, function, vertical line test, no slope, zero slope, linear growth, linear decay. However, she quickly made it clear that she

was interested in the students' ideas about what these notions mean, not in textbook definitions that they don't understand:

*“Uh, you have your own notions of what some of these terms mean, already. Whatever context, is whether or not I- I recognize them and I can use them in some meaningful way. It's not that I can recite a definition. That's meaningless, it always has been.”*

The teacher then reminds students of the  $y = mx + b$  form of a linear equation, which was introduced during Lesson 3, and sums up the meaning of  $m$  and  $b$ . She then highlights the equations of the form  $y = mx$  or  $y = kx$  as a special class of equations that represent direct variation. She sums up that when a function represents direct variation, the  $y$ -intercept is 0, which means that the line goes through the origin. The teacher also makes a new connection for students between an “object” view of  $y = mx$  and a “process” view of  $y = kx$ , in which  $k$  act as a constant operator on  $x$  values to produce associated  $y$  values.

“Matome” in the US classrooms doesn't look like a consistent structural feature of a lesson in the same way as it appears in the Japanese lessons. It's not something we can predict or count on, but it does occur.

#### *Matome in Australian Classrooms*

On the whole Australian teachers do not give a specific summary at the end of (or during) each lesson, they tend to wait until they get to the end of a topic to before they summarize the important issues and concepts. However they often use the beginning of the next lesson to review and reiterate the important point from the day or lesson before. The three examples given relate to concepts that the teacher has been working on for several lessons.

In the Lesson13/14 in the school AU4, the teacher has been teaching the students simple geometry and the students have attempted many problems relating to the relationships between adjacent angles. At the end of this double lesson the teacher summarizes the important things that the students should have grasped from the previous activities. He writes a general example on the board and asks them to contribute to the summary. Some students make notes in their books.

In another example from AU3-L14, the teacher has been carrying out a series of lessons on decimals and percentages, she has allowed the students' time for revision and is summarizing important points before the next lesson when they will sit a test. The teacher clears the board of revision questions and writes up a couple of percentage questions she then asks specific students to assist her in solving these problems.

#### *Matome in Hong Kong Classrooms*

There are only a few example of Matome among the lessons in all the three Hong Kong classrooms. In the event in HK2-L04 (00:37:21:23 to 38:57:14) the teacher summed up the

lesson by emphasizing the two main points of the method of elimination by addition and subtraction. He pinpointed the things that need to be taken care and refreshed students mind by asking them questions. *“I’ve taught elimination today. There are two main points for the method of elimination by addition/subtraction. You have to be aware of a few points. First, when using elimination, you have to choose either  $x$  or  $y$ .”* (00:37:21:23-00:37:30:11)

In another example, HK1-L04 (00:20:25:21 to 00:21:39:03), the teacher summed up the lesson by reminding students to pay attention to the change of signs in transformation of equalities in factorization. A student has a question on the change of signs and teacher further elaborated that.

Teachers’ behavior in the video clips looks consistent with those in Shanghai and in Japan. They are talking to the whole class in front of the blackboard, pointing at the blackboard occasionally. However, the teachers in Hong Kong summarize and highlight the lesson only on occasions.

#### *Matome in German Classrooms*

In one example (GE1-L1, 00:37:23:17 to 00:39:33:06), the teacher wants to sum up how a procedure works. He does this in an interactive mode. In another school (GE2-L1), the teacher lets the students work out a description of what they have done. This can also be interpreted as summing up, at least as the teacher’s intention. Another event occurs in the same lesson, when the teacher talks over something again that some students have presented a proof at the blackboard. In these cases, teachers just made comments on what students had presented or answered.

The lesson event in German classrooms, in which the teacher is talking to whole class in front of blackboard, looks similarly but their utterances are slightly different from those in other countries. In the lesson event the teachers shortly sum something up or make some comments on students’ procedure to solve problem. But it seems to be not so common for them to conclude the lesson with mentioning to something they did in the lesson retrospectively.

#### ***Students’ Perceptions of the Importance of “Matome”***

In this section, the post-lesson student interviews are analyzed for exploring the significance and the meaning that the students associated with the event type. The methodology employed in the Learner’s Perspective Study offered students the opportunity in post-lesson video-stimulated interviews to identify for the interviewer those elements in the lesson that they felt to be significant. Data collection involved videotaping classroom and individual interview data, using the video record as stimulus for their reconstruction of classroom event. The teacher and the students interviewed after lessons were given control of the video replay and asked to identify and comment upon classroom events of personal importance.

In the post-lesson video-stimulated interview after 10<sup>th</sup> lesson at the school JP1, one student directly identified the video segment that corresponded to the event type as felt to be significant. The student OBA mentioned to the event at the end of the lesson as follows.

- OBA* Here, it's number three some time ago, isn't it?  
*INT* Is it here? Um, forty-three minutes and fifty-five seconds. When the teacher explained about rate of change...  
*OBA* Yes.  
*INT* It's the explanation for rate of change some time ago.  
*OBA* Yes. It's here. We were told to underline here in the textbook.  
*INT* So, that means, as you said, rate of change is important.  
*OBA* Yes. We went through that part here, so I was underlining and listening to the teacher carefully at the same time.

The data suggest that the lesson event is recognized as an important moment within the entire lesson, not only by the teacher who usually initiates the event but also by the student. If the teacher keeps summarizing and highlighting the main points of the lesson across the daily lessons, the students may become aware of the importance of the particular lesson event.

The interviewer asked JITSU, a student from the same school, after the first lesson to tell what he thought that the lesson was about and what is the best thing for him to learn it. He mentioned as, “*when I listen to teacher's talking, I always take a note and check a point.*”

- JITSU* Today, I studied about a proportion. I think.  
*INT* Ok.  
*JITSU* For my opinion, a proportion is my favorite, so I could think about it easily.  
*INT* Ok, thanks. Question number two.  
*JITSU* Yes.  
*INT* How, do you think, you best learn something like that?  
*What do you think, the best thing to do?*  
*JITSU* At first, when I listen to teacher's talking, I always take a note and check a point.  
*Also I always try to think something by myself at first. I don't rely on somebody.*  
*INT* Ok, thanks.

His recognition of the importance of taking a note and checking a point of teachers' talk emerges from the data. Another student SUZU, a student of JP3, also responded to the question of “When you think it's a good class?” as follows.

INT            *When you think it's a good class,*  
 SUZU        *Yes.*  
 INT            *What should happen in the class?*  
 SUZU        *...in the class,*  
 INT            *Yeah?*  
 SUZU        *Uh,*  
 INT            *Do you have anything that you think is a good class?*  
 SUZU        *I can present my answer, and then listen to my friend's way as well,*  
 INT            *Yeah?*  
 SUZU        *The teacher's final comment, or answer,*  
 INT            *Yeah?*  
 SUZU        *Listen to it carefully, and to make a good note from it,*  
 INT            *It might be good.*

The student also clearly mentioned to the importance of listening to “The teacher’s final comment, or answer” carefully and of “*making a good note from it*”. These interview data suggest that not only the teacher, but also the students seem to recognize the function of Matome in reflecting and identifying the point of the classroom activity. The analysis shows that, not only the teacher who usually initiates the lesson event, but the students who seem to be audiences also perceive it as the event of significance to their learning.

## DISCUSSION

### ***“Matome” as an Internationally-Recognizable Event***

The proposed approach to the international comparisons of lessons by the LPS team postulated "lesson event" that would be regarded to serve as the basis for comparisons of classroom practice internationally. The "lesson event" is conceived as an event type sharing certain features common across the classrooms of the different countries studied. The analysis reported in this paper reveals that the particular type of lesson event “Matome” is frequent in occurrence in different classrooms on different cultures, taking a similar observable form, but is enacted with variation at the level of actual classroom practices.

The data analyzed in this paper revealed that there are commonalities among the lesson events in terms of associated observable teachers’ behaviors. Those included are teacher’s public talk in the form of “short lecture” with or without interactions with the students, the effective use of the chalkboard for organizing and recording what has happened in the lessons, and the particular use of the textbook as a source to which both the teacher and the students can refer. The analysis of the particular lesson event in eighth-grade mathematics classrooms reveals that “Matome” which takes a similar observable form in different classrooms can be seen as internationally-recognizable event carried out with different functional role.

There are four key aspects to the events from the teacher's perspective that emerge from the data cited above. For the Japanese teachers, the event "Matome" appeared to have the following principal functions: (i) highlighting and summarizing the main point in the lesson, (ii) promote students' reflection on what they have done, (iii) setting the context for introducing a new mathematical concept or term based on the previous experiences, and (iv) making connections between the current topic and previous one. Part of these functions seemed to be shared by the teachers in different cultures.

The data in LPS suggest that by attending local interpretations of classroom practices in each country, we can cast a new light on the international comparative research. Based on their extensive observations of lessons in the elementary schools in China, Japan, and the US, for example, Stevenson and Stigler (1992) pointed out as follows.

*We began to see how Asian teachers create coherent lessons. The lessons almost always began with a practical problem such as the example we have just given or with a word problem written on the blackboard.... Before ending the lesson, the teacher reviews what has been learned and relates it to the problem she posed at the beginning of the lesson. American teachers are much less likely than Asian teachers to begin and end lessons in this way. For example, we found that fifth-grade teachers in Beijing spent eight times as long at the end of the class period summarizing the lessons as did those in Chicago. (Stevenson & Stigler, 1992, p.179)*

There were both commonalities and differences among the events in the classrooms on Hong Kong, Japan, and Shanghai with respect to the functional role of "Matome". "Motome" in Hong Kong, for instance, looks differently from those in other two cultures. Also, teachers in Shanghai and in Japan are engaged in "Matome" in quite similar way but still can be different in their intensions. These result means that the label "Asian teachers" would not be an appropriate for describing the differences between classroom practices in different cultures. We need to have local interpretation to each classroom in each culture.

The student post-lesson interview data from Japanese LPS schools shows that, not only the teacher who usually initiates the lesson event, but the students who seem to be audiences also perceive it as the event of significant to their learning. Again, having the learners' perspectives together with teachers' goals, intentions, and interpretations, we can approach to participants' meaning construction in the classroom.

### ***"Matome" as an Indispensable Element in Japanese Mathematics Lessons***

One of the characteristics of mathematics lessons in Japanese schools identified by several cross-cultural studies relates to the frequent exposure of students to alternative solution methods for a problem (Stevenson & Stigler, 1992; Lee, Graham & Stevenson, 1996). Japanese mathematics teachers, as was also the case in the LPS Japanese classrooms, often

plan to organize an entire lesson around the multiple solutions to a single problem in a whole class instruction mode. Since the teachers place an emphasis on finding alternative ways to solve a problem, Japanese classes often consider several strategies. It would be natural, then, that for the classes to discuss the relationships among different strategies proposed from various viewpoints such as mathematical correctness, brevity, efficiency and so on. The teaching style with an emphasis on finding many ways to solve a problem naturally invites certain teacher's behavior for summarizing.

#### *Story or Drama, as a Metaphor for Lessons*

There seems to be supporting conditions and shared beliefs among the Japanese teachers for having "Matome" often at the end of the lessons or at the end of sub-units. Any lesson has parts of an opening, "core", and closing. This is particular the case for Japanese lessons which begins and ends by students' bowing. A lesson is regarded as a drama, which has a beginning and leads to a climax, by Japanese teachers. In fact, one of the characteristics of Japanese teachers' planning of lessons is the deliberate structuring of the lesson around a climax, "Yamaba" or "Miseba" in Japanese. Most teachers think that a lesson should have a highlight.

Stigler and Perry (1988) found *reflectivity* and *coherence* in Japanese mathematics classroom. The meaning they attached to *coherence* is similar to that used in the literature on story comprehension. Stigler and Perry (1988) noted as follows.

*A well-formed story, which also is the most easily comprehended, consist of a protagonist, a set of goals, and a sequence of event that are causally related to each other and to the eventual realization of the protagonist's goals. An ill-formed story, by contrast, might consist of a simple list of events strung together by phrases such as "and then....," but with no explicit reference to the relations among events....The analogy between a story and a mathematics classroom is not perfect, but it is close enough to be useful for thinking about the process by which children might construct meaning from their experience in mathematics class. A mathematics class, like a story, consists of sequences of events related to each other and, hopefully, to the goals of lesson, (p.215)*

Often mentioned idea of "KI-SHO-TEN-KETSU" by Japanese teachers in Lesson Study meetings (Lewis & Tsuchida, 1998), an idea originated in the Chinese poem, further suggests that Japanese lessons has a particular structure in which a flow is moving toward the end ("Ketsu", summary of the whole story).

The lesson event Matome appeared to serve for promoting the reflection by the teacher and the students. Stigler and Perry (1988) also found *reflectivity* in Japanese mathematics classroom. They pointed out that the Japanese teachers stress the process by which a problem is worked and exhort students to carry out procedure patiently, with care and

precision. Given the fact that the schools are part of the larger society, it is worthwhile to look at how they fit into the society as a whole. The event type seems to rest on a tacit set of core beliefs about what should be valued and esteemed in the classroom. As Lewis noted, within Japanese schools, as within the larger Japanese culture, *Hansei*---self-critical reflection---is emphasized and esteemed (Lewis, 1995). Of special interest is in exploring a difference between cultures at this level.

Sekiguchi (1998) emphasized the importance of recognizing social and cultural situatedness of mathematics education research.

*Research participants, settings, unit of data analysis, interpretation, educational implications are all socially and culturally constrained. The reliability and validity of research results are, therefore, also socially and culturally bounded. (p.394)*

We can learn something from other countries only if we have relevant information and interpret the information in a sensible way.

#### CONCLUDING REMARKS

In this paper the form and functions of the particular lesson event “Matome” in eighth-grade mathematics classrooms were examined with the data from Australia, Germany, Hong Kong, Japan, Mainland China, and the USA. The analysis reported in this paper reveals that the particular type of lesson event “Matome” is frequent in occurrence in different classrooms on different cultures, taking a similar observable form in different classrooms, but is enacted with variation at the level of actual classroom practices.

Analyzing the form and functions of the particular lesson event invites us to attend the meaning of the event to the participants in the classroom with in an educational system. An approach is needed to identify the tacit set of core beliefs about what should be valued and esteemed in the classroom. There is a Japanese proverb, “if the beginning is good, then the end is also good”, which suggest that “Matome” itself occurs as a part of system. “Matome” needs to be examined in relation to other lesson events.

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APPENDIX: Three examples of “Matome” taken from the Japanese data

The following three examples show how each of the two Japanese teachers engaged in “Matome”.

Example 1: JP3-L3, (00:43:08:15 to 00:43:35:18)

Example 2: JP1-L3 (00:24:43:06 to 00:27:17:26)

Example 3: JP3-L7 (00:34:05:16 to 00:40:20:14)

[Country, School, Lesson Number, Start and End Times]

Example 1: JP3-L3, (00:43:08:15 to 00:43:35:18)

00:43:08:15 T *Yes, um, today, we will end here but we did something extremely important today. Um, it will have to be next week, solving the equation from KINO's question will have to be next week.*

00:43:22:13 T *But if we finish up to here, I think you'll be able to solve tons of equation. Check the calculation when you need to and I'll ask you sometimes. I'll ask you to show me how much you can do but is that ok?*

00:43:35:18 T *I think we were able to finish just about everything, up to the important ways of thinking of equations. You should be able to solve everything. Ok? Now, I'll give you the rest of the time to jot things down.*

Example 2: JP1-L3 (00:24:43:06 to 00:27:17:26)

00:24:43:06 T *And, these are called linear function.*

00:24:47:00 T *Because they are all shown as a linear equation, they are called linear functions. Note it somewhere in your notebook.*

00:25:05:12 T *And please look at this type of equations, in which B is zero.*

00:25:18:28 T *They are in the same group, but linear functions. What did we call this kind of equations in seventh grade?*

00:25:33:27 T *Huh? Do you all remember that? How did you call them? How did you describe the relation between x and y?*

00:25:48:28 S *X is directly proportional to y.*

00:25:49:23 T *Yes, the proportion.*

00:25:51:07 T *When we learned this in seventh grade, we said that they are proportional,*

00:25:54:15 T *but actually you already understood it as a kind of linear functions, only difference is if it has B or not.*

00:26:06:07 T *You can see it in the textbook. Please open it and see it yourself. It's in page fifty-seven.[Writing on the blackboard]*

00:26:41:10 T *Okay, look at tenth line, no I mean ninth line. Just what we talked about. It's summarized there.*

- 00:26:57:13 T *Draw an underline from ninth line.*
- 00:27:07:05 T *We can see what just we talked about in words;*
- 00:27:08:25 T *having two variables  $x$  and  $y$ , if  $y$  can be expressed with the linear equation of  $x$ , then we call it a linear function.*
- 00:27:17:26 T *And a linear function is expressed as  $y=x+b$ . Okay?*

Example 3: JP3-L7 (00:34:05:16 to 00:40:20:14)

- 00:34:05:16 T Actually, DOEN has introduced this way in the class before. I looked for the date of that class, and it was sixty, no. June sixth, oh, it was continued from June fourth to sixth.
- 00:34:23:15 T I think it was example one we were doing on this day, uh, have you found it? When we were answering example one. We used Kagen-hou for that, and each side, no, what am I saying?
- 00:34:36:10 T Um, the question with the process of adding both of the expressions together, and then solving the expression with only  $Y$  as we can remove  $X$ . The way I was talking about was introduced by DOEN here.
- 00:34:47:07 T That way was, um.
- 00:34:50:09 S June sixth?
- 00:34:52:10 T Yeah, I suppose it was June sixth. I'll do it on the blackboard. Can I just borrow this? This question, right?
- 00:35:11:25 T Well, if we look at this question now, we do know that there is possibility for using Kagenhou, maybe.
- 00:35:16:12 T Anyway, number them as number one and two for each of these, then make the expression number one as a expression of  $X$ , I suppose this was copied from somewhere, right?
- 00:35:31:06 T Well, make it as a expression of  $X$ , actually, we say that "transform the expression" in mathematically. I think you all know this expression though, anyway it becomes the form of " $X$  equals to".
- 00:35:58:01 T Substitute three into two, well, I'll skip the rest.
- 00:36:05:21 T I'll skip the rest, but, you change this expression number one by moving two- $Y$  to the right side and make it as nine minus two- $Y$ , then divide each side by five, and you'll get nine over five minus two- $Y$ .
- 00:36:19:11 T Then you'll have " $X$  equals to nine over five minus two- $X$ ", and you just substitute this whole set of expression into this  $X$  in number two. That was how you solved this question, right?
- 00:36:30:21 T Can you check it with your notebook? And can you understand that this way and the way on the right side of the blackboard have the same way of thinking? Can you see the idea? All right? Okay.
- 00:36:46:18 T Uh, later you'll see it in the textbook, but we call it as Dainyu-hou (the way of substitution).
- 00:36:52:06 T I mean, if we recall the past, you already knew two ways in the textbook at the

very first stage of these classes about system of equations.

00:37:03:12 T Actually, if we compare these two ways by this method right now, the calculation with Kagen-hou is quite complicated for the one on the right for sure.

00:37:12:19 T Um, but, there are some cases that it is easier for us to just substitute it in for the following procedure.

00:37:17:28 T Here, you can decide which to use, Dainyu-hou or Kagen-hou. Kagen-hou is what we have been using, right? In the future, you can do it.

00:37:29:06 T But, you probably need some training for making the right decision. Uh, so, as you calculate many kinds of questions, maybe you can just think like "oh, maybe I should use Kagen-hou for this one",

00:37:39:09 T or though you thought you should use Kagen-hou for that question you might find out that Dainyu-hou is better as you look at your friend's answer. That's how you can learn the better, more efficient way.

00:37:52:00 T And, actually I was surprised to see so many people have done it with Dainyu-hou just now.

00:37:58:02 T I suppose that's why the way of answering has been introduced in the beginning of the class, the one I just wrote on the side of this blackboard.

00:38:07:09 T Um, when I let the grade three students (year nine) answer the very same question, actually I had the very same way of giving that question as today.

00:38:13:04 T I mean, I didn't explain about Dainyu-hou before giving this question. Then, about seventy percent of the class took Kagen-hou.

00:38:20:08 T So, I was quite surprised to see how you had done it, well, maybe because there have been an answer with Dainyu-hou introduced in the class before,

00:38:24:27 T but there were quite many of you who took this Dainyu-hou.

00:38:29:23 T Okay. So, although I didn't write the title for this one, this is the title in the textbook. I'm going to write it from here. Page forty-four, this is example four, which is using Dainyu-hou

00:38:52:28 T Um, all the answers are written on the blackboard, but all of the answers in the textbook are using the way of writing on the right side. See?

00:39:02:27 T The way on the right explains that you can solve the same question with Kagen-hou as well. Uh, let me read the explanation of Dainyu-hou.

00:39:10:08 T Answer the following system of equations.  $Y$  equals to two- $X$  minus three, and make it as number one. Five- $X$  minus four- $Y$  equals to nine, and make it as expression number two.

00:39:20:03 T The way of thinking says that we can remove  $Y$  by substituting "two- $X$  minus three", which equals to  $Y$  in number one. Um, look at the place with a frame.

00:39:33:22 T You can see that " $Y$  equals to two- $X$  minus three" in the expression number one is framed with a number. You can just substitute it into  $Y$  in number two. That is what this means.

00:39:43:28 T The answer is the same as the ones on the blackboard, and I think they are more in detail than the textbook. So, I don't need additional explanation, I think.

00:39:51:13 T The definition of Dainyu-hou, I mean the explanation, well, I'll read the sentence on page forty-four, the two sentences before question six.

00:39:59:13 T Uh, we have removed Y by substituting number one into number two. This way of answering, the way of leaving only one kind of letters by substitution is called Dainyu-hou.

00:40:10:10 T Well, you don't have to memorize this word. You see? You can recall this by looking at the question, like "oh, we have that way!" You don't have to remember the word itself, no.

00:40:20:14 T You'll hear the word Dainyu-hou and Kagen-hou for the explanation for sometimes, so it will be handy if you can memorize them.