

*First Announcement (ver5)*

**APEC - Tsukuba  
International Conference on Innovative Teaching Mathematics  
through Lesson Study (II)  
- Focusing on Mathematical Thinking -**

**December 2 – December 7, 2006**

**Tokyo & Sapporo, JAPAN**

**A conference on the APEC project:**

**“Collaborative Studies on Innovations for Teaching and Learning Mathematics in  
Different Cultures (II) - Lesson Study focusing on Mathematical Thinking -”**

**General Introduction**

At the third APEC Education Ministerial Meeting held on 29-30 April 2004 in Santiago, the ministers defined the four priority areas for future network activities. “Stimulating Learning in Mathematics and Science” is one of the four priority area. Based on this priority, the APEC project “A Collaborative study on innovations for teaching and learning mathematics in different cultures among the APEC Member Economies” was approved by APEC Member Economies in August 2005. The project held meeting in last January 2006 at Tokyo in Japan and last July 2006 at Khon Kaen in Thailand. The project was managed by the Center for Research in Mathematics Education (CRME) in Khon Kaen University and the Center for Research on International Cooperation in Educational Development (CRICED) in University of Tsukuba. The result will be seen on the website: <http://www.criced.tsukuba.ac.jp/math/apec2006/>

Based on the success, the specialists from APEC economies decided to continue the project more four years in relation to following topics: Mathematical Thinking (year 2007), Communication (year 2008), Evaluation (year 2009), and Generalization (year 2010). The first three topics are selected in relation to three Lesson Study processes, Plan (for Mathematical Thinking), Do (for Communication) and See (for Evaluation). The result of each year will be based for the following year project. In the final year,

Generalization will be set for the benefit of all subjects in education.

For year 2007, the APEC project “Collaborative Studies on Innovations for Teaching and Learning Mathematics in Different Cultures (II) - Lesson Study focusing on Mathematical Thinking-” is accepted in May 2005 and approved at October 6, 2006. Mathematical Thinking is necessary ability for science, technology, economical life and development.

With Lesson Study approaches, the project aims to

- 1) Collaboratively share the ideas and ways of mathematical thinking which is necessary for science, technology, economical life and development on the APEC member economies, and
- 2) Collaboratively develop the teaching approaches on mathematical thinking through Lesson Study among the APEC member economies.

As the goal of project, we would like to publish the report (or book) with CD-roms including the video of good teaching practices for developing mathematical thinking for teacher education in APEC economies and the world. In order to achieve the goals of the project, activities will be implemented in four phases

Phase I, A workshop and a Lesson Study meeting (a kind of workshop for specialists) among key mathematics educators from APEC member economies hosted by Center for Research on International Cooperation in Educational Development (CRICED), University of Tsukuba, Japan will be organized in order to share the idea and ways of mathematical thinking on curriculum level and teaching level (at Tokyo & Sapporo, December 2006).

Phase II, Each co-sponsoring APEC member economy will engage in the Lesson Study project for developing some topics of mathematical thinking (February-July 2007).

Phase III, An International Symposium and a Lesson Study meeting (a kind of workshop for general teachers) will be organized in order to share teaching approaches for developing mathematical thinking by economies. The symposium will be hosted by Center for Research in Mathematics Education (CRME), Faculty of Education, Khon Kaen University, Thailand (at Khon Kaen, August 2007).

Phase IV, The professional development for school mathematics teachers will be conducted based on the obtained - best practice and learned-innovation (August-September 2007).

### **Specialists from member economies**

The project and the meetings are planned for all APEC economies' welfare. The project itself has been carried out by the specialists from member economies who participated in the past two meetings at Tokyo in last January 2006 and Khon Kaen in last June 2006, and at the same time it opens for new delegates who are recommended by all economies. From the project side, the specialists of the last meetings in Appendix 2 will be recommended to participate the meeting for the continuation of the project.

In the case of economies recommending new specialists, please consider following conditions of specialists for developing the products of the project.

Specialist;

- is expected to be a researcher of mathematics education,
- is working in the Ministry of Education or academic institutions including universities and teachers' colleges,
- has an experience of research in classroom at elementary school level,
- knows and feels interested in Lesson Study movements,
- is interested in the conference,
- will engage in Lesson Study and develop teacher education program in each economy in the project.
- must participate in both meetings in Japan and Thailand
- will present his/her reports both in Japan and Thailand

For the convenience, the list of specialists participated in the past meetings in January and June 2006 will be attached to this document.

Please let us know the specialists who are recommended from economies with the format (Appendix 1) that attached last pages of this document until October 30, 2006.

For sharing the welfare to improve the quality of education through the Lesson Study, it is very welcome the member economies will support travel grants for a number of delegates. Organizing committee will consider the ways to support one specialist from each economy by the APEC grant or the grant from Japan but the committee has to say that there is limitation. Depending on the APEC policy, the travel cost of one specialist from each APEC eligible member economy (Chile, China, Indonesia, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, Russia, Thailand, and Vietnam) should be supported by APEC grant. Economies who can dispatch by the self-grant will be recommended using self-grants for their participations.

The ways of support will be estimated after the specialists nominated from the each economy until October 30, 2006. If the number of delegates is larger than the limitation of the grant, organizing committee will trying to find the ways based on the APEC policy. The way of invitation will be informed participants until October 31, 2006.

The project is approved for all APEC welfare. The specialists supported by the APEC grant or the Japanese grant will be requested to present their report. In case more than two specialists in an economy expected to contribute, organizing committee recommends them integrating their report into one report.

### **Ways of Publications based on APEC Policy**

The results of Phase I and Phase III will be published as proceedings of meetings. For the welfare for APEC economies, all results including videos which will be presented in the meeting are going to be opened on the website:

<http://www.criced.tsukuba.ac.jp/math/apec2007/>

At the same time, depending on APEC EDNET policy, these results will be opened on the Knowledge Bank on APEC EDNET.

Based on the result of meetings, we are planning to develop a teacher education textbook for developing mathematical thinking.

### **Questions for Discussion in the Meeting of Phase I in Japan**

We focus on mathematical thinking as for teaching contents in elementary<sup>1</sup> school classrooms. It is necessary components for analyzing subject matter and planning the lesson with the specified aim. Here, we pose three questions which will be discussed at the meeting in Japan. Every specialist is expected to present their report in relation to these three questions with examples.

#### **Question 1: How mathematical thinking is defined in your curriculum documents and your lesson?**

From the view point of Lessons Study, Mathematical Thinking should be developed through lessons. It is defined by the curriculum and embedded in the aim of each lesson. Thus, curriculum documents of each economy would be the clearest resources for analyzing what mathematical thinking is in each economy.

In Japanese curriculum, mathematical thinking has been enhanced for clarifying the quality of activity from 1951 for secondary school and 1953 for elementary and middle

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<sup>1</sup> It may be until 12 or 13 years old.

school.

In Japanese curriculum documents, mathematical thinking is defined with mathematizing activity and it has three components to be taught: the ability of ‘see as’, ‘ways of thinking’, and ‘appreciation of its significance’. On evaluation standards in Japan, there are four categories: Attitude, Mathematical Thinking, Representation and Understanding. Each category is related with each other. Mathematical Thinking is based on mathematical attitude, done with mathematical representation and necessary for understanding. The order of these four categories itself resembles the process of thinking but it is not specific to mathematics because there are similar conditions existed in other academic subjects.

The Ministry of education, Japan, recommended teachers to have decision making conditions for teaching in the process of a lesson based on the observation conditions developed from these four categories. In lesson planning at the first part of Lesson Study process, teachers analyze subject matter and expect students’ responses. In this process, teachers plane the ways of decision with four categories. Thus, the Ministry recommended teachers to describe these four categories with specific mathematical conceptions which appear in specific lesson.

**OECD PISA and NCTM standard are the considerable documents for our common understanding before the meeting.**

In the Tokyo meeting on last January 2006, Jan de Lange described the meaning of mathematical literacy with necessary competency for living in OECD PISA.

<http://www.criced.tsukuba.ac.jp/math/apec2006/proceedings>

In OECD PISA (2003), mathematical literacy and key competencies of mathematics were defined with interesting problems: reasoning, argumentation, communication, modeling, problem-solving, reproduction and connection.

<http://www.pisa.oecd.org/dataoecd/1/60/34002216.pdf>

In NCTM Standard (2000), there were five content standards and five process standards are described with illuminating examples. Process Standards are as the following: Problem solving, Proof and reasoning, communication, connection and representation.

<http://standards.nctm.org/>

Both frameworks are not curriculum documents themselves which specify teaching contents in grades and orders such as the national curriculum standards of Japan and

meaning is not the same even if they use same words.

**Question 2: What is your key window for considering mathematical thinking?**

Mathematical thinking is open ideas. Thus, it is very difficult to discuss its development without having a window to discuss.

When we focus on each lesson, we easily focus on specific knowledge and skills (Understanding), and easily forget to develop Attitude, Mathematical Thinking and Representation. Japanese middle-school curriculum documents enhance a dynamic learning activity with the following three features of mathematics. First feature is reorganization through mathematization by reflective thinking. Second feature is acquisition and using mathematical concept on ideal world (existing expected harmonized world). Third feature is learning how to learn, develop and use mathematics in previous two types of learning. All three features are necessary perspectives for planning a lesson and learning how to learn, develop and use mathematics is a kind of mathematical thinking specially recommended in the classroom. Thus, learning how to learn itself is an important key window.

A very basic process of thinking was described by John Dewey (1910) with the importance of reflective thinking. Reflective thinking is a key window to develop mathematics such as mathematization (e.g., Hans Freudenthal, 1973)

The methods of developing mathematics was well-known by the work of George Polya (1957) in *'How to solve it'* It shows the strategies of mathematics and we can distinguish a variety of mathematical thinking by his perspectives. His idea is a key window shared in the world. *'Thinking mathematically'* by John Mason, Leone Burton and Kaye Stacey (1982) is a good resource for teacher education. Letting people know the way to develop mathematics itself is necessary for teaching mathematical thinking.

Mathematical thinking has been using to describe in the context of problem solving. It is a window as well as other windows. For example, from the view points of representation, the permanence of the equivalence of form is a way of expansion of mathematical form which is trying to keep the mathematical structure. Representation is also a key window.

Alan H. Schoenfeld is well known by his cognitive research on problem solving. He suggested Vygotskian perspective to develop mathematical thinking as internalized communication and the importance of belief (value) systems for thinking mathematically. From his perspective, the ways of communication is necessary for

developing mathematical reasoning. In this case, communication is a key window. Belief, Value and Attitude (including the affective domain) are also studied in cognitive (Douglas B. McLeod) or cultural context (Alan Bishop). These are a driving force of mathematical thinking. Then, these domains will be also key windows.

There are a number of researches which focus on special ways of reasoning. Induction and Analogy is well known by George Polya. Analogy is discussed with the knowledge development on the embodied cognition by George Lakoff and Rafael Nunez (2000) that is a framework to develop knowledge with hands-on activity such as dragging on the computer. Abduction is a kind of reasoning by Charles Sanders Peirce. Historically, Analysis is a kind of reasoning against proof (integration). Generalization process is described by Dorfler. W. Each way of reasoning will be also a key window.

There are a number of windows. Each window has specific range for describing object. Please consider our target of the meetings is sharing the framework to develop student's mathematical thinking by teachers in classrooms.

### **Question 3: How can we develop mathematical thinking through the lesson?**

In the problem solving approach for mathematics teaching such as Open-ended approach, students meet an unknown problem which can be solved with known mathematics. Students represent their ideas by themselves and discuss each others. Solvable or approachable unknown problem for students is an important condition of problem in a lesson. Even if most of mathematics problems for mathematicians are very difficult to solve in a year, it will be solved based on something already known.

In the process of communication, there is necessary to share the norms such as ideas could be explained what students already learned. It is a kind of learning how to learn in mathematics because it follows the deductive ways of reasoning specialized in mathematics. The communication in mathematics sometimes resembles the debate in Society but in mathematics everyone cannot decide the validity of ideas without sharing presupposition in community and can not decide it by the majority. But sometimes, authorized teachers teach everything without communication.

There are a number of didactical suppositions which must be useful for Lesson Study for developing mathematical thinking. Clarifying these suppositions based on authentic mathematical activity with example is useful for teachers to develop the lesson. Without examples, every teacher may agree the importance of these suppositions but difficult to understand real meaning in his/her teaching process and impossible to develop his/her lesson for implementing based on them.

In the case of Japan, these didactical suppositions are integrated as various teachers' theories of mathematics education with the results of Lesson Study. Problem Solving approach and Open Approach are models of Japanese teachers' theories.

### **The format of the report of workshop**

The number of pages is 4 or 5 pages, at most 10 pages. The format of your report is PME format. <http://www.pme30.cz/doc/PME30Template.rtf>

The report is expected to include your claims for mathematical thinking with examples. The report must be written based on your academic background because it will appear in the proceedings of the meeting. But the meeting itself is not the chance for your research presentation. Your paper is aimed to be used for discussion documents for each other in the workshop against three questions. All specialists are expected to read all reports before the meeting. The deadline for the submission of your report is November 24, 2006. We will put your report on the web site which can be seen by the specialists. After the workshop you may have a chance to rewrite for the proceedings. Proceedings are open for anyone.

Please consider that the final goal of the project is developing a teacher education textbook. Teachers do not have a chance to share your original academic ideas but have a chance to develop good lessons based on your ideas.

It is necessary to give your answers against the three questions. It is necessary to include some examples.

If you could include the example of a lesson with video, it is welcome. The format of writing with video is explained in the followings;

[http://www.criced.tsukuba.ac.jp/math/apec2006/progress\\_report/General/Conclusion.pdf](http://www.criced.tsukuba.ac.jp/math/apec2006/progress_report/General/Conclusion.pdf)

[http://www.criced.tsukuba.ac.jp/math/apec2006/progress\\_report/Specialist\\_Session/Isoda.pdf](http://www.criced.tsukuba.ac.jp/math/apec2006/progress_report/Specialist_Session/Isoda.pdf)

You are expected to report your result of Lesson Study with your video at the Thailand session in August, 2007 at Phase III.

### **The format of the lecture papers in open symposium**

The format of the paper is PME format with no limitation of the number of pages. Integrated issues of the trends of research, the curriculum developments in relation to mathematical thinking or teachers' theories for planning lessons to develop mathematical thinking are expected.

## Structure of Meeting in Tokyo and Sapporo, December 2-7, 2006

The aims of Phase I, first meetings are to share the ideas against the three questions and to know the lessons which develop mathematical thinking. APEC-Tsukuba meetings have three components:

First component is open symposium; in December 3 and 4

Lectures and a panel for sharing ideas of mathematical thinking to develop lessons by teachers

Second component is workshop; in December 5-7

Workshop to develop a collaborative framework for Lesson Study to develop mathematical thinking

Third component is Lesson Study Meeting; in December 2, 5 and 6.

Sharing examples of Lesson Study to develop mathematical thinking

### Schedule of APEC - Tsukuba meetings

Following are schedule of APEC – Tsukuba meetings in Tokyo & Sapporo. Titles of lectures are tentative.

**December 1 FRI - 2 SAT Morning:** Arrival days of Participants

In December 1 evening and 2 morning: “Symposium to develop excellent students in Mathematics” will be held.

**December 2 SAT. Afternoon:** First day of APEC Program from the noon.

APEC Lesson Study Meeting: For sharing examples to develop mathematical thinking. Elementary School of University of Tsukuba will be held.

**December 3 SUN:** Second day of APEC Program

APEC-Tsukuba International Conference: Tokyo Open Symposium with lectures  
Opening, keynote lectures and lectures.

**December 4 MON Morning:** moving to Sapporo

**December 4 MON Afternoon:** Third day of APEC Program

Sapporo Open symposium: One Panel and one Lecture

**December 5 TUE and 6 WED:** Forth and Fifth days of APEC Program

Workshop (morning) and Lesson Study (afternoon) in Elementary School

**December 7 THU:** Seventh day of APEC Program

Workshop and Closing,

Moving to Tokyo at night.

**December 8 FRI:** Departure day

**Venues of APEC - Tsukuba Conference in Tokyo and Sapporo**

The meetings will be held following places:

Dec. 1 FRI: JICA INSTITUTE FOR INTERNATIONAL COOPERATION

<http://www.jica.go.jp/english/contact/ific/index.html>

(Included accommodation in Tokyo)

Dec. 2 SAT: Attached Schools, University of Tsukuba at Tokyo

<http://www.gakko.otsuka.tsukuba.ac.jp/map.jpg>

Dec.3 SUN: JICA INSTITUTE FOR INTERNATIONAL COOPERATION

<http://www.jica.go.jp/english/contact/ific/index.html>

Dec 4-8 MON-FRI: JICA SAPPORO INTERNATIONAL CENTER

<http://www.jica.go.jp/branch/hics/jimusho/hics.html#map>

(Included accommodation in Sapporo)

**Important Information for Participants at APEC-Tsukuba Conference**

**First Announcement will send:**

**October 11, 2006**

Contact URL: <http://www.criced.tsukuba.ac.jp/math/apec2007>

**Dead line of the nomination of specialists from member economies:**

**October 30, 2006**

Contact address: [apec@criced.tsukuba.ac.jp](mailto:apec@criced.tsukuba.ac.jp)

**Invitation letter, Information of Trip and Second Announcement will be sent:**

**October 31, 2006**

Contact address: [apec@criced.tsukuba.ac.jp](mailto:apec@criced.tsukuba.ac.jp)

Contact URL: <http://www.criced.tsukuba.ac.jp/math/apec2007>

**Dead line of the submission of paper:**

**November 24, 2006**

Contact address: [apec@criced.tsukuba.ac.jp](mailto:apec@criced.tsukuba.ac.jp)

**All Papers for Discussion will be on the website:**

**November 27, 2006**

Contact URL (to be announced to specialists)

**Final Announcement will be on the website:**

**November 30, 2006**

Contact URL: <http://www.criced.tsukuba.ac.jp/math/apec2007>

**Arrival days of Participants**

**December 1 FRI - 2 SAT Morning**

### List of Correspondence of the Conference

Conference Host: University of Tsukuba  
Organized by Ministry of Education, Japan  
Supported by Japan International Cooperation Agency (JICA)  
Hokkaido University of Education  
Japan Society of Mathematical Education (JSME)  
Japan Society of Science Education (JSSE)

#### Organizing Committee

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**Appendix A****Specialists from the Economy**

Please fill and send it back through the economy (government) by e-mail.

\* Specialists will be already participated specialists of the both meetings on last January in Tokyo and last July in Thailand (see Appendix 2), or new persons who are recommended by the economy.

\*\*The specialist written on 1) will be supported by the APEC project grant or the Japanese grant. From the project side, the specialists of the last meetings will be recommended for the continuation of the project.

\*\*\*There is no limitation of the number of specialists who are recommended by each economy with self-grant.

1)

Names (First Middle Last)			
Title		Economy	
Affiliation (Institution)			
e-mail			
Tel/Fax			

2)

Names (First Middle Last)			
Title		Economy	
Affiliation (Institution)			
e-mail			
Tel/Fax			

3)

Names (First Middle Last)			
Title		Economy	
Affiliation (Institution)			
e-mail			
Tel/Fax			

## Appendix B

**LIST of Specialists (Experts)**  
**on the both meetings at Tokyo, last January and at Kohn Kaen, last June.**

NAME	economy	AFFILIATION	E-mail
Max Stephens	Australia	University of Melbourne	<a href="mailto:m.stephens@unimelb.edu.au">m.stephens@unimelb.edu.au</a>
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