

## [Speaker Presentation]

### Quality of Education needed for Mathematics: Findings from IEA TIMSS and OECD PISA Results

**Hanako Senuma**

Senior Researcher, Department for Curriculum Research, Curriculum Research Center, National Institute for Educational Policy Research of Japan



#### 1. Discussion Point; Quality of Education in Japanese Mathematics from International Perspectives

- High Achievement, Low Attitudes - since 1964
- Factors lead High Achievement; Curricula, Textbooks, Teaching
- Reasons for Low Attitudes; Does High Achievement lead Low Attitudes ?
- Mathematics v.s. Real World - Problem solving within/outside Mathematics

#### 2. Characteristics of IEA TIMSS and OECD PISA

##### 2.1 IEA TIMSS (Trends in International Mathematics and Science Study)

IEA (International Association for the Evaluation of Educational Achievement)'s First International Mathematics Study was conducted in 1964. IEA uses the curriculum, broadly defined, as the major organizing concept in considering how educational opportunities are provided to students, and the factors that influence how students use these opportunities. TIMSS curriculum model has three aspects.

- Intended Curriculum; National, Social and Educational Context
- Implemented Curriculum; School, Teacher and Classroom Context
- Attained Curriculum; Student Outcome and Characteristics

##### 2.2 OECD PISA (Programme for International Student Assessment)

OECD (Organization for Economic Co-operation and Development) PISA has been conducted since 2000. 'Literacy' concept was introduced to measure 15 years-old students' knowledge and skills after their graduation. Key components of Mathematical literacy are

- To identify and understand the role that mathematics plays in the world
- To make well-founded judgments
- To use and engage with mathematics

#### 3. Quality of Education in Japanese Mathematics from International Perspectives

##### 3.1 Second International Mathematics Study (SIMS)

Japan was top in 20 countries in SIMS in Grade 7 and attitudes toward mathematics were negative. "The Underachieving Curriculum" (C.McKnight,1987,USA) argues that Japan's high scores are due to excellence of curriculum. "Curriculum and Evaluation Standards for School Mathematics" (NCTM, 1989,USA) suggest that establishing a common curricula nationwide will improve mathematics achievement.

- Other Results of Japan: Very Little use of calculators, Gender difference; Low confidence  
Low attitude and High achievement.

### **3.2 Third International Mathematics and Science Study (TIMSS1995)**

Singapore was high achievement and high attitudes in TIMSS1995. Not only Japan but also Singapore, Korea, Hong Kong are high achievement.

### **3.3 TIMSS1995, 1999 Optional Study; Video-taped Study**

- Japanese lesson pattern as ‘problem solving’ can be associated high scores: reviewing the previous lesson, presenting the problem for the day, students working, discussing solution methods, summarizing (TIMSS1995 Video Study; Germany, Japan, USA)
- Different methods of mathematics teaching can be associated with high scores : the comparison between Japan and Hong Kong; introducing new contents, practicing new contents (TIMSS1999 Video Study; Australia, Czech, Hong Kong, Japan, Netherlands, Switzerland, USA)

### **3.4 PISA (Knowledge and Skill for tomorrow’s world)**

- Reading Literacy, Mathematical Literacy, Scientific Literacy, Problem Solving
- Around OECD average on Reading Literacy
- Top level but not top on Mathematical Literacy and Scientific Literacy
- In Japan target was student in Grade 10, but in many countries varies in several grades.

### **3.5 IEA’s Trends in International Mathematics and Science Study (IMSS2007)**

There is a substantial gap in Grade 8 achievement between 5 Asian countries and the other countries. High average countries scores are high in each mathematics cognitive domain; ‘Knowing’, ‘Applying’, ‘Reasoning’. Countries of high scores for mathematics tend to negative in student’s responses for ‘Enjoy’, ‘Boring’, ‘Like’ Mathematics are

## **4. New Mathematics Curricula**

New curricula in Japan will be put in forth in all elementary schools in April 2011 and in all lower secondary schools in April 2012. New curricula for mathematics and science will be put in forth in advance in 2009 as a transitional measure; More emphasis on mathematics and science from the results of International Study.

- Number of class periods spent on mathematics and amount of content will be increased
- More emphasis on mathematical thinking, representing and make judgment based on mathematics, appreciation, enjoyment of mathematics
- More emphasis on statistics and other areas related to our daily lives

### **Appendix: ‘Interest in Math’ tends to change**

Longitudinal data was analyzed for same 314 students from Grade 5 (1989) to Grade 12 (1996)/by NIER Japan. There are 5 alternatives; ‘5: intersting’, ••• ‘1: not interesting’ on ‘Interest in Mathematics’ Changing pattern is 313 for 314 students. Interest in Mathematics tends to change easily and it is important for teacher to pay attention to increase students motivations.