Preface

Understanding mathematical principles and procedures is essential in becoming a citizen of the data-driven and technological world of the 21st century, no matter what industry one is in. Mathematics education is indeed a key for human resources development and global competitiveness.

The Education Ministers of the Asia-Pacific Economic Cooperation (APEC) identified mathematics and science education as a priority in their most recent ministerial meeting in 2008. There, they released a strategic action plan and recommendations for the APEC Education Network. These recommendations recognize not only the need for high quality standards and assessments for mathematics education, but also the need for teachers with strong knowledge and expertise in providing high-quality learning opportunities for their students.

The APEC project, "21st Century Mathematics and Science Education for All in the APEC Region: Strengthening Developing Economies and Gender Equity Through Standards, Assessments, and Teachers", led by the U.S. and Thailand intends to make available promising practices and ideas from research on improving mathematics teaching and learning to all the APEC economies[1].

The main goals of this project are to: share exemplary practices in mathematics education from around the APEC region, and develop technical assistance from these promising practices to help APEC developing economies effectively replicate these practices based on their individual contexts.

As a part of this project the APEC Conference on Replicating Exemplary Practices in Mathematics Education was held from March 8 to March 12, 2010, with March 8 designated as a special one-day preconference event focusing on gender equity in mathematics and science education, at the International School of Tourism, Suratthani Rajabhat University, Samui Island. The conference was organized and led by the U.S. Agency for International Development, U.S. Department of Education and the Ministry of Education, Thailand.

This summary addresses: (1) What was discussed during the conference (2) The planned next steps in using these resources to provide high-quality learning experiences for teachers and students, and to establish a strong foundation for teaching mathematics and science for future generations.

The conference report

The ultimate goal of the conference was to develop a series of resources, recommendations, and action plans for the APEC Education Network mathematics project participants based on the presentations and discussions held during the conference. In order to address issues and concerns for improving mathematics teaching and learning, the project overseers and the conference chairs identified five major topics in mathematics education. Based on these topics, the 4-day conference was organized around five major topics and was designed for intensive discussion on each topic among not only the speakers and discussants but also including the active participants who were nominated by the each APEC member economy. The following

1 This is project was approved by the APEC, Human Resources Development Working Group [HRD 01 2009A]

are the five plenary sessions based on the five major topics that were identified by the conference organizers:

1. Standards plenary session
2. Curriculum plenary session
3. Teacher plenary session
4. Assessment plenary session
5. Interventions plenary session

Each plenary session began with presentations from selected monograph writers followed by break-out sessions, which provided the participants an opportunity to engage in discussion with the presenters and other active participants. Next, the whole group reconvened for panel discussions, which included all presenters of the plenary session and the discussants who represented the audience members of the resources from this project. 17 distinguished presenters and 5 discussants from 12 economies were invited and participated in the conference.

Standards Plenary Session

Based on the three session papers, the discussants and the active participants discussed what mathematical knowledge and skills are expected, and how these knowledge and skills should be introduced for the future generations. Ginsburg and Leinwand shared the results of the study comparing the standards from high-performing APEC economies, such as Hong Kong, China; Korea; and Singapore. Usiskin shared his ideas on the learning progression in grade 7-12 mathematics content. Wang shared the results from his study on using a new technology based curriculum.

The discussant of the session, Lim, highlighted some of the ideas and proposals that were discussed during the session:

- Gather, translate (into English) and post additional sets of standards from economies that are not currently available.
- Develop a set of “Guidelines for Conducting International Benchmarking Standards” including specific techniques or approaches for adapting a set of standards

Curriculum Plenary Session

The three session papers delved into the processes and principles for the development of mathematics textbooks based on standards and gave innovative ideas and examples on how textbook publishers, curriculum developers, and authors can ensure a more effective way for implementing them into the curricula. The first paper written by Shimizu and Watanabe discussed how mathematics textbooks were produced in Japan. The paper highlighted the processes involved in textbook writing and the roles played by the Ministry of Education and commercial publishers. The second paper, written by Lianghuo discussed the relevant processes necessary for developing mathematics textbooks based on 6 principles: Curriculum, Discipline, Pedagogy, Technology, Context and Presentation. The third presentation, by Ginsburg gave ideas on the principles and processes of the best way online resources can be published while keeping curriculum principles in mind.

The discussants of the session, Kaur and Soh, mentioned that it would be beneficial for many APEC economies to have guidance or a manual for textbook writers and

curriculum developers about the exemplary process of developing textbooks, reviewing the quality of textbooks, and the adaptation of textbooks. In order to do so, an in-depth study on comparing the practices among some of the high-performing economies is necessary. It is also suggested that seeking possibilities of publishing online curriculum materials as OpenCourseWare would be greatly beneficial for many APEC economies. Some of the participants agreed that they were going to make some sample materials available on the APEC KnowledgeBank Wiki site in the near future.

Teacher Plenary Session

The four papers presented at the teacher plenary session touched on some of the most important areas of mathematics teacher education: professional development, performance measures and reward systems, and a particular professional development approach to enhancing teachers' capacities in the classroom – Lesson Study. Akihiko Takahashi presented about a framework of professional development for teachers to grow professionally throughout their careers. Lee's paper describes the Singapore government's role in helping develop excellent teachers. Isoda and Inprasitha both consider the process and the adaptation of Lesson Study as a specific approach to developing excellent teachers.

The discussant of the session, Vistro-Yu, reported that the break-out session discussion focused on the mathematics preparation needed by teachers, professional development for teacher educators, the quality of beginning teachers, Singapore's system and methods for maintaining an excellent teaching force, and details of Thailand's experience with Lesson Study using the Open Approach as opposed to the Top-Down approach for mathematics teachers' professional development.

Although the participants agreed that professional development of teachers is a key for improving mathematics teaching and learning, the question of what kind of professional development works best for teachers still remains. For the teachers themselves, a content-based professional development is needed to address their weak content knowledge. However, to address the poor quality of teaching, pedagogical content knowledge that is deeply related to content must be their focus. In order to provide high-quality professional development for teachers, the participants agreed that the quality of professional development for professional developers (or PDPDers) should also be emphasized. Whatever framework is developed for the professional development of teacher trainers and PDers could be disseminated through Open Educational Resources (OER). Likewise, PDPDers could deliver materials using online OER courses. Participants also identified a need to compile resources, address practical issues of delivery, and provide various models of professional development. As for resources including textbooks, a practical issue that needs serious consideration is language. Works in English have to be translated to the language of the economy and vice versa.

Assessment Plenary Session

The three papers presented at the assessment plenary session described some of the key aspects of assessments. Cheng reported the current issues and trends in high school competency exams in Chinese Hong Kong, China. Stevens described New Zealand's example of the systematic use of formative assessment to improve student achievement. Anderson shared the approach of using formative assessment used in many international schools.

The discussant of the session, Suwaryani, reported that the participants agreed that both formative and summative assessments were important for ensuring the quality of the student learning. At the same time, some teachers may not able to see formative and summative assessment as an integral part of attempts to improve student learning, and may not know how to follow up on the results of the assessment.

Since teachers in developing economies are often required to teach students with diverse ability, including multi-grade teaching, knowledge and skill for using formative assessment to improve students learning is essential. Given these circumstances, having sets of assessment tasks and a guide for using assessment effectively in the APEC KnowledgeBank Wiki would be an ideal step following this conference.

Intervention Plenary Session

Three papers were presented at the intervention plenary session. Each paper described a unique intervention program for students with special needs. Cobb and Crombie shared ideas from the Algebra Project. The authors describe the Algebra Project, which is funded by Bob Moses, as a direct descendent of the community-organizing tradition of America's Civil Rights Movement. The project is designed to accelerate the mathematical learning of students who are under-performing in mathematics.

Gould reported the results of the, "Taking Off With Numeracy" (TOWN), which builds upon the work of the past ten years in the "Counting On" program and uses essentially the same learning framework employed in "Math Recovery" and "Count Me In Too". The program was designed to address the persistence of highly inefficient methods of calculating, which operates as both a whole class program and a within class intervention.

Vui gave some evidence showing the advantages of using multiple dynamic representations in promoting the exploration of mathematical ideas in mathematically gifted students. He argued that these students may need more help from outside schools, while on the other hand lower math achievers may need more assistance from inside schools.

The discussant of the session, Bao, pointed out some of the important considerations needed for establishing effective intervention programs by summarizing the discussion at the conference:

- Motivation principle is a key concept. Since only students can prevent themselves from being low achievers, establishing community organizations to encourage students, reducing class size to provide more attention to individual students, and providing for more hands on activities are important considerations for helping them catch up.
- Need to design intervention programs according to needs and target the greatest impact (i.e. identify and address the tipping point).
- Need to understand strategies to transfer promising practices including evolving and modifying practices to be implemented effectively in different economies.