How can we develop classroom communication?

With an example of classroom dialectic

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The communication is written in Japanese National Curriculum as for developing Problem Solving ability.

Significance of Communication descried in the national curriculum document

In Japan, the national curriculum standard, the course of study, is written as a law and it basically focused on the description of the content when we compared it with NCTM standards. In the subject of national language, Japanese, communication is clearly described as an aim but not in the case of mathematics. In the general preview of the national curriculum standard for elementary level, there are following descriptions for enhancing the project activities ‘Sogotekina Gakusyuuno Jikan’: Although it does not focused on the subject of mathematics, experimental study and problem-solving study such as investigation, presentation and discussion, developing by hands and productive activity are recommended. From the concept, it is clear that problem solving activity usually include the communication activity such as investigation (communicating with the object), presentation and discussion (communicating with others) in the Japanese teaching approach. Mathematics activity is enhanced in the national curriculum standard in mathematics for developing problem solving ability.

Based on the law, the Ministry of Education of Japan publishes teachers' guidebook of curriculum standards for each subject. In mathematics standard guidebook (See, Isoda 2006), problem solving is enhanced as consecutive of enhancement of mathematical activity:

> In enhancing the ability of problem solving, it is necessary to consider the following points:
> (1) To enrich the kind of teaching that makes each child become able to find what the problem is and to know the structure of the problem.
> (2) To enable children to collect necessary information for solving a problem, and to sort conditions.
> (3) To provide situations and time for solving problems on their own, and to allow them to participate in activities in which they can think insightfully and independently.
> (4) To diversify learning activities by introducing arithmetic activities such as manipulation and experiential activities, and to enable children to feel the joy of learning and the sense of accomplishment by using their creativity and their own methods.
> (5) To provide opportunities in which children can exchange their ways of problem solving with others and in which they learn from each other and appreciate the merits of the ideas of others and to have the classroom function as a place for group learning.
> To provide an opportunity to evaluate oneself and others, and to reflect on the steps of problem solving, which include the ways of thinking and processing, and to enable students to be aware of how well they can do and to know their personal challenge.

In Japan, these processes are called the problem solving teaching approach. (5) is a major component of the communication in this approach. Through (5), many ideas including misunderstanding will be treated in the classroom by teachers. Most of them are expected by the teacher before the lesson. Teacher plans the discussion before the lesson based on this anticipation.

Because the Japanese standard focused on the content, mathematics usually means concept and procedure. Many elementary school teachers do not understand the special meaning of 'mathematical' communication but they understand well that communication is a method of teaching. Here, the method of teaching is mathematics and mathematical problem solving. In this context, mathematical communications is a kind of communication that is possible to be developed throughout any subject for instance dualing the time for the project activities.

On the other hands, argumentation and proof are defined as the teaching content in mathematics at Junior Secondary level. In any curriculum, how to bridge proof and explanation (before proof) is a major problem. The elementary level Japanese

mathematics standards aimed for developing mathematical reasoning with following words:

> Through the mathematics activities on numbers and quantities and geometric figures, have children acquire the basic knowledge and skills, enrich the ability to think logically with insight about daily phenomena, appreciate the joy of those activities and the merit of mathematical operations, and willingly utilize them in daily life.

In Japanese, logical thinking is explained by the sequential reasoning such as induction, deduction and analogy. At elementary level, teachers and students do not distinguish those reasoning but are usually engage in the sequential explanation when exchanging each others' ideas with others.

The components of communication to develop mathematical thinking

In the discussed documents, the following features of mathematical communications were described: Dialectic (proof and refutation), Internalization of explanation and grounding for sharing, Representations, Competitive and Sympathetic Attitudes, and Language and Culture.

Depending on Vygotskian theorem to develop reasoning, inter-subjective ways of communication including tools will be embedded into the inner-subjective reasoning. The mathematical ways of communication in classroom are important for developing thinking. In Japan, the mathematical communication is deeply associated with the followings topics:

1) **Sequential Problem Posing and Solving**:

Firstly, the mathematical communication processes are proceed in the sequence: questions, answers and reasons. Problem solving approach itself follows the sequence such as from (1) to (5), from 'knowing what problem is' to 'appreciations of significance of the mutual ideas'. Hear, problem solving attitude such as getting solutions faster than others or finding innovative ideas and classroom norms such as trying to appreciate other's ideas will be developed and expected internalize.

2) **Formalized Mathematical Representations**:

Secondly, there are a number of representations which are used by children. Through reflection, we formalize such kinds of representations. In some countries, most of the representations are considered as informal. On the other hands, in Japan, elementary mathematics textbook, models, tables, tapes, and number lines are gradually introduced within the process of formalization and six different textbook companies almost preferred the same representations in each grade and beyond the

grades. This means that those representations are treated as the formal representation in the textbooks as well as numbers and expressions even if those representations are used only for scaffolding. Here, mathematical representations, tools for problem solving, are expected to become internalized.

3) Ways of Dialectic Discussions:

Thirdly, Dialectic ways of discussions are necessary for enhancing process (5). For the dialectic discussion, starting phases such as ‘for example’, ‘but then again’, ‘if’ and ‘in that case’ are very important because these starting phases symbolize that the consequential argumentations are affirmative or denial (Tanaka, 2001). Here, starting phases of anyone claim will be internalized (Isoda, Warashina, Yamamoto, to appear).

Isoda, M., (2006). Elementary School and Lower Secondary School Teaching Guide for the Japanese Course of Study: Mathematics (Grade 1-9).
(See. http://e-archive.criced.tsukuba.ac.jp/result_data.php?idx_key=1277)