Teaching mathematics through problem solving (1 & 2)

Training Programme Division

Focus of the discussion:

- Sharing the way you teach mathematics
- Why learning mathematics
- Example of a lesson activities
- What is Teaching through problem solving (TtP)
- Features of TtP
- Reflections

Activity 1: What is the sequence of your mathematics lesson?

- Tell your friend how you sequence your mathematics lesson?
- A, B, C, D (Think)

- Turn to your friend and discuss (Pair)

A ⟷ B C ⟷ D

- The pairs share in your group discussion (Share)

A & B ⟺ C & D

- share with the class

Sharing Session 1

?

?

?

?

?

Comparison of Lesson Sequence

Sequence of German lessons **(Stigler & Hiebert, 1999. p.78)**	**The U. S Pattern**
1. **Reviewing** previous material 2. **Presenting** the topic and the problem of the day 3. **Develop** the procedures to solve the problem (T directed the development, S work at the board, suggestion from others, T retains control) 4. **Practicing**	1. **Reviewing** previous material 2. **Demonstrate** how to solve problems for the day 3. **Practicing** 4. **Correcting** seatwork and assigning homework (step 2 to 4 can be repeated)

You are not alone !!

Mathematics Teaching based on your experiences

- What do you expect the students to learn?
  - content as in the syllabus
  - ?
  - ?
  - ?

- Are the experiences sufficient for the students??

  Yes ??

  No ??

Where is the benchmark?

Activity 2: Express ways of counting dots in mathematical expressions

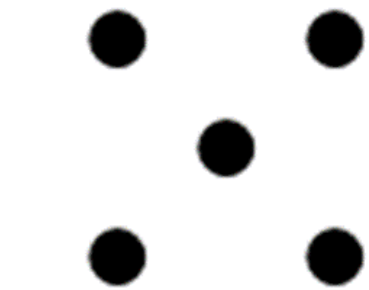
Objectives

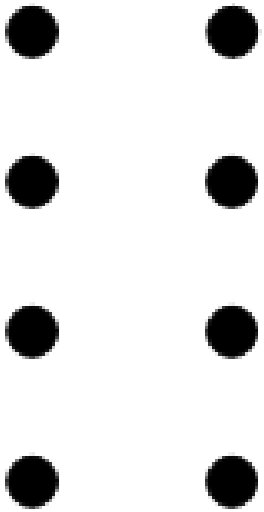
Students will be able to:

- express their ways of counting dots in mathematical expressions
- Infer other students ways of counting from their mathematical expressions

1. Understand how to express ways of counting in simple mathematical sentence

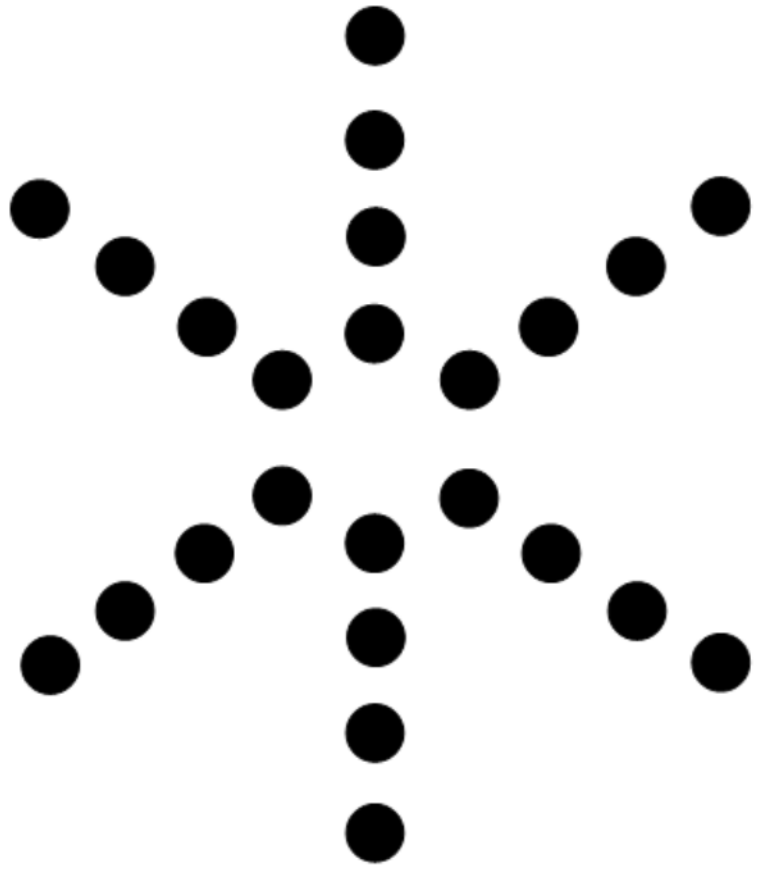
How many ways can you count these dots?





2. Posing the problem

- Think about ways to count the number of dots .
- For each way of counting, write **a mathematical expression** that describe the way of counting



3. Work individually

- **10 minutes**

- Role of the teacher?
  - ➢ Identify some interesting solutions.
  - ➢ Highlight the solutions during class discussion later

3. Students work individually

- Anticipate students responses

  4+4+4+4+4+4 =24

  6x4 =24

  12 x 2 =24

  10+10+4 =24

  and others

4. Compare and discuss in class

- Ask one student to explain a mathematical expression
- Let other students infer how the student counted the dots by interpreting the mathematical expression
- Ask student to justify his/her mathematical expression if the other student's inference is correct.
- Students understand a variety of ways to count dots

5. Expanding the learning

- Using the mathematical expression developed if

- each arm has 4 dots
- each arm has 10 dots

6 Summing up

- Help student to identify the learning

- Mathematical expression can be used to show ways of counting the number of dots

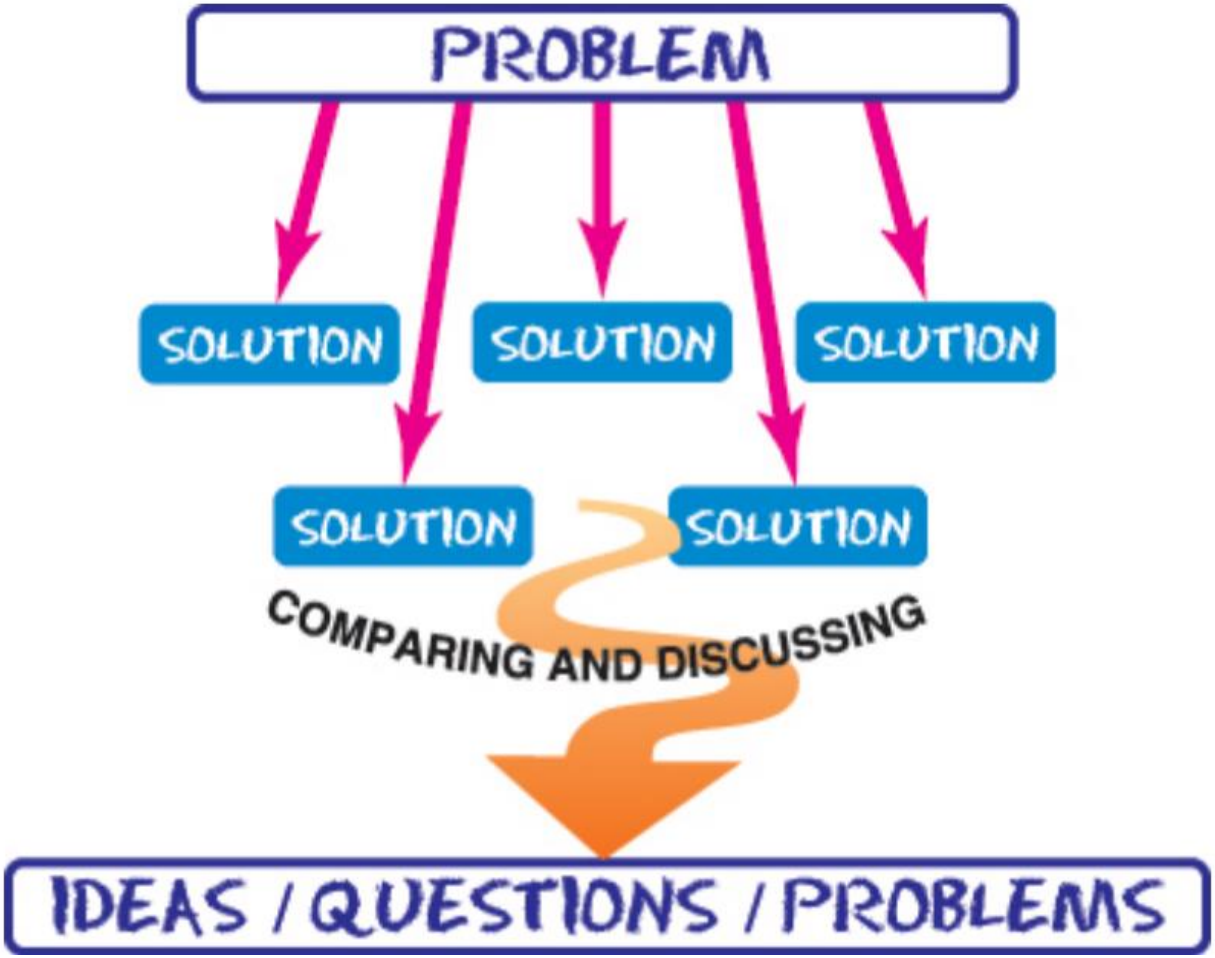
- Mathematical expression may be used to find number of dots even without seeing the actual diagram

What are the Stages involved in the activity?

I. Pose the problem, helping pupils understand the problem
II. Work independently
III. Whole class discussion
IV. Summarise
V. Consolidate learning through an additional problem

The Open-Ended Approach

(J. Stigler & Hielbert, 1999; J. Stigler, Gonzales, Kawanaka, Knoll, & Serrano, 1997; Becker & Shimada, 1997; Stevenson & Stigler, 1992)



Lesson sequence of Japanese classes

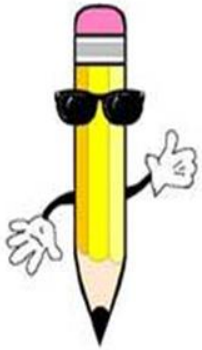
- Reviewing the previous lesson
  -T leas discussion, students recite main points, T's brief lecture notes
- Present the problem for the day (one key problem only)
- Students work individually or in groups
  - 20 minutes
- Discussing solution methods
  - select one or more students to share 9based on methods T had identified)
- Highlighting and summarising the major points
  - T present a brief notes on the main points of the lesson

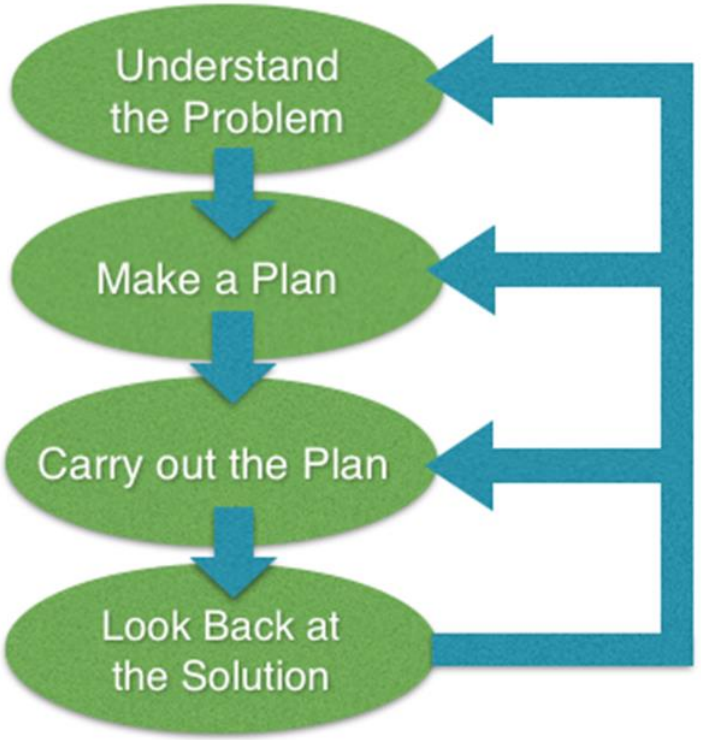
- (Stigler & Hiebert, 1999. p.79)

Reflections:

- Process of problem solving is much more than the 4 basic steps as in Polya's Model
- Many strategies are used

1. Draw a picture
2. Make a chart or list
3. Guess and Check
4. Use a formula
5. Look for a pattern
6. Work Backwards
7. Write a Number Sentence
8. Logical Reasoning





Polya's Problem Solving Model

Reflections:

- In the progress of solving problems:
  - involve thinking critically, creatively
  - collaboration
  - communicate
  - being challenged
  - interesting

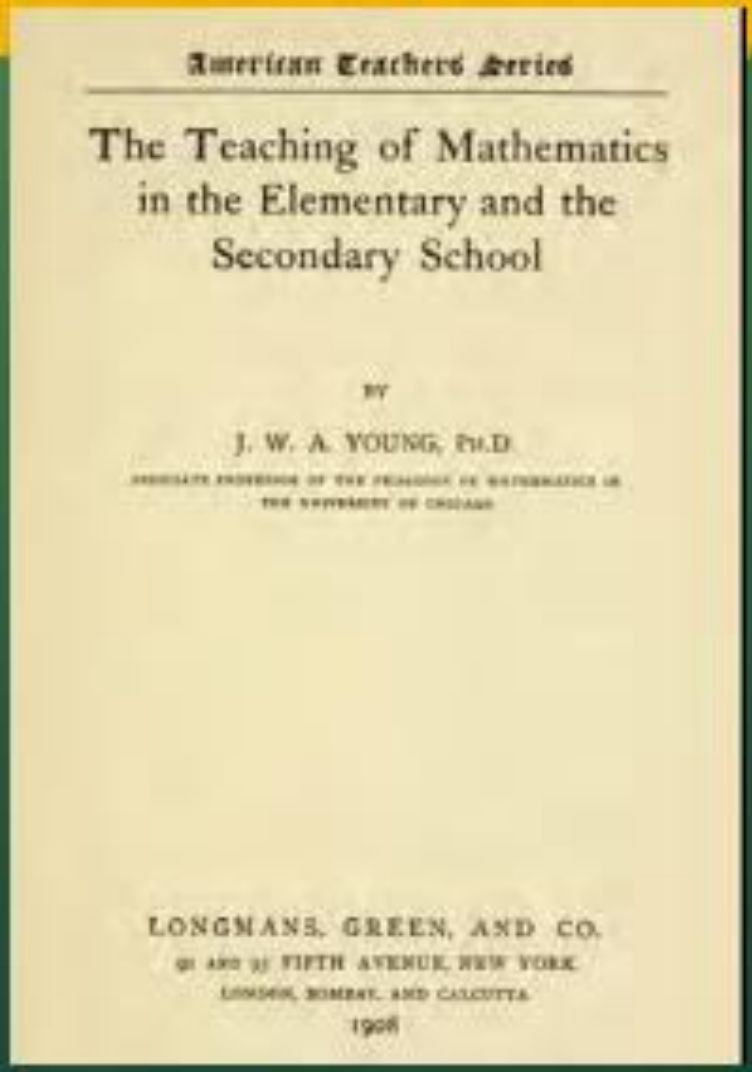
Why learn mathematics?

What are the purpose and the value of studying mathematics in primary and secondary schools?

- Source: Lesson Study Alliance

The Purpose and the Value of The Study of Mathematics in Primary and Secondary Schools

- The facts of mathematics, important and valuable as they are, are not the strongest justification for the study of the subject by all pupils. Still more important than the subject matter of mathematics is the fact that it exemplifies most typically, clearly and simply certain modes of thought which are of the utmost importance to everyone.


American Teachers Series

The Teaching of Mathematics in the Elementary and the Secondary School

BY

J. W. A. YOUNG, PH.D.

LONGMANS, GREEN, AND CO.

1906

Source: http://www.lessonstudygroup.net/lg/conference/-396223828.pdf

Some pupils are tempted to evade precisely that portion of the work which gives the benefit, by memorizing the results of the work of others. This temptation is great to some pupils, and perhaps no other subject can become so barren and dreary as mathematics so studied. Ten pages of mathematics *understood* are better than a hundred memorized and not understood, and one page actually worked out independently is better than ten pages clearly but passively understood. The question is not *how much?* but *how?* The object is mastery, attainment of the spirit of the subject, and not to train the memory, or to ingest a large bulk of mathematical fact and formulas.

Memorizing.

(J.W.A. Young, 1908, p.38)

Source: http://www.lessonstudygroup.net/lg/conference/-396223828.pdf

Thinking mathematically (Mason, J. burton& Stacey, K. , 1982)

- **You can think mathematically**
- improved by practice with reflection
- is provoked by contradiction and surprise
- is supported by an environment of questioning, challenging and reflecting

Problem solving
(Standards and focal Points, NCTM)

- Problem solving means engaging in a task, solutions is not known in advance
- Good problems enable students to solidify and extend their knowledge and to stimulate new learning.
- Most mathematical concepts can be introduced though problems (familiar experiences in students' lives or from mathematical contexts).
- Students need to develop a range of strategies for solving problems,

Reference:

- Lesson Study Alliance : Helping teachers work together to improve teaching & learning. http://www.LSAlliance.org
- Becker, J. P., & Shimada, S. (1997). *The open-ended approach: A new proposal for teaching mathematics*. Reston, Virginia: National Council of Teachers of Mathematics.
- Stevenson, H., & Stigler, J. (1992). *The learning gap*. New York: Summit.
- Stigler, J., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.