Differences in how level 1, level 2, and level 3 teachers use a textbook
- Ideas to Implement CCSS -

Akihiko Takahashi, Ph.D.
Lesson Study Alliance
LSAlliance.org

A little more background

An Agenda for Action: Recommendations for School Mathematics of the 1980s

- Problem solving be the focus of school mathematics in the 1980s

Second International Mathematics Study (SIMS) 1981-1982

- A Nation at Risk: The Imperative for Educational Reform, A Report to the Nation and the Secretary of Education United States Department of Education, 1983
- The Underachieving Curriculum: Assessing U.S. School Mathematics from an International Perspective. A National Report on the Second International Mathematics Study. 1987

  "The U. S. mathematics curriculum is characterized by a great deal of repetition and review, with the result that topics are covered with little intensity. "(p.12)

  "Mathematics curriculum, in both form and substance, is needed. This activity should begin at the early grades of the elementary school." "With respect to form, the excessive repetition of topics from year to year should be eliminated. A more focused organization of the subject matter, with a more intense treatment of topics, should be considered." (p.15)

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"America 2000" under the Bush administration, 1989

By the year 2000 U.S. students will be the first in the world in science and mathematics achievement.

NCTM's Curriculum and Evaluation Standards for School Mathematics, 1989

Intentional ambiguity yields a wide variety of curriculum materials

Third International Mathematics and Science Study (TIMSS), 1995

A mile wide and an inch deep

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NCTM's Principles and Standards for School Mathematics, 2000

The Final Report of the National Mathematics Advisory Panel, 2008

- Any approach that continually revisits topics year after year without closure is to be avoided.

To Address the Problem of a Curriculum That Is "a Mile Wide and an Inch Deep."

A focused, coherent progression of mathematics learning, with an emphasis on proficiency with key topics, should become the norm in elementary and middle school mathematics curricula. (CCSS)

[We have to have curricula with] more "sequential" organization, allocating significant amounts of content to specified places in the mathematics program and facilitate intense coverage of that subject matter. (The Underachieving Curriculum, 1987)

Common Core State Standards for Mathematics

- Standards for Mathematical Practice

  The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- Standards for Mathematical Content

  These Standards define what students should understand and be able to do in their study of mathematics. These Standards do not dictate curriculum or teaching methods.

Standards for Mathematical Practice

Mathematically proficient students…

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

Three Levels of Teaching

Level 1: Teachers can tell students important basic ideas of mathematics such as facts, concepts, and procedures.

Level 2: Teachers can explain the meanings and reasons of the important basic ideas of mathematics in order for students to understand them.

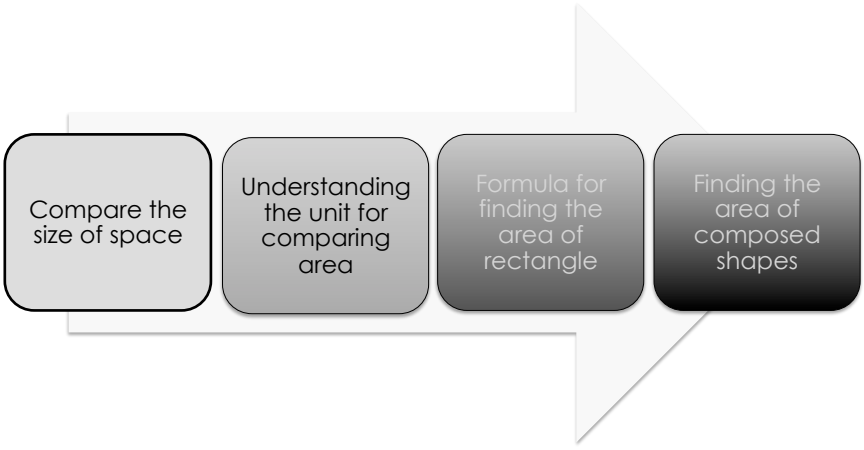
Level 3: Teachers can provide students opportunities to understand these basic ideas, and support their learning so that the students become independent learners.

Level 3 is a way to address the standards for mathematical practice

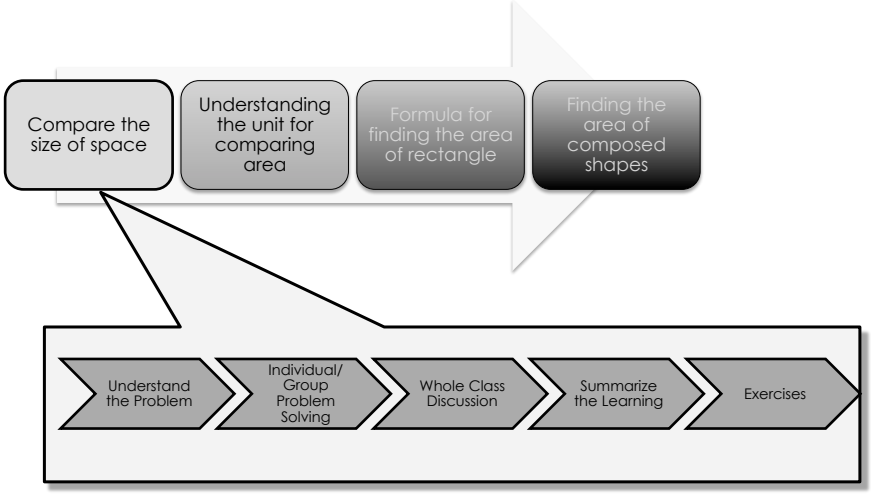
To Implement the CCSS

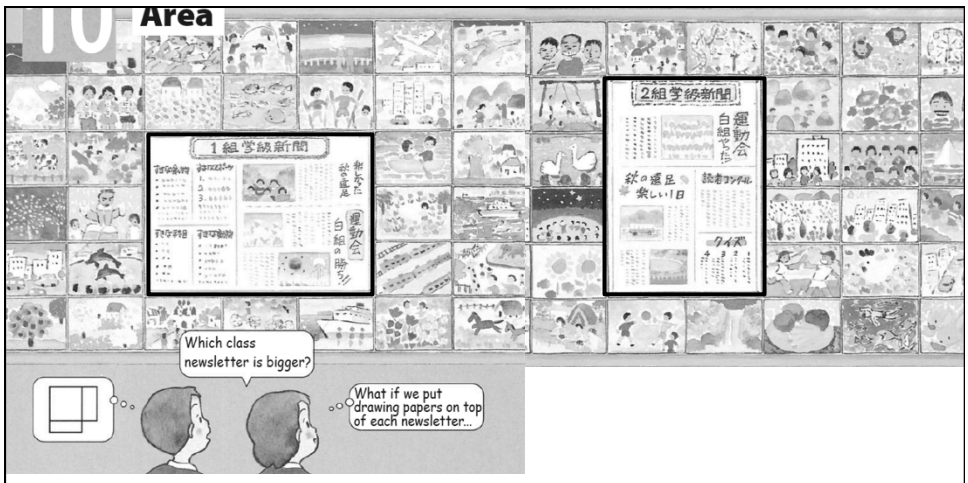
1) Designing units to facilitate intense coverage of specific content(s).
   - Clear expectations for achievement
   - Establish substantial body of mathematics prior to moving on to the next unit.
2) Teachers should develop knowledge and expertise to address the standards of mathematical practice.

Designing a Unit using a series of Problems

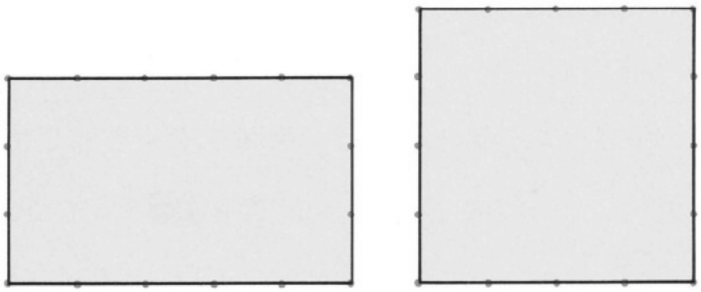


Designing a Unit using a series of Problems

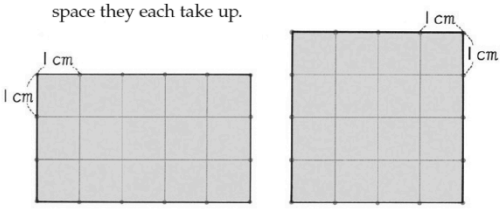




Think about ways to compare and express the size of space!



1 As shown below, divide the sides of the rectangle and the square into 1 cm segments and compare how much space they each take up.

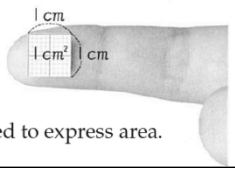


2 How many 1 cm squares are there inside the rectangle and the square?

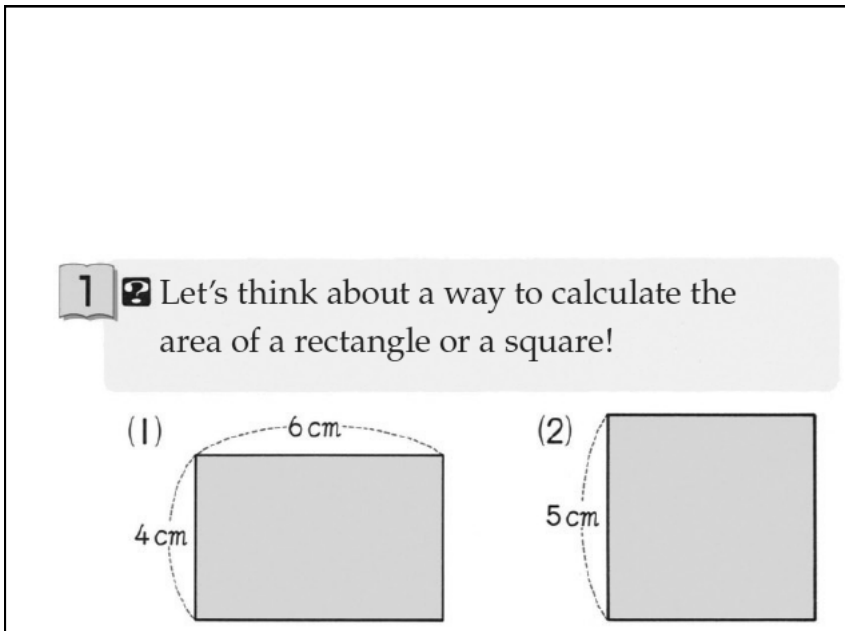
The amount of space inside the rectangle and the square can be expressed by the number of 1 cm squares that fill up the space.

The amount of space inside a shape is called the **area**.

The area of a square with 1 cm sides is called **1 square centimeter**, and it is written as $1\ cm^2$.



Square centimeter is a unit used to express area.



1. To teach this content, how would you segment your given 45 minutes? Please explain how you would divide the lesson into segments and how many minutes you would spend for each segment.
2. In order for students to understand the main point of this lesson, which part of the lesson do you think should be emphasized? Why do you think that part of the lesson should be emphasized?

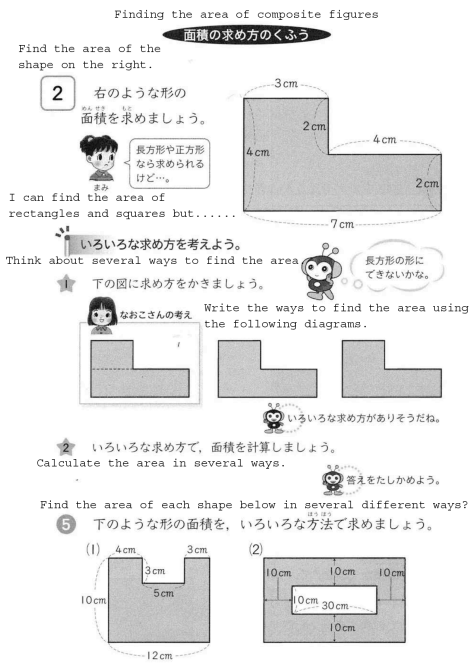


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Table 1: Some of the responses to the Question 1

A Level 1 teacher's response	**A Level 2 teacher's response**	**A Level 3 teacher's response**
Think about how to find the area (5 minutes)	Review prior learning (5 minutes)	Introduction to the problem: encourage students to use prior learning to find the answer (10 minutes)
Explain Naoko's idea [which is described in the textbook] (5 minutes)	Individual problem solving (10 minutes)	Individual problem solving: let each student explain the solution method by using diagrams, math sentences, or words. (10 minutes)
Ask students to describe other approaches and make sure all the approaches reach to the same area (10 minutes)	Comparing and discussing (10 minutes)	Whole class discussion for examining each solution: present own solution and understand other solutions. Find similarities and differences among the solutions (20 minutes)
Exercises (15 minutes)	The first exercise (10 minutes)	Summarizing: reflect on own solution (5 minutes)
Check the answer for the excises (10 minutes)	The second exercise (10 minutes)	

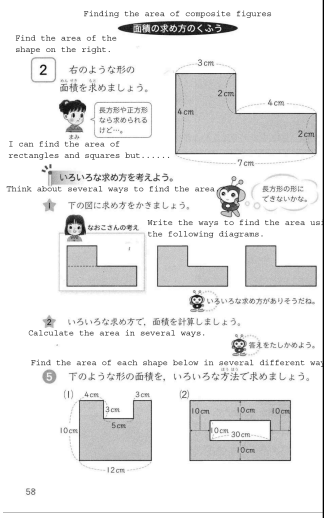

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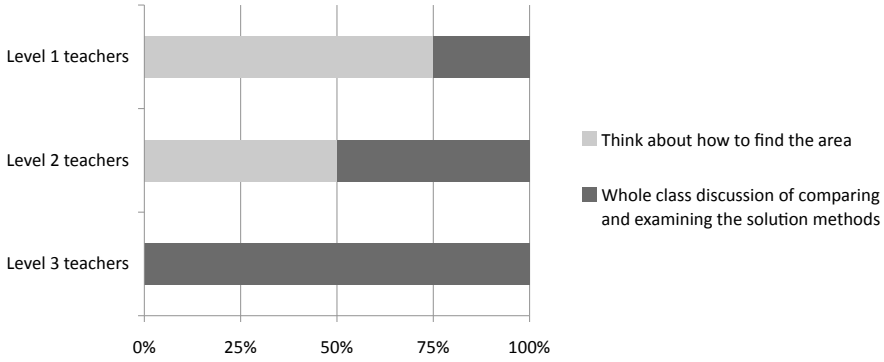
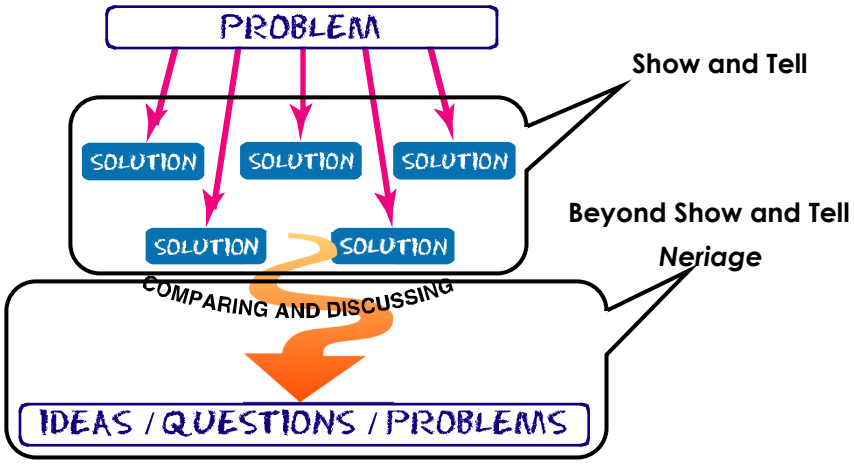
Table 2. Responses to the question (c), which part of the lesson you would think to be emphasized.



Teaching through Problem Solving

- An exemplary practice for Level 3 teaching -



Two Major Types of Professional Development

1) Phase 1 professional development focuses on developing the knowledge for teaching mathematics,
    a) through reading books and resources, listening to lectures, and watching visual resources such and video and demonstration lessons.
2) Phase 2 professional development focuses on developing expertise for teaching mathematics
    a) teachers should plan the lesson carefully, teach the lesson based on the lesson plan, and reflect upon the teaching and learning based on the careful observation. Japanese teachers and educators usually go through this process using Lesson Study

Table 1: A framework for developing programs and resources for mathematics teacher education

	To become a Level 1 teacher	To become a Level 2 teacher	To become a Level 3 teacher
Phase 1 Professional Development	Strengthen knowledge of mathematics… …through: • Studying textbooks and workbooks • Using online resources and courses	Acquire knowledge of mathematics teaching and learning— 1) Pedagogical content knowledge 2) Knowledge of the curriculum 3) Knowledge of the students 4) Knowledge of pedagogy… …through: a) University courses b) Professional development workshops c) Online resources d) Classroom videos e) Classroom observations, including participating in research lessons	Update knowledge of mathematics teaching and learning… …through: 1) Workshops 2) Evening and summer coursework
Phase 2 Professional Development		Understand the process of lesson study … …through: ▪ Designing mock-up research lessons as part of university coursework ▪ Lesson study during student teaching	Develop expertise for teaching (*neriage* etc.)… …through Lesson Study

Takahashi, A. (2011). The Japanese approach to developing expertise in using the textbook to teach mathematics rather than teaching the textbook. In Li, Y. & Kaiser, G. (Eds), Expertise in Mathematics Instruction: An international perspective, New York: Springer.