What Teachers Need to Effectively Implement the Common Core State Standards

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Lesson Study Alliance

Thank you for all your support.

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)
  - Conceptual understanding (comprehension of mathematical concepts, operations, and relations),
  - Procedural fluency (skills in carrying out procedures flexibly, fluently, and appropriately),
  - Strategic competence (ability to formulate, represent, and solve mathematical problems),
  - Adaptive reasoning (capacity for logical thought, reflection, explanation, and justification), and
  - Productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

Adding It Up

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.

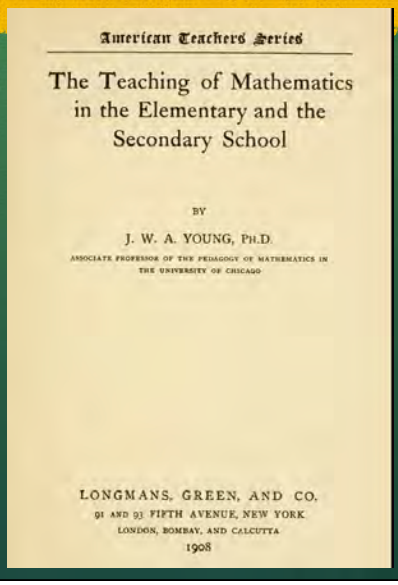
Three Levels of Teaching

- 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.

Is Level 3 a new way of teaching mathematics?

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.

ASSOCIATE PROFESSOR OF THE PEDAGOGY OF MATHEMATICS IN THE UNIVERSITY OF CHICAGO

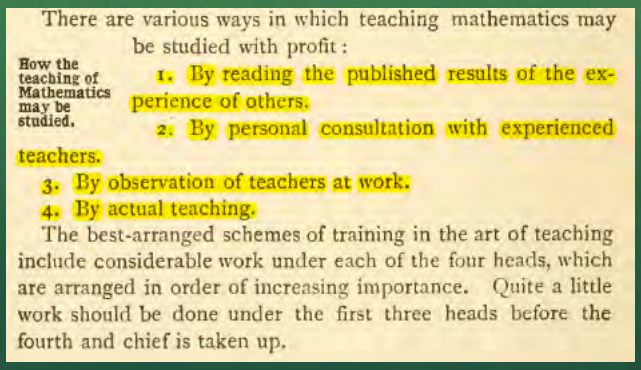
LONGMANS, GREEN, AND CO.
91 AND 93 FIFTH AVENUE, NEW YORK
LONDON, BOMBAY, AND CALCUTTA
1908

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)

Ways to Become Level 3 Teachers



There are various ways in which teaching mathematics may be studied with profit:

How the teaching of Mathematics may be studied.

1. By reading the published results of the experience of others.
2. By personal consultation with experienced teachers.
3. By observation of teachers at work.
4. By actual teaching.

The best-arranged schemes of training in the art of teaching include considerable work under each of the four heads, which are arranged in order of increasing importance. Quite a little work should be done under the first three heads before the fourth and chief is taken up.

(J.W.A. Young, 1908, p.8)

Two Major Types of Professional Development

Phase 1 professional development focuses on developing the knowledge for teaching mathematics,

through reading books and resources, listening to lectures, and watching visual resources such and video and demonstration lessons.

Phase 2 professional development focuses on developing expertise for teaching mathematics

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

How would the Level 3 Teaching Look Like for Teaching Speed?

- A Level 1 Teaching would look like…
- A Level 2 Teaching would look like…

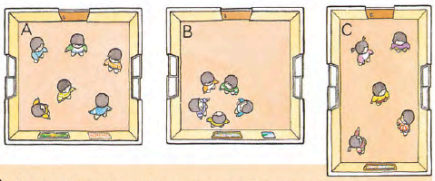
In order to teach math lessons utilizing Level 3 Teaching…….

STOP managing lessons, START managing units (Phil Daro)

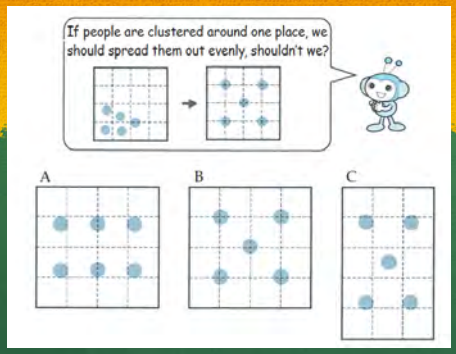
Japanese Math Textbook Grade 5B p. 23-25

▶ **Crowdedness**

1 Kiyoshi and his friends will sleep in cabins A, B and C at camp.
Which cabin is the most crowded?



2 Let's think about how we can figure out how crowded something is!



Understanding mathematical ideas using "real-world " context

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Understanding mathematical ideas beyond the context

Anticipating Students' Responses

Area of Cabin and the Number of People

	Area (m^2)	Number of People
A	16	6
B	16	5
C	15	5

Cabin A:16÷6=2.666
Cabin C: 15÷5=3

m^2 / people

6×5=30
Cabin A:16×5=80
Cabin C: 15×6=90

m^2 / people

Cabin A: 6÷16=0.375
Cabin C: 5÷15=0.333…

people / m^2

16×15=240
Cabin A:6×15=90
Cabin C: 5×16=80

people / m^2

Using the Idea to Solve a Similar Problem (Exercise)

1 Please compare the crowdedness of the gardens of Classes A and B.

Area of Gardens and Number of Plants

	Area (m^2)	Number of Plants
Class A	15	120
Class B	12	100

Applying the Idea to a New Problem Situation

Various per unit quantities

2 At Yoshiko's farm, which is 600m^2, 1968kg of potatoes were produced.
At Tadashi's farm, which is 900m^2, 2682kg of potatoes were produced.
Which farm was better at producing potatoes?

1 Please explain these 2 students' methods.

Yoshiko
1968÷600
= ☐ (kg)
Tadashi
2682÷900
Makoto = ☐ (kg)

Yoshiko
600÷1968
= ☐ (m²)
Tadashi
900÷2682
= ☐ (m²) Ritsuko

2 Which farm did better at producing potatoes?

Crops of agricultural products can also be compared using the per unit quantities.

Applying the Idea to a New Problem Situation

1 A car can go 135km on 15ℓ of gasoline. Another car can go 262km on 25ℓ of gasoline.
Which car is more fuel efficient?

Applying the Idea to a New Problem Situation

Population density

3 We researched the areas and populations of Toyama city and Ohita city.
Let's compare the crowdedness of Toyama city and of Ohita city!

Area and Populaion of Toyama city and Ohita city (1995)

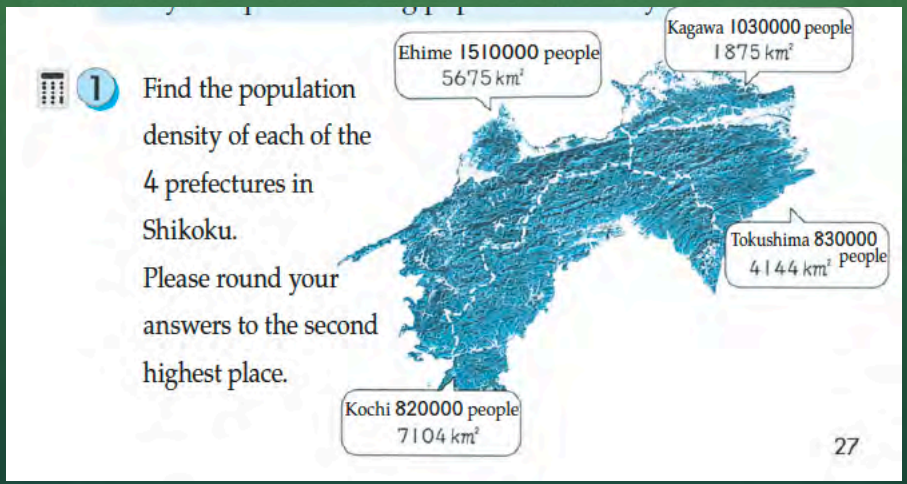
	Area (km^2)	Population (people)
Toyama city	209	325303
Ohita city	361	426981

1 How many people are there per $1km^2$ in Toyama city and Ohita city ?
Please round your answers to the second highest place.

Toyama city··· $325303 \div 209 =$ ☐ Answer: ☐ people

Ohita city··· $426981 \div 361 =$ ☐ Answer: ☐ people

Using the Idea to Solve a Similar Problem (Exercise)



1 Find the population density of each of the 4 prefectures in Shikoku.
Please round your answers to the second highest place.

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Practice 1

① Emiko recorded how many minutes she read last week. How many minutes a day did she read on average?

Amount of Time Read

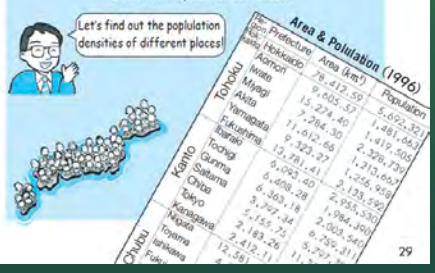
Day of the Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Time	45min	0	50min	30min	45min	1 h	2 hs

② Five people are in a car. If the average weight of a person is 62kg, and the weight of the car is 1200kg, how many kilograms is the weight of the people and the car altogether?

③ A car can go 7.5km on 1ℓ of gasoline and another car can go 12km on 1ℓ of gasoline.
If the two cars travel the same 270km route, what will be the difference in the amount of gasoline used by the cars?

Challenge

Let's Find Population Densities!



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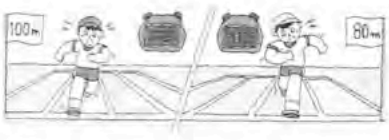
Applying the Idea to a New Problem Situation

How to compare speed

1 The table on the right shows the distance and time that Susumu and Kiyoshi ran.
Who ran faster, Susumu or Kiyoshi?

Distance and Time

	Distance (m)	Time (sec.)
Susumu	100	20
Kiyoshi	80	18



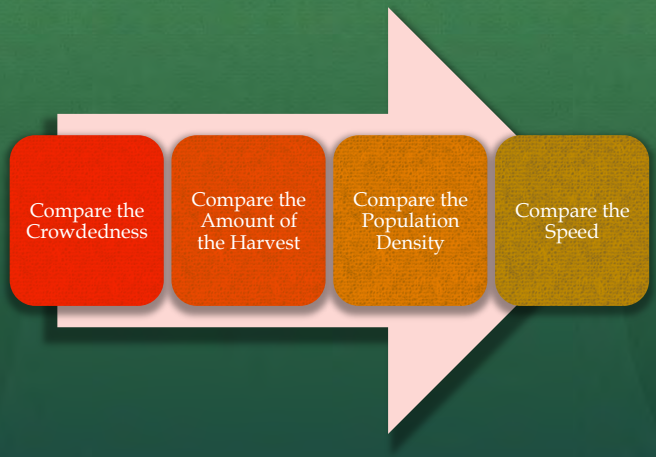
Using the Idea to Solve a Similar Problem (Exercise)

How to express speed

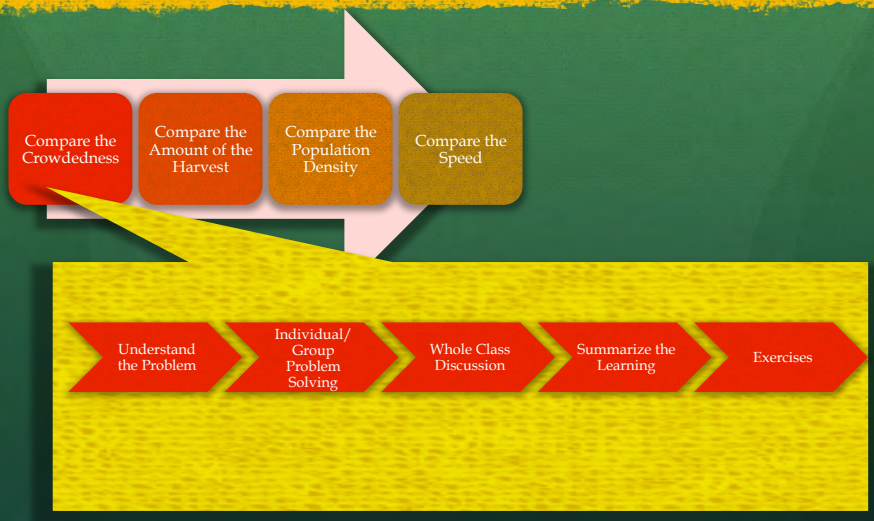
2 The bullet train "Hikari" travels 558km in 3 hours, and "Yamabiko" travels 392km in 2 hours. Which travels faster?

Let's think about how we can express speed!

Designing a Unit using a series of Problems to Lead the Students to Understand the ideas



Each Lesson is Based on Problem Solving



In order to develop expertise…..

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learning by reading, listening, and seeing is not sufficient.

Two Major Types of Professional Development

- Phase 1 professional development focuses on developing the knowledge for teaching mathematics,
  - through reading books and resources, listening to lectures, and watching visual resources such and video and demonstration lessons.
- Phase 2 professional development focuses on developing expertise for teaching mathematics
  - 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

Lesson Study is an ideal Phase 2 Professional Development

Traditional Workshop	Lesson Study
• Begins with answer	• Begins with question
• Driven by outside "expert"	• Driven by participants
• Communication flow: trainer to teachers	• Communication flow: among teachers
• Hierarchical relations between trainer & learners	• Reciprocal relations among learners
• Research informs practice	• Practice is research

Contrasting methods of professional development (reprinted from Lewis, 2002, p.12)

In order to START managing units

- When design lessons we usually pick tasks or activities for the lesson
  Then see connections to some of the standards.
- When design lessons for students to master some of the standards in a specific time period, it would be better to start designing a continuous flow unit.

Lesson plan template to support designing continuous flow units

1. Title of the Unit
2. Goals of the Unit
3. Relationship of the Unit to the Standards
4. About the Unit
   a) what the students need to learn according to CCSS;
   b) what are the possible challenges that students have to deal with (e.g. typical misunderstandings, lack of prier experiences) ;
   c) how the unit is designed to support the students accomplish the above objective;
   d) how the unit is designed to address the CCSS Standards for Mathematical Practice 1-8 (pp.7-8).
5. Flow of the Unit
6. Plan of the Lesson
7. Evaluation

Lesson Study as A Public Proving Ground for Standards-Based

- A Public Proving Ground for Standards-Based Practice: Why We Need It, What It Might Look Like By Catherine C. Lewis Education Week
  - you can find the link from the CLSG website/ Readings