

CHARACTERISTICS OF JAPANESE MATHEMATICS LESSONS

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Typical flow of a mathematics class

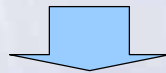
- ✧ Demonstrates a procedure
- ✧ Assigned similar problems to students as exercises
- ✧ Homework assignment
- ✧ Presents a problem to the students without first demonstrating how to solve the problem
- ✧ Individual or group problem solving
- ✧ Compare and discuss multiple solution methods
- ✧ Summary, exercises and homework assignment



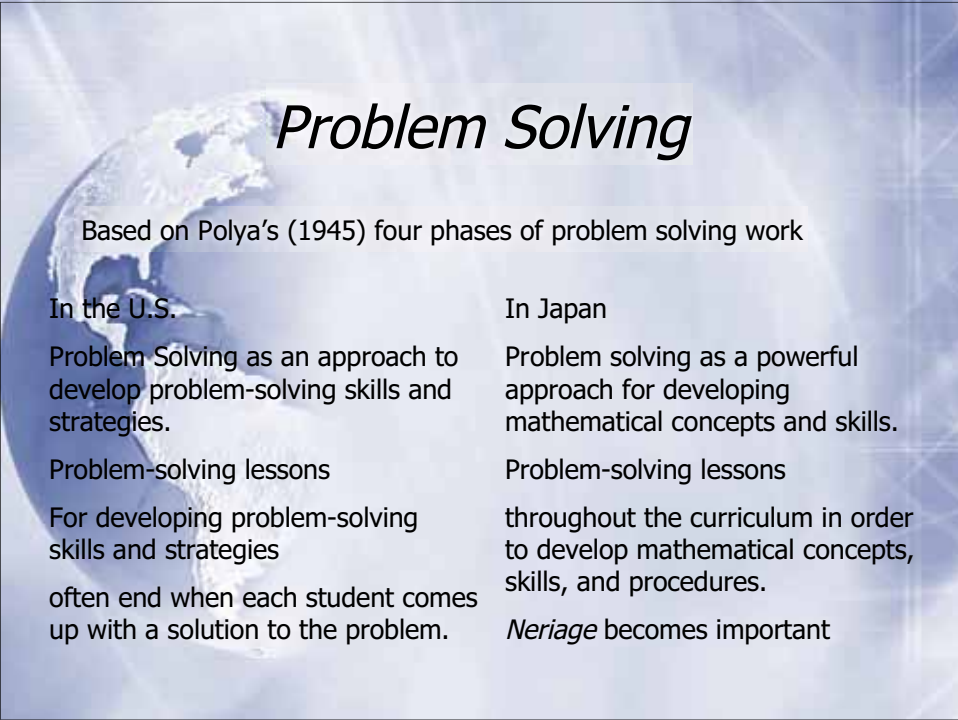
Major Reform Movement In Japan

During the 1970s and 1980s

Traditional classroom that
focuses on teachers' instruction



student-centered classroom that
focuses on students'
engagement in mathematical
activities.



Problem Solving

Based on Polya's (1945) four phases of problem solving work

In the U.S.

Problem Solving as an approach to
develop problem-solving skills and
strategies.

Problem-solving lessons

For developing problem-solving
skills and strategies

often end when each student comes
up with a solution to the problem.

In Japan

Problem solving as a powerful
approach for developing
mathematical concepts and skills.

Problem-solving lessons

throughout the curriculum in order
to develop mathematical concepts,
skills, and procedures.

Neriage becomes important

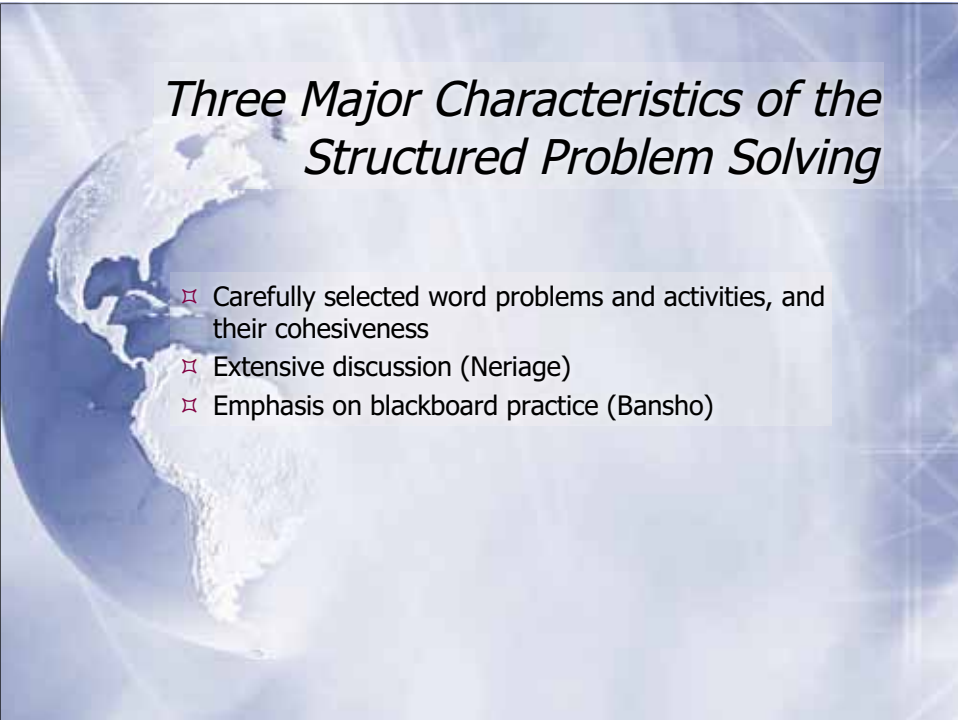
Characteristics Of Japanese Mathematics Lessons

- ✧ Teachers appear to take a less active role, allowing their students to invent their own procedures for solving problems. And those problems are quite demanding, both procedurally and conceptually.
- ✧ Teacher, however, carefully design and orchestrate lessons so that students are likely to use procedures that have been developed recently in class. An appropriate motto for Japanese teaching would be
"structured problem solving"

(Stigler, Hiebert 1999)

- ✧ Historically, Japanese mathematics teaching and learning has been focused on developing mathematical thinking skills by using a variety of story problems.
- ✧ Japanese structured problem solving was built on the firm foundation of emphasizing story problems in mathematics teaching and learning.
- ✧ Based on the existing resources of story problems and of lesson plans focusing on promoting mathematical thinking, Japanese teachers, researchers, and administrators worked collaboratively through Lesson Study
- ✧ to create interest in mathematics, and to stimulate creative mathematical activity in the classroom during the collaborative work of students.





Three Major Characteristics of the Structured Problem Solving

- ✧ Carefully selected word problems and activities, and their cohesiveness
- ✧ Extensive discussion (Neriage)
- ✧ Emphasis on blackboard practice (Bansho)



Carefully Selected Word Problems and Activities, and Their Cohesiveness

- ✧ Each lesson is designed around solving a single problem to achieve a single objective in a topic
- ✧ Examples from a Japanese mathematics textbook series

To Develop the Concepts and Skills for Finding the Area of Basic Figures

10 Area Class newsletters posted on the bulletin board

Which class newsletters is bigger?

What if we put drawing papers on top of each newsletter?

Let's think about a way to compare and express the size of these shapes.

1 Area

Area

Which one of the shapes on the right takes up more space, the rectangle or the square? And how much more space does it use? Let's think about a way to express how big they are.

Like in the example below, divide the sides of your square and rectangle into 1 cm units and compare how much space they each use.

Inside the rectangle and square, how many of the small 1 cm squares are there?

The size of the space inside the rectangle and square can be expressed by how many 1 cm squares fill up space.

The size of the 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 the area.

How many cm^2 is the area of the rectangle and the square on page 23?

How many cm^2 is the area of each shaded part below?

Draw many shapes with the area of 4 cm^2 .

Math Story

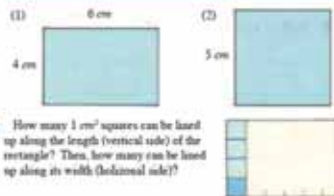
Areas of Shapes with Equal Perimeters

All the shapes below have equal perimeters, but their areas are different.

Area of Rectangles and Squares

Formula for Area of Rectangles and Squares

- 1 Let's think of a way to calculate the area of a rectangle or a square.



How many 1 cm^2 squares can be laid up along the length (vertical side) of the rectangle? Then, how many can be laid up along its width (horizontal side)?

How many 1 cm^2 squares are there inside the whole rectangle? Let's multiply to find out. What is the area of the rectangle?

How many cm^2 is the area of the square? Let's multiply to find out.

In order to find the area of a rectangle or a square, follow these steps.

- 1 Measure the lengths of two sides that are adjacent to each other.
- 2 Multiply the two numbers that represent the lengths of the two sides.

Area of a rectangle = length \times width

Area of a square = side \times side

You can find the area of a rectangle by the expression with a length, too.



The above math sentences are called the formulas for area of a rectangles and a square.

- 1 How many cm^2 is the area of the rectangle and square below?
(1) A rectangle 15 cm long and 23 cm wide.
(2) A square 20 cm on each side.

- 2 Measure the sides of the rectangle on the right, and find the area.



- 3 Find the area of a rectangle 30 mm long and 6 cm wide.



When calculating area, you need to use the same units of measurement for all sides.

To Extend Their Capacity to Use These Formulas on Irregular Shapes

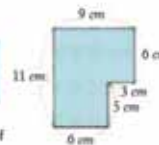
Building upon what they learned in the fourth grade, students in the fifth grade are given opportunities to develop the formulas for finding the area of a parallelogram, triangle, trapezoid, rhombus, regular polygon, and circle.

- 4 In order to draw a rectangle with an area of 28 cm^2 that is 7 cm wide, how many cm long should it be?



Ideas for Finding the Area

- 2 Let's think of a way to find the area of the shape on the right.

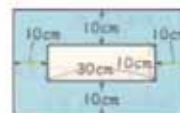


- Let's explain each friend's way of thinking.



- Let's find the area using each method.

- 1 How many cm^2 is the area of the shape on the right?



Extensive Discussion (Neriage)

- ✧ One of the most important roles of the teacher during a lesson is to facilitate mathematical discussion after each student comes up with a solution
- ✧ Because the goal is to develop students' understanding of mathematical concepts and skills, a teacher is expected to facilitate mathematical discussion for students to achieve this goal
- ✧ This discussion is often called *Neriage* in Japanese, which implies polishing ideas.
- ✧ In order to do this, teachers need a clear plan for the discussion as a part of their lesson plans, which will anticipate the variety of solution methods that their students might bring to the discussion



Emphasis on Blackboard Practice (Bansho)

- ✧ To compare, contrast, and discuss ideas that students present
- ✧ To help to organize student thinking and discovery of new ideas



Figure 4: Use of blackboard (*Bansho*)



Conclusion

- ✧ Japanese mathematics teaching, especially for elementary grades, includes a significant amount of problem solving in order to provide students the environment to construct their understanding of concepts and procedures in mathematics.
- ✧ The characteristics of Japanese mathematics lessons are the result of collaboration among Japanese educators, researchers, and policymakers, including efforts from the lesson study practitioners.
- ✧ The effort to improve mathematics teaching and learning is still ongoing.