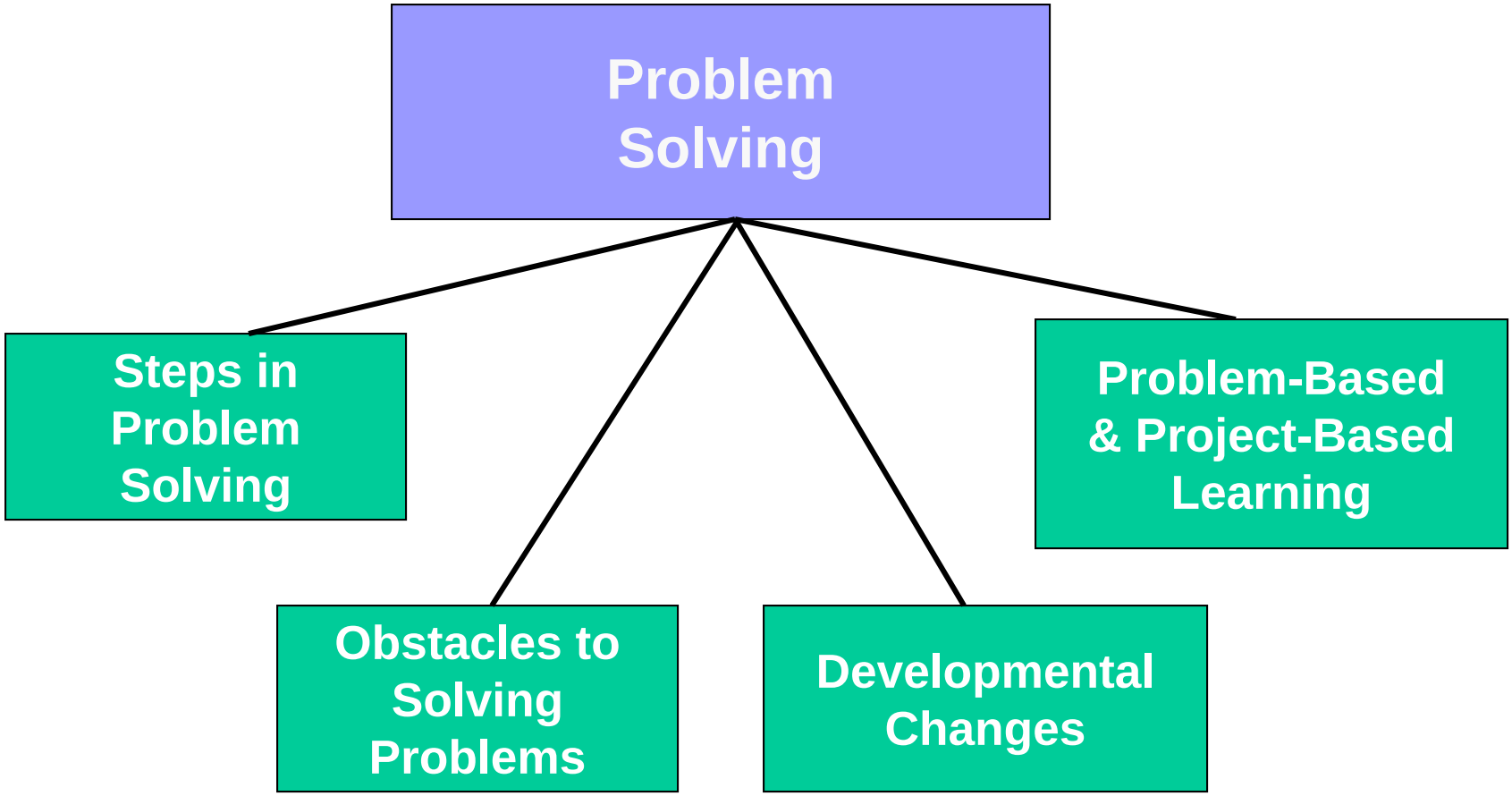
Complex Cognitive Processes



Problem Solving

…involves finding an appropriate way to attain a goal.

1. **Find and Frame Problems**
   - ✓ first you need to recognize that you have a problem
   - ✓ well-defined problems versus open-ended problems

Problem Solving

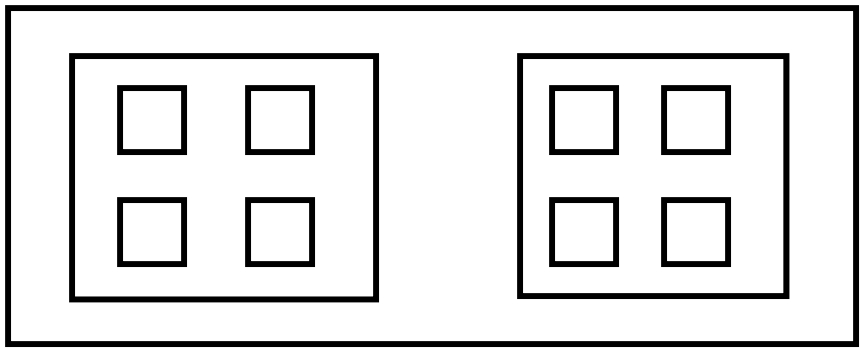
2. Develop Good Strategies

- ✓ *setting subgoals*
  e.g., preparing a science project
- ✓ *algorithms & heuristics*
  e.g., elimination strategies for multiple choice exam questions
- ✓ *means-end analysis*

Example - Problem #1

There are three separate, equal-sized boxes. Inside each box are two separate, small boxes, and inside each of the small boxes are four even smaller boxes. How many boxes are there altogether?

Problem #1 Solution



Key Strategy: Use External Representation

Example - Problem #2

With a 7-minute hourglass and an 11-minute hourglass, what is the simplest way to time the boiling of an egg for 15 minutes?

Key Strategy: Generate all possibilities

Problem Solving

3. **Evaluate Solutions**

   - ✓ *first you need a clear criterion for a successful solution*

     e.g., just completing a project or receiving positive feedback, etc.

4. **Rethink and Redefine Problems and Solutions Over Time**

An Example of Functional Fixedness

Luchin's Water Jug Problem

You have three jugs that hold different amounts. There are no marks on the jugs to allow you to fill the jugs partially and still know how much you have. Indicate how you can use your three jugs to obtain the amount listed under "goal."

	A	B	C	Goal
1.	21	127	3	100
2.	14	163	25	99
3.	18	43	10	5
4.	20	59	4	31
5.	23	49	3	20

Luchin's Water Jug Problem

Solution: B – A – (2c) works for all problems

A – C is easier and works for #5

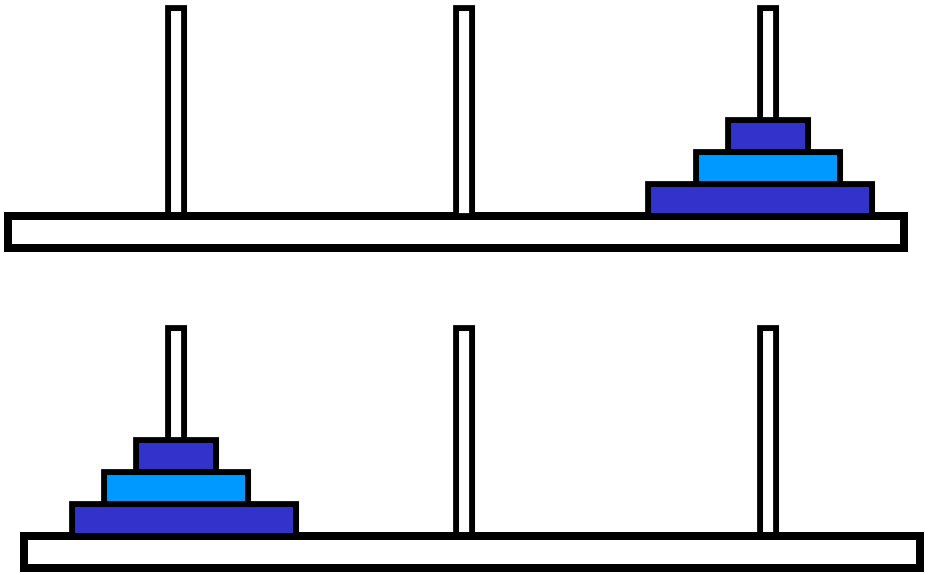
1. 127 – 21 – 6 = **100**
2. 163 – 14 – 50 = **99**
3. 43 – 18 – 20 = **5**
4. 59 – 20 – 8 = **31**
5. 49 – 23 – 6 = **20**
5. 23 – 3 = **20**

Functional Fixedness: Inability to see solution due to previous experience or learning

Developmental Changes

- Children become better planners with age
- Older children's greater knowledge enable them to solve a broader range of problems
- Older children can handle more complex problem solving
- Older children demonstrate more effective strategic problem solving

A DEVELOPMENTAL STUDY OF PLANNING: MEANS-ENDS ANALYSIS



Move the discs from the right side to the left side as shown in the 1st display

Cannot place a larger disc on a smaller disc

Move only one disc at a time

DEVELOPMENTAL FINDINGS FROM THE TOWER OF HANOI PROBLEM

Performance success from 3 to 6 yrs

older children can solve problems with more moves

What happens when a child can't move a disc directly toward the goal

younger children break the rules

older children start to plan moves in advance

DEVELOPMENTAL FINDINGS FROM THE TOWER OF HANOI PROBLEM

Helping children solve Tower problem

keep a 2nd tower in display showing the end state (lessens cognitive demands on memory)

ask children to verbalize what they are doing and why (helps them monitor their performance and focus on their strategies)

Problem-Based Learning

Problem-Based Learning emphasizes solving authentic problems like those that occur in daily life.

Teachers orient students to a problem and get students to explore and discover solutions on their own.

Example: YouthALIVE! at the Children's Museum of Indianaolis – students solve problems related to planning and installing exhibits.

What is Transfer?

Transfer occurs when a person applies previous experiences and knowledge to a new situation.

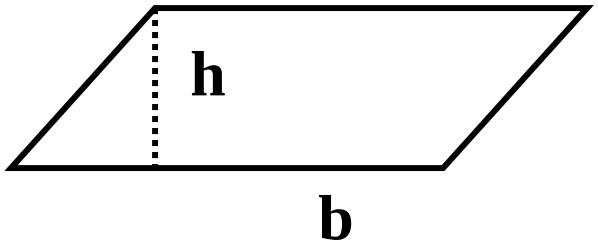
Schools are not effectively educating our students if they do well on tests but cannot apply their knowledge flexibly and adaptively on problems outside the classroom.

Types of Transfer

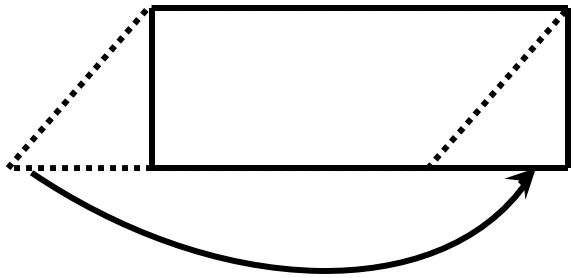
	Learning Situation:
Near transfer →	Is similar to initial learning.
Far transfer ⟶	Is different from initial learning situation.
Low-road ⟶	Almost unconsciously transfers to new situation.
High-road ⟶	Is conscious and effortful

PROMPTING “FAR” TRANSFER: THE PARALLELOGRAM

Ask the child to find the area



Give the child scissors and a paper cutout of a parallelogram



Insight:

All parallelograms can be changed into rectangles

PROMPTING “FAR” TRANSFER: THE PARALLELOGRAM

Transfer to novel problems