# Problem Solving

## Moving from Mathematics Instruction to Numeracy Development

Central Alberta Regional Consortium

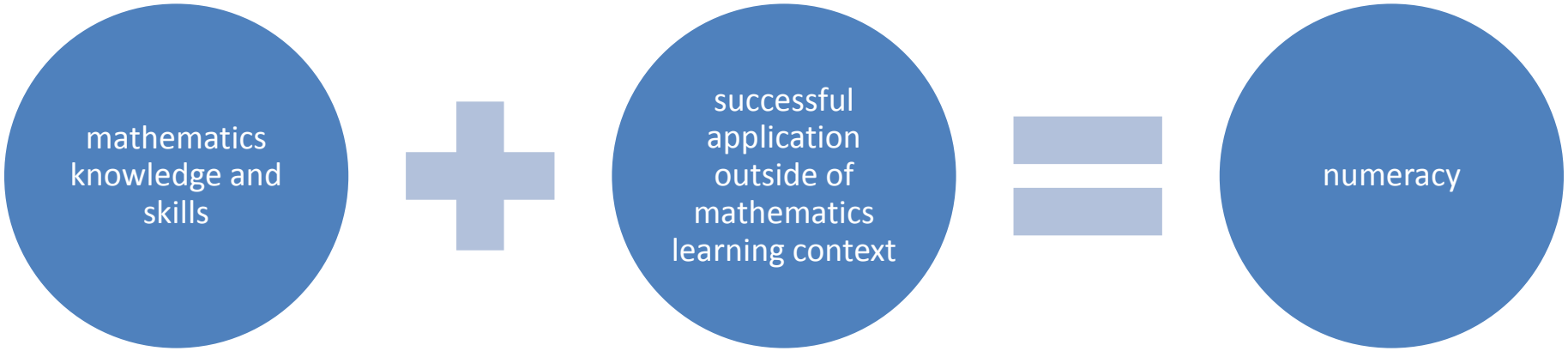
Alberta Regional Consortia

Alberta

# Literacy


language knowledge and skills
successful application outside of language learning context
literacy

# Numeracy


mathematics knowledge and skills
successful application outside of mathematics learning context
numeracy

# Problem Solving

Students are expected to:

- develop and apply new mathematical knowledge through problem solving.

# Problem Solving

Problem solving is not a subsection of the mathematics curriculum but rather **a method of teaching**.

# Problem Solving

Problem solving should provide an interesting and motivating way for new skills to be acquired.

A problem-solving activity must ask students to determine a way to get from **what is known** to **what is sought**.

If students have already been given ways to solve the problem, it is not a problem, but practice.

A true problem requires
students to **use prior learnings**
**in new ways and contexts**.

Problem solving requires and builds depth
of **conceptual understanding**
and **student engagement**.

# What the research says…

- Understanding the underlying concept is the goal for all areas of mathematics.
- **Explicit instruction** allows students with disabilities to obtain a deep understanding of mathematical concepts.

**Action:**

- Teach an explicit strategy that students can apply to several related concepts.

Harniss, Carnine, Silbert, and Dixon (2010)

# What the research says…

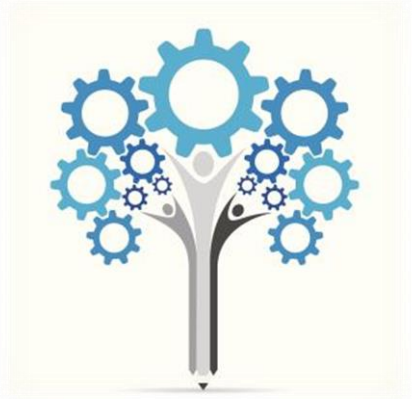
- When students are **emotionally invested** in their learning they are more likely to remember and understand the concepts and skills they are using.

**Action:**

- **Connect the math** we are teaching with the **interests, experiences, and disposition** of students.

# What the research says…

- Mathematics can be given meaning by beginning with a problem that has importance to the student's life and preferences.



# Numerous problem-solving strategies can be developed using a student's interest and experiences.

team statistics


individual player statistics


team statistics

rankings

box scores

# Meal planning and cooking

fractions

counting

measuring

estimation

time

computing whole numbers

temperature

# Field trips

counting

weighing

computing

time

money

interpreting numbers

# Questions to consider…

- Does the learning activity engage students in a meaningful way?
- Are the students able to connect new skills with previously learned skills?
- Does the learning activity allow the students to use mathematical reasoning to solve a problem?

Developing mathematical understanding in students with intellectual disabilities
http://www.ttacnews.vcu.edu/2014/11/developing-mathematical-understanding-in-students-with-intellectual-disabilities

# Scenario #1

- Grade 8 students go to a local grocery store on a monthly basis as part of their community-based instruction program.
- The teacher has predetermined the items to be purchased and divided the items among her students.
- One student will need to weigh produce, two students will need to obtain a designated number of items, while another student must find a brownie mix less than $5.00.

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# Scenario #2

- Students in another grade 8 class also use grocery shopping as a community based outing. However, several weeks prior to the grocery store activity, the teacher begins the unit by introducing the idea of having a special lunch as a class.
- Students are asked about special events in their lives that have food associated with them (e.g., birthdays, Thanksgiving).
- Discussion topics also include what foods are special to students, what makes the food special, etc.
- The teacher spends a few days eliciting comments from students about special occasions.

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# Scenario #2 continued

- The teacher challenges her students with the statement, “I’ve decided that for our special class luncheon we are going to prepare brussel sprouts and beets.”
- Most students let her know that they do not like her choices.
- The teacher then facilitates a discussion about when it is important to have a choice and what is the best way to make a class decision.
- This discussion leads to the activity of voting, polling, and graphing.

# Scenario #2 continued

- Once the students have reached a decision on the lunch menu, the teacher explains that the class will be divided into two equal teams to prepare the meal, one for the main course and one for dessert.
- The class offers strategies for dividing up the class (e.g., boy/girl, counting, color of hair).
- Each group is given a recipe and directed to determine the amount, type of ingredients, and the approximate cost needed to feed the entire class.
- The summation of the unit is the trip to the grocery store to shop, to use math strategies learned in class, and to follow recipes to prepare the luncheon.

# Questions to consider…

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# Increasing numeracy independence

**Modelled numeracy**
*(I do and talk, you watch)*

Shared numeracy
*(I do, you help)*

Guided numeracy
*(you do, I help)*

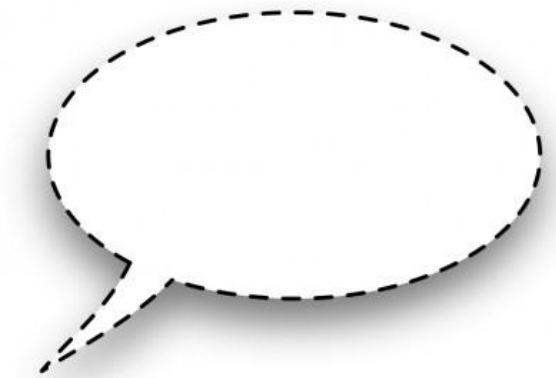
Independent numeracy
*(you do, I watch)*

**scaffolding**

# Modelled numeracy

- Demonstrate problem solving and applying by **‘thinking out loud’**.
- Demonstrate to students **daily**.
- Work within a **problem solving framework**.

*I do and talk, you watch…*



# Problem solving framework

- ❑ **Clarify** the problem.
- ❑ **Choose** methods, tools, procedures, skills needed to address the problem.
- ❑ **Use and/or apply** the tools and methods chosen.
- ❑ **Interpret** and check appropriateness of the application.
- ❑ **Communicate** the method and approach, and the outcome achieved, for the appropriate purpose and audience.

*I do and talk, you watch…*

# **Clarify** the problem.

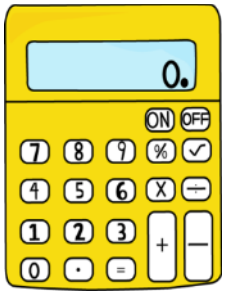
Seek further information and ask questions:

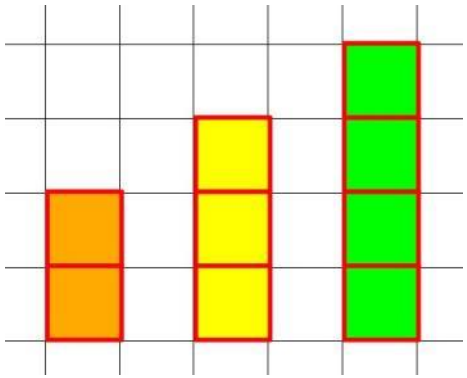
- ❑ What do I know?
- ❑ What do I need to find out?
- ❑ Would it help to make a sketch or draw what I have to do?

*I do and talk, you watch…*

# **Choose** methods, tools, procedures, skills needed to address the problem.

- ❑ What tools do I need to do this task?
- ❑ How will I organize my information?
- ❑ How will I display my information?





*I do and talk, you watch…*

# **Use and/or apply** the tools and methods chosen.

- ❑ Do I know how to use the tools I've chosen?
- ❑ Is my work clear and easily understood?
- ❑ How much time have I got to do the task?
- ❑ Am I sure it will work or should I allow time for some trial and error?

*I do and talk, you watch…*

# **Interpret** and check appropriateness of the application.

Interpret results in the context of the task or problem:

- ❑ What does it mean? (i.e., “So what?”)
- ❑ Do my results/findings seem reasonable? Do they make sense? Why?
- ❑ Are my calculations correct? How do I know?

*I do and talk, you watch…*

# **Communicate** the results and the process for a given audience.

- ❑ What conclusions can I make on the basis of my efforts?
- ❑ What did I learn from doing this task?

*I do and talk, you watch…*

# Increasing numeracy independence

Modelled numeracy
*(I do and talk, you watch)*

**Shared numeracy**
*(I do, you help)*

Guided numeracy
*(you do, I help)*

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*(you do, I watch)*

**scaffolding**

# Shared numeracy

- Shared solving and applying is an interactive experience **guided by a teacher**.
- **Student interactivity** with each other and with the teacher is the distinguishing feature.
- Generally accomplished using an **enlarged text** (hard copy of the problem/task) that all students can see.
- Problems must be suitable for students to join in the experience.

*I do, you help…*

# Shared numeracy

- Summarize the problem as a brief story to be read aloud.
- If a word problem, read the problem aloud.
- Help students to clarify the context:
  - ❑ What are we being asked to do?
  - ❑ Can we picture this?
    Could we draw a picture of what is happening?

*I do, you help…*

# Problem solving graphic organizer

What do we know?

What do we need to find out?

What tools will we use?

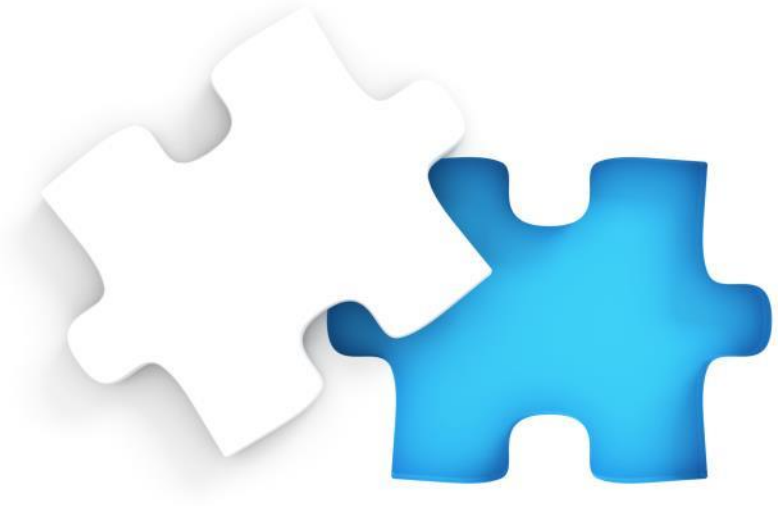
**SOLVE IT!**

Our answer:

*I do, you help…*

# Connecting back…

- Does the solution make sense?
- Once a solution has been determined, the student applies this back to the real life context.



*I do, you help…*

# Extending and deepening learning

- For efficiency, the student will need to practice many scenarios using stories to solve problems in classroom settings.
- Students also need opportunities to apply emerging skills in real life activities.
- With new problem solving skills, the student gains increased autonomy in managing everyday situations.