Paying Attention to Mathematics Education

K – 12 Capacity Building in Mathematics

Welcome regional DSB teams to our Spring 2014 Session
Today’s agenda

Focus

Understanding the present

Establishing our initial understanding about spatial reasoning

Grounding our thinking in the ‘doing’ of math

What does the research say?

A taste of what spatial reasoning is

How do we promote spatial reasoning?

Re-visiting our initial understanding about Spatial Reasoning
Imagining Forward Together

How Do We Support K-12 Literacy and Mathematics Learning and Teaching?

Connect

How are the ideas and the information that were presented connected to what you already know?

 Extend

What new ideas do you have about the information presented that extended your thinking in a new direction?

Challenge

What questions, puzzles or challenges come to mind from the information presented?
Understanding the present...

Dr. Christine Suurtamm, University of Ottawa

http://mathforum1314.wordpress.com/
Understanding the present...

Turn and Talk about Dr. Suurtamm’s message

• Share an aha!
• Share a wondering
Goals

Because we believe:

– a teacher’s “mathematics knowledge for teaching” can be built through purposeful and precise activities.

– educator efficacy is an important consideration for professional learning.

Our goal

• To connect research with practice

  – to increase awareness of the importance of spatial reasoning in mathematics learning and teaching
Spatial thinking is not an add-on to an already crowded school curriculum, but rather a missing link across that curriculum. Integration and infusion of spatial thinking can help to achieve existing curricular objectives.

(National Research Council, 2006, p. 7)
Visualize the meaning of:

$$\frac{3}{4} \div \frac{1}{4} = 3$$
Visualize this ...

You have three-fourths of a cup of flour.

How many one-fourth cups do I have?

http://www.isenegger.ca/tapatoo/CLIPS/swfPlayer.html?swfURL=tools/ubPouringContainerToolCreator.swf
Using area to represent

\[
\frac{3}{4} \div \frac{1}{4} = 3
\]
Using a set of objects to represent

\[\frac{3}{4} \div \frac{1}{4} = 3\]
Using a number line to represent

\[
\frac{3}{4} \div \frac{1}{4} = 3
\]
Which representation makes sense to you?

\[
\frac{3}{4} \div \frac{1}{4} = 3
\]
Spatial Reasoning can involve...

spatial visualizing  
manipulating  
(di)composing  
perspective-taking  
orienting  
scaling up or down  
shifting dimensions  
proportional reasoning  
navigating and wayfinding  
moving one’s body in space  
locating  
creating/designing objects  
creating/reading visual forms  
comparing  
non-verbal reasoning  
imagining objects in space
A call for action

... that we recognize spatial thinking as important not only across mathematical strands but also across subject areas, and that educational researchers and system leaders develop better understandings and supports to foster spatial literacy in students.

The National Research Council 2006
Why pay attention to spatial reasoning?

• Spatial reasoning is critical to mathematical thinking and achievement

• Spatial reasoning is malleable and can be improved through experience

• Schools play an important role in promoting spatial reasoning
“[Thinking] spatially and visually is central to problem solving”

Dr. Walter Whiteley, York University
Thinking with the ‘mind’s eye’ ...
Can you visualize the outcome?

http://nrich.maths.org/6307
Practising spatial visualization

http://spatiallearning.org/resource-info/Spatial_Ability_Tests/Paper_Folding_Test.pdf
Practising spatial visualization

http://spatiallearning.org/resource-info/Spatial_Ability_Tests/Paper_Folding_Test.pdf
Spatial Reasoning can involve...

- spatial visualizing
- manipulating
- (de)composing
- perspective-taking
- orienting
- scaling up or down
- shifting dimensions
- proportional reasoning
- imagining objects in space
- navigating and wayfinding
- locating
- comparing
- non-verbal reasoning
- creating/designing objects
- creating/reading visual forms
- moving one’s body in space

NEW

Ontario
How can we promote spatial reasoning?

Spatial visualization

Can you imagine this?

Close your eyes
The power of gesture

“... several studies in mathematics education show that the use of gestures help students build understanding; ... This research shows that gestures may be incredibly powerful in helping form pathways in the brain and in the development of conceptual understandings”

Goldin-Meadow, S. 2005
Dehaene et al., 2003
Paying Attention to Spatial Reasoning
Spatial Reasoning can involve...

- spatial visualizing
- manipulating
- (de)composing
- orienting
- perspective-taking
- proportional reasoning
- (de)composing
- diagramming
- imagining objects in space
- shifting dimensions
- creating/designing objects
- creating/reading visual forms
- comparing
- non-verbal reasoning
- illuminating
- navigating and wayfinding
- creating/drawing objects
- creating/designing objects
- moving
- locating
- creating/designing objects
- creating/reading visual forms

How will **you** pay attention to **spatial reasoning**?