


The Literacy and Numeracy Secretariat
Le Secrétariat de la littératie et de la numératie


Leading Student Achievement Symposium

Learning *Mathematics for Teaching*

presented by

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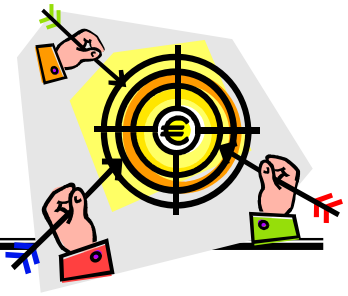
Student Achievement Officers, Numeracy

January 26, 2007

Learning Goals



During this session, participants will:

- discuss the history of numeracy professional development in Ontario
- explore the characteristics of effective professional learning discuss job-embedded professional learning strategies to improve mathematics instruction and student learning of mathematics
- becoming familiar with notions of *mathematics for teaching*
- learn mathematics through problem solving
- develop strategies for teaching mathematics through problem solving

What do You Think?

What do you think an elementary teacher needs to know and be able to do to teach mathematics effectively in a province rich with diversity?

1. **Think** and record 5 ideas, individually.
2. **Pair** and turn to an elbow partner and share your 5 ideas.
3. **Share** one idea that you heard with your small group.

It isn't just knowing how to do math; rather it is knowing mathematics in ways that are useable in the practice of teaching.

Think-Pair-Share

Let's Do Math as a Teacher!

1. Pick a number. → 13
2. *Double it.* → 26
3. *Add 6.* → 32
4. *Double again.* →
5. *Subtract 4.* →
6. *Divide by 4.* →
7. *Subtract 2.* →
8. What's your final number?

A. Why did you end up with that number?

B. How does it work?

C. Will it work for any number?

Analyze and Explain

What does It Look Like as an Algebraic Expression?

$$\left(\frac{2(2X+6)-4}{4}\right)-2$$

Pick a number, double it, add 6, double again, subtract 4, divide by 4, subtract 2.

What is the Focus of Job-Embedded Learning *Mathematics for Teaching?*

THE LITERACY AND NUMERACY SECRETARIAT presents...
in partnership with Curriculum Services Canada

DR. DEBORAH LOEWENBERG BALL

November 2, 2005 webcast

CHAPTERS

1: Intro
2: Purpose and Overview
3: Deborah's Teaching Background and Inquiry
4: What Mathematical Knowledge do Teachers need
5: The Quality of Mathematics Teaching
6: Practice-Based Approach
7: Doing Mathematics as a Teacher
8: Mathematics Knowledge for Teaching
9: Research About Mathematics Knowledge for Teaching
10: Learning Mathematics for Teaching
11: Outro

PLAY

Deborah Loewenberg Ball
Mathematics for Teaching

- Expert personal knowledge of subject matter is often, ironically, inadequate for teaching.
- It requires the capacity to deconstruct one's own knowledge into a less polished final form where critical components are accessible and visible.
- Teachers must be able to do something perverse: work backward from a mature and compressed understanding of the content to unpack its constituent elements and make mathematical ideas accessible to others.
- Teachers must be able to work with content for students while it is in a growing and unfinished state.

What Do Teachers Need to Know and Be Able to Do Mathematically?

- Understand the sequence and relationship between math strands within textbook programs and materials within and across grade levels
- Know the relationship between mathematical ideas, conceptual models, terms, and symbols
- Generate and use strategic examples and different mathematical representations using manipulatives
- Develop students' mathematical communication – description, explanation, and justification
- Understand and evaluate the mathematical significance of students' comments and coordinate discussion for mathematics learning

LET'S DO MATH as a Teacher!

A. Organize into groups of three.

B. Follow the four steps.

1. Write down two numbers.
2. Write down another two numbers which total 36.
3. Write down a third set of two numbers with a difference of 8.
4. Write down a fourth set of two numbers with a total of 36 and a difference of 8.

C. How could you adjust your pairs of numbers to meet the criterion #4?

Focus on students':

- drawn, modelled, and written mathematical work
- learning actions and interactions
- oral, modelled, and written evidence of learning

Analyze Math Thinking

How Are These Problems Related?

1. Write down two numbers.
2. Write down another two numbers which total 36.
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4. Write down a fourth set of two numbers with a total of 36 and a difference of 8.
5. How could you adjust your pairs of numbers to meet the criterion #4?

There are 36 children on a bus. There are 8 more boys than girls.

a. How many boys?

b. How many girls?

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Answer:
22 boys, 14 girls

There are 36 children on a bus. There are 8 more boys than girls.

a. How many boys?

b. How many girls?

Keeping differences as 8

# of Boys	# of Girls	Differences	# of Students
30	22	8	52
28	20	8	48
26	18	8	44
24	16	8	40
22	14	8	36

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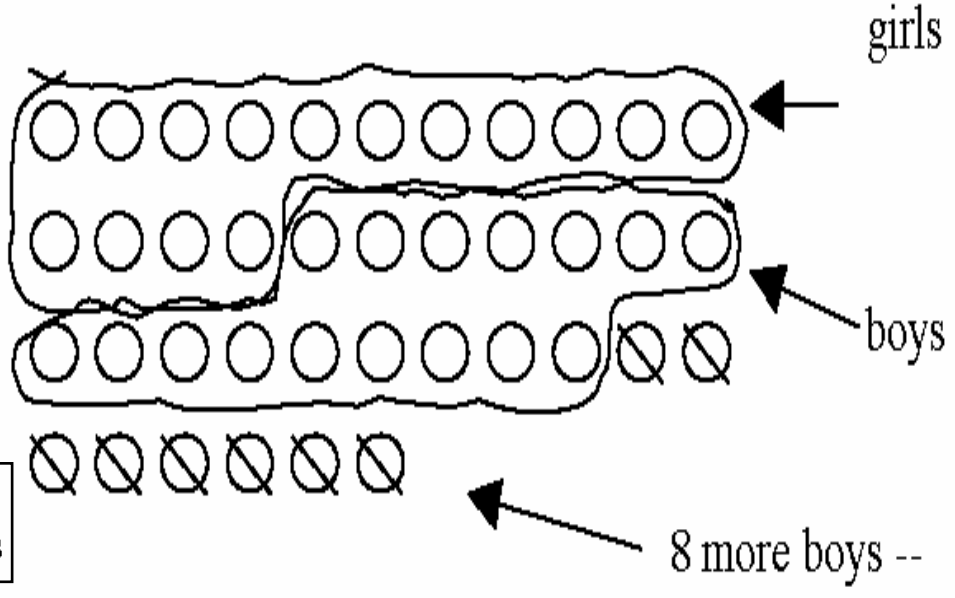
Drawing objects

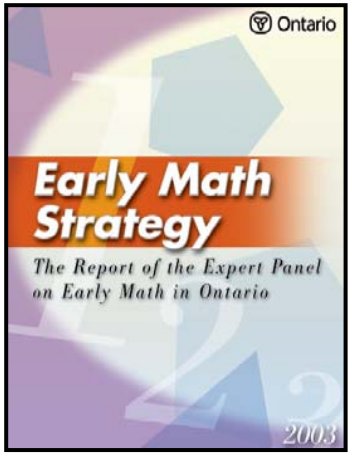


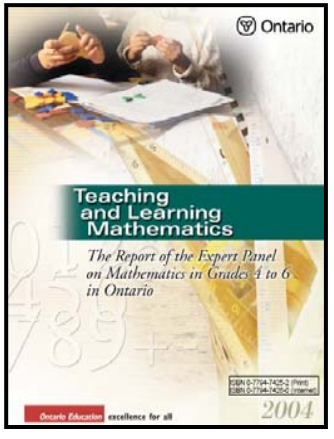
Answer:
22 boys, 14 girls

How we began . . .

Tiered training sessions (provincial, regional, board) to learn about:

- Early Math Strategy (Expert Panel Report) and Guide to Effective Instruction in Mathematics (K to 3, K to 3 NSN, K to 3 GSS)
- Junior Expert Panel Reports and the Guide to Effective Instruction in Mathematics (Gr 4 to 6 NSN)
- Board summer institutes





From Professional Development to Professional Learning … **School Boards**

School boards began:

- to rethink their in-service approaches so teachers could participate in collaborative forms of professional learning
- to study the notion of job-embedded professional learning
- to use various coaching, co-teaching, mentoring, and teaching inquiry/study models

Job-embedded professional learning engages all educators in collaborative work to use data to identify gaps and devise professional learning goals and strategies to improve mathematics instruction and student achievement.

From Professional Development to Professional Learning … **Joyce & Showers**

Learning Steps	Knowledge Mastery	Skill Acquisition	Classroom Application
Presentations	40% to 60%	10%	5%
Demonstration classes	80%	10% to 40%	5%
Practise new learning	80%	80%	5%
Coaching →	80%	80%	80%

adapted from Joyce and Showers, 1995

How we are continuing ...

- A Guide to Effective Instruction in Mathematics, Kindergarten to Grade 6: Volumes One to Five

  (released December 2006)

- Guide to Effective Instruction in Mathematics: Number Sense and Numeration, Grades 4 – 6: Volumes 1- 6

  (to be released early 2007)

How we are continuing

LNS Professional Learning Series

Modules to use with:

- Guide to Effective Instruction in Mathematics, K to 6
- Guide to Effective Instruction in Mathematics: Number Sense and Numeration, Grades 4 - 6

Regional Meetings for Numeracy Leaders

Kingston (Jan 15), Halton (Jan 16), Barrie (Jan 17), Thunder Bay (Jan 19), London (Jan 25), Sudbury (Jan 30), Toronto York (Feb 5)

How we are continuing ... LNS Professional Learning

LNS Professional Learning	Date (2007)
LNS Facilitator Modules – Handbook and PPTs - Addition and Subtraction - Multiplication and Division - Fractions, Decimals, Percents, Ratios … - Problem Solving	Month of January 2007 and beginning of February 2007
Web Conferences - Regional Meeting Follow-Up	Last week in March (1/2 day)
Webcast – Making Math Accessible	March 28, 2007 (4:00-5:00 pm)
Webcast – Numeracy Coaching	June 20, 2007 (4:00-5:00 pm)
Coaching Institute #2	July 5 and 6, 2007

How We are Continuing … Publication and Release Schedule

Guides to Effective Instruction in Math (resource guides)	LNS Facilitator Handbook Modules (support implementation)	Release Date
K to 6 (5 volumes)	Problem Solving	Jan 2007
Gr 4 to 6 – Number Sense and Numeration (6 volumes)	❑ Add/Sub – Whole and Decimal Numbers ❑ Mult/Division – Whole and Decimal Numbers ❑ Fractions, Decimals, …	Feb/Mar 2007
K to 3 (PA, DMP, M) and Gr 4 to 6 (GSS, PA, DMP, M) … in edit and publication	To be developed	2007-2008

Example of Professional Learning Teacher Inquiry/Study

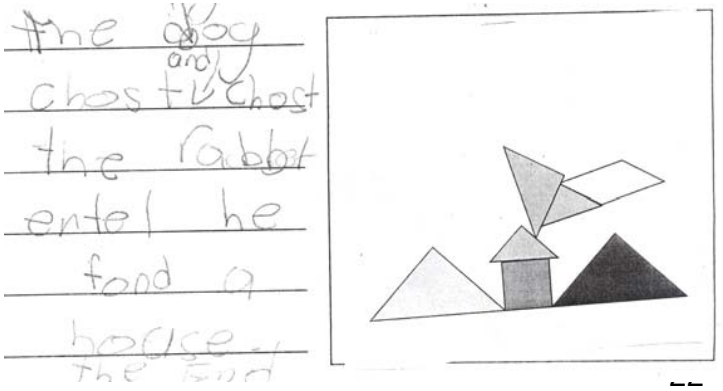
- "Inquiry engages teachers in working on dilemmas and difficult situations that will appear in every teacher's practice. Participants learn that solutions depend on contextual information and that there is never only one answer to any one problem."
- "They re-examine their strategies and are supported and stimulated to try fresh ways of dealing with dilemmas in practice.'
- "Instead of an expert or theoretician telling teachers what works and should be carried out in practice, case participants are able to revisit scenarios in their own classrooms, draw on their experiences of success or failure and share expertise from a variety of perspectives."

Example of Professional Learning - Co-Teaching

- "Co-teaching is an informal professional learning arrangement in which teachers with different knowledge, skills and talents have agreed to share responsibility for designing, implementing, monitoring and/or assessing a curriculum program for a class of students on a regular basis (e.g., biweekly, monthly, or per term)."
- "The purpose of co-teaching is to enable groups of teachers to improve their instruction and their understanding of students' thinking and learning through shared observation, and analysis of student work."
- "Co-teaching makes it possible for teachers to engage in teaching as collaborative problem-solving."

Co-Teaching

- What are some key aspects of co-teaching?
- What does the numeracy coach do?
- What do the teacher(s) do?
- How does co-teaching help teachers learn *mathematics for teaching*?
- How does co-teaching help students learn?



Example of Professional Learning - Coaching

- "Coaching is a formal relationship that is established by a third party organizer (e.g., principal, curriculum leader or supervisory officer) or between two parties (e.g., an inviting teacher and a coach) to meet a particular learning goal."
- "Because the coach is assigned a formal role, it is that role which defines the relationship."
- "Coaching involves teachers in processes in which they collaborate, refine, reflect, conduct research, expand on ideas, build skills and knowledge and problem solve in order to improve student learning and achievement."
- "Yet coaching needs to be non-evaluative and build upon a foundation of mutual respect."

Most Effective Professional Learning - Job-Embedded ... **Fullan, Hill, Crevola**

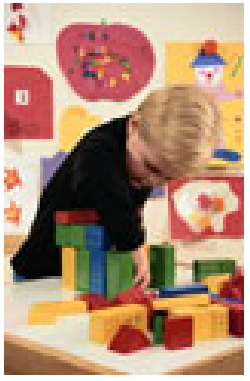
- It must be grounded in inquiry and reflection, be participant-driven, and focus on improving planning and instruction
- It must be collaborative, involving the sharing of knowledge and focusing on communities of practice
- It must be ongoing, intensive, and supported by modeling, coaching, and the collective solving of specific problems so that teachers can implement their new learning and sustain changes in practice.
- It must be connected to and derived from teachers' work with students – teaching, assessing, observing, and reflecting on the processes of learning and development.

- Breakthrough, 2006

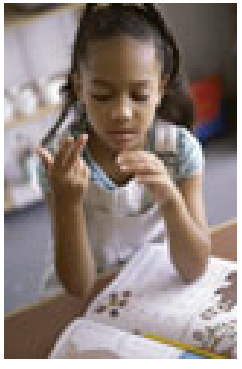
Professional Learning Opportunities for *Mathematics for Teaching*

- Print resources – *Guide to Effective Instruction* Modules (Number Sense and Numeration – Primary, Junior; other strands for primary and junior to be released 2007)
- Facilitator Support Modules for *Guides to Effective Instruction* –
- E-learning.ca – web-based professional learning modules
- School-based co-teaching, mentoring, coaching, and teacher inquiry/studies organized by school boards
- Summer institutes
- Video on demand of provincial conferences at www.curriculum.org
- Webcasts (monthly) at Curriculum Services Canada at www.curriculum.org

Suggestions for Learning *Mathematics for Teaching*

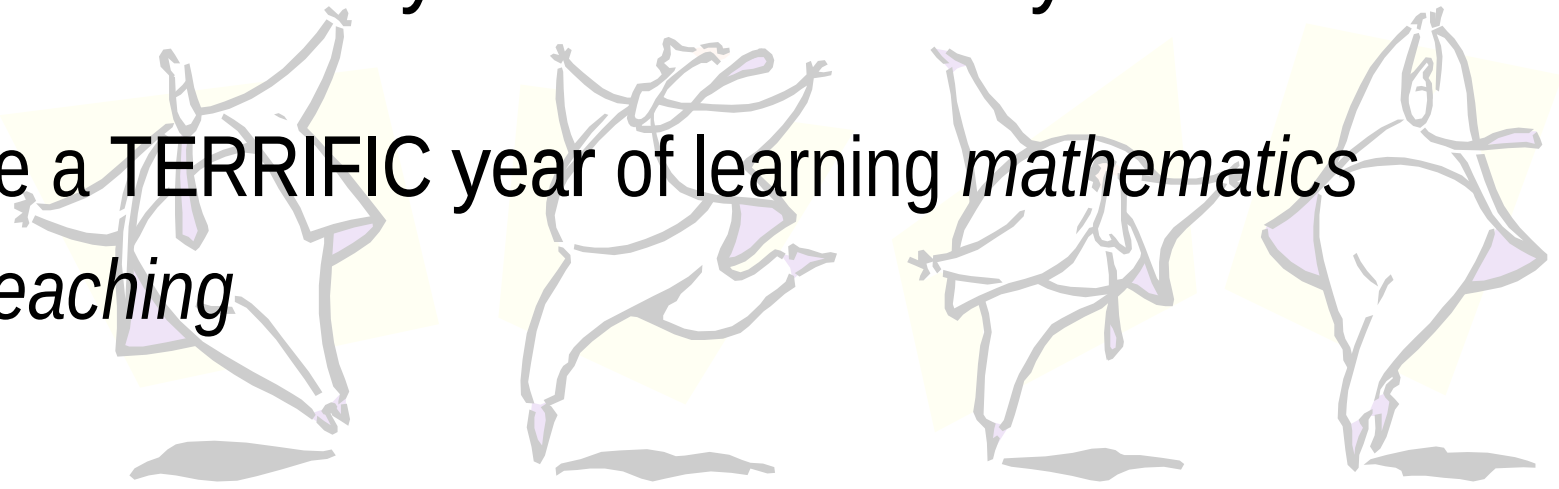


- Be precise and consistent with the use of oral and written mathematical language – drawings, symbols, terms
- Figure out why procedures work, not just how to do them
- Try to solve problems in more than one way, using different representations
- Analyze which manipulatives are/not appropriate for students to model their mathematical thinking
- Listen to and probe others' thinking, especially when struggling
- Study students' thinking and work
- Plan and practise coordinating students' sharing of their mathematical solutions for learning mathematics



GREAT to meet you and work with you!

Have a TERRIFIC year of learning *mathematics for teaching*



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