

Learning Mathematics for Teaching – January 2007

Kathy Kubota-Zarivnij, Student Achievement Officer, The Literacy and Numeracy Secretariat

Mary Lou Kestell, Student Achievement Officer, The Literacy and Numeracy Secretariat

During this presentation, Mary Lou Kestell and Kathy Kubota-Zarivnij review numeracy professional development as it has occurred in Ontario over the last few years. They explore the characteristics of effective professional learning and discuss job-embedded professional learning strategies to improve mathematics instruction and student learning of mathematics. Participants are asked to do some mathematics collaboratively with colleagues and become familiar with *mathematics for teaching*. Kestell and Kubota-Zarivnij have participants discuss strategies for teaching and learning mathematics through problem-solving.

Contact:

For more information on *Learning Mathematics for Teaching*, visit www.curriculum.org or contact:

Kathy Kubota-Zarivnij at kathryn.kubota-zarivnij@ontario.ca

Mary Lou Kestell at marylou.kestell@ontario.ca

Resources:

PowerPoint presentation: A copy of Kestell and Kubota-Zarivnij's PowerPoint slides for the presentation is available. Go to the home page of your principals' association and click on the Learning *Mathematics for Teaching* button to access the slides.

Segments:

- 1...Introduction
- 2...What Do Teachers Do When They See a Math Problem?
- 3...The Nature of Mathematics that Teachers Need to Know for Teaching
- 4...How and Why Should Teachers Study Math for Teaching?
- 5...Observing Mathematical Actions
- 6...Provincial Professional Learning Supports
- 7...Models of Job-Embedded Professional Learning

1...Introduction

(Length: 3 minutes)

Synopsis:

Kubota-Zarivnij outlines the learning goals of this professional learning session.

Look for the following:

- The five learning goals of the session

After viewing Segment 1:

- Identify one or two ideas you identified in response to the question, "What do you think elementary teachers need to know and be able to do mathematically to be effective in their teaching of mathematics?" Use those ideas to focus your listening and viewing of the rest of the professional learning session.

Digging Deeper:

- PPT #2–3

2...What Do Teachers Do When They See a Math Problem?

(Length: 3 minutes)

Synopsis:

Kubota-Zarivnij poses a problem and then asks principals to think about what teachers should be thinking about when they pose a problem. More than looking for the correct calculation, they should be prompting students to wonder:

- Why did you end up with this number?
- How does this set of instructions work mathematically?
- Will it work for any number (e.g., whole, decimals, fractions, integers)?

Kubota-Zarivnij interacts with the audience to gather responses to the problem. She talks about conversations with parents about what math class looks like these days. She discusses the questions we want teachers to ask and students to engage in for deeper learning of mathematics. Kubota-Zarivnij then explains what the longevity of a problem means and about how mathematical thinking can grow across the grades when analysis and explanation become normal and natural parts of a math class.

Look for the following:

- Besides listening for a correct response to the question, what else should we be doing to make mathematics learning deeper?
- Comments about how mathematicians work
- Information about the importance of having students analyze and explain their mathematical thinking

After viewing Segment 2:

- Take some time to reflect on the questions posed after doing the math problem. Think about analyzing and explaining the mathematics in the problem. Revisit the conversation about the value of this problem, its longevity, and how mathematics grows across the grades. Have a similar discussion to answer the same questions about another math problem identified by staff or in a resource.
- Consider how this conversation could become a topic for a PLC at your school. How could you lead such a discussion with a math problem that would engage your primary and junior teachers?

Digging Deeper:

- PPT#4–5

3...The Nature of the Mathematics that Teachers Need to Know for Teaching

(Length: 16 minutes)

Synopsis:

Dr. Deborah Loewenberg Ball is an internationally renowned researcher who studies the nature of mathematics that teachers need to know for teaching. This segment includes a section of the webcast that was presented in November 2005, in which Deborah illustrates the difference between knowing mathematics and *knowing mathematics for teaching*.

Kubota-Zarivnij leads participants through a conversation about the standard multiplication algorithm (using the example of 2-digit by 2-digit multiplication) and has them analyze student solutions to evaluate the significant mathematical thinking that students used to get their solutions.

Look for the following:

- The difference between the nature of the math one needs to know as an well-educated adult, and the mathematics one needs to know to teach mathematics
- What mathematics the students' work demonstrates that they know
- What problem you could pose to identify what the students were thinking

After viewing Segment 3:

- Look at some student work and talk with a small group of colleagues about what mathematical thinking the students were doing to solve the problems. Rather than describing what is wrong, identify what is correct. Discuss the questions one might pose to uncover the student thinking.
- Lead a brainstorming session with teachers, asking them to “unpack” the mathematical knowledge one would need to know to successfully determine the difference between 534 and 187, and to make up a problem that matched the procedural requirements of such an operation (or any other math question your teachers are interested in discussing).

Digging Deeper:

- Deborah Loewenberg Ball webcast from November 2005 (chapter 7)
- PPT #6

4...How and Why Should Teachers Study Math for Teaching?

(Length: 19 minutes)

Synopsis:

Kubota-Zarivnij summarizes Dr. Ball's views about the difficulties teachers have unpacking their own mathematical knowledge (relationships between and among concepts, alternative algorithms, and mental math). She examines how and why teachers should study to be more prepared to identify students' cognition and to move that thinking forward. Kubota-Zarivnij suggests some goals and poses some questions that school leaders might consider for a study of curriculum that could improve math instruction and student achievement in mathematics.

Look for the following:

- Questions that you are interested in studying
- Where and what topic(s) to use to focus your mathematical conversations with teachers
- Comments about mathematical communication and representation

After viewing Segment 4:

- Make a list of questions you might study with your teachers in order to teach math effectively.
- From the list of goals for *learning math for teaching*, identify which aspects you and your staff might want to study before setting up your next school improvement plans.

- Start a staffroom discussion about how the relationships between concepts of mathematics relate to alternative algorithms, standard algorithms, and mental math by posting some student work on a single operation that spans the grades, such as multiplication from Grades 3 to 6.
- In teams of teachers, examine each challenge and record ideas about actions that might prompt teachers to work collaboratively on addressing the issue. Use a chart like the one below to record ideas.

What do teachers need to know and be able to do mathematically?	What actions could we take to study this?
1. Understand the sequence and relationship between math strands within textbook programs and materials, both within and across grade levels	
2. Know the relationship between mathematical ideas, conceptual models, terms, and symbols	
3. Generate and use strategic examples and different mathematical representations using manipulatives	
4. Develop students' mathematical communication — description, explanation, and justification	
5. Understand and evaluate the mathematical significance of students' comments and coordinate discussion for mathematics learning	

Digging Deeper:

- PPT #7–8

5... Observing Mathematical Actions

(Length: 9 minutes)

Synopsis:

Using another problem, Kubota-Zarivnij has one participant in each group act as an observer of the mathematical actions while the others do the math. She talks about the importance of students talking in math class. She models a process for planning a lesson by identifying words and concepts she needs to activate before posing the lesson problem. She analyses learning goals and decides on what mathematics she needs to know that the students know before the problem solving starts (slide 10).

Look for the following:

- The observations participants made about the math actions
- Ideas about strategies one could use to engage more students in doing math
- Discussion about strategies that younger students can use to solve problems we only think of as needing an algebraic solution

After viewing Segment 5:

- Consider presenting a math problem, such as this one or another one identified by your lead math teacher(s), at a divisional- or whole-staff in-service. Have

one person in each group of three or four act as observer while the others engage in problem solving. Then focus the debrief discussion on the mathematical actions identified by the observers.

- View the webcast “Making Mathematics Accessible to All Students” to observe students’ actions during warmup, while working on a problem, while looking back, and while consolidating.

Digging Deeper:

- PPT #9–12

6...Provincial Professional Learning Supports

(Length: 8 minutes)

Synopsis:

This section presents an overview of the origins and development of a job-embedded professional learning model that The Literacy and Numeracy Secretariat are following to build sustainable practices for improving the teaching and learning of mathematics in Ontario. This model depends heavily on the participation of educators at all levels of responsibility. It casts all educators as curious learners who go to work every day to learn and solve problems on the spot — conducting business in education that is focused directly on building the success of each and every child — enabling them to read, write, do math, and think critically at high levels.

Look for the following:

- Information about publications that could be used for study with your colleagues (e.g., *The Expert Panel Reports on Primary and Junior Mathematics*; *Guides to Effective Instruction in Mathematics: Kindergarten to Grade 6*)
- The slide that quotes the research of Joyce and Showers — information about the importance of teachers’ learning being focused on just-in-time learning directly related to their work with students
- Comments about the importance of collaboration — breaking down the isolation of teachers and finding ways for them to plan, instruct, reflect, and assess together

After viewing Segment 6:

- Locate the resources and give them prominent shelf space that your staff have access to (e.g., in the staffroom, your office, the library).
- View the numeracy e-learning modules and/or The Literacy and Numeracy Secretariat’s webcasts.

Digging Deeper:

- PPT #13–19

7...Models of Job-Embedded Professional Learning

(Length: 31 minutes)

Synopsis:

Kubota-Zarivnij outlines some different approaches to job-embedded professional learning — teacher inquiry and co-teaching. She talks about some related work that she and Kestell have been doing across the province.

Look for the following:

- Descriptions of components of teacher inquiry and co-teaching
- Ideas about how to organize for co-teaching
- Ideas about how you can initiate and participate in co-teaching with your teachers
- How assessment *for* learning is used to make instructional decisions

After viewing Segment 7:

- Talk about which model of job-embedded professional learning might work in your school
- Talk with a colleague (e.g., vice-principal, lead teacher, principal from a school near yours) and pick one or two goals from slides 7 or 8 that you want to learn about with your staff in this way
- Follow some of the suggestions that Kubota-Zarivnij gives near the end of her presentation

Digging Deeper:

- PPT #20–26