

Webcasts for Educators
Student Achievement Division

Viewer's Guide

Math Study Groups:
Learning in a Collaborative Culture
of Inquiry, Study, Action

Multi-media resource for professional learning



support every child
reach every student





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On this DVD you will find a Print and Video Resources folder which contains WMV files, this Viewer's Guide (PDF) and Additional Resources such as monographs, visual organizers and lessons.

To order the multi-media package

Math Study Groups: Learning in a Collaborative Culture of *Inquiry, Study, Action*

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Student Achievement Division, Ontario Ministry of Education.

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Overview

This webcast follows a group of educators as they investigate and implement strategies to improve student engagement, learning and achievement in mathematics. It features the work of the Toronto Catholic District School Board's Math Study Group, consisting of principals, teachers, mathematics consultants, a superintendent and a faculty of education course director, working within an *Inquiry, Study, Action* framework.

Video Segments at a Glance

Activating Thinking (Before): These segments are designed to activate thinking through goal setting, monitoring, observations and questions about classroom practice.

Developing Learning (During): These segments are designed to develop thinking and learning related to the study group's inquiry through:

- preparation for co-teaching the public research lesson
- analysis of the prior lesson's Bansho
- analysis of the public research lesson plan
- co-teaching the public research lesson

Consolidating Learning (After): These segments are designed to consolidate learning through:

- analysis of the student learning and teaching
- problem solving using Bansho related to the public research lesson
- highlighting and summarizing future classroom and school implementation strategies
- reflections about the professional learning framework

The video will provide a valuable glimpse into one of the Math Study Group's professional learning sessions. It also captures their efforts at implementation between study group sessions. Additional resources are provided in the Print and Video Resources folder to complement thinking and professional learning.

Key characteristics of effective professional learning include the following:

- **Teacher-directed and research-supported inquiry** where educators, facilitators and researchers work collaboratively to engage in areas of mutual interest
- **Classroom-embedded learning** where the primary site of inquiry and professional learning is within the classroom context
- **Cyclical, iterative and sustained inquiry**
- **Collaborative asset-oriented models of learning** where all participants consider themselves learners
- **Action-oriented activity** that focuses on students, student thinking and student demonstrations of understanding through planning, implementing and evaluating interventions

Bruce & Flynn, (In press)

A math study group is a community of practice that is characterized by collaborative inquiry and action oriented study. Principals, teachers and superintendents along with other educators learn together in classrooms, within schools and across schools. The learning is iterative – that is, it builds upon itself as cycles of learning that repeat and grow. The professional learning is situated in students' acquisition of mathematics and is grounded by the study of *The Ontario Curriculum, Grades 1-8, Mathematics*, student responses and research.

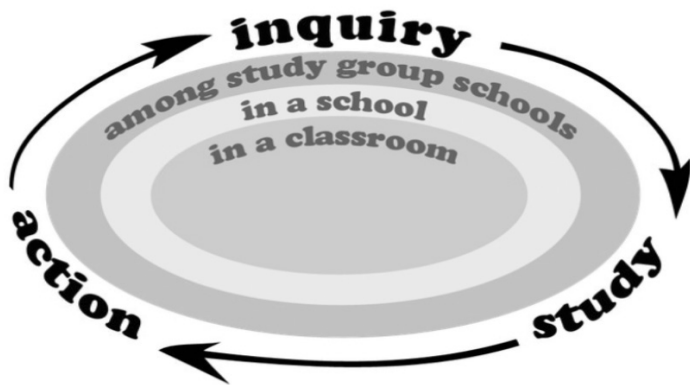
From Viewing to Action

In this webcast, viewers will have the opportunity to:

- become familiar with the conceptual and organizational framework of the Toronto Catholic District School Board's Math Study Group
- study mathematics for teaching, specifically in terms of the meaning of equivalence
- analyze the work of teaching mathematics through reviewing educational research, examining the design of a sequence of problems, studying mathematical annotations and developing success criteria during the highlights and summary part of the lesson based on students' work.
- explore several mathematics professional learning strategies, such as co-teaching, public research lessons and the development and analysis of Bansho

The framework for professional learning is composed of three phases of learning both within study group sessions and across study group sessions. School leaders facilitate learning between sessions and the superintendent facilitates learning at administrator team meetings. These nested processes allow for ongoing reflective monitoring with responsive actions. Throughout, principals learn side-by-side with teachers, the superintendent and students.

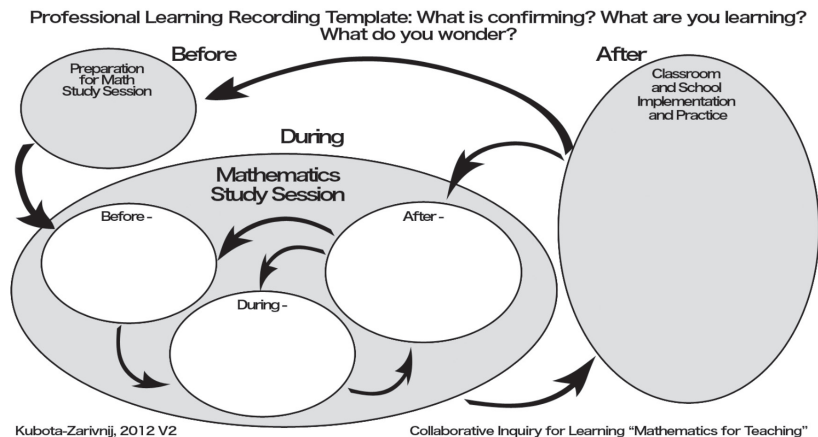
Organizer #1



This organizer is available in the Additional Resources folder.

In viewing the webcast, consider recording your thoughts about *Inquiry, Study, Action* within the nested three-phase framework regarding what happens “during” a study group session and how this links to the “before” and “after” of the sessions.

Organizer #2



This organizer is available in the Additional Resources folder.

“The more leaders focus their influence, their learning and their relationships with teachers on the core business of teaching and learning, the greater their influence on student outcomes.”

Robinson et al., 2009

VIDEO SEGMENTS

Activating Thinking (Before)

Overview

(2:35)

This webcast follows a study group consisting of teachers, principals, a superintendent and a university educator in one of their learning sessions. During the study session, the director of education joins the study group. Between sessions, teachers and principals implement their learnings and continue their *Inquiry, Study, Action*. This clip opens with the facilitator sharing how the study group work has influenced her school, school community and the other schools.

What questions emerge for you after listening to this clip?

How might we foster the conditions necessary for a collaborative culture of Inquiry, Study, Action?

Goals of Inquiry, Study, Action

(5:15)

This clip describes the overarching aims of the professional learning as well as the specific goals of the study group. Their inquiry is generated from classroom dilemmas and questions that teachers and principals ask about teaching and student learning of mathematics through problem solving. These sorts of questions form the study goals of the group and are monitored regularly to see if they are improving student engagement, learning and achievement in mathematics.

The aim of professional learning within the collaborative inquiry of the study group is:

- to improve student engagement, learning and achievement in mathematics
- to improve instruction in mathematics
- to develop and support job-embedded professional learning networks among teachers, principals, vice-principals, mathematics consultants/coordinators, superintendents and the director of education

In what ways are these professional learning aims similar to yours, and in what ways are they different?

Describe your mathematics professional learning context. What are some challenges to implementing mathematics professional learning?

How do you determine if your professional learning efforts are working?

In response to students' learning needs, the study group's inquiry focuses on:

- students' mathematical communication (oral, written) of their thinking while solving a problem
- students' comprehension of problems and other students' solutions to a problem
- ways to engage student in confidence, risk-taking and perseverance to make sense of and in solving a problem

What are your goals? How are these connected with students' needs? How will you know if your professional learning is of help to students?

The work of the study group is shared electronically in a wikispace. These materials are available in the Additional Resources folder.

How might a shared space, such as a blog, wiki or other forum contribute to your professional learning?

How might this aspect of co-learning contribute to the mobilization of knowledge beyond the professional learning sessions?

Setting the Context for Inquiry

(7:08)

This clip offers some of Deborah Loewenberg Ball's thinking as well as some principals', teachers' and other study group members' questions and wonderings that are part of the context of *Inquiry, Study, Action*.

Mathematics for Teaching

Deborah Loewenberg Ball's work suggests that in the teaching of mathematics, some educator actions include:

- sequencing of math content and curriculum materials
- generating and using strategic examples and multiple representations
- using precise mathematical terminology
- understanding and analyzing multiple solutions
- evaluating the mathematical significance of students' comments and coordinating discussion for learning
- building correspondence between mathematical ideas, models and symbols

In what ways does your teaching of mathematics incorporate these “educator actions”?

What are some other actions in which you engage when you are teaching mathematics?

Which of these actions are challenging to you in your current practice?

What resources would you/do you find helpful in addressing these challenges?

Problem solving is an integral part of the mathematics curriculum in Ontario and is the main process for helping students achieve the expectations for mathematics outlined in the curriculum documents...

Certain conventions of mathematics must be explicitly taught to students.

A Guide to Effective Instruction in Mathematics: Kindergarten to Grade 6

Analyzing and Interpreting Students' Thinking

(8:06)

This segment includes footage from the study session and footage from school-based co-teaching that occurred between the study group sessions. Principal and teacher teams bring samples of written student work providing opportunities for educators to practice their articulation of the mathematics they see.

The study group analyzes student work with three key questions focusing the discussion:

- What mathematics is evident in students' communication (i.e., oral, written, modeled)?
- What mathematical language should we use to articulate the mathematics we see and hear from students (e.g., mathematical actions, concepts, models of representations, strategies)?
- What are the mathematical connections between students' different solutions (i.e., how does one solution mathematically elaborate from the next)?

In what ways do these discussion questions elicit important mathematics for teaching information?

Reflect on the study group's analysis of the student work. What do/did you notice? What are you wondering about?

What do you notice within the video segment that might have contributed to the knowledge and understanding of mathematics for teaching of the study group educators?

Describe how this segment added to your own understanding of mathematics for teaching.

Considerations when analyzing data...

Purpose: Why did we collect this data? How did we think it might be of use?

Description: What are the patterns/items of interest that you notice from this data?

Limitations: What are the limitations of this data?

Inferences and Questions: What further questions does this data generate for you?

Next Steps: What other data do we need to help frame future action?

Developing Learning (During)

Studying Mathematics for Teaching

(10:59)

This segment includes:

- lessons taught between study group sessions
- discussions of results of a monitoring strategy used to study students' understanding of equality
- reflections on Carpenter, Franke and Levi's *Thinking Mathematically* – Chapter 2 <http://www.heinemann.com/shared/onlineresources/E00565/chapter2.pdf>

As part of their study of students' understanding of equivalence, the study group asked students in each of their schools to solve the problem:

What is the value of the box? $4 + 8 = \square + 5$

What do you think a student who gives an answer of 12 might be thinking? Of 17?

At each school, student responses were collected prior to the study meeting.

How might the student responses have contributed to the inquiry both within the schools and within the study group? What other data might support monitoring and reflective practice?

What might have led to this thinking? What might you ask of the student to support/develop his/her understanding of equivalence?

In preparation for the public research lesson, the study group examines the work of Carpenter, Franke and Levi.

What are some of the instructional ideas?

How does the study group's review of the research related to their inquiry influence their actions?

How is the concept of equivalence positioned across grades within The Ontario Curriculum, Grades 1-8, Mathematics?

Examining the Public Research Lesson

(15:06)

The public research lesson takes place in the classroom of one of the teachers participating in the Math Study Group's inquiry into mathematics for teaching. The teacher, the study group facilitator and the school administrator co-teach along with any other study group members who are available. It is through this process that the public research lesson is developed.

In this segment, viewers can watch portions of the lesson from the previous day. The lead teacher discusses the mathematical focus, instructional strategies used and student readiness for the public research lesson. In order to more effectively examine the research lesson, study group members first solve the problems in at least two different ways using the Assessment for Learning Seating Plan tool (included in the Additional Resources folder).

The lead teacher shares the Bansho from the previous day's lesson.

How does this contribute to your understanding of Bansho? Of the mathematics for teaching? Of the students' previous learning?

How might the study of Thinking Mathematically, the sharing of the previous-day's lesson and the solving and review of the public research lesson problems contribute to the learning of the educators in the study group?

The School Effectiveness Framework identifies the following as indicators of effective numeracy instruction:

- Learning experiences provide the conditions for students to activate prior knowledge, develop thinking and consolidate learning.
- New learning is built on students' prior mathematical knowledge and understandings.
- All students and educators form a learning community where mathematics inquiry is framed positively and risk-taking is the norm.
- Documentation of students' mathematical thinking, analyses and discussion are used to illustrate different aspects of effective mathematics learning.
- Student thinking is visible and reflects the mathematics currently being learned

School Effectiveness Framework, Revised 2013

How are these indicators reflected in the practices highlighted in this clip?

In examining the research lesson which was written the previous day, the principals, teachers, superintendent and in this case, the director of education changed the “before” questions.

Pre-planned 'Before' questions

$$\begin{array}{l} 7+5 = \square + 3 \\ \square + 3 = 7+5 \\ 10+2 = \square \\ 12 = \square + 6 \\ 10+2 = \square + 6 \\ 12 = \square \end{array}$$

Modified 'Before' questions

$$\begin{array}{l} 7+5 = \boxed{8} + 4 \\ \boxed{8} + 4 = 7+5 \\ 4 + \boxed{8} = 5+7 \\ 7+5 = 4 + \square \\ 5+7 = \square + 6 \end{array}$$

What do you notice about the changes? Why might the study group have made these changes?

How does this process contribute to the professional learning of the group?
How does it contribute to their understanding of mathematics for teaching?

Organizing for the Public Research Lesson

(3:55)

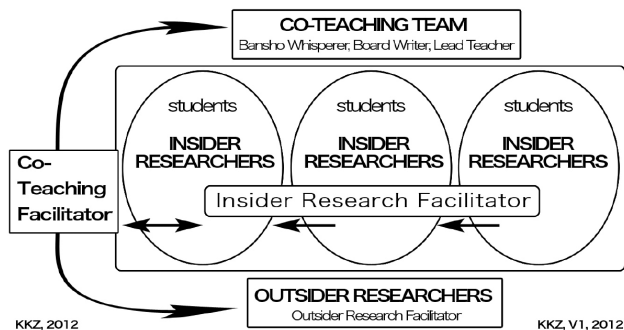
The study group utilizes co-teaching as a strategy for implementation of the lesson. Their purpose in co-teaching is to improve their content pedagogical knowledge and instruction, as well as their understanding of students' thinking and learning through shared observation and analysis of student work.

- Co-teaching makes it possible for educators to engage in teaching as collaborative problem-solving and as a “teach-aloud.”
- Co-teaching provides more “eyes” and “ears” in the classroom.
- The co-teaching team watches, listens to and records students' mathematical thinking in order to exchange their observations and instructional insights and suggestions during and after a lesson.

During the public research lesson, while members of the study group have different roles, every educator is observing, documenting and analysing student learning.

Organizer #3

“Public Research Lesson” Structure



This organizer is available in the Additional Resources folder.

The roles and protocols of the study group educators during the public research lesson are designed to maximize the learning opportunity of the educators and the authenticity of observing students at work.

The Co-Teaching Team collaboratively considers – and incorporates – observations and insights from the study group in order to implement the instructional strategies in the most effective way possible. One protocol, among others, of the teaching team is redirecting students to interact and discuss ideas and questions with one another to help them clarify their thinking.

The Co-Teaching Team

- **The Bansho Whisperer** (a term created by the Grade 3 Math Study Group): This person receives feedback (observations and analysis of students' mathematical thinking) from the study group members through the co-teaching facilitator. It is the Bansho Whisperer who filters and then communicates observations and insights to the board writer and lead teacher in order to improve the lesson implementation.
- **The Board Writer:** This person takes on the responsibility of developing the Bansho throughout the lesson.
- **The Lead Teacher:** This person is the sole voice of the co-teaching team with whom the students interact throughout the lesson. The lead teacher offers questions and prompts to the students to provoke specific mathematical detail and analysis, as well as re-voicing students' ideas, so that students can reflect on specific aspects of each other's mathematical reasoning.

Because it is often difficult for the co-teaching team to understand every student's mathematical thinking or for the study group members to know the ever-evolving rationale for the instructional decisions made throughout the lesson, a systematic process for sharing information is used. This study group employs "Insider Researchers, Outsider Researchers" and "Facilitators" for this purpose.

The Insider Researchers sit among the students, recording what students say and do mathematically on the Assessment for Learning Seating Plan tool.

The Outsider Researchers record details of the co-teaching process, instructional decisions and strategies used by the co-teaching team in relation to classroom discourse. In order to document student thinking in response to the lesson, these people do not talk with the students. If needed, during the public research lesson, the researchers may share their observations with the facilitator.

The Facilitators are a conduit between the co-teaching team and the insider/outsider researchers. They gather observations and insights from the insider/outsider researchers for the purpose of providing feedback to the co-teaching team, so that instructional decisions are well-informed by students' responses. In the same way, the facilitators communicate the thinking of the co-teaching team about instructional decisions to the insider/outsider researchers.

How might this structure provide precise knowledge about the learning of the students without interfering with students' thinking?

How might this structure lead to the sharing of knowledge between and among the study group members?

What aspects of this structure might be of support within your professional learning context? What other structures support co-teaching in your learning context?

The Public Research Lesson

(5:03)

During the public research lesson, the co-teaching team implements the lesson that was planned the previous day. In this clip, we watch the co-teaching team interact with students and with the facilitators. The principals, teachers, superintendent and director of education share observations about student learning in response to the instructional decisions of the co-teaching team.

The Math Problem Solving Lesson Plan (included in the Additional Resources folder) used by this study group includes:

- specific curriculum expectations
- learning goals
- materials
- rationale
- math annotations
- description of three phases of the lesson:
 - Activating Student Thinking (Before)
 - Developing Student Thinking (During)
 - Consolidating Student Thinking (After)

Of note, this lesson plan further plans for “Consolidating Student Thinking (After)” by noting the organization criteria for discussing student work, the anticipated Highlights/Summary (success criteria) and the practice.

What aspects of this lesson plan might support your planning for mathematics learning?

How are the learning goals and success criteria positioned in the context of the public research lesson?

The learning environment, ... is “the third teacher” that can either enhance the kind of learning that optimizes our students’ potential to respond creatively and meaningfully to future challenges or detract from it.

The Third Teacher

Student communication, confidence, risk-taking and perseverance are aspects of the goals of the study group.

*What aspects of the classroom might support students in achieving these goals?
What other aspects of the classroom environment might be considered?*

What evidence is there of student understanding of equivalence?

Consolidating Learning (After)

Next Actions in Classrooms and Schools

(6:51)

After the public research lesson, the study group considers their learnings and what their next actions will be in their classrooms and schools.

The facilitator states “this truly was a public research lesson”. What do you think she meant by this? In what ways might this be important?

What did the study group learn about equivalence through the public research lesson? In what ways does learning relate to their research study of Thinking Mathematically? How does it connect to their own school data?

In what ways do you think that the idea of “compare” goes beyond the public research lesson to other areas of the math curriculum?

The facilitator leads a discussion about a possible trajectory of student learning of equivalence.

How do you develop an understanding of the development of student understandings of big ideas, strategies and models in mathematics? What resources do you use?

Reflections on the Study Group’s Organizational Structure

(9:45)

In this segment, the narrator describes the nested iterative system of learning, the roles of each member of the study group and the teachers, superintendent and principals reflect on their work through this collaborative professional learning of *Inquiry, Study, Action*.

The study group undertook, and collectively produced:

- researched lesson plans
- assessment for learning seating plan tools
- student work samples to lesson problems
- Bansho layouts
- hypothetical teaching/learning trajectories for math concepts derived through collective analysis of a range of student solutions to a lesson problem

- ongoing and focused practice in implementing mathematics teaching strategies, such as coordinating whole class discussion, Bansho, precision in co-teaching moves and processes for knowledge mobilization during a public research lesson
- strategies for classroom and school-wide teacher inquiry/study

Reflect on your current context for mathematics professional learning. How might you integrate some of the concepts and strategies presented here?

References and Related Reading

Bruce, C., & Flynn, T. (In press). *Assessing the effects of collaborative professional learning: Efficacy shifts in a three-year study*. Alberta Journal of Educational Research.

Carpenter, T.P., Franke, M.L., & Levi, L. (2003). *Thinking mathematically: Integrating arithmetic and algebra in the elementary school*. Portsmouth, NH: Heinemann.

Robinson, V. et al. (2009). *Ideas into action*. Ontario Leadership Strategy, Bulletin #1.

Ontario Ministry of Education Resources

Capacity Building Series

The Third Teacher (2012)

Asking Effective Questions in Mathematics (2011)

Bansho (Board Writing) (2011)

Communication in the Mathematics Classroom (2010)

The School Effectiveness Framework (2013)

Paying Attention to Mathematics Education, K–12 (2011)

A Guide to Effective Instruction in Mathematics: Kindergarten to Grade 6 (2008)

Notes:

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