Creating the Conditions for Learning Mathematics
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Overview

[The] progression of student strategies from early concrete modelling through to efficient, alternative or standard algorithms is neither linear nor developmental. Instead, the progression is experiential – the result of classroom experiences in which teachers effectively support children in solving problems using their own methods. How do teachers do this?

Lawson, 2007

How do teachers do this? This resource offers a chance to co-learn alongside two educators – Margaret Allen, an elementary school teacher who is also working towards her Masters of Education, and Dr. Alex Lawson, a university researcher with a focus on children’s mathematical learning in the elementary grades.

Margaret teaches at a large school in Peel District School Board, where many students are English Language Learners and/or come from homes with socio-economic challenges. She is working towards her Masters of Education under the direction of researcher Dr. Lawson, who joins her in this webcast for the purpose of analysing evidence of what students understand and can do mathematically, and to support Margaret in her teaching.

In this resource, viewers can:

- watch classroom footage
- share in the analysis/reflections of educators
- consider the mathematics that students learn within the Ontario Curriculum
- explore how contexts can set the stage for learning
- examine the different strategies and models that children use to solve problems as they develop an understanding of mathematical big ideas

Also featured in this webcast are the insights of Doug Clements and Lucy West on how to create the conditions for learning mathematics.

Exploring Pathways of Understanding

Exploring the possible paths that lead to student understanding of mathematics within a developmental framework allows educators to:

- develop rich tasks with strong mathematical contexts
- be responsive to student thinking by;
  – providing meaningful feedback
– asking precise, timely and appropriate questions
– designing further learning opportunities that re-enforce and build on current understandings
• plan for whole class, pair, and individual conversations

Through planning, teachers can anticipate likely student contributions, prepare possible responses and make decisions about how to structure students’ presentations to further their mathematical agenda for the lesson.

For additional reading and reflection...
http://gse.berkeley.edu/faculty/RAEngle/SteinEngleSmithHughes(inpress).pdf

Teaching/Learning Frameworks for Mathematics

Landscapes of Learning

While there are a number of research-based developmental frameworks that provide insight into how students acquire mathematical skills and concepts, the educator featured in this video uses the Landscape of Learning to guide her in how she plans for students’ achievement of the expectations within The Ontario Curriculum.

The Landscape of Learning is a framework developed to support teachers in understanding the journeys of learning mathematics focused on important strategies, big ideas and models. The approach conceives of learning as a developmental journey, which is often not linear but rather is messy, along a landscape.

Paraphrased from Contexts for Learning Mathematics, Multiplication, Cathy Fosnot

In Fosnot’s Landscape of Learning framework, there are three domains:

• **Strategies** (named within the rectangles on the landscape) – observable methods that children use to solve a problem (e.g., “skip counting”).

• **Big ideas** (named within the ovals on the landscape) – the central organizing ideas within mathematics that children often construct through reasoning as they work with different strategies. They are the critical ideas and big leaps in development of the structure of children’s reasoning (e.g., “unitizing”).
• **Models** (named within the triangles on the landscape) – the mathematical organizations that support children’s mathematics. They are best developed from models of thinking about a specific context (for example, a Connect 4 game board), to models for thinking generalized across new situations and contexts (e.g., a game board that becomes an array).

Adapted from *Contexts for Learning Mathematics*, 2007

**Note to viewer:** Fosnot’s *Landscape of Learning* (Multiplication/Division and Number Sense, Addition and Subtraction) are available at the back of this viewer’s guide as well as on this DVD.

In Margaret’s class, they are working toward the Grade 2 curriculum expectation of investigating multiplication as the combining of equal groups. Her lessons offer students repeated opportunities to move toward achieving this expectation as they represent and explain their thinking while solving problems that lead them forward in their conceptual understanding of and flexibility with multiplication.

Margaret uses the *Landscape of Learning* to support her planning for contextually rich tasks. She anticipates these tasks will push her students toward the concept of multiplication through first grouping the objects and then determining their total number by:

- counting the objects in the groups by ones
- skip counting
- doubling
- using repeated addition

All the while, students are developing and deepening their understanding of the big idea of unitizing: using numbers to count not only objects in a group, but to also count the groups – and to do so simultaneously.

These experiences provide students not only with a deepening understanding of multiplication that will eventually move beyond repeated addition, but also with the groundwork for proportional reasoning.

**For additional reading and reflection...**

“Paying Attention to Proportional Reasoning” (For ideas about the concept of unitizing, see p.7)
http://www.edugains.ca/newsite/math2/index.html
Three-Part Lesson Framework

Planning lessons using a three-part lesson framework offers teachers a structure that can promote student understanding of mathematics. This webcast contains an uninterrupted viewing of student learning through the three phases:

- **Phase 1 – activating student thinking** (also referred to as ‘Before, Minds On, Getting Started’)
- **Phase 2 – developing student thinking** (also referred to as ‘During, Action, Working On It’)
- **Phase 3 – consolidating student thinking** (also referred to as ‘After, Consolidation with Highlights, Summary and Practice’)

In response to her first lesson, where the context of the problem was potentially one of multiplication (“How many squares are there on an 8 x 8 checker board?”), Margaret saw children use a full range of strategies from counting by ones through to beginning multiplication. In the first (or activation) phase of the lesson featured on this webcast, she hopes that by having students revisit their own thinking, a larger number of them will use more efficient methods and – most importantly – move toward the big idea of unitizing.

The teacher introduces the task, ensuring that students understand the new context. During the middle phase of her lesson, students work in pairs to develop solutions to the Connect 4 game board task. Margaret conferences with student pairs, using the landscape to understand where they are within the developmental framework. She listens to their thinking, asks questions and offers suggestions and refinements.

During the third phase of her lesson, she considers the students’ work and chooses two or three pairs to share, basing her selections on the mathematics that she believes will be of benefit to the learning of the class. During this phase, students question, challenge and make meaning of each other’s thinking. Throughout the three parts of the lesson, Margaret asks questions that foster reasoning and possibly lead to generalizations beyond the context of the task.

**Note to viewer:** As you view this resource, you may wish to record your thoughts using the organizer “Thinking about the learning that occurs within a three-part lesson framework”, which is available at the back of this viewer’s guide as well as on this DVD.
Thinking about the Math

Anticipating students’ responses involves developing considered expectations about how students might mathematically interpret a problem, the array of strategies – both correct and incorrect – they might use to tackle it, and how those strategies and interpretations might relate to the mathematical concepts, representations, procedures, and practices that the teacher would like his or her students to learn.

Stein, Engle, Smith & Hughes, 2007

This webcast shows student work (and students at work) in response to two tasks:

Yesterday’s task: The checker board
How many pieces will I need to buy so that every square on the board is covered?

Today’s task: The Connect 4 game board
How many pieces are needed to fill the game board?

Prior to viewing the webcast footage, it is beneficial to:

- try the tasks and record anticipated student solutions
- identify the mathematics within these solutions
- highlight the strategies on the landscapes of learning organizers
- identify where these strategies reside within The Ontario Curriculum, Grades 1–8 Mathematics, Revised 2005

The math that emerges in response to solving these two tasks includes strategies, big ideas and models that can be found within the two Landscape of Learning organizers provided on this DVD – “Multiplication/Division” and “Number Sense, Addition and Subtraction.” You may wish to view the following eight student work samples to further your thinking.
### Student Work Samples

- **Samples 1–4** show student solutions to the checkerboard task. As you identify the strategies, consider the order of sample 1, sample 2, sample 3 and sample 4. Does the mathematics progress in any way? *Describe.*

- **Similarly, samples 5–8** show student solutions to the Connect 4 game board task. *Describe the connections between the solutions.*

- *Describe the connections between the student solutions to the checkerboard task and the Connect 4 task.*

- **When examining each poster of student work,** consider the questions posed to the right of the poster.

### Notes:

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**Student Work, Sample 1**

Discussion about this student work can be viewed within the webcast by choosing the menu option *Analysing Yesterday’s Lesson* (2:17–4:24)

<table>
<thead>
<tr>
<th>Prompts for Thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identify the mathematics within these solutions</td>
</tr>
<tr>
<td>• Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.</td>
</tr>
<tr>
<td>• Identify where these strategies reside within <em>The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005</em></td>
</tr>
</tbody>
</table>

How many pieces will I need to buy so that every square on the checkerboard is covered?

What questions do you have?

Notes:
Student Work, Sample 2

Discussion about this student work can be viewed within the webcast by choosing the menu option Analysing Yesterday’s Lesson (4:30–5:00)

Prompt for Thinking
- Identify the mathematics within these solutions
- Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.
- Identify where these strategies reside within The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005

What questions do you have?

Notes:
Student Work, Sample 3

Discussion about this student work can be viewed within the webcast by choosing the menu option Analysing Yesterday’s Lesson (5:05–7:06)

Prompts for Thinking

• Identify the mathematics within these solutions

• Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.

• Identify where these strategies reside within The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005

What questions do you have?

Notes:

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10.
Student Work, Sample 4

Discussion about this student work can be viewed within the webcast by choosing the menu option Analysing Yesterday’s Lesson (8:40–9:50)

Prompts for Thinking

- Identify the mathematics within these solutions
- Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.
- Identify where these strategies reside within The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005

What questions do you have?

Notes:
**Student Work, Sample 5**

This student work can be viewed within the webcast by choosing the following menu options:

*Analysis of Activating and Developing Student Thinking* (7:55–9:17)
*Developing Student Thinking* (5:52–6:55)

### Prompts for Thinking

- Identify the mathematics within these solutions.
- Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.
- Identify where these strategies reside within *The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005*.

**What questions do you have?**

Notes:

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<table>
<thead>
<tr>
<th>How many pieces are needed to fill the Connect 4 game board?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The answer is 42, because we counted it twice. We added the 40th column and the 20th column, and it was 42.</td>
</tr>
</tbody>
</table>

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Student Work, Sample 6

This student work can be viewed within the webcast by choosing the following menu options:
Analysis of Activating and Developing Student Thinking (2:36–7:53)
Developing Student Thinking (1:05–1:54)

How many pieces are needed to fill the Connect 4 game board?

Prompts for Thinking

• Identify the mathematics within these solutions
• Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.
• Identify where these strategies reside within The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005

What questions do you have?

Notes:
Student Work, Sample 7

This student work can be viewed within the webcast by choosing the following menu options:
Analysis of Activating and Developing Student Thinking (9:17–17:06)
Analysis of Consolidating Student Thinking (5:16–8:48)
Developing Student Thinking (6:55–15:09)

How many pieces are needed to fill the Connect 4 game board?

Prompts for Thinking

• Identify the mathematics within these solutions
• Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.
• Identify where these strategies reside within The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005

What questions do you have?

Notes:
**Student Work, Sample 8**

This student work can be viewed within the webcast by choosing the following menu options:

- Developing Student Thinking (2:44–5:48)

**Prompts for Thinking**

- Identify the mathematics within these solutions
- Using the landscapes of learning, “Examining Student Strategies” organizer or another tool, highlight the strategies being used to solve the problem.
- Identify where these strategies reside within The Ontario Curriculum, Grades 1 – 8 Mathematics, Revised 2005

What questions do you have?

Notes:

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How many pieces are needed to fill the Connect 4 game board?
Teaching mathematics is about facilitating mathematical development. This means that you cannot get all learners to the same landmarks at the same time, in the same way, any more than you get all toddlers to walk at the same time, in the same way! All you can do is provide a rich environment, turn your classroom into a mathematical community and support the development of each child in the journey toward the horizon.

Fosnot, 2007

There are three clips in this section. Viewers can observe student learning and teacher actions within a three-part lesson framework that occurs across a 90-minute block of time.

- **Activating Student Thinking**
- **Developing Student Thinking**
- **Consolidating Student Thinking**

As you view the clips, make note of and/or discuss with colleagues what aspects of Margaret’s classroom are reflective of the above quote. What do you notice and what questions do you have?

**Activating Student Thinking – Before, Getting Started, Minds On**
(14:40)

In this class, students are working towards an understanding of multiplication.

During their last lesson, the students completed a task that asked them to determine the number of pieces required to cover every square on a checkerboard (see “Analysing Yesterday’s Lesson” for more information). In this clip, students are asked to:

- *do a “gallery walk” of their previous day’s work*
- *select solutions of their peers that make sense to them*
- *label what they see*

After continuing the activation through a class discussion, Margaret introduces the lesson task of determining the number of pieces required to fill a Connect 4 game board which has 6 rows and 7 columns.
John Van de Walle suggests that the beginning of a math lesson has the purposes of:

- **mentally preparing students for learning by activating their prior knowledge**
- **ensuring that students understand the lesson task and what is expected of them in their work – without being told how to do it**

**Math Reflections**

Consider Margaret’s lesson goal of having more students progress from the strategies of counting by ones and skip counting, to the strategy of repeated addition as they move towards the big idea of unitizing in the development of an understanding of multiplication.

- Why does she have them label someone else’s strategy?
- What evidence suggests that this activation did or didn’t support her goal?
- How do you determine in your own teaching whether or not your method of activation has worked for the students?

**Pedagogic Reflections**

“Gallery Walk is an interactive discussion technique that gets students out of their chairs and into a mode of focused and active engagement with other students’ mathematical ideas (Fosnot & Dolk, 2002). The purpose of the Gallery Walk is to have students and the teacher mathematically engage with a range of solutions through analysis and response. It is often carried out after students have generated solutions to a mathematics lesson problem.

Communication in the Mathematics Classroom, Capacity Building Series, 2010

- The purpose for this gallery walk was …
- The learning that came from this for the students was… for the teacher was… what evidence of this is there in the clip?
- What resonated with you about using a gallery walk as an activation strategy rather than as part of a consolidation strategy? With colleagues, discuss similarities and differences.

Too often, the rationale for what we do in the classroom isn’t obvious to students, and students don’t have access to the information. We as teachers must clarify the reasons for our instructional choices so they are informed and motivated.

Burns, 1995"
Reflect on Marilyn Burns’ idea. Do you agree? Disagree? Why?
What aspects of “Activating Student Thinking” create the conditions for learning mathematics?

Developing Student Thinking – During, Working On It, Action (15:09)

As students work to make sense of the mathematical ideas embedded in the problem, both teachers and students use questions to develop and clarify their mathematical thinking.

Asking Effective Questions, Capacity Building Series, 2011

Student pairs work independently to solve the lesson task of determining the number of pieces required to fill a Connect 4 game board with 6 rows and 7 columns. The students record their thinking in a way that will support their peers in understanding that thinking.

Math Reflections

Margaret’s lesson goal is to have more students progress from the strategies of counting by ones and skip counting to the strategy of repeated addition as they move towards the big idea of unitizing in the development of an understanding of multiplication.

• Are the strategies, big ideas and models in the students’ work and conversations the ones you had anticipated?
• Which student pair’s thinking and work might benefit the whole class to consider? Why do you think this?

Pedagogic Reflections

Writing and talking enable learners to make their mathematical thinking visible. It is through writing and talking that teachers obtain a window into their students’ thinking. Both writing and talking are tools for discovery, enabling learners to make new connections as they engage in the process. The fluid nature of talk, allows for the quick brainstorming of many ideas while the permanent quality of writing provides an important trail of our children’s thinking.

Whitin & Whitin, 2000
• Observe how Margaret enters the conversation with the students. What did you notice?
• For pairings and groupings to work effectively there needs to be accountability and responsibility for the learning. What evidence of this can you observe in the shared learning of the task?
• What aspects of “Developing Student Thinking” create the conditions for learning mathematics?

**Consolidating Student Thinking** – After, Consolidation – with Highlighting, Summarizing and Practice
(16:05)

Cathy Fosnot says that “powerful math congresses are structured to push the mathematical development of your community.”

**Math Reflections**

During the congress, Margaret asks students to give name to the strategies they believe their peers are using.

• *How are the students’ names for their strategies reflected in the landscape?*
• *What other strategies did students talk about?*
• *Which strategies seem to be understood by most students? Why do you think this?*
  *What questions would you ask these students to ascertain this more precisely?*

Through questioning and pair-dialogues, Margaret hopes to move her students’ understandings during the congress along the trajectory towards an understanding of multiplication. She begins her math meeting by asking the students to analyse the written solution that will, in a moment, be discussed with the class.

**Pedagogic Reflections**

Through questioning and pair-dialogues, Margaret hopes to move her students’ understandings during the congress along the trajectory towards an understanding of multiplication. She begins her math meeting by asking the students to analyze the written solution that will, in a moment, be discussed with the class.

*A key purpose of questioning is to help students connect what they are learning to what they already know. Asking questions helps guide students as they link what they know to what they are learning. Questioning is an instructional tool that can impact both process (how students learn) and content (what students learn).*

O’Connell, 2005
One aspect of highly effective questions is that they foster reasoning and proof. You are invited to watch the Lucy West Clip, “Questioning,” included in this webcast.

- Where did you notice this?
- How might you ascertain your own strengths when you ask questions?
- How did the context of the lesson task support Margaret’s students in their learning?

What did you notice about the classroom atmosphere that encourages all students to participate in classroom discussions?

- What strategies did Margaret incorporate to consolidate and clarify her student’s thinking?
- Share some of the strategies you have implemented that establish an inclusive environment where students feel safe to discuss their thinking, solutions, uncertainties and wonderings.

How did the congress in this lesson create the conditions for learning mathematics?

### Analyses

There are four clips in this section:

- Analysing Yesterday’s Lesson
- Thinking About Today’s Lesson Task
- Analysis of Activating and Developing Student Thinking
- Analysis of Consolidating Student Thinking

Throughout this portion of the webcast, Alex probes Margaret to clarify and develop deeper understanding of mathematics content and instructional practices. As you view the various clips, consider how you would respond to Alex’s questions. You may choose to use the organizer “Developing A Deeper Understanding” at the end of the viewer’s guide.
Analysing Yesterday’s Lesson
(10:58)

Pedagogic Reflections

Assessment is the process of gathering information that accurately reflects how well a student is achieving the curriculum expectations in a subject or course. The primary purpose of assessment is to improve student learning. Assessment for the purpose of improving student learning is seen as both ‘assessment for learning’ and ‘assessment as learning.

Growing Success: Assessment, Evaluation and Reporting in Ontario Schools, 2010

Would you consider Margaret and Alex’s dialogue to be “assessment?” Why or why not?

Margaret and Alex are analyzing the math work. Think about their discussion, and record some of their comments.

• How is this dialogue helpful?
• What new content learning have you gleaned from this discussion?
• How is assessment an important part of creating the conditions for learning mathematics?

Thinking About Today’s Lesson Task
(9:47)

Consider the Connect 4 game board.

• Because of Margaret’s use of colour, what strategies, and big ideas do you anticipate students might use?
• She left two empty spaces at the top of two columns. What strategies, and big ideas do you anticipate students might use because of this?

What else do you notice about how Margaret has constructed the context of the day’s lesson task?
Traditionally, the array model has been used for multiplication. Research by Battista (1998), however, suggests that this model is often difficult for learners to understand because it requires a substantial cognitive reorganization to be able to coordinate rows and columns simultaneously — and thus an understanding of arrays goes through successive stages of development. Further, students’ early strategies for multiplication are more representative of repeated addition and skip-counting — strategies that are often better represented on a number line and/or with a ratio table, such as a t-chart.

Fosnot, 2007

- Although the first mention of the array in The Ontario Curriculum, Grades 1 – 8, Mathematics, 2005 is in Grade 3, why might Margaret have selected a game board that is set up in an array?
- How do you anticipate students will solve the lesson task?
- How does the context of the lesson task foster the development of landmarks within the landscapes? Within The Ontario Curriculum, Revised 2005?

Margaret and Alex spend time anticipating what students might do.

- How is anticipation of student solutions an important part of creating the conditions for learning mathematics?

Analysis of Activating and Developing Student Learning
(17:07)

In this clip, Margaret and Alex watch video of the classroom lesson recorded that morning and consider the student work. As they do so, both use the Landscape of Learning to identify what students know and can do as they move towards achieving the Grade 2 curriculum expectation of investigating multiplication. They also refer to the Landscape of Learning to construct feedback and plan next steps.

- What tools do you and your colleagues use to identify your students understanding, provide feedback and plan next steps?
Throughout the discussions Margaret talks about anticipating student strategies and solutions.

• *How is your analysis the same or different from Alex and Margaret’s? What are your wonderings?*
• *How is analysis an important part of creating conditions for learning mathematics?*

**Analysis of Consolidating Student Thinking**
(15:14)

It is during whole-class discussion that students explain and justify their ideas and strategies as well as challenge and ask for clarification from their classmates.

*Communications in the Mathematics Classroom, Capacity Building Series, 2010*

Margaret and Alex continue to use video from the morning lesson (along with the landscape of learning) as they analyze the time spent towards consolidating the day’s learning. Alex begins the discussion by asking Margaret about how she has planned her math congress.

• *After students have the opportunity to mathematize (view the context through a mathematical lens), what is the educator’s role in supporting them in gaining a deeper understanding of mathematics?*

Margaret’s strategy for consolidating the learning within the lesson is a math congress.

• *What other strategies have you used (or could use) to consolidate students’ thinking?*

During the congress, one of the students gave an incorrect response.

• *What did Margaret do?*
• *What might be the benefits to student learning?*

Consider what might be the next lesson for Margaret’s students.

• *What did Margaret suggest? Why?*
• *How is your analysis the same and different from Alex and Margaret’s? What are your wonderings?*
• *How is analysis an important part of creating conditions for learning mathematics?*
It is an essential fact that children learn mathematics primarily through...doing, talking, reflecting, discussing, observing, investigating, listening, and reasoning.

Copley, 2000

Some of the main activities to successfully facilitate math talk include:

- assigning tasks that require students to work together and develop joint solutions and problem solving strategies
- providing instruction and modelling behaviours focusing on group skills, shared leadership and effective math communication
- encouraging students to explain and compare their solutions and solution strategies with peers in a supportive and challenging manner

The teacher, as the classroom facilitator, needs to make decisions about when to intervene – and when to let erroneous conversations continue.

- To what extent did you notice the use of the talk moves and strategies in the video?
- What benefits do you see to incorporating these in your practice?
- How might you assess the impact of math talk in your classroom?
- How is math talk an important part of creating conditions for learning mathematics?

Every week, Margaret ensures that she conferences with all the pairs, assessing where each student is in her/his learning. Through precise questioning, she pushes that learning forward along the trajectory.

Alex probes Margaret about her groupings, and how she has paired her students.

- How has Margaret paired her students? What are the possible effects on learning?
- In what ways are students accountable to their partner?
- How does Margaret create the conditions that will allow her to spend extended lengths of time with each pair of students?
- How is conferencing an important part of creating the conditions for learning?

Consider the common threads that all three teachers mention when discussing their own professional learning. Reflect with your colleagues on the various ways you could engage in professional learning, or have engaged in your own professional learning.

- How is professional learning an important part of creating the conditions for learning mathematics?
Knowledgeable Others

As you view the following clips featuring Lucy West and Doug Clements, what ideas do they offer that might create the conditions for learning mathematics in your classroom?

Lucy West

Questioning (2:54)
Lucy West presents statistics that emphasize the importance of questioning that fosters accountable talk in the classroom. She asks us, “What is it we are trying to make happen in our classes? Are we taking a professional learning stance?”

Talk, Task and Feedback (4:22)
Oracy development and the importance of cognition as an outcome of discourse are two of the factors that contribute to the successful interconnection of talk, task and feedback. Students must learn to listen to each other.

Student Voice (3:21)
Lucy outlines how teachers can foster student voice by encouraging them to articulate their reasoning, and by valuing their ideas in the classroom. As teachers, we need to find out what the students are thinking.

Culture of Classroom Discourse (7:11)
Children have two responsibilities: speak up, and listen (and expect to be listened to).

• What factors are evident in a culture of classroom discourse?
• How would one promote accountable talk, listening and collaboration?

Making Meaning (3:39)
The goal of teaching is not to cover the curriculum. Rather, it is to uncover the possibilities for meaningful learning.

Doug Clements

Learning Trajectories (8:36)
Doug Clements talks about the importance of understanding how mathematical thinking develops in children, how they learn and the early learning program expectations.

Intentional Play-based Learning (5:13)
Doug addresses the need to recognize the “teachable moments” during play in order to stretch children’s understanding, and to lay the foundations for thinking.
Intentional Instruction (4:22)
A talk about how essential it is to build up a sequence of ideas through intentional large and small group mini-lessons.

Integrated Concrete Concepts (8:44)
Doug addresses the benefits of using technology with young learners of mathematics.

Early Math Learning (1:43)
Doug discusses the importance of developing early math skills.

**Concluding Thoughts**

Honouring Children’s starting points enables educators to build on students’ mathematical knowledge with an inquiry-based approach, developing purposeful and meaningful mathematical experiences in the classroom. It is also important to realize that the ways in which young children think in mathematical situations can be quite unique. Educators must be particularly careful not to assume that children see situations, problems, or solutions as adults do. Instead, good teachers interpret what the child is doing and thinking and attempt to see the situation from the child’s point of view.

Clements & Sarama, 2009

Consider how the messages in the above quote reflect the practice demonstrated in this resource.

- **What strategies have you and your colleagues implemented?**
- **Do these strategies allow you to take the time to interpret what the child is doing and thinking – and to understand the child’s point of view?**

This viewing guide has encouraged you to reflect on your own practice while watching these resources. You may wish to use the “Reflecting on my Practice” organizer, provided at the end of this viewer’s guide, to make notes on the content you have seen, and how it relates to your own experience.
Resources and Related Reading


Ontario Ministry of Education Resources:

*Capacity Building Series*
- Maximizing Student Mathematical Learning in the Early Years (2011)
- Asking Effective Questions in Mathematics (2011)
- Communication in the Mathematics Classroom (2010)

*What Works? Research Into Practice*
- Dr. Alex Lawson – Learning Mathematics vs. Following “Rules” (2007)
- Dr. Catherine D. Bruce – Student Interaction in the Math Classroom (2007)

Organizers

Landscapes of Learning – Multiplication/Division

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Thinking about the learning that occurs within a three-part lesson framework

<table>
<thead>
<tr>
<th>What are you wondering about?</th>
<th>What do you notice the students doing and saying?</th>
<th>What do you notice the teacher doing and saying?</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Activating Student Thinking (Before, Minds On, Getting Started)</em></td>
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<tr>
<td><em>Developing Student Thinking (During, Action, Working On It)</em></td>
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<tr>
<td><em>Consolidating Student Thinking (After, Highlights &amp; Summary, Practice)</em></td>
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</tbody>
</table>
### Examining Student Strategies

<table>
<thead>
<tr>
<th>Student Work Sample</th>
<th>Strategies</th>
<th>Big Ideas</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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<td>8.</td>
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<tr>
<td>Alex’s questions</td>
<td>Personal responses and wonderings</td>
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</tbody>
</table>
## Reflecting on my Practice

<table>
<thead>
<tr>
<th>Repeating</th>
<th>Current Program</th>
<th>Future Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>These practices have</td>
<td></td>
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<tr>
<td>proven successful</td>
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<td>and are supported</td>
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<tr>
<td>by current research.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Re-thinking</th>
<th>Current Program</th>
<th>Future Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>These practices have</td>
<td></td>
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<tr>
<td>had some measure</td>
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<tr>
<td>of success but may</td>
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<td>need some modifying</td>
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<td>to enhance their</td>
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<td>effectiveness.</td>
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