

Institute Objective

To improve mathematics instruction by providing district-level trainers with professional development resources focused on facilitating students' mathematical understanding through problem solving, communication, and reasoning.

| Time | Notes | Materials |
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| 8:30-9:15 | <p>OPENING SESSION: VDOE Specialists</p> <ul style="list-style-type: none"> • Welcome and Introductions • Purpose of the institute, history, and charge to trainers • Complacency caused by high SOL assessment scores building need to increase emphasis on instruction that promotes mathematical understanding • Content vs. Process Standards - Importance of the process standards and connection to the CCSS' Standards for Mathematical Practice • Mathematics through problem solving vs. Mathematics for problem solving • The importance of the vertical articulation of content • New SOL assessments and the impact on instruction | |
| (15 min.) 9:30-9:45 | <p>Icebreaker Activity: MAKING CONNECTIONS</p> <ul style="list-style-type: none"> • Have participants introduce themselves to those at their table. • Discuss a possible pattern that exists in your group. Examples of possible patterns might be (brown hair, blonde hair, brown hair, blonde hair) or (glasses, no glasses, glasses, no glasses). • When it is your table's turn, please stand up so that the pattern you have selected is visible to the rest of the group. The rest of the group will make conjectures about what the pattern could be. | |
| | <p>Overview of Day</p> <ul style="list-style-type: none"> • Communication and Reasoning through Number Talks • The Teacher's Role in Mathematical Discourse • Mathematics Through Problem Solving • Looking at Student Communication and Reasoning – The "Frog Problem" • Tasks to Promote Communication and Reasoning • Processing and Summarizing | <p>Overview posted on chart paper (for reference throughout the day)</p> |
| (10 min.) 9:45-9:55 | <p>Communication and Reasoning through Number Talks (purpose: to cause dissonance about what mathematics really is – mathematics involves thinking and reasoning; not blindly following procedures that may or may not make sense; to draw attention to the importance of communication and reasoning)</p> <ul style="list-style-type: none"> • Ask participants to solve the following problem mentally (and attempt to think of more than | <p>Chart paper & Markers for facilitator</p> |

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| (25 min.) 9:55-10:20 | <p>one way to find the sum)</p> <ul style="list-style-type: none"> • 198 + 57 • Have participants share how they solved the problem/Facilitator records strategies on chart paper • THINK-PAIR-SHARE: What is the power in having more than one strategy? <p>Let's try another problem: (encourage participants to try a strategy shared during the earlier problem)</p> | |
| (20 min.) 10:20-10:40 | <ul style="list-style-type: none"> • Have participants solve $26 + 27$ in more than one way • Participants share strategies/facilitator records on chart paper • View video of second graders solving same problem – ask participants to note strategies used by students • Table groups: Discuss the various strategies used by students (facilitator should see page 343 and 344 in Number Talks book for a discussion of the strategies used in the video) • Large Group: What is the important mathematics that students are using and/or developing? What is the mathematics they understand that allows them to be flexible with numbers in this way? <ul style="list-style-type: none"> ▪ Quick jot: What is the teacher's role during a number talk? (Have teachers jot words or phrases down to capture their ideas – no discussion. There will be an opportunity for whole group debrief until after K viewing) <p>What do number talks look like in Kindergarten? (purpose: have participants see what it looks like to share thinking in kindergarten)</p> <ul style="list-style-type: none"> ▪ Watch video that shows students engaging with ten frames/dot cards <p>Table Groups Discuss:</p> <ul style="list-style-type: none"> • What student understanding is being assessed thru this number talk? • What do you see/notice about the way the teacher orchestrates the communication/discourse in the classroom? <p>Whole Group: Debrief the two questions above</p> | <p>Number Talks Video 2.3 (2.10 mins.) (Parrish, S. Number Talks: Helping Children Build Mental Math and Computation Strategies. Sausalito, CA: Math Solutions)</p> <p>Number Talks Video K.1 (5.31 mins.) (Parrish, S. Number Talks: Helping Children Build Mental Math and Computation Strategies. Sausalito, CA: Math Solutions)</p> |
| 10:40 -10:55 | BREAK | |
| (25 min.) 10:55-11:20 | <p>The Teacher's Role in Mathematical Discourse (purpose: provide/discuss specific types of teacher moves for orchestrating discourse)</p> <p>Why use Number Talks? THINK-PAIR-SHARE: What is the value of implementing number talks in the mathematics classroom? (what is the value for students, and for teachers)</p> | |

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| | <ul style="list-style-type: none"> • show Key Components and benefit slides • Then ask –“Thinking about both videos we’ve viewed, what do you think a teacher may need to do to create an environment that allows for this kind of math talk?” • Introduce the Five Productive Talk Moves (Chapin, et al.) • Use Productive Talk Moves as a lens to observe a number talk <ul style="list-style-type: none"> ▪ Show video (16 + 15) twice (once all the way thru to give participants sense of the entire number talk) ▪ During second viewing, participants are ask to hold up pencil when they hear a talk move; facilitator pauses the tape and participants name the talk move and record on the matrix <p>Processing Activity: What kind of math talk currently happens in your classroom? Which talk moves are you already comfortable with? Which ones might you wish to incorporate in future lessons?</p> | <p>5 Productive Talk Moves Matrix for Viewing/ Recording</p> <p>Number Talks Video 2.2 (3.07 mins.) (Parrish, S. Number Talks: Helping Children Build Mental Math and Computation Strategies. Sausalito, CA: Math Solutions)</p> |
| <p>(10 min.) 11:20-11:30</p> | <p>Transition: In order to have an environment that focuses on reasoning and problem solving me must think carefully think about the kinds of things we ask students to do.</p> <p>Pass out Richardson quote – have participants read; do a THINK-PAIR-SHARE on what it means to them. Notice the connections between the quote and Virginia’s goals for students (the process standards).</p> | <p>Handout of Richardson Quote</p> |
| <p>(30 min.) 11:30-12:00</p> | <p>Mathematics Through Problem Solving: Frog Problem (purpose: to explore tasks that allow you to rely on reasoning and communicate reasoning using multiple strategies and representations)</p> <ul style="list-style-type: none"> • Small groups solve this problem in at least two different ways, record on chart paper, post on wall <p><i>There were 57 frogs in the pond. Some were swimming and some were sunning. There were about twice as many frogs swimming as were sunning. How many frogs were swimming and how many frogs were sunning? Use pictures, numbers, and/or words to prove that your answer makes sense.</i></p> <p>GALLERY WALK – before or after the lunch break; noting different solution strategies and representations</p> | <p>Chart paper, markers, tape</p> |

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| 12:00-12:50 (45 min.) 1:00-1:45 | <p>LUNCH</p> <p>Looking at Student Communication and Reasoning – First Graders Solve Frog Problem (purpose: to explore student work and see how student’s representations communicate their reasoning and reveal insight into their mathematical understanding)</p> <ul style="list-style-type: none"> • Give teachers the student work samples from the Frog Problem that show different approaches/representations. • Have them hypothesize about students’ understanding, taking note of the <u>evidence</u> they are using to draw their conclusions. For each student, discuss and record: <ul style="list-style-type: none"> • How does this student represent his/her thinking? • What does this student appear to understand (or not understand)? • What would I do next for this student? <p>WHOLE GROUP Discussion:</p> <ul style="list-style-type: none"> • How did this problem provide opportunities for students to reason and communicate? • If you were going to choose students to share their solutions, which students would you choose and why? • Does the order that you have students share matter? | <p>Packet of First Grade Student Work – Frog Problem</p> <p>Graphic Organizer: Looking at Student Work</p> |
| 1:45 – 2:00 | <p>BREAK</p> | |
| (40 min.) 2:00-2:40 | <p>Tasks that Promote Communication and Reasoning (purpose: identify characteristics of rich tasks, modify LL tasks)</p> <ul style="list-style-type: none"> • Share Slide: <i>Characteristics of Rich Mathematical Tasks</i> • Ask participants what made the frog problem a rich task? (<i>participants identify the appropriate characteristics</i>) • The important part of the process of examining tasks is to be aware of the “thinking” provoked by the task and how it aligns with the goal for student learning. • Ask participants to sort the ‘sample tasks’ into lower level/higher level tasks • Small groups record their classifications on the T-chart by placing a tally for each task under low level and high level and then take time to develop characteristics of low level tasks/higher level tasks (serves as formative assessment for facilitator) • Facilitator leads discussion on tasks where there was varied response from participants (why did your group place this task here...what about the task caused your team to place it in this category? Ideas can be noted on chart paper if the facilitator wishes.) | <p>Tasks</p> <p>T-chart for Whole Group recording of sort data</p> |

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| (20 min.) 2:40-3:00 | <ul style="list-style-type: none"> • Follow with VDOE slides (<i>defining characteristics of LL/HL</i>) – recategorize any tasks after looking at the newly revealed criteria (See p. 6 in the book <i>Implementing Standards-Based Mathematics Instruction</i> for a task analysis chart and further discussion) <p><i>The level and kind of thinking in which students engage determines what they will learn.</i> (Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, Oliver, & Human, 1997)</p> <p>Choosing Tasks/Modifying Tasks</p> <ul style="list-style-type: none"> • Have participants choose either task #5 or #11 to modify it to bump up the cognitive demand (to become a better window into student thinking and reasoning) • Refer to characteristics of HL tasks (slides #26 – 27) • Whole Group - Share some changes they made to the LL tasks • Share slide “Why use cognitively demanding tasks?” | |
| (10 min.) 3:00-3:10 | <p>Vertical Articulation</p> <ul style="list-style-type: none"> - Vertical Articulation Documents - help us to identify the important mathematics that we want students to learn - help us know what prior knowledge students might bring - help us know how the understanding they are developing will be used in later grades <p>Share slide showing third grade SOL item (multi-step); the new VASOL requires that students applying higher level thinking skills...</p> | <p>Vertical Articulation Documents (Participants will receive copies during opening session)</p> |
| (10 min.) 3:10-3:20 | <p>Processing and Summarizing – Why are the process standards important?</p> <ul style="list-style-type: none"> ▪ Have each participant write words or short phrases on Sticky notes and place in the middle of table ▪ Using those words and phrases, the group should synthesize those ideas by creating a bumper sticker that summarizes the ideas shared today. | <p>Sticky notes</p> <p>4 ¼ x 11 sheets of cardstock (at least one per group)</p> |

QUOTE -

*Children need to experience **mathematics as problem solving**: investigating, seeing what happens if..., and using mathematics to find out things for themselves that they don't already know. Rather than trying to figure out what the teacher wants them to do, children need to understand that **mathematics is about reasoning**: making conjectures about why something is the way it is and then checking out those conjectures; thinking for oneself rather than trying to figure out what the teacher wants. Rather than being a task done quietly by a child at her desk, **mathematics is about communication**: clarifying her thinking by talking to her friends, by listening to what they have to say, by finding ways to write down her experiences and her thinking with words, with diagrams and pictures, and with mathematical symbols. Rather than being a set of isolated skills and procedures to be practiced and drilled until they are mastered, **mathematics is about connections**: seeing the relationship between mathematical ideas, seeing mathematics everywhere one looks.*

Kathy Richardson (1999)

Additional Resources to Explore:

VDOE K-5 Mathematics Module: Number and Number Sense – module
<http://www.doe.virginia.gov/instruction/mathematics/elementary/index.shtml>

There are many additional resources for ten frames, dot cards, and number talks on the web.