Contest Corner: Increasing Classroom Discourse and Computational Fluency through Number Talks

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The eight Mathematics Teaching Practices, "which represent a core set of high-leverage practices and essential teaching skills necessary to promote the deep learning of mathematics," are identified in The National Council of Teachers of Mathematics (NCTM) *Principles to Actions* (NCTM, 2014, p. 9) and are summarized in Figure 1.

Mathematics Teaching Practices
Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.
Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.
Use and connect mathematical representations. Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.
Facilitate meaningful mathematical discourse. Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
Pose purposeful questions. Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.
Build procedural fluency from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.
Support productive struggle in learning mathematics. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.
Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

Figure 1: Mathematics teaching practices (NCTM, 2014, p.10)

According to NCTM, "Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments. Effective mathematics teaching engages students in discourse to advance the mathematical learning of the entire class. Mathematical discourse includes the purposeful exchange of ideas through classroom discussion, as well as through other forms of verbal, visual, and written communication. The discourse in the mathematics classroom gives students opportunities to share ideas and clarify understandings, construct convincing arguments regarding why and how things work, develop a language for expressing mathematical ideas, and learn to see things from other perspectives." (NCTM, 2014, p. 29).

***Number Talks* were introduced into elementary classrooms in 2010** and are gaining popularity in popular mathematics curriculum such as Math Solutions, Math Perspectives, Math Coach and statewide initiatives. *Number Talks* has become a teaching tool that is appropriate at any grade level and is considered an effective means to promote discourse in the mathematics classroom, while also improving mental math and computational skills. The *Number Talks* process is an effective means to solve mathematics contest problems with a class, group, or math club when they are preparing for competition.

What are *Number Talks*? According to Parrish (2014), "*Number Talks* are a short, ongoing daily routine that provides students with meaningful ongoing practice with mental computation. *Number Talks* are structured short sessions completed alongside the ongoing math curriculum." They were developed for classroom teachers to engage students in "mental math" through grappling with interesting mathematics problems, *Number Talks* only last 5 to 15 minutes and are not intended to replace current curriculum or take up the majority of the time spent on mathematics. Teachers use *Number Talks* regularly as introductions to the day's mathematical practice, as "warm ups" for other lessons, or as stand-alone extended engagements with mathematical concepts.

Number Talks allow teachers to obtain a better understanding of the student's thinking and of their confidence in computing mentally, when they engage their students in *Number Talks*, observe the students doing these mathematical tasks, and listen to their explanations of how they solved the task. *Number Talks* reveals student's level of understanding numbers and the number system.

Today's mathematics curricula and instruction must focus on preparing students to be mathematically proficient, so they can compute accurately, efficiently, and flexibly. According to Parrish, "**Accuracy** refers to the ability to produce an accurate answer, **efficiency** to the ability to choose an appropriate expedient strategy for a specific computation problem and **flexibility** refers to the ability to use number relationships with ease when computing." The primary goal of *Number Talks* is computational fluency. Students use number relationships and the structures of numbers to compute proficiently.

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In *Number Talks*, students develop computational fluency while thinking and reasoning like mathematicians. They are asked to make connections and look for relationships and thus are engaged in "doing mathematics." When students share their strategies with others, they learn to clarify and express their thinking, thereby developing mathematical language. This, in turn, allows students to learn to express their mathematical processes verbally and/or in writing. These are the same skills called for in the Common Core State Standards for Mathematical Practice. (CCSS, 2010).

According to Math Solutions, there are some basic number relationships necessary for students to understand before they can develop computational fluency. These skills include:

1. An understanding that all numbers are composed of smaller numbers.
2. All numbers can be taken apart and combined with other numbers to make new numbers.
3. What we know about one number can help us figure out other numbers.
4. What we know about parts of smaller numbers can help us with parts of larger numbers.
5. Numbers are organized into groups of tens and ones (then, hundreds, tens, and ones, etc.)
6. What we know about numbers to 10 helps us with numbers to 100 and beyond.

Number Talks can be added to the daily routine of any class. First, the teacher presents a problem to the class, often while they are seated in the common area. Students are given time to figure out the answer, typically using mental math - no paper or pencil. Parrish suggests that students give a silent signal, such as thumbs up against their chest when they have a solution as not to interrupt the thinking of students who are still composing a solution. Students can use additional fingers to signal additional strategies they develop to find an answer. Students share their answers; teacher records the responses of three to five volunteers. Then, the teacher calls on students to defend their answer by sharing how they solved the problem. Correct and incorrect answers are explained in hopes that students who may have arrived at an incorrect answer will be able to find where his/her thinking was flawed. Often, students are asked to choose which strategy they feel is most efficient. Not everyone has to agree on the same strategy. A teacher can give a quick exit slip to see if a student can use a specific strategy to solve a similar problem, or can explain how they solved a similar problem, depending on the goal of the *Number Talks*. Figure 2 shows the basic six step format *Number Talks* usually follows.

Steps to implementing *Number Talks*
1. Teacher presents the problem. Problems can be presented in many different ways: models shown on a screen, a word problem, a contest problem or a simple written problem such as 35% of 200 to name a few.
2. Students figure out their answer. Students are given time to solve the problem.
3. Students share their answers. Several students volunteer to share their answers and they are recorded on the board.
4. Students share their thinking. Student volunteers share how they got their answers. The teacher records the student's thinking.
5. The class agrees on the "real" answer for the problem. The answer that the class collectively determines is the right answer is presented as one would the results of an experiment. There should be a sense of confirmation rather than a feeling that the problem is a test of who is right and who is wrong.
6. The steps are repeated for additional problems.

Figure 2: Six steps to *Number Talks* (Math Perspectives, 2007)

Parrish states in her book, *Number Talks: Helping Children Build Mental Math and Computational Strategies,* that there are several necessary components to assure that *Number Talks* are successful in reaching the goal to promote discourse in the mathematics classroom, and also improving mental math and computational skills. First, the teacher must create a safe, risk-free environment, built on mutual respect. Students must be given the opportunity to share their strategies and justifications with their peers. The teacher has to assume the roles of facilitator, questioner, listener, and learner. The important question changes from "What answer did you get?" to "How did you solve this problem?" *Number Talks* should encourage students to build on number relationships to solve problems instead of memorized procedures. The teacher's goals and purposes for the *Number Talks* determine the numbers and operations that are chosen. Careful planning is necessary to design "just right" problems for the students.

The teacher's role in *Number Talks* is to provide a safe environment where each student's thinking is valued. The teacher must select groups of problems that allow access to all students. Problems must highlight important mathematical concepts. The teacher must value every student's thinking, focusing on how students get their answers. He/she must provide adequate wait time. *Number Talks* shifts the focus from, *See what the teacher sees*, to "*What do YOU (the student) see?* The teacher must record, clarify, and restate the student's responses. Lastly, the teacher must realize "if the student doesn't get it, then it is the teacher's responsibility to figure out that student's misconception or lack of proficiency and begin instruction at that point."

Number Talks shifts the focus from, "See what I (the teacher) see," to "What do YOU (the student) see?"

Numerous resources are available to assist teachers in their journey to incorporate *Number Talks* into their daily routine. Internet resources include Inside Mathematics: Classroom Videos: *Number Talks*; Math Perspectives: Teacher Development Center: Developing Mathematical Minds: *Number Talks.* Additionally, *Number Talks Helping Children Build Mental Math and Computational Strategies,* by Parrish, includes a DVD with classroom videos of *Number Talks* in Kindergarten through fifth grade.

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"Atoms have such a long life that each of our own atoms existed in many millions of organisms before being built into our bodies. So there's a good chance that your body houses atoms that were once part of a famous historical figure. Cells also contain water molecules, and these too are recycled. We drink water that once came from rivers. It leaves our bodies as urine, is purified, travels to the sea, evaporates, and then returns to our taps via rain and rivers. The biologist Lewis Wolpert calculated that the number of water molecules in a glass of water is so great (outnumbering the number of glasses of water in the sea) that there's a real likelihood of us drinking one that has been through, say, Napoleon's bladder. So our molecules have been constructed from hand-me-down atoms and are surrounded by water that has passed through countless bodies."

Swaab, D. F. (2014). *We are our brains: A neurobiography of the brain, from the womb to Alzheimer's*, 361. New York, NY: Spiegel & Grau.

"… almost all the neuronal activity is entirely internal. Little is dedicated directly to the peripheral tasks of vision, or hearing, or other senses, or motor performance. Most of it is dedicated to thinking."

Lynch, G. & Granger, R. (2008). *Big brain: The origins and nature of human intelligence*, 51. New York, NY: Palgrave MacMillan.