What is Cognitively Guided Instruction?

As PD, CGI is designed to provide teachers with knowledge of the development of children's mathematical thinking and new strategies that promote enduring mathematical development. CGI draws from decades of research about how children approach mathematics and problem solving. The Common Core Standards promote concepts drawn from CGI.

As a pedagogical strategy, the CGI approach focuses on teaching mathematics rather than teaching a curriculum program. At the core of this approach is the practice of listening to children's mathematical thinking and using it as a basis for instruction. Research based on frameworks of children's cognitive processes (in the domains of addition and subtraction, multiplication and division, base-ten concepts, multi-digit operations, algebra, geometry and fractions) provides guidance to teachers in listening to their students. A tenet of CGI is that there is no singular means of implementing the approach. Furthermore, a teacher practicing good judgment is central to making decisions that benefit their students – judgment based upon what they learn from listening to students' thought processes. The research leading to the development of the CGI approach (Carpenter et al., 2000, p. 3) studied:

(a) the development of students' mathematical thinking;
(b) instruction that influences that development;
(c) teachers' knowledge and beliefs that influence their instructional practice; and
(d) the ways in which teachers' knowledge, beliefs, and practices are influenced by their understanding of students' mathematical thinking.

This work led to the conclusion that children are able to solve problems without direct instruction, by drawing upon informal knowledge of everyday situations.

What is a Number Talk?

A Number Talk is a short, ongoing daily routine that provides students with meaningful ongoing practice with computation. A Number Talk is a powerful tool for helping students develop computational fluency because the expectation is that they will use number relationships and the structures of numbers to add, subtract, multiply and divide

Number Talks should be structured as short sessions alongside (but not necessarily directly related to) the ongoing math curriculum. It is important to keep Number Talks short, as they **are not intended to replace current curriculum or take up the majority of the time spent on mathematics.** In fact, teachers need to spend only 5 to 15 minutes on Number Talks. Number Talks

are most effective when done everyday.

What is the Goal of Number Talks?

The primary goal of Number Talks is computational fluency.

Children develop computational fluency while thinking and reasoning like mathematicians. Children are asked to make connections and look for relationships and thus are engaged in "doing mathematics." When they share their strategies with others, they learn to clarify and express their thinking, thereby developing mathematical language. This in turn serves them well when they are asked to express their mathematical processes in writing

In order for children to become computationally fluent, they need to know particular mathematical concepts that go beyond what is required to memorize basic facts or procedures. Students need to understand that:

• Numbers are composed of smaller numbers. • Numbers can be taken apart and combined with other numbers to make new numbers. • What we know about one number can help us figure out other numbers. • What we know about parts of smaller numbers can help us with parts of larger numbers. • Numbers are organized into groups of tens and ones (and hundreds, tens and ones and • What we know about numbers to 10 helps us with numbers to 100 and beyond and so forth.)

What is the format for Number Talks?

Number Talks are a large or small group meeting where the teacher poses intentionally selected problems for students to solve. They are short, ongoing conversations where children are encouraged to add, subtract, multiply and divide in ways that are meaningful to them, rather than following procedures that are not.

All Number Talks follow a basic six-step format. The format is the same, but the problems and models used will differ for each number talk.

1. Teacher presents the problem. Problems are presented in many different ways: as dot cards, ten frames, sticks of cubes, models shown on the overhead, a word problem or a written problem such as 5 – 2 or 223 + 129 or 45% of 60.

2. Students figure out the answer. Students are given time to figure out the answer. To make sure

students have the time they need, the teacher asks them to give a “thumbs-up” when they have determined their answer. The thumbs up signal is unobtrusive- a message to the teacher, not the other students.

3. Students share their answers. Four or five students volunteer to share their answers and the teacher records them on the board.

4. Students share their thinking. Three or four students volunteer to share how they got their answers. (Occasionally, students are asked to share with the person(s) sitting next to them.) The teacher records the student's thinking.

5. The class agrees on the "real" answer for the problem. The answer that the class together determines is the right answer is presented as one would the results of an experiment. The answer a student comes up with initially is considered a conjecture. For some students, it may take one more experience for them to understand what is happening with the numbers and for others it may be out of reach for some time. The mantra should be, "If you are not sure or it doesn't make sense yet, keep thinking."

6. The steps are repeated for additional problems. There are several elements that must be in place to ensure students get the most from their Number Talk experiences.

What is the Teacher’s Role during Number Talks?

Teachers do not teach specific strategies to the children during Number Talks because it is important that the children think for themselves and use the mathematics they determine is most applicable to the problem at hand.

The teacher's job is to carefully select and present the types of problems that make the particular mathematics and number relationships evident to the students. Through focused, frequent and ongoing experiences, the children learn the mathematics necessary for computational fluency.

The teacher can meet the various levels of thinking that students have reached by providing problems of varying degrees of difficulty. However, for all children to gain from Number Talks, everyone should have access to the problems presented. That is, the children should be able to work on the problem in some way. Teachers can make sure children have access to the problems in three ways: 1) by allowing them to solve problems in their own ways; 2) by presenting problems at varying levels of difficulty ensuring that every child is able to solve at least some of the problems correctly and 3) by providing models for support.

The models should help children develop more and more efficient strategies as they learn to take numbers apart and as they recognize particular relationships among the numbers. The models need to be aids to thinking, not tools for getting answers or to demonstrate memorized procedures. Children should become less and less dependent on the use of the models for any particular concept, ultimately not needing the model at all.

During a Number Talk, the interaction between teacher and students should be like a conversation rather than a report.

The teacher:

Provides a safe environment where each child's thinking is valued.
Selects groups or strings of problems that allow access to all children.
Selects problems that intentionally highlight mathematical concepts.
Values everyone's thinking, focusing on how children get their answers.
Provides adequate wait time.
Shifts the focus from, "See what I see," to "What do YOU (the child) see?"
Records, clarifies, restates.
Realizes that it if the children don't get it, then it is the teacher's responsibility to figure out their misconceptions or lack of proficiency and to begin instruction at that point. The teacher asks questions:
Who would like to share their thinking?
Who did it another way?
How many people solved it the same way as Billy?
Does anyone have any questions for Billy?
Billy, can you tell us where you got that 5?
How did you figure that out?
What was the first thing your eyes saw, or your brain did?