CGI Math

A cognitively guided instruction (CGI) classroom is about problem types, about solution strategies and about how children develop cognitively. CGI is about teachers making instructional decisions based on their knowledge of individual children's thinking. Children approach problem solving willingly and responsibly and recognize that their thinking is critical.

AN overarching goal of CGI is that children will progress from reliance on (a) directly modeling the action in arithmetic word problems to (b) some form of counting or (c) use of abstract number facts. Additionally, I hope my students will develop the (d) ability to use invented algorithms in the solution of problems.

For instance, over time, children will progress (at their own time and rate of development) along the following lines. Children may start with direct modeling and move forward into use of number facts, and then begin using direct modeling again when more difficult problems are encountered. A student-to-student problem solving strategy discussion is stressed, and is facilitated by the teacher.

JRU Problem (location of unknown at end of problem): Anna had 7 strawberries. She got 5 from Marlon. How many strawberries does Anna have now?	
Direct modeling, for example:	a) by using counters,
Counting, for example:	b) using a counting strategy, like counting on from 7. . .8(1), 9(2), 10(3), 11(4), 12(5)
Using number facts, for example:	c) or a fact strategy, like 5 + 5 = 10 and 2 more is 12 Children develop an understanding of number by using number facts as derived from solving problems.
Invented Strategy	d) Children might use a mental set of 5 blocks as landmarks, or a doubles plus two strategy. They may think of a mental number line or number chart when solving the problem. If the problem is automatically solved, the child needs a more difficult number choice.

Another CGI goal is that children will develop more flexible strategies. They will be able to solve problems in more than one way.

For example, a child who first solves a joining problem like (7 + ? = 12) by counting on from 7 to 12 (8(1), 9(2), 10(3), 11(4), 12(5) should come to see that the problem can also be solved by counting down from 12 - 11(1), 10(2), 9(3), 8(4), 7(5). A child will be able to use both counting on and counting down for the same problem, or see it as both joining objects and separating objects. Working on CGI problems, will help children view addition and subtraction as inverse operations.

By using landmark numbers such as 5 and 10 to solve problems, students will work towards developing place value understanding and an understanding of number. Over time, children will develop recall of number relationships, first about doubles (4 + 4 = 8), or counting by 2's or 5's, and then by recalling number facts that are convenient for solving the problems they experience.

Another CGI goal is to work for understanding of number relationships.

Join Result Unknown (JRU) and Separate Result Unknown (SRU) are the types of problems found most often in textbooks. This is not true problem solving, which uses many problem types to lead to deep understanding of the arithmetic operations. Children need to know how to decode and use information to solve problems, not just how to compute.

Rather than distinguishing between addition and subtraction, CGI organizes problem types according to their implied actions. Any of the three numbers in a problem (the starting number, the number indicating a physical change, and the resulting quantity following the change) can be the unknown in a story problem. The children begin to see on their own that addition and subtraction are inverse operations.

Levels of Understanding

Instead of insisting upon a specific (traditional) approach where a child mimics an adult's solution methods, teachers in CGI classrooms learn to spend time understanding children's methods, which will help increase student confidence in mathematics. In general, students begin by directly modeling the situation presented in the problem and progressively move toward applying abstract number facts.

Consider the following Separate Start Unknown (SSU) problem:

Stephanie had some pinecones. She gave 6 to Ricardo. Now she has 8 pinecones. How many pinecones did Stephanie start with?

Needing materials to solve a problem, a child using direct modeling would pull out a large pile of counters and remove 6. After counting the remainders, if there were more or fewer than 8, the child would push all the counters together again and adjust the size of the starting pile accordingly. Then he/she would repeat the actions of removing, counting, checking, and adjusting until there were 8 counters remaining. The child must recognize the need to count the 6 removed and the 8 remaining counters to get an answer of 14.

Once children gain confidence in not needing to physically represent the problem situation, they may use counting strategies to solve problems. A child at this level might solve the above problem by starting at 8 and counting up 6 more to get to 14, possibly using her fingers to count.

At advanced levels of understanding, children know an easier way to solve the problem using addition or subtraction facts. A child at these levels immediately knows that adding 6 and 8 can solve the problem. If a child knows "6+6=12" then he can add 2 to that total to reach 14 (derived facts). However, the most expedient solution method would be to automatically know that 6 added to 8 are 14 (known facts). If the child knows answers automatically, harder number choices are given to provide the child with thinking and problem solving opportunities and a chance to grow in problem solving abilities.

For more information about CGI, search for the Wisconsin Center of Educational Research, University of Wisconsin-Madison, Madison,

Wisconsin.
http://www.promisingpractices.net/program.asp?programid=114

http://www.wcer.wisc.edu/NCISLA/Publications/newsletters/NCRMSE/VOL1NUM2.pdf

A book about CGI:

http://books.heinemann.com/products/E00137.aspx