What Does a CGI Classroom Look Like?

An Introduction to Cognitively Guided Instruction

Cognitively Guided Instruction, often abbreviated as CGI, is an approach to teaching mathematics that builds on children's natural problem-solving strategies. Based on over 20 years of research, CGI identifies specific strategies students use to help teachers understand how students think so that they can guide them toward mathematical understanding. So, you may ask, what does a CGI classroom actually look like?

Differences on the Surface

Pretend for a moment that you are observing three teachers all of whom are teaching the first-grade concept of subtraction using CGI. The first thing you would likely notice is that each has her or his classroom arranged differently. One teacher has students sitting at tables of four so that students can talk as they work. Another teacher has students sitting first on the carpet in a circle, and then allows them to spread out all over the room to work on problems individually in their math notebooks. The third teacher sits with a small group of students at a problem-solving center who share their strategies with each other. Obviously, using a CGI approach does not involve a particular class configuration.

In these classrooms, teachers pose different types of story problems to introduce subtraction. One teacher has addition and subtraction problems mixed together. Another teacher is using subtraction problems only, while the third teacher is using what appear to be missing-addend problems as well as more traditional subtraction problems. So, CGI does not use a pre-specified set of problems in a given sequence to teach the curriculum. Teachers who use CGI are not limited to specific resources, either. One teacher might read a children's book to provide context for the story problems. Another could refer to a recent field trip to a city park. A third might use a textbook as a teaching resource.

Similarities Underneath

Despite these differences, you would notice several important similarities. As we saw, all of these teachers use story problems to introduce a topic. Further, these teachers would not show the children how to solve these problems. In fact, teachers who use CGI usually tell the children to solve the problems any way they can. They also encourage students to use any tools they want, in a way that makes sense to them and that they can explain or show

to another child, or to the teacher. When observing this for the first time, many teachers are mildly surprised that children have so much to say about math.

This may be surprising because so many of us rely on teacher's explanations and demonstrations to teach a concept or skill. This scenario reverses the usual order of instruction that many teachers follow. First, children solve problems and develop meaning for addition and subtraction.

Then, they learn to write number sentences to represent addition and subtraction.

The Teacher's Role in CGI

CGI teachers use their knowledge of problem types and solution strategies to make decisions about their curriculum. This knowledge helps them determine what each child understands and then decide how to help the child extend their understanding. These teachers know that children are able to solve story problems without direct instruction on strategies, because children naturally direct model story situations about which they have informal knowledge.

For example, consider the following problem, called a "Separate Result Unknown" problem.

> *Jennifer has 17 pieces of candy. She gave 8 of the pieces of candy to her brother. How many pieces of candy does Jennifer have left?*

Initially, most children use a tool such as cubes (or tallies or counters) to direct model this situation. They count out 17 cubes, remove 8 of them to show the candies that went to Jennifer's brother, and then count the number of cubes left. However, students may also apply more advanced strategies such as counting back from 17 to 8. They might even count up from 8 to 17 or derive 17 – 8 by figuring 17 – 7, which is 10, and then 10 – 1, which is 9.

CGI and the Benefit to Teachers

When you talk to the teachers about what they are going to do the next day, along with their mathematical goals, you hear them talking about the things they heard their students express and the strategies they saw their students use. They know what these strategies tell them about children's understanding of addition and subtraction.

Perhaps the most striking feature of CGI is that these teachers have a sense of ownership of this knowledge of children's thinking. It empowers them to make decisions, often on the spot. They know when to push, when to hold back, and how to make a problem easier or harder. They know how to support children to make sense of problems in their own ways. They know when to use a story problem and when not to. They know what problems to give next to support children's learning. They know how to listen. Most importantly, they say their curriculum is never quite the same from one year to the next, because the problems they pose depend on the children in their class.

Additional Reading:

Carpenter, T. P., Ansell, E., Franke, M. L., Fennema, E. & Weisbeck, L. (1993). Models of problem solving: A study of kindergarten children's problem-solving processes. *Journal for Research in Mathematics Education, 24*(5), 427-440.

Carpenter, T. P., Fennema, E., Franke, M., Levi, L. & Empson, S. B. (1999). *Children's Mathematics: Cognitively Guided Instruction*. Portsmouth, NH: Heinemann.

Carpenter, T. P., Fennema, E., Franke, M., Levi, L. & Empson, S. B. (2000). *Cognitively Guided Instruction: A Research-Based Teacher Professional Development Program for Elementary Mathematics*. Research Report 003. Madison, WI: National Center for Improving Student Learning and Achievement in Mathematics and Science.

Carpenter, T. P., Franke, M., & Levi, L. (2003). *Thinking mathematically: Integrating Arithmetic and Algebra in Elementary School*. Portsmouth, NH: Heinemann.

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