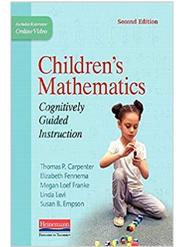# Cognitively Guided Instruction

By Thomas Carpenter, Elizabeth Fennema,
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Cognitively Guided Instruction (CGI) is a research-based approach to teaching number operations. It focuses on problem contexts and children's thinking. The research base on children' mathematical thinking upon which CGI is based shows that children are able to solve problems without direct instruction by drawing upon informal knowledge of everyday situations. For an overview of CGI, an article is available at:

The foundation of this approach is listening to children's thinking and choosing appropriate problems for them to work on based on their level of understanding. CGI problems have three main structures and the idea is that students will work with a variety of problems with these structures using all operations and increasing in difficulty based on the numbers that are used.

Problem Structures:
 ____ + 8 = 15   (start unknown)
7 + ____ = 15   (change unknown)
7 + 8 = ____   (result unknown)

The following problem examples were extracted from an online article that is no longer available for reference.

The following problems are examples. You can change the names, objects or contexts to make the problems more meaningful to your students. The numbers can also be adjusted so that the are at a "just right" level for your students.

Addition

Result Unknown:
- You have 4 books to read. You get 3 more books from the library. How many books do you have now?
- Robin has 98 toy cars. Her parents gave her 45 more toy cars for her birthday. How many toy cars will she have then?
- There are 320 boys in a club. 29 girls join the club. How many children are in the club all together?
- Jane gave 10 pieces of candy to Sam. Fred gave Sam 6 pieces of gum. Mary gave Sam 12 pieces of gum. How many pieces of gum does Sam have now?

Change Unknown
- Kristin had 17 apples. How many more apples will she need to have 39 apples all together?
- Eric has 72 golf balls. He finds some more in the basement. Now Eric has 183 golf balls. How many golf balls did Eric find in the basement?
- Columbus saw 25 whales in the ocean. How many more whales will he need to see to make it 3 dozen whales all together?
- There were 450 kids in the school. Some more kids came to the school. Now there are 920 kids at the school. How many more kids came to the school?

Start Unknown
- Clifford has some bones. Emily gave him 23 more bones. Now Clifford has 46 bones. How many bones did Clifford have to start with?
- Mrs. Wistrom saw some ducks. Then she saw 156 more ducks. All together, Mrs. Wistrom saw 234 ducks. How many ducks did she see to begin with?
- Mom had baked some cookies. Then she baked 4 dozen more cookies. All together, mom has baked 58 cookies. How many cookies did mom bake to begin with?
- Jeff had some leaves in a bag. Then he found 16 more leaves, and put those in the bag. Now Jeff has 76 leaves. How many leaves did Jeff find to begin with?

Subtraction

Result Unknown

• Jessica had 14 toy cars. She lost 11 of the cars. How many cars does she have left?
• Melissa had 78 pumpkin seeds. She gave 23 of them to her brother. How many pumpkin seeds does Melissa have left?
• There were 156 ornaments on the tree. 120 of the ornaments fell off the tree. How many ornaments are left on the tree?
• Dan has 386 papers in his desk. He threw away 17 of them. How many papers does Dan have left in his desk?

Change Unknown

• Mikey had 16 leaves. Some of her leaves blew away. Now she has 7 leaves left. How many of her leaves blew away?
• Sara had 99 goldfish. She gave some away. Now she has 32 goldfish left. How many goldfish did Sara give away?
• 320 children wore their Halloween costumes to school. Some of the children took their costumes off at recess. There were 210 children left wearing costumes. How many children took their costumes off at recess?
• There were 42 cookies on a plate. Dad ate some of the cookies. Now there are 29 cookies left on the plate. How many cookies did Dad eat?

Start Unknown

• Ashley had some guppies. She gave 28 guppies to Timmy. Now Ashley has 12 guppies left. How many guppies did Ashley have to start with?
• Ryan had some trick-or-treat candy. He gave 123 pieces of candy to his sister. Now Ryan has 100 pieces of candy left. How many pieces of candy did Ryan have to begin with?
• Mrs. Wistrom had some pencils. She lost 24 of them. Now she has 6 left. How many pencils did Mrs. Wistrom have to begin with?
• A clown had some balloons. 56 of the balloons floated away. Now the clown has 45 balloons left. How many balloons did the clown have to start with?

Multiplication

• Mrs. Wistrom has 4 boxes of candy. There are 10 pieces of candy in each box. How many pieces of candy does she have now?
• Tommy has 4 packages of Pokemon cards. There are 7 cards in each package. How many cards does Tommy have all together?
• Our classroom has 6 jars. There are 8 butterflies in each jar. How many butterflies are in our room all together?
• Farmer Ted has 10 hens. There are 6 eggs under each hen. How many eggs are there all together?

Division

Here are some examples of **Measurement Division** problems:
• Meagan has 15 cookies. She puts 3 cookies in each bag. How many bags can she fill?
• Karen has 18 Gummy Worms. She puts 3 in each Halloween treat bag. How many bags will she fill?
• Room 124 is going on a hayride. There are 27 kids in the class. 9 kids can fit on a wagon. How many wagons must they take?
• The hens laid 20 eggs. There are 4 eggs under each hen. How many nests are there in the hen house?

Here are some examples of **Partitive Division** problems:

• Megan has 15 cookies. She puts the cookies into 5 bags, with the same number of cookies in each bag. How many cookies are in each bag?
• Karen has 16 caterpillars. She puts the caterpillars into 4 jars, with the same number of caterpillars in each jar. How many caterpillars are in each jar?
• Mom has 12 marshmallows. She puts the marshmallows on 4 sticks, to roast. How many marshmallows are on each stick?
• Mrs. Bell has 20 stickers. She gives them to 10 children, so that they each have the same amount. How many stickers did each child get?

The following is an example of how the same problem context and structure can be used within a class with a wide range of abilities and English language levels. The structure of the problem stays the same, but the numbers and amount of text can be adjusted.

Colin had a collection of **19** marbles. He got some new marbles for his birthday. After his birthday he counted his marbles and he had **43**. How many marbles did he get for his birthday?

Colin had a collection of **38** marbles. He got some new marbles for his birthday. After his birthday he counted his marbles and he had **86**. How many marbles did he get for his birthday?

Colin had **8** marbles.
He got some new marbles.
Now he had **14**.
How many new marbles did he get?