CGI
Problem Solving for K-5 Teachers

Teachers' Institute

July 11, 2014

Problem Solving

- Solve this problem in a way that **makes sense** to you.
- Share **your** strategy and solution with your table
- As a table group, share **one** strategy to share with the whole group.
- Make a **poster** showing this strategy

Action

Mathematical Practices

1. **Make sense of problems and persevere in solving them**
2. **Reason abstractly and quantitatively**
3. **Construct viable arguments and critique the reasoning of others**
4. **Model with mathematics**
5. **Use appropriate tools strategically**
6. **Attend to precision**
7. **Look for and make use of structure**
8. **Look for and express regularity in repeated reasoning**

Routine vs. Non routine problems

- **How would you define or describe routine math problems?**
- **How would you define or describe non routine math problems?**
- **Why are both important opportunities for students to experience throughout an instructional cycle?**

What do you think Cognitively Guided Instruction (CGI) is?

- **Thinking about the words…how would you and a partner define CGI?**
- **Based on your definition of CGI, what student and teacher actions would you observe?**

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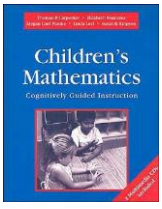
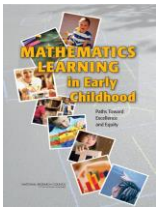
Research – Problem Types

CGI is a result of extensive research from the University of Wisconsin during the 1980's and 1990's.





Problem types identified in CGI Research as well as in Mathematics Learning in Early Childhood from The National Research Council.

ARIZONA'S
COLLEGE AND CAREER READY STANDARDS

AZCCRS in Mathematics contains two different tables that address the **problem types** that all students in K-5 should have the opportunity to experience and master.

Table 1 Addition and Subtraction Situations

Arizona Mathematics Standards Articulated by Grade Level

Table 1. Common addition and subtraction situations.[6] *CGI terms included for problem types in italics.*[7]

	Result Unknown *ARU*	Change Unknown *ACU*	Start Unknown *ASU*
Add to *Join*	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
	Result Unknown *SRU*	**Change Unknown** *SCU*	**Start Unknown** *SSU*
Take from *Separate*	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 – ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3
	Total Unknown *Whole Unknown*	**Addend Unknown** *Part Unknown*	**Both Addends Unknown**[5]
Put Together / Take Apart[4] *Part-Part-Whole*	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
	Difference Unknown	**Bigger Unknown** *Compared Quantity Unknown*	**Smaller Unknown** *Referent Unknown*
Compare[3]	("How many more?" version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? ("How many fewer?" version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	(Version with "more"): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	(Version with "more"): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, 7 + 3 = 5

Table 2 – Multiplication & Division Situations

Arizona Mathematics Standards Articulated by Grade Level

Table 2. Common multiplication and division situations.[7] *CGI terms included for problem types in italics.*[8]

	Unknown Product *Multiplication (M)* 3 x 6 = ?	Group Size Unknown *Partitive Division (PtD)* ("How many in each group?" Division) 3 x ? = 18, and 18 ÷ 3 = ?	Number of Groups Unknown *Measurement Division (MsD)* ("How many groups?" Division) ? x 6 = 18, and 18 ÷ 6 = ?
Equal Groups *Grouping/Partitioning*	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example.* You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example.* You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example.* You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays,[4] Area[5] *Combination*	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example.* What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example.* A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? *Area example.* A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare *Multiplicative Comparison, Rate, & Price*	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example.* A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example.* A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example.* A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	$a \times b = ?$	$a \times ? = p$, and $p \div a = ?$	$? \times b = p$, and $p \div b = ?$

Guiding Students to Share

1. Can you explain your thinking?
2. Where did you start?
3. How did you get your answer?
4. How do you know your answer is correct?
5. Can you justify/explain your solution?

Make the explanation an expectation!

Answers alone are no longer good enough.

Student sharing supports the Standards for Mathematical Practice as students should be able to "explain to themselves the meaning of a problem, look for entry points to begin work on the problem, and plan and choose a solution pathway" (MP 1) and "justify their conclusions, communicate them to others, and respond to the arguments of others" (MP 3).

Common Characteristics of a CGI Classroom

- Problem solving is a **key** component of math instruction
- Students decide how they should solve a problem; **multiple** strategies are used and shared
- Students **justify** and **communicate** to their teachers and peers how they solved the problems
- Teachers understand children's problem solving strategies and use that knowledge to **plan** instruction
- Problem solving is done **consistently** throughout the year

Thank you
Enjoy the rest of the conference
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