

## Cognitively Guided Instruction (CGI)

### Grade Levels

- \* K-3
- \* Special Education K-3

### Approved Areas of Professional Development

- \* Content
- \* Instructional Strategies
- \* Assessment
- \* Standards/Frameworks/Curriculum Alignment
- \* Principles of Learning/Developmental Stages
- \* Cognitive Research
- \* Building a Collaborative Learning Community

### Description

Cognitively Guided Instruction (CGI) is a three-year professional development opportunity offered by the Arkansas Department of Education, education service cooperatives, and the university STEM centers. It is designed for teachers to learn a researched-based framework for how elementary school children learn concepts of number and operation. Children's understanding of algebraic concepts – both properties of operations and properties of equations – is embedded in these frameworks. Teachers also learn how to use the framework to inform their mathematical instruction. The knowledge that teachers gain in a CGI workshop enhances how they implement any curriculum or resource materials.

### Professional Development Schedule

| Year 1   | Content  |
|--|--|
| Four-day summer institute  | <ul style="list-style-type: none"><li>* Frameworks for how children solve addition, subtraction, multiplication, and division problems</li><li>* Frameworks for how children develop an understanding of the base ten number system</li><li>* How to design problems for their students that embed the Common Core State Standards for Mathematics</li><li>* How to adapt problems for learner differences in ways that support all children's ability to engage in rigorous mathematical problem solving</li><li>* How to pose problems to children in a manner that supports and develops children's problem solving abilities</li></ul> |
| Two-day session in the fall semester   |  |
| School-based, classroom embedded professional development is a part of the two-day session in the fall semester. |  |
| One-day session in the spring semester   |  |
| Year 2   | Content  |
| Four-day summer institute  | <ul style="list-style-type: none"><li>* Refine understanding of the frameworks from CGI Year 1 and increase ability to use these frameworks to inform math instruction</li><li>* Integrate instruction in operations and algebraic thinking</li><li>* Tailor questions to gain essential information to determine each student's progress in</li></ul>   |
| Two sessions in the fall or spring semester.   |  |
| School-based, classroom embedded professional development is a part of the two-day session in the school year.   |  |

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|  | understanding of specific math standards<br>* Differentiate instruction in ways that support each student's participation in rigorous mathematical problem solving   |
| <b>Year 3</b>  | <b>Content</b>   |
| Three-day summer institute   | * Refine understanding of the frameworks learned in CGI years 1 and 2<br>* Integrate experiences with children with understanding of the mathematical frameworks to design instruction that engages all children at an appropriate level of rigorous mathematical problem solving<br>* Increase ability to integrate instruction in operations and instruction in algebraic thinking<br>* Develop the ability to use mathematical notation to help children reflect on the algebraic properties of their solution strategies<br>* Integrate number facts instruction with teaching for understanding |
| Two-day session in the fall semester   |  |
| School-based, classroom embedded professional development is a part of the two-day session in the fall semester.<br>Two-day session in the spring semester |  |

### Research

Carpenter, T. P., Ansell, E., Franke, M. L., Fennema, E., and Weisbeck, L. (1993). Models of problem-solving: A study of kindergarten children's problem-solving processes. *Journal for Research in Mathematics Education*, 24(5), 528-441.

Carpenter, T. P., Fennema, E., Franke, M. L., Levi, L., & Empson, S. B. (1999). *Children's mathematics: cognitively guided instruction*. Portsmouth, NH: Heinemann.

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C. P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal*, 26 (4), 385-531.

Carpenter, T. P., Franke, M. L., Jacobs, V. R., Fennema, E., and Empson, S. B. (1998). A longitudinal study of invention and understanding in children's multidigit addition and subtraction. *Journal for Research in Mathematics Education*, 29(1), 3-20.

Jacobs, V. R., Franke, M. L., Carpenter, T. P., Levi, L., Battey, D. (2007). Professional development focused on children's algebraic reasoning in elementary school. *Journal for Research in Mathematics Education*, May 2007.

Jacobs, V. R., Lamb, L. L. C., Philipp, R. A., & Schappelle, B. P. (2011). Deciding how to respond on the basis of children's understandings. In M. G. Sherin, V. R., Jacobs, & R. A. Philipp (Eds.) *Mathematics teacher noticing: Seeing through teachers' eyes*. New York: Routledge.

### Contact Information

For additional information, contact the mathematics specialists at your local education service cooperative or university STEM center.