



The Research for

# Algebra Readiness

Executive Summary

Dr. Rosemary Papa

Dr. Ric Brown, Educational Consultants

 **Glencoe**

 **Macmillan  
McGraw-Hill**

*The McGraw-Hill Companies*

The following is a brief summary of the literature base for Glencoe’s *Algebra Readiness* with additional information about how the program meets California Mathematics Standards. The full report can be found in *The Research Base for Algebra Readiness*, which is an extension of a paper developed in February of 2007 “Research Base of Effective Mathematics Instruction” by Dr. Rosemary Papa.

## The Research Base for *Algebra Readiness* Executive Summary

*Dr. Rosemary Papa, Dr. Ric Brown*

### Overview

The guide for the development of the Glencoe's *Algebra Readiness* program states that the purpose of the program is to reach the estimated 50% of entering high school students who are not algebra ready. The goal is to provide them with the skills to learn successfully and efficiently so that they can achieve in algebra. The writing guide lists ways that the *Algebra Readiness* program can help students by using

- connections between concepts that reveal big ideas
- truly differentiated instruction, not just differentiated examples
- vocabulary instruction and English language support that goes beyond a mere list
- presentation of small amounts of content
- numerous examples with different strategies
- step-by-step exercises to walk through processes
- communication practice – peer reviews, explanations, presentations, etc.
- experiences that are engaging and motivating, including hands-on activities and assessment

The sections that follow provide a brief summary of the literature base for *Algebra Readiness* and include specific examples of that research literature as well as how the program meets California Mathematics Standards. The full report can be found in *The Research Base for Algebra Readiness*.

### Mathematical Proficiency for All Learners

#### Struggling Learners

General strategies found to be successful (Butler, Beckingham, & Lauscher, 2005) in the support of students with math learning challenges include:

- engaging the students in constructive conversation;
- supporting students' reflection on their learning; and,
- the need for teachers to engage in dynamic, curriculum-based forms of assessment.

Research also suggests a variety of instructional strategies that are effective to meet the needs of students with special needs—including those with physical disabilities, mental impairments, and/or learning disabilities; English Language Learners (ELL); and low-performing students who require some special attention to bring out the best of their abilities. The research has found that effective instruction for special-needs students includes:

- setting clear goals for students (Bray and Turner, 1986, Cherkas-Julkowski and Gertner, 1989; Ferritti, 1989; Ferritti and Cavalier 1991, as cited by Baroody, 1996; Schunk, 1985, as cited by Mastropieri, Scraggs, and Shinh, 1991);
- using a “big ideas” structure for concepts (Kameenui and Carnine, 1998, as cited by Fuson, 2003, p. 88);
- teaching content that is presented within meaningful contexts (Miller and Mercer, 1997, as cited by Allsopp, Lovin, Green, and Savage-Davis, 2003);
- laying ample groundwork by providing background knowledge (Bray and Turner, 1986, Cherkas-Julkowski and Gertner, 1989; Ferritti, 1989; Ferritti and Cavalier 1991, as cited by Baroody, 1996; Kameenui and Carnine, 1998, as cited by Fuson, 2003);
- sequencing instruction to go from the concrete to the abstract (Miller and Mercer, 1997, as cited by Allsopp et al., 2003);
- using mediated scaffolding (e.g., visual supports with cues, teachers’ feedback on thinking, peer tutoring) (Kameenui and Carnine, 1998, as cited by Fuson, 2003);
- discussing mathematics using language (Miller and Mercer, 1997, as cited by Allsopp et al., 2003);
- building in multiple practice opportunities (Miller and Mercer, 1997, as cited by Allsopp et al., 2003) and time for review by students (Kameenui and Carnine, 1998, as cited by Fuson, 2003);
- providing continual feedback (Miller and Mercer, 1997, as cited by Allsopp et al., 2003; Fuson, 2003; Blankenship, 1978 and Schunk and Cox, 1986, as cited by Mastropieri et al., 1991).

Three of these elements of effective special needs instruction—modeling, mediated scaffolding, and feedback—are discussed in further detail in the full paper.

## How *Algebra Readiness* Reflects the Research on Mathematical Proficiency for All Learners

The guides for developing *Algebra Readiness* are quite explicit and accurately reflect the research base for the authors developing the material. A summary of the strategies identified in the research include:

- clear goals
- math conversation and discourse
- vocabulary support
- enrichment
- ELL methods
- Escaffolded questions
- word problems
- tiered questions
- sequencing
- writing about mathematics
- graphics and visuals
- feedback
- student reflection
- dynamic, diagnostic, and prescriptive assessment
- cooperative learning

Each chapter in the *Algebra Readiness* program begins with clearly stated goals. In the series, goals are expressed in ‘The What’ and ‘The Why’ sections of each chapter. Vocabulary in both English and Spanish are included in a ‘Key Vocabulary’ box. For example, in Chapter 1 (Lesson 1.2, A Plan for Problem Solving), ‘The What’ is learning how to approach problems and solve them. ‘The Why’ is so students can solve a real-life problem concerning how many hours of work will be needed to buy a computer.

Word problems are given in a sequenced manner with graphic and visual support for all materials. In Lesson 8.2 of *Algebra Readiness*, the method is repeated in a task to make two congruent triangles using geoboards (visually first, then with manipulatives) and rubber bands. A sequenced approach is demonstrated via drawings.

Student reflection, cooperative learning, conversation and discourse are encouraged. In the *Algebra Readiness* material, a ‘Talk Math’ box appears. For example, in Chapter 8, students are paired to discuss similarities and differences between shapes.

Enrichment activities are given for all materials. Additionally, online activity is encouraged (ca.algebrareadiness.com).

Tiering and scaffolding of questions appear in all materials. Teachers are shown alternative pedagogical strategies to explain concepts. For example, in Chapter 1, a ‘Mental Math Minute’

instructs students (orally, written, or in pairs) to describe patterns within a series of numbers. In a 'Scaffolding Questions' box, students take turns writing responses to prompts such as, "Write three numbers that have a sum of 25."

Finally, diagnostic and prescriptive assessment and feedback are used extensively. A readiness quiz begins each chapter. As lessons are taught, practice questions are given to assess understanding. These questions cover math concepts, vocabulary, and data-driven decision making. A 'Common Error Alert' is included in the Teacher Edition to assist in instruction. In addition, a 'Spiral Review' section assesses learning along with a concluding progress check. For all lessons, additional examples provide alternative ideas for concept presentation.

In summary, the development of the *Algebra Readiness* materials is based, to a large extent, on the relevant and current literature in the area of mathematics instruction.

### **How *Algebra Readiness* Relates to the California Mathematics Content Standards**

The linkage of *Algebra Readiness* to the California Mathematics Content Standards is clear and complete. Both the Student and Teacher Editions are explicit as to what standards are being met.

Each lesson begins with key concepts and the California-shaped icon in blue and gold identifying which standards are being addressed. For example, in Chapter 1, a plan for problem solving is introduced. The California icon identifies three grade 7 standards to be covered, (Algebra Functions 1.1 and Mathematical Reasoning 1.2 and 3.3). 'The What' is presented: "I will learn how to approach problems and solve them". 'The Why' relates to a real-life situation concerning the number of hours needed to work to buy a computer.

An outstanding feature in the program, which is strongly supported in the literature, is the opportunity for practice questions directly related to the standard covered. This assures that students become familiar with the format utilized for subsequent testing.

In summary, the Student and Teacher Editions of each chapter of Glencoe's *Algebra Readiness* program provide a section on California Mathematics Standards covered. It is clear that *Algebra Readiness* is ubiquitously tied to the California Content Standards.

## References

Allsopp, D., Lovin, L., Green, G., & Savage-Davis, E. (2003). Why students with special needs have difficulty learning mathematics and what teachers can do to help. *Mathematics Teaching in the Middle School*, 8, 308-314.

Baroody, A.J. (1996). Self-invented addition strategies by children with mental retardation. *American Journal on Mental Retardation*, 10, 72-89.

Bray, N.W. & Turner, L.A. (1986). The rehearsal deficit hypothesis. In R. Ellis & N.W. Bray (Eds.), *International review of research in mental retardation* (Vol. 14, pp. 55-111). New York: Academic Press.

Cherkes-Julkowski, M. & Gertner, N. (1989). *Spontaneous cognitive processes in handicapped children*. New York: Springer-Verlag.

Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life*. New York: Basic Books.

Ferritti, R.P. (1989). Problem solving and strategy production in mentally retarded persons. *Research in Developmental Disabilities*, 10, 19-31.

Fuson, K.C. (2003). Developing mathematical power in whole number operations. In J. Kilpatrick, W.G. Martin, & D. Schifter (Eds.), *A research companion to principles and standards for school mathematics* (pp. 68-94). Reston, VA: National Council of Teachers of Mathematics. in *Mathematics Education*, 30 (3), 286-315.

Mastropieri, M.A., Scraggs, T.E., & Shinh, S. (1991). Mathematics instruction for learning disabled students: A review of research. *Learning Disabilities Research and Practice*, 6 (2), 89-98.

Vygotsky, L. (1986). *Thought and language*. Cambridge, MA: MIT Press.