The Research Base for

California Math Triumphs

Executive Summary

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The following is a brief summary of the literature base for McGraw-Hill's *California Math Triumphs* with additional information about how the program meets California Mathematics Standards. The full report can be found in *The Research Base for California Math Triumphs,* 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 *California Math Triumphs* Executive Summary

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Overview

The guide for the development of the *California Math Triumphs* program states that the purpose of the program is to assist students who are two or more years below grade level in grades 1 to 12. The goal is to provide them with the skills to learn successfully and efficiently so that they can achieve with basic grade level materials. The program is intended as a pull-out course for students to accelerate their learning and be able to return successfully to the regular program. Assessment is diagnostic and imbedded so that the teacher can better monitor entrance and exit from the program. The writing guide lists the following key differences from the typical textbook:

- consumable volumes that allow for flexibility and personalized instruction
- 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 chunks 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 the research base for this program with specific examples as well as how it matches that base and meets California Content Standards.

Mathematical Proficiency for All Learners

Intervention

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, Cherkes-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 not too difficult (Bray and Turner, 1986, Cherkes-Julkowski and Gertner, 1989, Ferritti, 1989, Ferritti and Cavalier 1991, as cited by Baroody, 1996; Baroody, 1996) and 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, Cherkes-Julkowski and Gertner, 1989, Ferritti, 1989, Ferritti and Cavalier 1991, as cited by Baroody, 1996; Kameenui and Carnine, 1998, as cited by Fuson, 2003);
- modeling by teachers (Allsopp et al., 2003; Baroody, 1996; Blankenship, 1978, as cited by Mastropieri et al., 1991);
- 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);
- using reinforcement (e.g., earning verbal praise) (Mastropieri et al., 1991); and,
- 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.

Addressing Specific Mathematics Disabilities

A synopsis of relevant research noted that four different kinds of mathematics disability have been identified (Geary, 1994, as cited by Fuson, 2003). They, and what the research suggested as useful strategies to address them, are as follows.

- Semantic memory disabilities: Students experience trouble with verbal and phonetic memory but may have normal visuospatial skills. Instruction that employs visual clues is most effective for these learners (Fuson, 2003).
- Procedural deficits: Students use less advanced methods overall. Conceptually based instruction is especially helpful for these students (Fuson, 2003).
- Visuospatial disabilities: Students struggle with concepts that use spatial relations (e.g., place value). Instruction most helpful for these students includes extra cues to support visual processing and focuses on methods that can be carried out in either direction (Fuson, 2003).
- Problem-solving deficits: Such students benefit from problem-drawing supports, including visual representations and manipulatives (Fuson, 2003).

Special Needs Students and English Language Learners (ELL)

To support academic achievement for non-native speakers of English and other diverse learners, Secada (1992) recommended:

- intervening early;
- providing ongoing extra support materials and strategies;
- using a student's native language for instruction;
- using a structured curriculum or focus teaching on basic skills;
- using small-group instruction, preferably in cooperative learning settings; and,
- carefully grouping students by specific ability, if necessary (Secada, 1992).

Additional research supports the following practices.

- Teach students in ways that are responsive to their readiness levels (e.g., Vygotsky, 1986), interests, i.e. differentiated instruction (e.g., Csikszentmihalyi, 1997), and learning profiles (e.g., Sternberg, Torff, and Grigorenko, 1998) (as cited by Tomlinson, 2000).

- Flexible groupings (including small workgroups, cooperative learning groups, cross-grade groups, between-grade groups, grouping by ability for guided or independent practice, as well as whole class, and individual practice settings) can improve the mathematical achievement of special-needs students (Slavin, Madden, and Leavey, 1984, as cited by Mastropieri et al., 1991; Mastropieri et al., 1991; Secada, 1992; Slavin, Madden, Karweit, Livermon, and Dolan, 1990, as cited by Secada, 1992).
- Burris, Heubert, and Levin (2006) found that students in heterogeneous groupings (including minority and low SES students) who have completed advanced math courses increase mathematical achievement.

According to Goldenberg (2006), the instructional practices seen as having a positive impact on English Language Learners specific to math include:

- clear instructions and expectations;
- additional opportunities for practice; and,
- extended explanations.

How *California Math Triumphs* Reflects the Research on Mathematical Proficiency for All Learners

The guides for the development of the *California Math Triumphs* program are quite explicit and accurately reflect the research base in terms of use by those developing the materials. A summary of the strategies identified in the research include:

- clear goals
- vocabulary support
- ELL methods
- word problems
- sequencing
- graphics and visuals
- student reflection
- cooperative learning
- math conversation and discourse
- enrichment
- scaffolded questions
- tiered questions

- writing about math
- feedback
- dynamic diagnostic and prescriptive assessment

Each chapter in the *California Math Triumphs* series begins with clearly stated goals. In the *California Math Triumphs* series, 'Key Concepts' are presented at the beginning of each chapter with critical vocabulary highlighted. For example, in Chapter 2 (Volume 1A, Place Value), the key concept is "Place value is the value assigned to each digit based on its position in the number." The words, place value and digit, are highlighted and their meaning is explained in a 'Vocabulary' box to the side of the page. As well, to accomplish the goals for English language learners (ELL), an 'English Learner Strategy' box is included with teaching tips for such students. This is consistent for all chapters.

Word problems are given in a sequenced manner with graphic and visual support for all materials. For example in Lesson 5.1 (*California Math Triumphs*, Chapter 5, 1B), the explanation of division of 8 by 2 (a word problem dividing eight pretzels between a student and friend) is sequenced in a horizontal, vertical and fraction method. Number boxes, sentences and pictures are utilized.

Student reflection, cooperative learning, conversation and discourse are encouraged throughout the *California Math Triumphs* chapters. In the Teacher Edition (Chapter 2, 1A), a strategy is given to divide students into small groups to create posters for discussion utilizing various numbers demonstrating place value.

Enrichment activities are given in all materials. In the *California Math Triumphs* series, a 'Math Challenge' box in each chapter provides puzzles and brain teasers for those seeking extra work.

Tiering and scaffolding of questions appear in all materials. A strategy in *California Math Triumphs* asks students to work through and write answers to questions to 'Understand, Plan, Solve and Check'. In a place-value example (Chapter 2. 1A), students work with charts (hundreds, tens and ones) to make the greatest number value with the digits 3, 4 and 5.

Finally, diagnostic and prescriptive assessment and feedback are used extensively in *California Math Triumphs*. A readiness quiz begins each chapter. As lessons are taught, practice questions are given to assess understanding. These questions cover both the math concepts and vocabulary.

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 *California Math Triumphs* is based, to a large extent, on the relevant and current literature in the area of math instruction.

California Mathematics Content Standards

The California State Board of Education (California, 2006) developed the mathematics content standards to establish what they believe all students in California need to know with respect to mathematics. They were established to achieve six goals:

- Develop fluency in basic computational skills.
- Develop an understanding of mathematical concepts.
- Become mathematical problem solvers who can recognize, and solve routine problems readily and develop ways to reach a solution or goal where no routine path is apparent.
- Communicate precisely about quantities, logical relationships, and unknown values through the use of symbols, models, graphs, and mathematical terms.
- Reason mathematically by gathering data, analyzing evidence, and building arguments to support hypotheses.
- Make connections among mathematical ideas, and between mathematics and other disciplines.

How *California Math Triumphs* Relates to the California Mathematics Content Standards

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

For example, each lesson begins with key concepts and the California-shaped icon in blue and gold identifying which standards are being addressed. In the Teacher Edition, a 'Chapter at a Glance' section outlines the entire chapter in terms of California Standards in each lesson along with a plainly written objective. For example, in Chapter 1 of Volume A, Standard 2NS1.1 is identified as key. That Standard, Grade 2, Number Sense refers to counting, reading, and

writing of whole numbers to 1000. The objective in plain terms is stated as count, read, and model numbers to 1000. In Volume A, Chapter 5 (Division), two California Standards are noted, one from grade 3 (Number Sense 2.2) and one from grade 4 (Number Sense 3.2). Since concepts drive the *California Math Triumphs* program, both standards are covered even if from different grade levels.

Chapter 8 presents the unique conceptual feature of the *California Math Triumphs* program while covering triangles and quadrilaterals. The standards are presented contiguous with the California icon, but since the material is topic based, standards in both grades 5 and 7 are covered (5MG2.2 and 7 MR 1.1). This approach assures that students in the program get all material related to the standard as well as the necessary prerequisite and sequential material.

An outstanding additional feature in the program, which is strongly supported in the research 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 Edition of each chapter in the *California Math Triumphs* series provides a section on California Intervention Standards to be covered. It is clear that the content addressed in the *California Math Triumphs* program is ubiquitously tied to the California Intervention Standards.

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