

# **P R I M E**

## **PRompt Intervention in Mathematics Education**

### ***Mathematics Intervention Programs***

*Editor*

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2005

Ohio Resource Center for Mathematics, Science, and Reading  
and  
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## PRIME Mathematics Intervention Programs

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The mathematics intervention programs listed here include programs that were presented at the PRIME conference April 21, 2005, or featured in the handout distributed at the conference. Though all programs ultimately involve students, teachers, and curriculum, the programs listed below have been arbitrarily grouped into programs that focus directly on students, programs that focus on professional development for teachers, and programs that are based largely on curricular materials.

### PROGRAMS THAT FOCUS DIRECTLY ON STUDENTS

Programs in this category are listed roughly according to the ages of the students involved, beginning with preschool and ending with a college level program. Of course, many programs span several grade levels, and some are adaptable to levels not intentionally targeted.

**Title: Head Start**

**Audience:** 3- and 4-year-olds and their families

**URL:** <http://www.ohsai.org/>

**Reference:** Sophian, C. (2004). Mathematics for the future: Developing a Head Start curriculum to support mathematics learning. *Early Childhood Research Quarterly*, 19, 59-81.

Services include parental training in areas of child development, as well as specific strategies to support children in reading and mathematics. A pilot curriculum familiarizes children with alternative units for counting and the effects of variation in unit size on numerical outcomes. Results indicate significant positive effects on mathematics achievement in the intervention group.

**Title: Chicago Child-Parent Center Project**

**Audience:** Preschool–grade 3 students and families

**URL:** <http://www.ecechicago.org/pages/home/programs/preschool/>

Child-parent centers are located in or near low-income elementary schools and function under the leadership of the elementary school principal. The centers provide support during the transition from preschool to formal schooling. Training and resource materials focus on child development, literacy, and mathematics. Parents play numerous roles within the center in exchange for the support they receive.

**Title: Project Excel**

**Audience:** Bilingual K-3 classrooms

**References:** Flores, A. (1995). Bilingual lessons in early-grades geometry. *Teaching Children Mathematics*, 1(7), 420-424;

Percy, R. I. (1991). *Project Excel: Gifted potential*. San Diego, CA: San Diego City Schools.

The geometry activities in this project were used to identify gifted bilingual students. Early intervention programs are crucial to identify, attract, and retain students from underrepresented populations in programs for gifted students.

**Title: Saturday Program**

**Audience:** Students in grades K-5

**URL:** [http://www.greatschools.net/modperl/browse\\_school/oh/519/](http://www.greatschools.net/modperl/browse_school/oh/519/)

The Arlington Park Elementary School in Columbus, Ohio, has initiated a variety of strategies over the last several years to improve mathematics achievement, including an after-school

program and a Saturday program focused on helping students do well on achievement and other tests.

**Title: PALS Math**

**Audience:** Students in grades K-6

**URL:** <http://kc.vanderbilt.edu/kennedy/pals/index.html>

Peer Assisted Learning Strategies Math (PALS Math) has been approved by the U.S. Department of Education's Program Effectiveness Panel as an effective educational practice. Repeated evaluations of PALS Math indicate that high-achieving, average-achieving, and low-achieving students, as well as students with learning disabilities, make greater progress in PALS classrooms than their counterparts in typically structured classrooms. This program trains peers to tutor each other in a guided manner to increase mathematical skills. Training packets are designed for computations and applications, including critical thinking skills.

**Title: Head Start Follow-on Intervention**

**Audience:** Children in grades 2 and 3

**Reference:** Reynolds, A. J. (1994). Effects of a preschool plus follow-on intervention for children at risk. *Developmental Psychology, 30*(6), 787-804.

The follow-on intervention was significantly positively correlated with school adjustment for economically disadvantaged children. The duration of the intervention might be just as important, or more important, to children's adjustment than the timing of the intervention. There must be equal concern for "upward" expansion of Head Start programs after students enter formal schooling.

**Title: Winburn Family Project**

**Audience:** Children in grades 2-6 and their parents

**Reference:** Strutchens, M., Thomas, D., & Perkins, F. D. (1997). Mathematically empowering urban African American students through family involvement: Equity in mathematics education is about access. In J. Trentacosta & M. J. Kenney (Eds.), *Multicultural and gender equity in the mathematics classroom* (pp. 230-235). Reston, VA: National Council of Teachers of Mathematics.

This 8-week project focused on developing students' and their parents' mathematics skills through the use of literature with cultural connections. At the end of the project, parents showed an increased ability to ask their children meaningful questions, and the parents expanded their use of physical models as a means to help both themselves and their children understand mathematical concepts.

**Title: Kids2Kids**

**Audience:** Students in grades 3-6

**URL:** <http://www.orrville.k12.oh.us/district/initiatives/index.asp#maple>

One of the goals of Maple Street School in Orrville is for all students to improve their mathematics skills. To accomplish this goal, many students have become members of the Principal's Math Club and have participated in the Kids2Kids tutoring program where older students tutor younger students.

**Title: Reciprocal Peer Tutoring**

**Audience:** 4<sup>th</sup>- and 5<sup>th</sup>-grade students and families

**Reference:** Fantuzzo, J. W., Davis, G. Y., & Ginsburg, M. D. (1995). Effects of parent involvement in isolation or in combination with peer tutoring on student self-concept and mathematics achievement. *Journal of Educational Psychology, 87*(2), 272-281.

This program used both parental involvement and reciprocal peer tutoring as an approach to improve students' mathematics achievement. The program provided parents with a variety of

levels of engagement as it encouraged them to learn about and develop their roles in helping their children.

**Title: Title I Parent Programs**

**Audience:** Elementary and middle grades students and families

**URL:** <http://www.nctic1p.org/>

**Reference:** Shaver, A. V., & Walls, R. T. (1998). Effect of Title I parent involvement on students' reading and mathematics achievement. *Journal of Research and Development in Education*, 31(2), 90-97.

The National Coalition of Title I/Chapter I Parents (NCTIC1P) helps economically disadvantaged parents develop skills needed to make sound decisions regarding their children's education. One such program sponsored meetings to provide information, training, and discussion with teachers and other parents. Parents were provided with an update of their child's progress in reading and mathematics. Time was also provided for parents to work together with their children on specific skills presented at the meetings.

**Title: ERG**

**Audience:** Middle school girls

**Reference:** Koontz, T. (1997). Know thyself: The evolution of an intervention gender-equity program. In J. Trentacosta & M. J. Kenney (Eds.), *Multicultural and gender equity in the mathematics classroom: The gift of diversity* (1997 Yearbook, pp. 186-194). Reston, VA: National Council of Teachers of Mathematics.

ERG (Enrichment Readiness for Girls) was a middle school intervention program named after a unit of potential energy. This successful program was designed to encourage middle school girls to continue mathematics, science, and computer courses throughout high school. Among the goals of the program were to encourage group problem-solving projects and to increase career awareness in technical fields.

**Title: QUASAR**

**Audience:** Middle school students

**Reference:** Silver, E. A., & Stein, M. K. (1996). The QUASAR Project: The revolution of the possible in mathematics instructional reform in urban middle schools. *Urban Education*, (30)4, 476-521.

QUASAR (Quantitative Understanding: Amplifying Student Achievement and Reasoning) was funded by the Ford Foundation and located at the University of Pittsburgh's Learning Research and Development Center. The project aimed to raise low levels of student participation and performance in mathematics. QUASAR was an urban middle school demonstration project that fostered the development and implementation of improved mathematics instructional programs in economically disadvantaged communities. The program was developed around three key principles: (1) all students are able to learn a broad range of mathematical content; (2) all students can acquire a deeper and more meaningful understanding of mathematical ideas; and (3) all students can demonstrate proficiency in mathematical reasoning and complex problem solving.

**Title: The Algebra Project**

**Audience:** Middle school students, parents, and teachers

**Reference:** Moses, R. P., & Cobb, C. E. (2001). *Radical equations: Math literacy and civil rights*. Boston, MA: Beacon Press.

This project aims to provide access to algebra curriculum for all students. Instruction includes five crucial components (from concrete to abstract): (a) Physical Events, (b) Pictorial Representations/Modeling, (c) Intuitive Language/People Talk, (d) Structured Language/Feature Talk, and (e) Symbolic Representation. The Algebra Project also raises parents' awareness of the importance of algebra, and it teaches mathematical ideas to parents so they are able to help their children with homework.

**Title: Cognitive Tutor Algebra****Audience:** Algebra I students**URL:** <http://pact.cs.cmu.edu/>

Cognitive Tutor Algebra is a full year Algebra I course developed collaboratively by Carnegie Mellon and an award-winning high school mathematics teacher. The program incorporates software that tracks individual students' learning, gives hints, and provides an interface that links text, graphs, equations, and tables. Typically students spend two days per week working in a computer lab environment and three days per week working on small-group activities in the classroom.

**Title: The Saturday Academy Program****Audience:** High ability minority students in grades 7-9 and their parents/guardians**Reference:** Hayden, L. B., & Gray, M. W. (1990). A successful intervention program for high ability minority students. *School Science and Mathematics, 90*(4), 323-333.

Students who participated in this program were identified as academically talented, had at least a B average, and were recommended by a mathematics teacher, science teacher, or counselor at their schools. The program included summer enrichment and a parent/guardian component. The program had a significant effect on high school graduation, college enrollment, and selected major in college. The effect was more pronounced for males than females.

**Title: Science Bound Project****Audience:** Grades 8–12 students and families**URL:** <http://www.iprt.ameslab.gov/SB/>.

The Science Bound program at Iowa State University is a partnership between a local school district and the university that aims to increase ethnic minority students' participation in science and technology. It includes a component that works with parents to promote the learning of mathematics and science. The family support component provides ways for families to encourage their children to pursue a mathematics- or science-related career.

**Title: Strategic Content Learning****Audience:** Secondary school level**Reference:** Butler, D. L. (1998). A strategic content learning approach to promoting self-regulated learning by students with learning disabilities. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 160-183). New York: Guilford Press.

The Strategic Content Learning (SCL) instructional model is built on learning-disabled students' awareness of strategic behavior, ability beliefs, and self-regulation. First, students are asked to analyze an academic task they need to accomplish. Next, they discuss strategies they know to accomplish this task. They are then assisted in acting strategically and monitoring progress toward task completion. Results include improved performance on specific academic tasks; development of personalized and focused strategies, strategy transfer across contexts, and flexibly adapted strategic approaches across tasks.

**Title: Self-Regulation Empowerment Program****Audience:** Learning-disabled secondary school students**Reference:** Cleary, T. J., & Zimmerman, B. J. (2004). Self-Regulation Empowerment Program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychology in the Schools, 41*, 537-550.

This school-based intervention program incorporates a problem-solving model from school psychology. The first phase of the intervention empowers students to feel in control of their academic outcomes. A coach helps students connect the strategies they use with their outcomes. Second, the coach provides strategy instruction. Third, students engage in a cyclical feedback loop, in which they set goals, select strategies for accomplishing the goals, monitor their strategy

use, and make adjustments when necessary. The intervention supports the development of self-regulated learning behaviors.

**Title:** EMPT

**Audience:** Students in grades 10-12

**URL:** <http://www.empt.org/empt/>

EMPT (Early Mathematics Placement Test) is a high school mathematics intervention program designed to help students, counselors, and parents make decisions on appropriate mathematics courses in grades 11 and 12, based on aspirations reported during the testing process. The Ohio EMPT Program placement tests are administered to high school sophomores, juniors, and seniors to give them an indication of where they stand in terms of mathematical understandings and readiness for college or the workplace. After receiving their individualized results, students must talk to a counselor and/or teacher for advice on what is the best mathematics class to schedule for the next term and/or school year. This process helps ensure that students are prepared for college level mathematics courses or are prepared for a skilled work experience. EMPT is intended to eliminate the need for remedial mathematics courses or basic mathematical on-the-job training. The test results are not placed in a student's college record and the tests are not a state or federal requirement. EMPT-type intervention has been recommended in the document *Ready or Not: Creating a High School Diploma That Counts*, a publication of the American Diploma Project. EMPT is funded by the Ohio Board of Regents and is based at The Ohio State University.

**Title:** Strategies of School Success

**Audience:** First- or second-year college students

**URL:** <http://dennislearningcenter.osu.edu/index.asp>

College learning centers frequently support students through strategy remediation efforts typically focused on general learning strategies. The learning strategies course at Ohio State University supports students' efforts in four areas: taking reasonable risk, taking responsibility for outcomes (e.g., avoid procrastination and believe in ability to succeed), searching the environment (e.g., actively listening or reading and preparing for exams), and using feedback. Higher grade point average and increased motivation for academic learning have been found for participating students as compared with students who do not take this course.

### PROGRAMS THAT FOCUS ON PROFESSIONAL DEVELOPMENT FOR TEACHERS

The programs listed in this category help students by helping teachers recognize, diagnose, and prevent student difficulties. These programs provide teachers with techniques and perspectives to enhance the mathematics learning of all students, regardless of the particular curriculum materials being used. Some of these programs focus on a specified context, but all include methods that can enrich teaching and learning in any context.

**Title:** Mathematics Recovery

**Audience:** First-grade students

**URL:** <http://www.mathrecovery.com/>

Mathematics Recovery, developed in Australia, involves specialist teachers working to advance the mathematical knowledge of low-attaining first-grade students to a level where they can learn successfully in a regular class. This intervention is accomplished through a short-term teaching cycle utilizing intensive, individualized instruction. Mathematics Recovery is designed for implementation at a district or state level via a year-long professional development course for teachers.

**Title: CGI****Audience:** Teachers of grades K-3**URL:** <http://ccvi.wceruw.org/ccvi/CGISpider/newsletter/newsletter.asp>

CGI (Cognitively Guided Instruction) is a problem-based approach to mathematics instruction for kindergarten through third grade. The strategies and principles encouraged through CGI professional development are not textbook or program specific and have been proven effective for students with diverse racial and ethnic backgrounds. Children's prior knowledge is central to instructional decision making in this teaching approach. CGI focuses on children's mathematical thinking and communication.

**Title: Project IMPACT****Audience:** Teachers of grades K-3**URL:**

Project IMPACT (Improving Mathematics Practices and Classroom Teaching), funded by the Ohio Department of Education, is a professional development experience supporting school teams of K-3 teachers to increase their effectiveness in teaching mathematics. Participants engage in an in-depth study of K-3 content focusing on number sense and equality. The mathematical process standards are the platform for learning and teaching mathematics.

**Title: OMAP****Audience:** Teachers of grades 7-10**URL:** <http://www.ode.ohio.state.oh.us>

OMAP (Ohio Mathematics Academy Program) summer professional development is offered for teachers to help them understand the concepts featured in the Ohio *Academic Content Standards* and to address the Standards in their own classrooms. Professional development modules in algebra, geometry, and data analysis and probability have been created and shared with teachers through this program.

**Title: ACCLAIM****Audience:** All students and teachers in rural settings**URL:** <http://acclaim-math.org/>

ACCLAIM (Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics) aims to understand how the rural context pertains to learning and teaching mathematics and to articulate in scholarly works the "meaning and utility" of learning and teaching in rural contexts.

**Title: IMPACT****Audience:** Predominantly minority urban elementary students and their teachers**Reference:** Campbell, P. F., & Rowan, T. E. (1997). Teacher questions + student language + diversity = mathematical power. In J. Trentacosta & M. J. Kenney (Eds.), *Multicultural and gender equity in the mathematics classroom* (1997 Yearbook, pp. 60-70). Reston, VA: National Council of Teachers of Mathematics.

IMPACT (Increasing the Mathematical Power of All Children and Teachers) helped teachers as they planned lessons that incorporated meaningful, real-world mathematics problems "aimed a little higher than usual for the students." Teachers reported that the expectations they held for their students increased and that their students had improved both their mathematics and language proficiency more than under other approaches.

**Title: Mathematics Case Methods Project****Audience:** Teachers**URL:** <http://www.weted.org/pub/docs/mem.htm>**Reference:** Barnett-Clark, C., & Ramirez, A. (2004). Language pitfalls and pathways to mathematics. In R. N. Rubenstein & G. W. Bright (Eds.), *Perspectives on the teaching of*

*mathematics* (66<sup>th</sup> Yearbook, pp. 56-66). Reston, VA: National Council of Teachers of Mathematics.

This professional development program aimed to help teachers analyze the impact of language on their students' mathematical understanding. Specific language "pitfalls" and their implications are discussed.

**Title:** Japanese Lesson Study  
**Audience:** Teachers at any level  
**URL:** <http://www.oai.org/smart/pdf/STv3i3.pdf>

The SMART Consortium is providing leadership for a number of mathematics and science education projects in northeast Ohio. One such project is centered on the idea of lesson study. "Lesson study" is a process for improving student achievement in which teachers jointly plan, observe, analyze, and refine classroom lessons called "research lessons." Lesson study has its roots in Japanese education, but since 1999 has been implemented in sites across the United States.

### PROGRAMS BASED LARGELY ON CURRICULUM MATERIALS

Instructional materials can be instrumental in effective intervention. Listed below is a small sample of the wide variety of curriculum and resource materials that teachers can use in assisting students. In addition, the first paper below suggests criteria for evaluating the appropriateness of a mathematics program.

**Title:** Connected Equitable Mathematics Curriculum (CEMC)  
**Audience:** All students and teachers  
**Reference:** Goodell, J. E., & Parker, L. H. (2001). Creating a connected, equitable mathematics classroom: Facilitating gender equity. In B. Atweh, H. Forgasz, & B. Nebres (Eds.), *Sociocultural research on mathematics education* (pp. 411-431). Mahwah, NJ: Lawrence Erlbaum.

CEMC researchers identify 12 characteristics of what they consider essential features of an ideal mathematics curriculum, and they provide a framework for discussions about and progress towards more gender-inclusive and equitable curriculum.

**Title:** *Success for All/Math Wings*  
**Audience:** Preschool and kindergarten students and families  
**URL:** <http://www.successforall.net/>

*Success for All/Math Wings* is a developmentally appropriate reading and mathematics program for preschool and kindergarten students. The program places great emphasis on parental involvement and provides strategies for involving parents. Each school building has a family support team that provides programs and services for parents.

**Title:** *Family Math*  
**Audience:** Grades K-8 students and families  
**URL:** <http://www.lhs.berkeley.edu/equals/FMnetwork.htm>

*Family Math* is based on the philosophy that (1) all children can learn and enjoy mathematics and (2) parents and other family members are their children's first and most influential teachers. *Family Math* topics relate to the school mathematics curriculum, including algebra, probability, statistics, estimation, logic, geometry, and measurement. *Family Math* is the doing of mathematics and uses inexpensive materials of all kinds—beans, blocks, bottle caps, toothpicks, coins—to help people figure out ways to solve problems.

**Title: Computer Software as Intervention**

**Audience:** Elementary school students and teachers

**URL:** <http://perrynet.sparcc.org/genoa/pages/welcome.htm>

Schools such as Genoa Elementary School in the Perry Local Schools in Massillon, Ohio employ computers to provide assistance to children in mathematics.

**Title: National Science Foundation Funded Mathematics Programs**

**Audience:** Elementary, middle grades, and high school students and teachers

**URLs:** Elementary: <http://www.comap.com/elementary/projects/arc>

Middle grades: <http://www.showmecenter.missouri.edu>

High school: <http://www.ithaca.edu/compass>

Over the past decade or so, an interesting variety of innovative curriculum materials have been developed with NSF funding to reflect the spirit and intent of national Standards in mathematics. The websites listed above provide an introduction to these materials at the indicated levels.