REL NORTHEAST & ISLANDS

REGIONAL EDUCATIONAL LABORATORY at EDC

Middle School Mathematics Intervention

Description of Request:

Our Middle School is in need of improvement in the area of mathematics and has an integrated a mathematics intervention class for students who are not making yearly adequate progress.

Questions:

1. What are effective mathematics intervention programs for middle schools?

Report:

Following an established REL-NEI Reference Desk research protocol, we conducted a search for research reports as well as descriptive and policy-oriented briefs and articles in this area. The sources included federally funded organizations, additional research institutions, several educational research databases, and a general Internet search using Google and other search engines. We also searched for appropriate organizations that may act as resources on this issue. We have not done an evaluation of these organizations or the resources themselves, but offer this list to you for your information only.

Our Researchers have found that the research evidence is showing some trends. "Consistent with an earlier review of elementary programs, this article concludes that programs that affect daily teaching practices and student interactions have larger impacts on achievement measures than those emphasizing textbooks or technology alone (Slavin, Lake & Groff, 2008; see below)." Additionally, "The WWC rated the effectiveness of middle school math curricula based on the available research evidence. In looking at math achievement for the 7 curricula:

- *I Can Learn® Pre-Algebra and Algebra* had positive effects.
- *Saxon Middle School Math* had positive effects.
- *Cognitive Tutor* had potentially positive effects.
- *The Expert Mathematician* had potentially positive effects.
- *UCSMP Algebra* had potentially positive effects.
- Two other curricula had mixed effects on math achievement (WWC Topic Report – Middle School Math, see below)."

Question:

1. What are effective mathematics intervention programs for middle schools?

1.1. WWC Topic Report – Middle School Math. *What Works Clearing House; July 30, 2007; 4 pages.*
Source: U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse
(http://ies.ed.gov/ncee/wwc/pdf/MSM_TR_07_30_07.pdf)
See the findings noted in the report section above and on page 1 of the Topic Report. "The What Works Clearinghouse (WWC) reviewed interventions to promote middle school students' math knowledge and skills. Because there is some variation in how school districts organize middle school, we considered curricula aimed at students in grades 6 through 9, covering one or more of the following content areas: numbers and operations, algebra, geometry, measurement, and data

analysis and probability. Only core, comprehensive math curricula were eligible for inclusion in this review. These curricula extend over the course of one semester or more, are central to students' regular school instruction, and are based on any combination of text materials, manipulatives, computer software, videotapes, and other materials."

1.2. Effective Programs in Middle and High School Mathematics: A Best Evidence Synthesis.
Slavin, R., Lake, C., and Groff, C.; October 2008; 124 pages.
Source: Best Evidence Encyclopedia
(http://www.bestevidence.org/word/mhs_math_Oct_21_2008.pdf)
See also the updated Educator's Summary at:
(http://www.bestevidence.org/word/mhs_math_Mar_11_2009_sum.pdf)
From the Abstract, "This article reviews research on the achievement outcomes of mathematics programs for middle and high schools. Study inclusion requirements included use of a randomized or matched control group, a study duration of at least twelve weeks, and equality at pretest. There were 102 qualifying studies, 28 of which used random assignment to treatments. Effect sizes were very small (weighted mean ES=+0.03 in 40 studies) for mathematics curricula, and for computer-assisted instruction (ES=+0.10 in 38 studies). They were larger (weighted mean ES=+0.18 in 22 studies) for instructional process programs, especially cooperative learning (weighted mean ES=+0.42 in 9 studies). Consistent with an earlier review of elementary programs, this article concludes that programs that affect daily teaching practices and student interactions have larger impacts on achievement measures than those emphasizing textbooks or technology alone."

1.3. A Synthesis of Empirical Research on Teaching Mathematics to Low-Achieving Students.
Baker, S., Gerston, R., and Lee, D.; September 2002; The Elementary School Journal; pp. 51 – 73.
Source: The Center on Instruction part of the Regional Comprehensive Center network
(http://www.centeroninstruction.org/files/BakerGerstenLee2002.pdf)
"The purpose of this study was to synthesize research on the effects of interventions to improve the mathematics achievement of students considered low achieving or at risk for failure. …

The set of 15 studies provides some ideas about ways to improve the performance of low-achieving students in mathematics. Although this is not a large body of research, four findings are consistent enough to be considered components of best practice. Other findings are more tentative, based on only a few studies.

One consistent finding is that providing teachers and students with specific information on how each student is performing seems to enhance mathematics achievement consistently. This practice has been recommended for many years, yet the extent to which it is implemented is unclear. The effect of such practice is substantial, raising scores, on average, by .68 SD units.

A second consistent finding represents an important strand in contemporary research. Using peers as tutors or guides enhances achievement. Research shows that the use of peers to provide feedback and support improves low achievers' computational abilities and holds promise as a means to enhance problem-solving abilities. If nothing else, having a partner available to provide immediate feedback is likely to be of great benefit to a low achiever struggling with a problem. A crucial feature of this approach is that the topics being covered are ones on which curriculum-based measurement data suggest areas where a student needs extra practice and support.

Third, providing clear specific feedback to parents of low achievers on their children's successes in mathematics seems to have the potential to enhance achievement, although perhaps only modestly. More research needs to be conducted before firm conclusions are drawn. Advantages of this approach are that it is relatively easy to implement and can lead to other long-range benefits in school-home communication.

Fourth, in terms of curricula, a small body of research suggests that principals of direct or explicit instruction can be useful in teaching mathematical concepts and procedures. This includes both the use of strategies derived from cognitive psychology to develop generic problem-solving strategies and more classic direct instruction approaches where students are taught one way to

solve a problem and are provided extensive practice. With the latter approach, concepts involving fractions, ratios, or decimals are presented using a wide range of examples.

Additional Organizations to Consult

- **Doing What Works**
  (http://dww.ed.gov/topic/topic_landing.cfm?PA_ID=8&T_ID=22&Tab=1)
  "The National Mathematics Advisory Panel conducted a systematic and rigorous review of the best available scientific evidence for the teaching and learning of mathematics and provided recommendations that lay out concrete steps to improve mathematics education, with a specific focus on preparation for learning algebra. The Panel worked in task groups and subcommittees to address areas of mathematics teaching and learning including *Conceptual Knowledge and Skills*, *Learning Processes*, *Instructional Practices*, *Teachers and Teacher Education*, and *Assessment*. Five task groups carried out detailed syntheses of research evidence that addressed each group's major questions and met standards of methodological quality. Three subcommittees were charged with completion of a particular advisory function for the Panel. The research findings cited in these reports underpin the mathematics practices and content included on the Doing What Works website."

Resources on Mathematics Interventions in General

- **Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools.** *Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., and Witzel, B.; 2009; (NCEE 2009-4060) Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education; 104 pages.*
  Source: U.S. Department of Education, Institute of Education Sciences
  (http://ies.ed.gov/ncee/wwc/pdf/practiceguides/rti_math_pg_042109.pdf)
  "This practice guide offers eight recommendations for identifying and supporting students struggling in mathematics (table 2). The recommendations are intended to be implemented within an RtI framework (typically three-tiered). The panel chose to limit its discussion of tier 1 to universal screening practices (i.e., the guide does not make recommendations for general classroom mathematics instruction). Recommendation 1 provides specific suggestions for conducting universal screening effectively. For RtI tiers 2 and 3, recommendations 2 though 8 focus on the most effective content and pedagogical practices that can be included in mathematics interventions."

Key words and search strings used in the search:

Mathematics AND "effective intervention" OR evidence AND "middle school'

Search databases and websites:

Institute for Education Science Sites: Regional Educational Laboratory Program (REL); What Works Clearinghouse (WWC); Doing What Works (DWW); National Center for Education Statistics (NCES); Institute for Education Sciences (IES); IES Practice Guides

Other Federally Funded Sites: The Assessment and Accountability Comprehensive Center; The National High School Center; The Center on Innovation and Improvement; The Center on Instruction; The National Comprehensive Center for Teacher Quality; National Center for Education Statistics (NCES) Datasets: K – 12; National Assessment of Educational Progress (NAEP; Center for Data-Driven Reform in Education (CDDRE); National Center for Research on Evaluation, Standards, and Student Testing; National Center for Performance Incentives; National Research Center on the Gifted and Talented; National Research Center on Rural Education Support; National Research and Development Center on School Choice, Competition and Achievement; National Dissemination Center for Children with Disabilities; Access Center for Improving Outcomes for All Students K-8; Center for Comprehensive School Reform and Improvement;; Small Learning Communities Centers; Education Commission of the States; Regional Comprehensive Centers; Equity Centers; Regional Resource Centers

Additional Data Resources: The Campbell Collaboration; Education Development Center; WestEd; American Institutes for Research; Just for Kids; The Education Trust; SRI International; ERIC; EBSCO Databases; Education

Index Retrospective; FirstSearch (OCLC); ProQuest; Educator's Reference Complete; HeinOnline; Education Daily; Government Executive; http://www.googlescholar.com; http://www.google.com; general internet search

Criteria for inclusion:

When Reference Desk Researchers review resources, they consider, among other things, four factors:

1. **Date of the publication:** The most current information is included unless in the case of nationally known seminal resources
2. **Source and funder of the report/study/brief/article:** Priority is given to IES, nationally funded, and certain other vetted sources known for strict attention to research protocols;
3. **Methodology**: i.e. Random control trial studies, surveys, self-assessments, literature reviews, policy briefs, etc. Priority for inclusion is given generally to random control trial study findings; however, the reader should note at least the following factors when basing decisions on these resources: Numbers of participants (just a few? Thousands?); Selection (did the participants volunteer in the study, or were they chosen?); Representation (were findings generalized from a homogeneous or a diverse pool of participants? Was the study sample representative of the population as a whole?
4. **Existing knowledge base:** Although we strive to include vetted resources, there are times when the research base is slim or non-existent. In these cases we have included the best resources we could find, which may include newspaper articles, interviews with content specialists, organization websites, etc.

REL Northeast and Islands

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