
Research in Brief:

Effective practices for teaching math to struggling students



What types of math instruction are effective for students who struggle to learn math concepts and procedures?

A recent systematic review synthesized research on the effects of interventions to improve the mathematics achievement of students considered low achieving or at risk for failure. Findings show that the following strategies lead to improvements in mathematical ability of struggling math students:

- Providing students and teachers with data on student performance.
- Using peers as tutors or instructional guides.
- Using principles of explicit instruction in teaching math concepts and procedures.
- Providing clear and specific feedback to parents on their children's mathematics success.

What is a meta-analysis?

A meta-analysis is a study that combines the results of several other studies. A meta-analysis involves selecting several high-quality studies in a specific research area and analyzing the findings collectively. This provides researchers with a larger sample size and allows them to draw stronger conclusions than those based on individual studies.

What did they do?

The researchers conducted a literature search in ERIC and PsycINFO from studies that were published from 1971-1999 that included specific instructional mathematics-based intervention strategies to improve the mathematics performance of low-achieving school-age students. They also examined bibliographies of research reviews in the area of learning disabilities.

The following criteria qualified a study for inclusion in the meta-analysis:

- Interventions provided math instruction, or structured opportunities for students to practice or apply classroom mathematics lesson objectives
- Math instruction must have lasted for a minimum of 90 minutes during the course of the intervention
- Experimental or quasi-experimental intervention studies that employed group-design methods with a control group
- Included at least one mathematics performance or achievement measure where students had to demonstrate mathematics proficiency in some way
- Must have reported statistical measures so that effect sizes could be calculated.

599 studies were identified, and 194 were selected for further review. Only 17 studies met the inclusion criteria and were included in the review.

Key Points

- ⇒ ***Low achievers struggle with problem solving and discussion of mathematical concepts without solid preparation in the underlying mathematical foundations. This supports explicit mathematical instruction as a means to improve mathematical abilities.***
- ⇒ ***Feedback on student performance to both teacher and student enhances consistent mathematics achievement for struggling learners***
- ⇒ ***Peers as tutors or guides can improve low-achievers' computational abilities, may enhance problem-solving abilities, and provides immediate feedback to students struggling on a problem***
- ⇒ ***Positive and specific feedback to parents encourages celebration of student achievements, is relatively easy to implement, and can lead to other benefits in school-home communication***

For an in-depth look at effective mathematics instruction see: Slavin, R. E., Lake, C., & Groff, C. (2010). [What Works in Teaching Math? Educator's Guide](#). Center for Research and Reform in Education.



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Definition of Low Achieving

Students in the studies used were identified as low achieving in mathematics on the basis of their performance on standardized or informal tests, or by their placement in remedial mathematics classes.

What did they find?

They found that the following four key strategies were effective in improving struggling math learner's achievement in math:

1) Providing Specific Data or Recommendations to Teachers and Students

The progress of low-achieving students was consistently monitored and graphed, and then students and teachers received information on the student's performance. Students received teacher- or computer-generated recommendations regarding the types and quantity of problems they should work on. This had a moderate effect size of +0.57

In some studies, teachers also received computer-generated recommendations on what content to teach the full class based on the aggregate performance data, which had an effect size of +0.51

The two effect sizes suggest that the combination of providing teachers with data and then making specific instructional recommendations may be more beneficial than solely providing them with data on student performance. However, advantages and limitations regarding providing data or the combination of data and recommendations is speculative and needs further investigation.

2) Peer-Assisted Learning

Two types of approaches were looked at. Both relied on students *working in pairs* (as opposed to larger groups of 4-6), role reciprocity, and tightly structured formats for tutoring sessions in which students were given training for.

The use of peers to provide feedback and support improved struggling students' *computational* abilities, with a moderately strong effect size of +0.66 (the highest effect size of the four strategies), and is a promising means to enhance problem-solving abilities.

However, it is unclear how helpful peer-assisted learning might be in other areas of mathematics, such as general math ability.

3a) Explicit Teacher-Led Instruction

Often referred to as *direct instruction*, this technique involves teaching rules, concepts, principles, and problem-solving strategies.

Interventions discussed in the studies generally began with teacher modeling of the step-by-step logic behind solving mathematical problems. Lessons proceeded with individual practice of similar problems, and teachers provided close supervision and quick corrections and feedback. At the end of each lesson, students reviewed strategies or formulated in their own words what they learned as a means of processing key principles and strategies.

The outcomes for explicit instruction were consistently positive, with an overall effect size of +0.65

3b) Contextualized Teacher-Facilitated Instruction

This strategy is characterized for stressing real-world applications and focusing on conceptual understanding. In this approach, the teacher acts as a facilitator as students work through real-world examples of mathematical concepts and discusses alternative solutions with peers or the teacher.

Due to inconsistent effect sizes across studies and a very small overall effect size of +0.01, there is less clarity about the benefits of this instructional technique.

There are plausible explanations for the overall ineffectiveness of this strategy in the studies explored, such as differences between groups unrelated to the intervention, differences in age groups, and differences in implementation (it is a recently developed approach, so it lacks well-defined practice).

4) Providing Parents with Information about Student Successes

Providing specific feedback to parents of low achievers on their children's successes in mathematics has a modest effect size of +0.42 in enhancing mathematical achievement. Feedback was provided through home-school contacts that described students' efforts and successes in mathematics. Feedback provided was (a) specific, objective, and honest and (b) detailed successes instead of failures or difficulties.

This brief summary was prepared from: Baker, S., Gersten, R., Lee, D.S (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. The Elementary School Journal, 103(1), 51-73.

Please see original document for full details. In the case of any disagreement between this summary and the original document, the original document should be seen as authoritative.