Using Practice Guides to Enhance Mathematics Education

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What is a Practice Guide?

The Institute of Education Sciences (IES) publishes practice guides to

* share rigorous evidence and expert guidance on addressing education-related challenges not solved with a single program, policy, or practice.
* develop recommendations for a coherent approach to a multifaceted problem.

Panels of Experts

* **Topic selection** is informed by inquiries and requests to the What Works Clearinghouse Help Desk, formal surveys of practitioners, and a limited literature search of the topic's research base.
* IES recruits a **panel chair** who has a national reputation and expertise in the topic.
* The chair, working with IES, then selects panelists to co-author the guide. Panelists are selected based on their expertise in the topic area and the belief that they can work together to develop relevant, evidence-based recommendations. Panels include **at least one practitioner** with relevant experience.

Peer Review

* External peer review, independent of the IES staff that supported the development of the guide.
* Reviewers determine whether the evidence cited in support of particular recommendations is up-to-date and that studies of similar or better quality that point in a different direction have not been overlooked.
* Evaluate whether the level of evidence category assigned to each recommendation is appropriate.

Levels of Evidence

* Represents the panel's judgment of the quality of the existing research to support a claim that, when these practices were implemented in past research, positive effects were observed on student outcomes.

Criteria for Evidence Rating

* The number of studies
* The design of the studies
* The quality of the studies
* Whether the studies represent the range of participants and settings on which the recommendation is focused
* Whether findings from the studies can be attributed to the recommended practice
* Whether findings in the studies are consistently positive

Criteria	STRONG Evidence Base	MODERATE Evidence Base	MINIMAL Evidence Base
Validity	High internal validity (high-quality causal designs). Studies must meet WWC standards with or without reservations.[3] **AND** High external validity (requires multiple studies with high-quality causal designs that represent the population on which the recommendation is focused). Studies must meet WWC standards with or without reservations.	High internal validity but moderate external validity (i.e., studies that support strong causal conclusions but generalization is uncertain). **OR** High external validity but moderate internal validity (i.e., studies that support the generality of a relation but the causality is uncertain).[4]	The research may include evidence from studies that do not meet the criteria for moderate or strong evidence (e.g., case studies, qualitative research).
Effects on relevant outcomes	Consistent positive effects without contradictory evidence (i.e., no statistically significant negative effects) in studies with high internal validity.	A preponderance of evidence of positive effects. Contradictory evidence (i.e., statistically significant negative effects) must be discussed by the panel and considered with regard to relevance to the scope of the guide and intensity of the recommendation as a component of the intervention evaluated.	There may be weak or contradictory evidence of effects.
Relevance to scope	Direct relevance to scope (i.e., ecological validity)—relevant context (e.g., classroom vs. laboratory), sample (e.g., age and characteristics), and outcomes evaluated.	Relevance to scope (ecological validity) may vary, including relevant context (e.g., classroom vs. laboratory), sample (e.g., age and characteristics), and outcomes evaluated. At least some research is directly relevant to scope (but the research that is relevant to scope does not qualify as strong with respect to validity).	The research may be out of the scope of the practice guide.
Relationship between research and recommendations	Direct test of the recommendation in the studies or the recommendation is a major component of the intervention tested in the studies.	Intensity of the recommendation as a component of the interventions evaluated in the studies may vary.	Studies for which the intensity of the recommendation as a component of the interventions evaluated in the studies is low; and/or the recommendation reflects expert opinion based on reasonable extrapolations from research.

Criteria	STRONG Evidence Base	MODERATE Evidence Base	MINIMAL Evidence Base
Panel confidence	Panel has a high degree of confidence that this practice is effective.	The panel determines that the research does not rise to the level of strong but is more compelling than a minimal level of evidence. Panel may not be confident about whether the research has effectively controlled for other explanations or whether the practice would be effective in most or all contexts.	In the panel's opinion, the recommendation must be addressed as part of the practice guide; however, the panel cannot point to a body of research that rises to the level of moderate or strong.
Role of expert opinion	Not applicable	Not applicable	Expert opinion based on defensible interpretations of theory (theories). (In some cases, this simply means that the recommended practices would be difficult to study in a rigorous, experimental fashion; in other cases, it means that researchers have not yet studied this practice.)
When assessment is the focus of the recommendation	For assessments, meets the standards of *The Standards for Educational and Psychological Testing*.[5]	For assessments, evidence of reliability that meets *The Standards for Educational and Psychological Testing* but with evidence of validity from samples not adequately representative of the population on which the recommendation is focused.	Not applicable

16 Practice Guides

1. Assisting Students Struggling with Mathematics: Response to Intervention (RTI) for elementary and middle schools
2. Encouraging Girls in Math and Science
3. Improving Mathematical Problem Solving in Grades 4 Through 8
4. Developing Effective Fractions Instruction for Kindergarten Through 8th Grade
5. Improving Adolescent Literacy: Effective Classroom and Intervention Practices
6. Effective Literacy and English Language Instruction for English Learners in the Elementary Grades
7. Assisting Students Struggling with Reading
8. Teaching Elementary School Students to Be Effective Writers
9. Improving Reading Comprehension in Kindergarten Through 3rd Grade
10. Using Student Achievement Data to Support Instructional Decision Making
11. Organizing Instruction and Study to Improve Student Learning
12. Reducing Behavior Problems in the Elementary School Classroom
13. Helping Students Navigate the Path to College: What High Schools Can Do
14. Dropout Prevention
15. Turning Around Chronically Low-Performing Schools
16. Structuring Out-of-School Time to Improve Academic Achievement

Assisting students struggling with mathematics: Response to Intervention (RTI) for elementary and middle schools (NCEE 2009–4060)

Tier 1

1. Screen all students to identify those at risk for potential mathematics difficulties and provide interventions to students identified as at risk.

Tiers 2 and 3

2. Instructional materials for students receiving interventions should focus intensely on **in-depth treatment of whole numbers** in kindergarten through grade 5 and on **rational numbers** in grades 4 through 8. These materials should be **selected by committee**.
3. Instruction during the intervention should be **explicit and systematic**. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.
4. Interventions should **include instruction on solving word problems** that is based on common underlying structures.
5. Intervention materials should include **opportunities** for students **to work with visual representations** of mathematical ideas and interventionists should be proficient in the use of visual representations of mathematical ideas.
6. Interventions at all grade levels should devote about **10 minutes** in each session to **building fluent retrieval of basic arithmetic facts**.
7. **Monitor the progress** of students receiving supplemental instruction and other students who are at risk.
8. Include **motivational strategies** in tier 2 and tier 3 interventions.

Encouraging girls in math and science (NCER 2007-2003)

1. Teachers should explicitly teach students that **academic abilities are expandable and improvable** in order to enhance girls' beliefs about their abilities. Students who view their cognitive abilities as fixed from birth or unchangeable are more likely to experience decreased confidence and performance when faced with difficulties or setbacks. Students who are more confident about their abilities in math and science are more likely to choose elective math and science courses in high school and more likely to select math and science-related college majors and careers.
2. Teachers should provide students with **prescriptive, informational feedback regarding their performance**. Prescriptive, informational feedback focuses on strategies, effort, and the process of learning (e.g., identifying gains in children's use of particular strategies or specific errors in problem solving). Such feedback enhances students' beliefs about their abilities, typically improves persistence, and improves performance on tasks.
3. Teachers should **expose girls to female role models who have achieved in math or science** in order to promote positive beliefs regarding women's abilities in math and science. Even in elementary school, girls are aware of the stereotype that men are better in math and science than women are. Exposing girls to female role models (e.g., through biographies, guest speakers, or tutoring by older female students) can invalidate these stereotypes.
4. Teachers can foster girls' long-term interest in math and science by **choosing activities connecting math and science activities to careers in ways that do not reinforce existing gender stereotypes** and choosing activities that spark initial curiosity about math and science content. Teachers can provide ongoing access to resources for students who continue to express interest in a topic after the class has moved on to other areas.
5. Teachers should provide opportunities for students to **engage in spatial skills training**. Spatial skills training is associated with performance in mathematics and science.

Developing effective fractions instruction for kindergarten through 8th grade: A practice guide (NCEE 2010-4039).

1. Build on students' informal understanding of **sharing and proportionality** to develop initial fraction concepts.
2. Help students recognize that **fractions are numbers** and that they expand the number system beyond whole numbers. **Use number lines** as a central representational tool in teaching this and other fraction concepts from the early grades onward.
3. Help students understand why **procedures for computations with fractions make sense.**
4. Develop students' **conceptual understanding of strategies** for solving ratio, rate, and proportion problems before exposing them to cross-multiplication as a procedure to use to solve such problems.
5. Professional development programs should place a high priority on **improving teachers' understanding of fractions** and of how to teach them.

Improving mathematical problem solving in grades 4 through 8 (NCEE 2012-4055).

1. **Prepare problems** and use them in whole-class instruction.
2. Assist students in **monitoring and reflecting on the problem-solving process.**
3. Teach students how to **use visual representations**.
4. Expose students to **multiple problem-solving strategies.**
5. Help students **recognize and articulate** mathematical concepts and notation.

Reflection

* Rate how often these practices happen in your classes.
* Which practices might you incorporate more often into your classes? How?
* Discuss in pairs/groups.
* Share big ideas.

Thank You!

* Practice Guides can be downloaded for free at http://ies.ed.gov/ncee/wwc/ and clicking on "Practice Guides."
* Questions? Contact

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* This presentation will be available on the Web at

http://csrakes.yolasite.com