

RTI: Best Practices in Mathematics Instruction & Interventions: Grades 6-12

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www.interventioncentral.org



Workshop PPTs and Handout Available at:

<http://www.interventioncentral.org/swgaresa>

Workshop Agenda: RTI Challenges...



Defining Research-Based Principles of Effective Math Instruction & Intervention



Understanding the Student With 'Math Difficulties'



Finding Effective, Research-Based Math Interventions



Screening and Progress-Monitoring for Students With Math Difficulties



Finding Web Resources to Support Math Assessment & Interventions

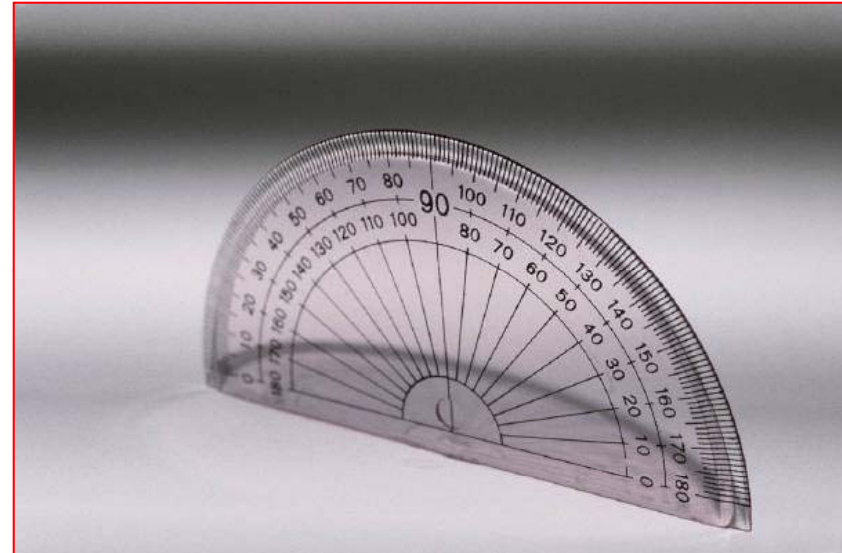
'Elbow Group' Activity: What are common student mathematics concerns in your school?

In your 'elbow groups':

- Discuss the most common student mathematics problems that you encounter in your school(s). At what grade level do you typically encounter these problems?
- Be prepared to share your discussion points with the larger group.



RTI Challenge: Defining
Research-Based
Principles of Effective
Math Instruction &
Intervention



An RTI Challenge: Limited Research to Support Evidence-Based Math Interventions

"... in contrast to reading, core math programs that are supported by research, or that have been constructed according to clear research-based principles, are not easy to identify. Not only have exemplary core programs not been identified, but also there are no tools available that we know of that will help schools analyze core math programs to determine their alignment with clear research-based principles." p. 459

Source: Clarke, B., Baker, S., & Chard, D. (2008). Best practices in mathematics assessment and intervention with elementary students. In A. Thomas & J. Grimes (Eds.), Best practices in school psychology V (pp. 453-463).

Response to Intervention

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BOARDS & COMMISSIONS

National Mathematics Advisory Panel






National Mathematics Advisory Panel Releases Final Report

On March 13, 2008, the National Mathematics Advisory Panel presented its Final Report to the President of the United States and the Secretary of Education. Copies of these ground-breaking reports, rich with information for parents, teachers, policy makers, the research community, and others, are provided below.




Foundations for Success: Report of the National Mathematics Advisory Panel

Final Report  [PDF](#) (851 KB) | [Word](#) (1 MB)

Draft Task Group Reports

- Conceptual Knowledge and Skills  [Word](#) (1.3 MB)
- Learning Processes  [Word](#) (7.9 MB)
- Instructional Practices  [Word](#) (2.9 MB)
- Teachers  [Word](#) (1.2 MB)
- Assessment  [Word](#) (876 KB)

Draft Subcommittee Reports


- Standards of Evidence  [PDF](#) (68 KB) | [Word](#) (276 KB)
- Instructional Materials  [Word](#) (958 KB)
- National Survey of Algebra Teachers for the National Math Panel  [PDF](#) (4.1 MB) | [Word](#) (3.2 MB)

[Fact Sheet](#)

Paper copies of these reports may be ordered at EDPubs.ed.gov.

If you need any of these documents in an alternative format, please contact the National Math Panel at NationalMathPanel@ed.gov.

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National
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Report
13 March 2008

Math Advisory Panel Report at:

<http://www.ed.gov/mathpanel>

2008 National Math Advisory Panel Report: Recommendations

- “The areas to be studied in mathematics from pre-kindergarten through eighth grade should be streamlined and a well-defined set of the most important topics should be emphasized in the early grades. Any approach that revisits topics year after year without bringing them to closure should be avoided.”
- “Proficiency with whole numbers, fractions, and certain aspects of geometry and measurement are the foundations for algebra. Of these, knowledge of fractions is the most important foundational skill not developed among American students.”
- “Conceptual understanding, computational and procedural fluency, and problem solving skills are equally important and mutually reinforce each other. Debates regarding the relative importance of each of these components of mathematics are misguided.”
- “Students should develop immediate recall of arithmetic facts to free the “working memory” for solving more complex problems.”

Source: National Math Panel Fact Sheet. (March 2008). Retrieved on March 14, 2008, from <http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-factsheet.html>

The Elements of Mathematical Proficiency: What the Experts Say...

5 Strands of Mathematical Proficiency

1. Understanding
2. Computing
3. Applying
4. Reasoning
5. Engagement

Source: *National Research Council. (2002). Helping children learn mathematics. Mathematics Learning Study Committee, J. Kilpatrick & J. Swafford, Editors, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.*

5 Big Ideas in Beginning Reading

1. Phonemic Awareness
2. Alphabetic Principle
3. Fluency with Text
4. Vocabulary
5. Comprehension

Source: Big ideas in beginning reading. University of Oregon. Retrieved September 23, 2007, from <http://reading.uoregon.edu/index.php>

Five Strands of Mathematical Proficiency

1. ***Understanding:*** *Comprehending mathematical concepts, operations, and relations--knowing what mathematical symbols, diagrams, and procedures mean.*
2. ***Computing:*** *Carrying out mathematical procedures, such as adding, subtracting, multiplying, and dividing numbers flexibly, accurately, efficiently, and appropriately.*
3. ***Applying:*** *Being able to formulate problems mathematically and to devise strategies for solving them using concepts and procedures appropriately.*

Source: National Research Council. (2002). *Helping children learn mathematics. Mathematics Learning Study Committee, J. Kilpatrick & J. Swafford, Editors, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.*

Five Strands of Mathematical Proficiency (Cont.)

4. *Reasoning: Using logic to explain and justify a solution to a problem or to extend from something known to something less known.*

5. *Engaging: Seeing mathematics as sensible, useful, and doable—if you work at it—and being willing to do the work.*

Source: National Research Council. (2002). *Helping children learn mathematics. Mathematics Learning Study Committee, J. Kilpatrick & J. Swafford, Editors, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.*

Response to Intervention

Five Strands of Mathematical Proficiency (NRC, 2002)

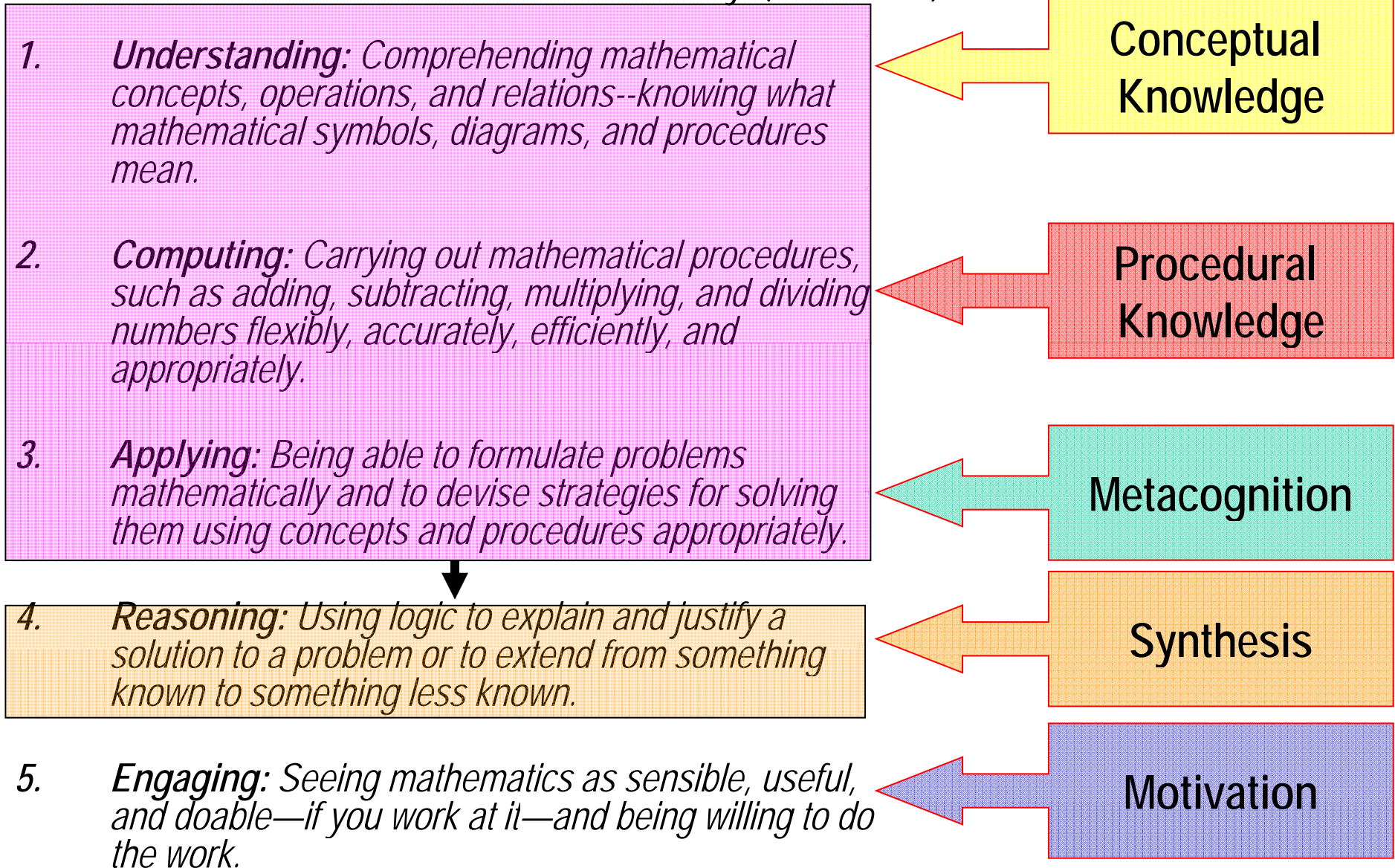


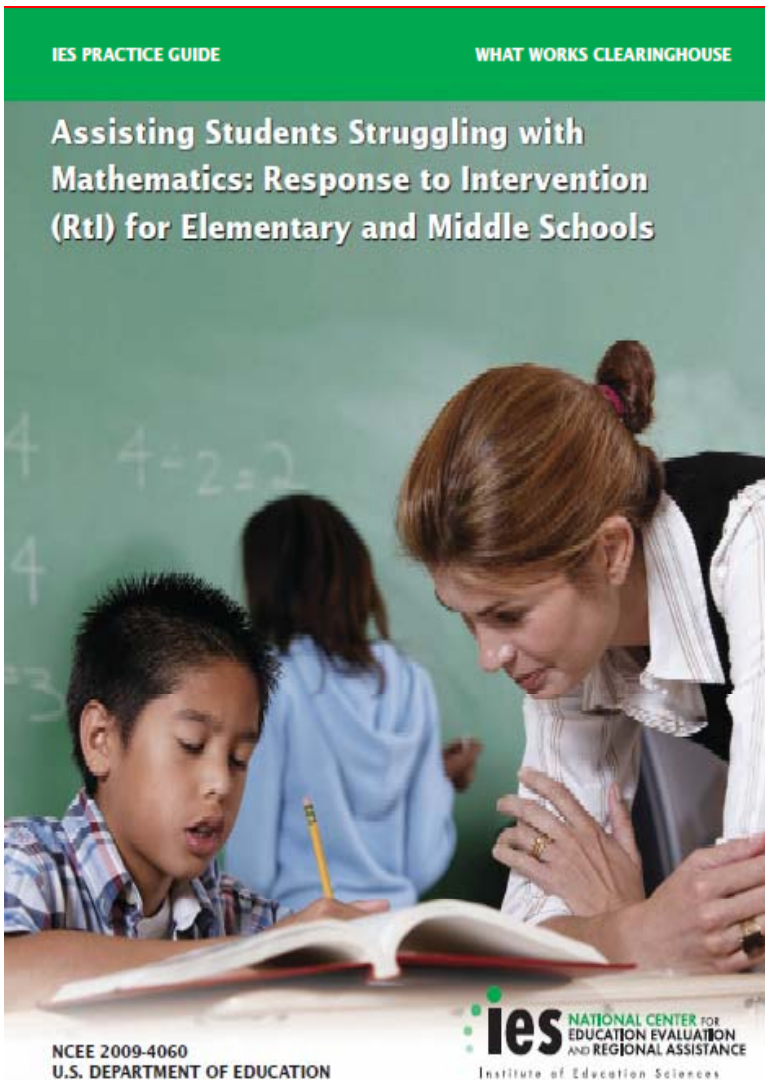
Table Activity: Evaluate Your School's Math Proficiency...

- *As a group, review the National Research Council 'Strands of Math Proficiency'.*
- *Which strand do you feel that your school / curriculum does the **best** job of helping students to attain proficiency?*
- *Which strand do you feel that your school / curriculum should put **the greatest effort** to figure out how to help students to attain proficiency?*
- *Be prepared to share your results.*

Five Strands of Mathematical Proficiency (NRC, 2002)

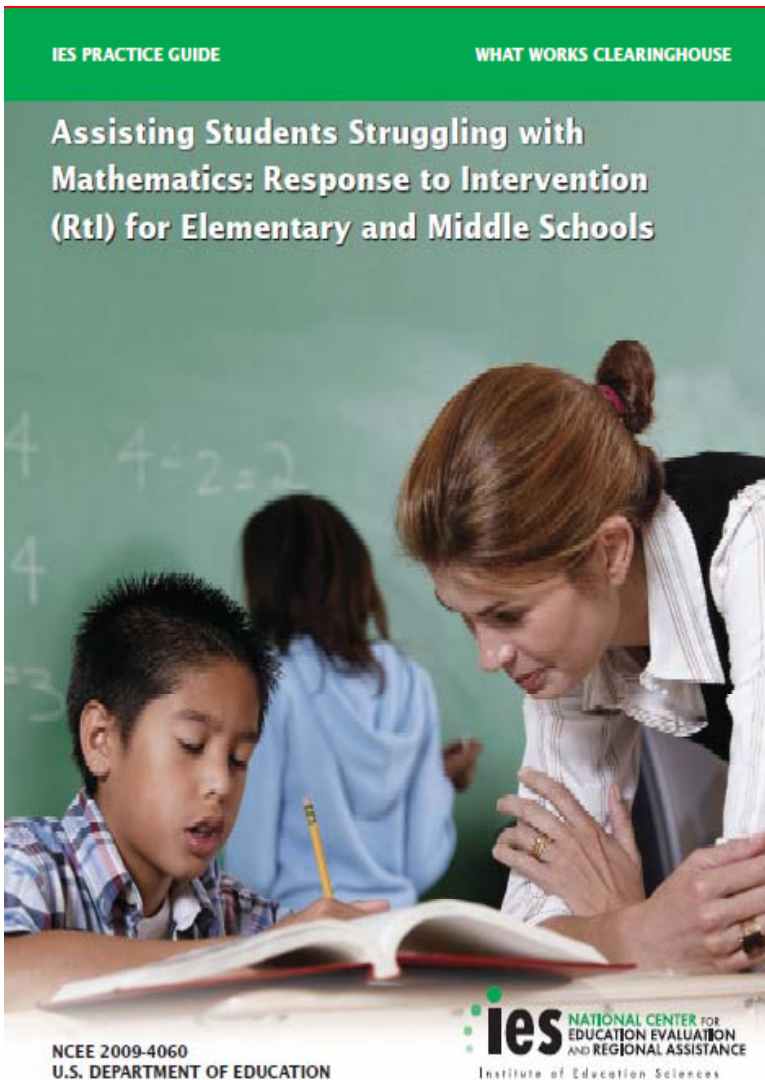
1. **Understanding:** *Comprehending mathematical concepts, operations, and relations--knowing what mathematical symbols, diagrams, and procedures mean.*
2. **Computing:** *Carrying out mathematical procedures, such as adding, subtracting, multiplying, and dividing numbers flexibly, accurately, efficiently, and appropriately.*
3. **Applying:** *Being able to formulate problems mathematically and to devise strategies for solving them using concepts and procedures appropriately.*
4. **Reasoning:** *Using logic to explain and justify a solution to a problem or to extend from something known to something less known.*
5. **Engaging:** *Seeing mathematics as sensible, useful, and doable—if you work at it—and being willing to do the work.*

Assisting Students Struggling with Mathematics: Rtl for Elementary & Middle Schools: 8 Recommendations



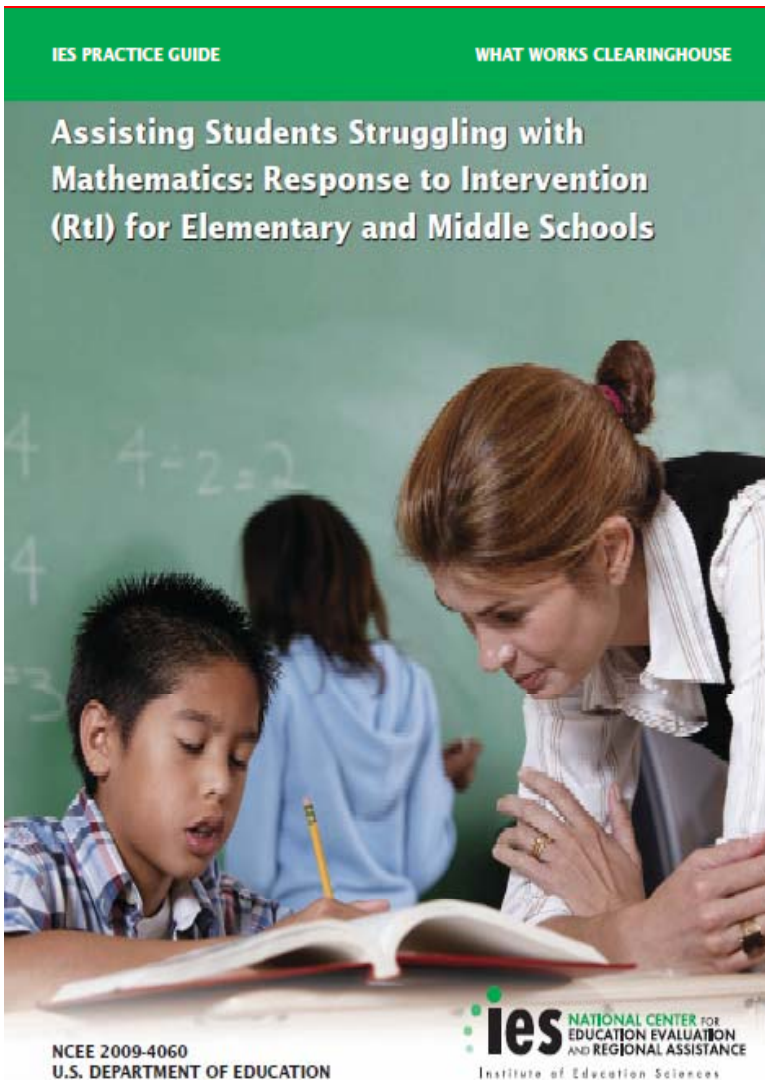
- **Recommendation 1.** Screen all students to identify those at risk for potential mathematics difficulties and provide interventions to students identified as at risk
- **Recommendation 2.** Instructional materials for students receiving interventions should focus intensely on in-depth treatment of whole numbers in kindergarten through grade 5 and on rational numbers in grades 4 through 8.

Assisting Students Struggling with Mathematics: Rtl for Elementary & Middle Schools: 8 Recommendations (Cont.)



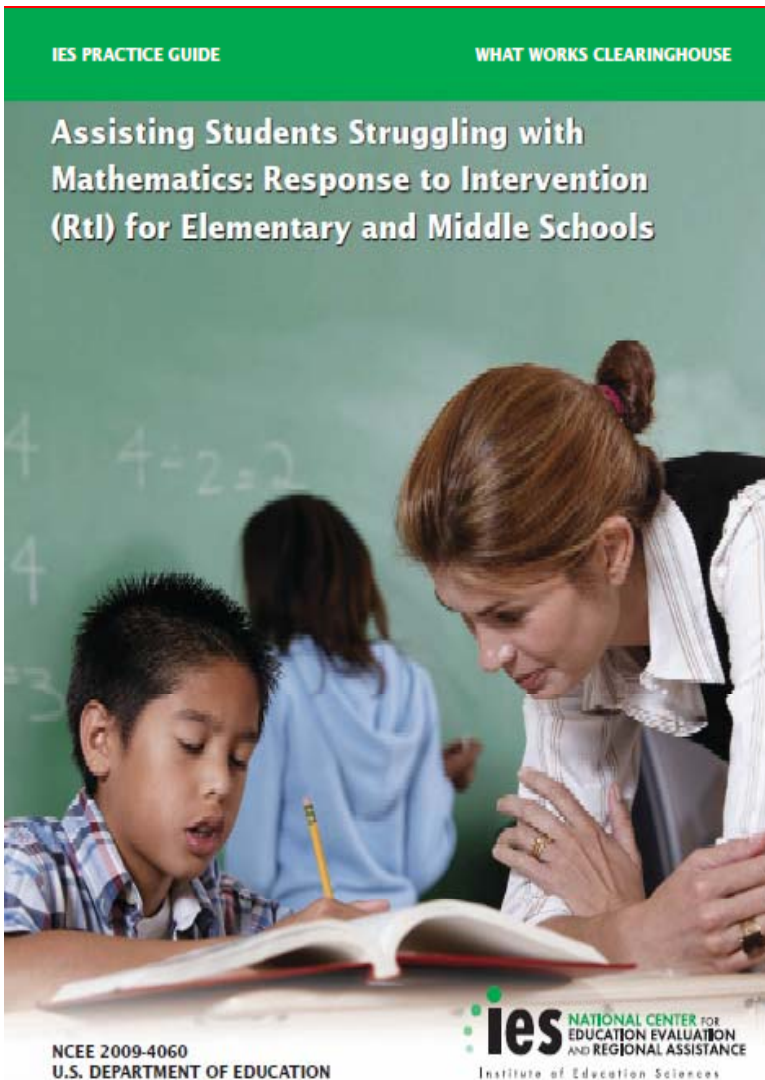
- **Recommendation 3.** Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review
- **Recommendation 4.** Interventions should include instruction on solving word problems that is based on common underlying structures.

Assisting Students Struggling with Mathematics: Rtl for Elementary & Middle Schools: 8 Recommendations (Cont.)



- **Recommendation 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
- **Recommendation 6.** Interventions at all grade levels should devote about 10 minutes in each session to building fluent retrieval of basic arithmetic facts

Assisting Students Struggling with Mathematics: Rtl for Elementary & Middle Schools: 8 Recommendations (Cont.)



- **Recommendation 7.** Monitor the progress of students receiving supplemental instruction and other students who are at risk
- **Recommendation 8.** Include motivational strategies in tier 2 and tier 3 interventions.

Teaching Math Vocabulary



Vocabulary: Why This Instructional Goal is Important

As vocabulary terms become more specialized in content area courses, students are less able to derive the meaning of unfamiliar words from context alone.

Students must instead learn vocabulary through more direct means, including having opportunities to explicitly memorize words and their definitions.

Students may require 12 to 17 meaningful exposures to a word to learn it.

Comprehending Math Vocabulary: The Barrier of Abstraction



"...when it comes to abstract mathematical concepts, words describe activities or relationships that often lack a visual counterpart. Yet studies show that children grasp the idea of quantity, as well as other relational concepts, from a very early age.... As children develop their capacity for understanding, language, and its vocabulary, becomes a vital cognitive link between a child's natural sense of number and order and conceptual learning. "

-Chard, D. (n.d.)

Source: Chard, D. (n.d.). *Vocabulary strategies for the mathematics classroom*. Retrieved November 23, 2007, from http://www.eduplace.com/state/pdf/author/chard_hmm05.pdf.

Math Vocabulary: Classroom (Tier I) Recommendations

- *Preteach math vocabulary.* Math vocabulary provides students with the language tools to grasp abstract mathematical concepts and to explain their own reasoning. Therefore, do not wait to teach that vocabulary only at 'point of use'. Instead, preview relevant math vocabulary as a regular a part of the 'background' information that students receive in preparation to learn new math concepts or operations.
- *Model the relevant vocabulary when new concepts are taught.* Strengthen students' grasp of new vocabulary by reviewing a number of math problems with the class, each time consistently and explicitly modeling the use of appropriate vocabulary to describe the concepts being taught. Then have students engage in cooperative learning or individual practice activities in which they too must successfully use the new vocabulary—while the teacher provides targeted support to students as needed.
- *Ensure that students learn standard, widely accepted labels* for common math terms and operations and that they use them consistently to describe their math problem-solving efforts.

Source: Chard, D. (n.d.). *Vocabulary strategies for the mathematics classroom*. Retrieved November 23, 2007, from http://www.eduplace.com/state/pdf/author/chard_hmm05.pdf.

Promoting Math Vocabulary: Other Guidelines

- Create a standard list of math vocabulary for each grade level (elementary) or course/subject area (for example, geometry).
- Periodically check students' mastery of math vocabulary (e.g., through quizzes, math journals, guided discussion, etc.).
- Assist students in learning new math vocabulary by first assessing their previous knowledge of vocabulary terms (e.g., *protractor*, *product*) and then using that past knowledge to build an understanding of the term.
- For particular assignments, have students identify math vocabulary that they don't understand. In a cooperative learning activity, have students discuss the terms. Then review any remaining vocabulary questions with the entire class.
- Encourage students to use a math dictionary in their vocabulary work.
- Make vocabulary a central part of instruction, curriculum, and assessment—rather than treating as an afterthought.

Source: Adams, T. L. (2003). Reading mathematics: More than words can say. *The Reading Teacher*, 56(8), 786-795.

Math Instruction: Unlock the Thoughts of Reluctant Students Through Class Journaling

Students can effectively clarify their knowledge of math concepts and problem-solving strategies through regular use of class 'math journals'.

- At the start of the year, the teacher introduces the journaling weekly assignment in which students respond to teacher questions.
- At first, the teacher presents 'safe' questions that tap into the students' opinions and attitudes about mathematics (e.g., 'How important do you think it is nowadays for cashiers in fast-food restaurants to be able to calculate in their head the amount of change to give a customer?'). As students become comfortable with the journaling activity, the teacher starts to pose questions about the students' own mathematical thinking relating to specific assignments. Students are encouraged to use numerals, mathematical symbols, and diagrams in their journal entries to enhance their explanations.
- The teacher provides brief written comments on individual student entries, as well as periodic oral feedback and encouragement to the entire class.
- Teachers will find that journal entries are a concrete method for monitoring student understanding of more abstract math concepts. To promote the quality of journal entries, the teacher might also assign them an effort grade that will be calculated into quarterly math report card grades.

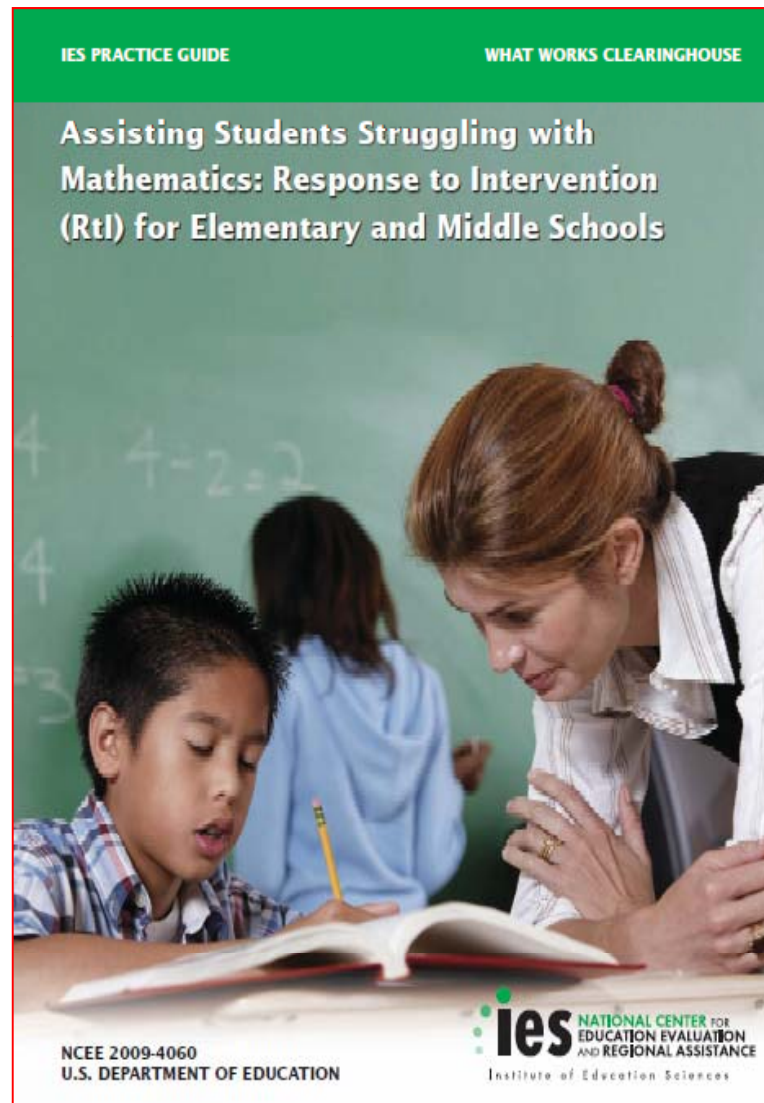
Source: *Baxter, J. A., Woodward, J., & Olson, D. (2005). Writing in mathematics: An alternative form of communication for academically low-achieving students. Learning Disabilities Research & Practice, 20(2), 119-135.*

Use Visual Representations in Math Problem-Solving



Response to Intervention

Assisting Students Struggling with Mathematics: Rtl for Elementary & Middle Schools



Encourage Students to Use Visual Representations to Enhance Understanding of Math Reasoning

- Students should be taught to use standard visual representations in their math problem solving (e.g., numberlines, arrays, etc.)
- Visual representations should be explicitly linked with “the standard symbolic representations used in mathematics” p. 31
- Concrete manipulatives *can* be used, but only if visual representations are too abstract for student needs.

Concrete Manipulatives>>>

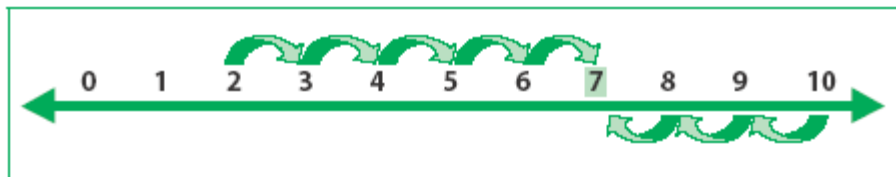
Visual Representations>>>

Representation Through Math Symbols

Source: Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools (NCEE 2009-4060). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from <http://ies.ed.gov/ncee/wwc/publications/practiceguides/>.

Examples of Math Visual Representations

Example 4. Representation of the counting on strategy using a number line



Example 5. Using visual representations for multidigit addition

A group of ten can be drawn with a long line to indicate that ten ones are joined to form one ten:

Simple drawings help make sense of two-digit addition with regrouping:

$$\begin{array}{r}
 36 \\
 +27 \\
 \hline
 63
 \end{array}$$

Source: Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). *Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools (NCEE 2009-4060)*. Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from <http://ies.ed.gov/ncee/wwc/publications/practiceguides/>.

Schools Should Build Their Capacity to Use Visual Representations in Math

Caution: Many intervention materials offer only limited guidance and examples in use of visual representations to promote student learning in math.

Therefore, schools should increase their capacity to coach interventionists in the more extensive use of visual representations. For example, a school might match various types of visual representation formats to key objectives in the math curriculum.

Source: Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools (NCEE 2009-4060). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from <http://ies.ed.gov/ncee/wwc/publications/practiceguides/>.

Math Core Instruction: *Peer-Guided Pause*

- Students are trained to work in pairs.
- At one or more appropriate review points in a math lecture, the instructor directs students to pair up to work together for 4-8 minutes.
- During each Peer Guided Pause, students are given a worksheet that contains one or more correctly completed word or number problems illustrating the math concept(s) covered in the lecture. The sheet also contains several additional, similar problems that pairs of students work cooperatively to complete, along with an answer key.
- Student pairs are reminded to (a) monitor their understanding of the lesson concepts; (b) review the correctly math model problem; (c) work cooperatively on the additional problems, and (d) check their answers. The teacher can direct student pairs to write their names on the practice sheets and collect them to monitor student understanding.

Source: Hawkins, J., & Brady, M. P. (1994). *The effects of independent and peer guided practice during instructional pauses on the academic performance of students with mild handicaps. Education & Treatment of Children, 17 (1), 1-28.*

Student Grades: Dual Function

Student grades serve two primary functions (Carifio & Carey, 2009):

1. Grades provide information to the student about his or her standing in the course and relative mastery of course content.
2. Grades 'rank' students against other students competitively, allowing educators to 'rank' individual students and judge their relative skills—in a single course and throughout a school career.

Source: Carifio, J., & Carey, T. (2009). A critical examination of current minimum grading policy recommendations. *The High School Journal*, 93(1), 23-37.

Teacher Grading Systems: Clear or Confusing?

- Providing regular feedback about course performance and grades is a strong recommendation for working with struggling math students (Baker, Gersten & Lee, 2002).
- However, if the grading system for a course is too complex, students may have difficulty tracking their performance and making the connection between grades and mastery of course content (Carifio & Carey, 2009).

Sources: Carifio, J., & Carey, T. (2009). A critical examination of current minimum grading policy recommendations. *The High School Journal*, 93(1), 23-37.

Baker, S., Gersten, R., & Lee, D. (2002). *A synthesis of empirical research on teaching mathematics to low-achieving students*. *The Elementary School Journal*, 103(1), 51-73.

Teacher-Assigned Grades: Potential Sources

Tests and quizzes	Effort
Evaluations of class participation	Neatness
Homework	Behavior
Oral presentations	Attendance
Notebook reviews	Labs & lab reports
Deduction of points: late work, lack of preparation for class	

Source: Carifio, J., & Carey, T. (2009). A critical examination of current minimum grading policy recommendations. *The High School Journal*, 93(1), 23-37.

Creating Grading Systems for Struggling Math Students: Considerations

- **Avoid 'Semester Killers':** Try not to calculate too large a part of the student's course grade on a handful of tests, as failure on any one could doom the student to course failure. If instead grades are spread across a larger number of smaller tests or quizzes, the student can recover from any one poor performance.
- **Simplify the Grading System:** Create a grading system that permits parents and students to see a direct correlation between student performance and course grades.

Source: Carifio, J., & Carey, T. (2009). A critical examination of current minimum grading policy recommendations. *The High School Journal*, 93(1), 23-37.

05:00

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Activity: Evaluating Your Grading System

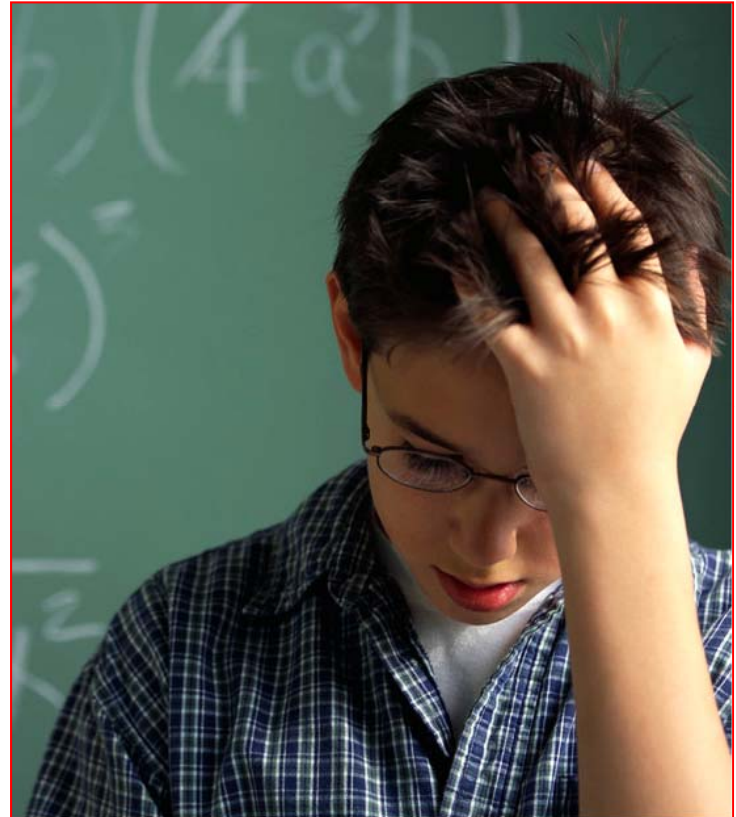
In your groups:

- Discuss the challenge of creating a grading system for your students that will enhance (or at least not hinder) their course performance.
- What ideas do you have to adjust your grading system to both maintain high standards and to better support struggling learners?

Recommendations for Grading Systems:

- **Avoid 'Semester Killers':** Try not to calculate too large a part of the student's course grade on a handful of tests, as failure on any one could doom the student to course failure. If instead grades are spread across a larger number of smaller tests or quizzes, the student can recover from any one poor performance.
- **Simplify the Grading System.:** Create a grading system that permits parents and students to see a direct correlation between student performance and course grades.

RTI Challenge:
Understanding the
Student With 'Math
Difficulties'



Who is At Risk for Poor Math Performance?: A Proactive Stance

"...we use the term mathematics difficulties rather than mathematics disabilities. Children who exhibit mathematics difficulties include those performing in the low average range (e.g., at or below the 35th percentile) as well as those performing well below average...Using higher percentile cutoffs increases the likelihood that young children who go on to have serious math problems will be picked up in the screening." p. 295

Source: Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities, 38*, 293-304.

Three General Levels of Math Skill Development

(Kroesbergen & Van Luit, 2003)

As students move from lower to higher grades, they move through levels of acquisition of math skills, to include:

- Number sense
- Basic math operations (i.e., addition, subtraction, multiplication, division)
- Problem-solving skills: "The solution of both verbal and nonverbal problems through the application of previously acquired information" (Kroesbergen & Van Luit, 2003, p. 98)



Source: Kroesbergen, E., & Van Luit, J. E. H. (2003). Mathematics interventions for children with special educational needs. Remedial and Special Education, 24, 97-114..

Computation Fluency: Benefits of Automaticity of 'Arithmetic Combinations' (Gersten, Jordan, & Flojo, 2005)

- There is a strong correlation between poor retrieval of arithmetic combinations ('math facts') and global math delays
- Automatic recall of arithmetic combinations frees up student 'cognitive capacity' to allow for understanding of higher-level problem-solving
- By internalizing numbers as mental constructs, students can manipulate those numbers in their head, allowing for the intuitive understanding of arithmetic properties, such as *associative property* and *commutative property*

Source: Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities, 38*, 293-304.

Response to Intervention

How much is $3 + 8$? Strategies to Solve...

Least efficient strategy: Count out and group 3 objects; count out and group 8 objects; count all objects:



More efficient strategy: Begin at the number 3 and 'count up' 8 more digits (often using fingers for counting):

$$3 + 8$$



More efficient strategy: Begin at the number 8 (larger number) and 'count up' 3 more digits:

$$8 + 3$$

Most efficient strategy: '3 + 8' arithmetic combination is stored in memory and automatically retrieved: **Answer = 11**

Source: Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities, 38*, 293-304.

Math Skills: Importance of Fluency in Basic Math Operations

"[A key step in math education is] to learn the four basic mathematical operations (i.e., addition, subtraction, multiplication, and division). Knowledge of these operations and a capacity to perform mental arithmetic play an important role in the development of children's later math skills. Most children with math learning difficulties are unable to master the four basic operations before leaving elementary school and, thus, need special attention to acquire the skills. A ... category of interventions is therefore aimed at the acquisition and automatization of basic math skills."

Source: Kroesbergen, E., & Van Luit, J. E. H. (2003). *Mathematics interventions for children with special educational needs. Remedial and Special Education, 24*, 97-114.

Profile of Students With Significant Math Difficulties

Spatial organization. The student commits errors such as misaligning numbers in columns in a multiplication problem or confusing directionality in a subtraction problem (and subtracting the original number—minuend—from the figure to be subtracted (subtrahend)).

Visual detail. The student misreads a mathematical sign or leaves out a decimal or dollar sign in the answer.

Procedural errors. The student skips or adds a step in a computation sequence. Or the student misapplies a learned rule from one arithmetic procedure when completing another, different arithmetic procedure.

Inability to 'shift psychological set'. The student does not shift from one operation type (e.g., addition) to another (e.g., multiplication) when warranted.

Graphomotor. The student's poor handwriting can cause him or her to misread handwritten numbers, leading to errors in computation.

Memory. The student fails to remember a specific math fact needed to solve a problem. (The student may KNOW the math fact but not be able to recall it at 'point of performance'.)

Judgment and reasoning. The student comes up with solutions to problems that are clearly unreasonable. However, the student is not able adequately to evaluate those responses to gauge whether they actually make sense in context.

Source: Rourke, B. P. (1993). Arithmetic disabilities, specific & otherwise: A neuropsychological perspective. *Journal of Learning Disabilities*, 26, 214-226.

05:00

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Activity: Profile of Math Difficulties

- Review the *profile of students with significant math difficulties* that appears on p. 9 of your handout.
- For each item in the profile, discuss what methods you might use to discover whether a particular student experiences this difficulty. Jot your ideas in the 'NOTES' column.

Profile of Students With Significant Math Difficulties (Rourke, 1993)	NOTES
Spatial organization. The student commits errors such as misaligning numbers in columns in a multiplication problem or confusing directionality in a subtraction problem (and subtracting the original number—minuend—from the figure to be subtracted (subtrahend).	
Visual detail. The student misreads a mathematical sign or leaves out a decimal or dollar sign in the answer.	
Procedural errors. The student skips or adds a step in a computation sequence. Or the student misapplies a learned rule from one arithmetic procedure when completing another, different arithmetic procedure.	
Inability to 'shift psychological set'. The student does not shift from one operation type (e.g., addition) to another (e.g., multiplication) when warranted.	
Graphomotor. The student's poor handwriting can cause him or her to misread handwritten numbers, leading to errors in computation.	
Memory. The student fails to remember a specific math fact needed to solve a problem. (The student may KNOW the math fact but not be able to recall it at 'point of performance'.)	
Judgment and reasoning. The student comes up with solutions to problems that are clearly unreasonable. However, the student is not able adequately to evaluate those responses to gauge whether they actually make sense in context.	

RTI Challenge: Finding Effective, Research-Based Math Interventions



The Key Role of Classroom Teachers as 'Interventionists' in RTI: 6 Steps



1. The teacher defines the student academic or behavioral problem clearly.
2. The teacher decides on the best explanation for why the problem is occurring.
3. The teacher selects 'evidence-based' interventions.
4. The teacher documents the student's Tier 1 intervention plan.
5. The teacher monitors the student's response (progress) to the intervention plan.
6. The teacher knows what the next steps are when a student fails to make adequate progress with Tier 1 interventions alone.

Secondary Students: Should Interventions Be 'Off-Level' or Focus on Grade-Level Academics?

There is a lack of consensus about how to address the academic needs of students with deficits in basic skills in secondary grades (Espin & Tindal, 1998).

- Should the student be placed in remedial instruction at a point of 'instructional match' to address those basic-skill deficits? (Instruction is adjusted *down* to the student)
- Or is time better spent providing the student with compensatory strategies to learn grade-level content and 'work around' those basic-skill deficits? (Student is brought *up* to current instruction)

Source: Espin, C. A., & Tindal, G. (1998). Curriculum-based measurement for secondary students. In M. R. Shinn (Ed.) *Advanced applications of curriculum-based measurement*. New York: Guilford Press.

Big Ideas: The Four Stages of Learning Can Be Summed Up in the 'Instructional Hierarchy'

(Haring et al., 1978)

Student learning can be thought of as a multi-stage process. The universal stages of learning include:

- Acquisition: The student is just acquiring the skill.
- Fluency: The student can perform the skill but must make that skill 'automatic'.
- Generalization: The student must perform the skill across situations or settings.
- Adaptation: The student confronts novel task demands that require that the student adapt a current skill to meet new requirements.

The stage of the learner can determine the appropriate intervention.



Source: Haring, N.G., Lovitt, T.C., Eaton, M.D., & Hansen, C.L. (1978). *The fourth R: Research in the classroom*. Columbus, OH: Charles E. Merrill Publishing Co.

Math Challenge: The student has not yet *acquired* math facts.



Solution: Use these strategies:

- Incremental Rehearsal
- Cover-Copy-Compare
- Errorless-Learning Worksheets
- Peer Tutoring in Math Computation with Constant Time Delay

Acquisition Stage: Math Computation: Motivate With 'Errorless Learning' Worksheets

In this version of an 'errorless learning' approach, the student is directed to complete math facts as quickly as possible. If the student comes to a number problem that he or she cannot solve, the student is encouraged to locate the problem and its correct answer in the key at the top of the page and write it in. This idea works best for basic math facts.



Such speed drills build computational fluency while promoting students' ability to visualize and to use a mental number line.

TIP: Consider turning this activity into a 'speed drill'. The student is given a kitchen timer and instructed to set the timer for a predetermined span of time (e.g., 2 minutes) for each drill. The student completes as many problems as possible before the timer rings. The student then graphs the number of problems correctly computed each day on a time-series graph, attempting to better his or her previous score.

Source: Caron, T. A. (2007). *Learning multiplication the easy way. The Clearing House*, 80, 278-282

Response to Intervention

'Errorless Learning' Worksheet Sample

Curriculum-Based Assessment Mathematics
Multiple-Skills Computation Probe: Examiner Copy

Item 1:
2 CD/2 CD Total
SUBTRACTION: 1-digit number from a
1- or 2-digit number: no regrouping

$$\begin{array}{r} 26 \\ - 11 \\ \hline 15 \end{array}$$

Item 2:
2 CD/4 CD Total
MULTIPLICATION: 2-digit number
times 1-digit number: no regrouping

$$\begin{array}{r} 34 \\ \times 2 \\ \hline 68 \end{array}$$

Item 3:
2 CD/6 CD Total
SUBTRACTION: 1-digit number from a
1- or 2-digit number: no regrouping

$$\begin{array}{r} 38 \\ - 22 \\ \hline 16 \end{array}$$

$$\begin{array}{r} 26 \\ -11 \\ \hline \end{array}$$

$$\begin{array}{r} 34 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 38 \\ -22 \\ \hline \end{array}$$

Source: Caron, T. A. (2007). *Learning multiplication the easy way. The Clearing House*, 80, 278-282

Acquisition Stage: Cover-Copy-Compare: Math Computational Fluency-Building Intervention

The student is given sheet with correctly completed math problems in left column and index card.

For each problem, the student:

- studies the model
- covers the model with index card
- copies the problem from memory
- solves the problem
- uncovers the correctly completed model to check answer

Source: Skinner, C.H., Turco, T.L., Beatty, K.L., & Rasavage, C. (1989). Cover, copy, and compare: A method for increasing multiplication performance. *School Psychology Review*, 18, 412-420.

Peer Tutoring in Math
Computation with
Constant Time Delay



Peer Tutoring in Math Computation with Constant Time Delay

- **DESCRIPTION:** This intervention employs students as reciprocal peer tutors to target acquisition of basic math facts (math computation) using constant time delay (Menesses & Gresham, 2009; Telecsan, Slaton, & Stevens, 1999). Each tutoring 'session' is brief and includes its own progress-monitoring component--making this a convenient and time-efficient math intervention for busy classrooms.

Peer Tutoring in Math Computation with Constant Time Delay

MATERIALS:

Student Packet: A work folder is created for each tutor pair. The folder contains:

- 10 math fact cards with equations written on the front and correct answer appearing on the back. NOTE: The set of cards is replenished and updated regularly as tutoring pairs master their math facts.
- Progress-monitoring form for each student.
- Pencils.

Peer Tutoring in Math Computation with Constant Time Delay

PREPARATION: To prepare for the tutoring program, the teacher selects students to participate and trains them to serve as tutors.

Select Student Participants. Students being considered for the reciprocal peer tutor program should at minimum meet these criteria (Telecsan, Slaton, & Stevens, 1999, Menesses & Gresham, 2009):

- Is able and willing to follow directions;
- Shows generally appropriate classroom behavior;
- Can attend to a lesson or learning activity for at least 20 minutes.

Peer Tutoring in Math Computation: Teacher Nomination Form

Reciprocal Peer Tutoring in Math Computation: Teacher Nomination Form

Teacher: _____ Classroom: _____ Date: _____

Directions: Select students in your class that you believe would benefit from participation in a peer tutoring program to boost math computation skills. Write the names of your student nominees in the space provided below.

Remember, students who are considered for the peer tutoring program should—at minimum—meet these criteria:

- Show generally appropriate classroom behaviors and follow directions.
- Can pay attention to a lesson or learning activity for at least 20 minutes.
- Are able to wait appropriately to hear the correct answer from the tutor if the student does not know the answer.
- When given a two-minute math computation probe to complete independently, computes **FEWER** than 20 correct digits (Grades 1-3) or **FEWER** than 40 correct digits (Grades 4 and up) (Deno & Mirkin, 1977).
- Can name all numbers from 0 to 18 (if tutoring in addition or subtraction math facts) and name all numbers from 0 to 81 (if tutoring in multiplication or division math facts).
- Can correctly read aloud a sampling of 10 math-facts (equation plus answer) that will be used in the tutoring sessions. (NOTE: The student does not need to have memorized or otherwise mastered these math facts to participate—just be able to read them aloud from cards without errors).

Number	Student Name	NOTES
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Peer Tutoring in Math Computation with Constant Time Delay

Tutoring Activity. Each tutoring 'session' last for 3 minutes. The tutor:

- *Presents Cards.* The tutor presents each card to the tutee for 3 seconds.
- *Provides Tutor Feedback.* [When the tutee responds correctly] The tutor acknowledges the correct answer and presents the next card.

[When the tutee does not respond within 3 seconds or responds incorrectly] The tutor states the correct answer and has the tutee repeat the correct answer. The tutor then presents the next card.

- *Provides Praise.* The tutor praises the tutee immediately following correct answers.
- *Shuffles Cards.* When the tutor and tutee have reviewed all of the math-fact carts, the tutor shuffles them before again presenting cards.

Peer Tutoring in Math Computation with Constant Time Delay

Progress-Monitoring Activity. The tutor concludes each 3-minute tutoring session by assessing the number of math facts mastered by the tutee.

The tutor follows this sequence:

- *Presents Cards.* The tutor presents each card to the tutee for 3 seconds.
- *Remains Silent.* The tutor does not provide performance feedback or praise to the tutee, or otherwise talk during the assessment phase.
- *Sorts Cards.* Based on the tutee's responses, the tutor sorts the math-fact cards into 'correct' and 'incorrect' piles.
- *Counts Cards and Records Totals.* The tutor counts the number of cards in the 'correct' and 'incorrect' piles and records the totals on the tutee's progress-monitoring chart.

Peer Tutoring in Math Computation with Constant Time Delay

Tutoring Integrity Checks. As the student pairs complete the tutoring activities, the supervising adult monitors the integrity with which the intervention is carried out. At the conclusion of the tutoring session, the adult gives feedback to the student pairs, praising successful implementation and providing corrective feedback to students as needed. NOTE: Teachers can use the attached form *Peer Tutoring in Math Computation with Constant Time Delay: Integrity Checklist* to conduct integrity checks of the intervention and student progress-monitoring components of the math peer tutoring.

Peer Tutoring in Math Computation: Intervention Integrity Sheet: (Part 1: Tutoring Activity)

Peer Tutoring in Math Computation with Constant Time Delay: Integrity Checklist

Tutoring Session: Intervention Phase

Directions: Observe the tutor and tutee for a full intervention session. Use this checklist to record whether each of the key steps of the intervention were correctly followed.

Correctly Carried Out?	Step	Tutor Action	NOTES
__ Y __ N	1.	Promptly Initiates Session. At the start of the timer, the tutor immediately presents the first math-fact card.	
__ Y __ N	2.	Presents Cards. The tutor presents each card to the tutee for 3 seconds.	
__ Y __ N	3.	Provides Tutor Feedback. [When the tutee responds correctly] The tutor acknowledges the correct answer and presents the next card. [When the tutee does not respond within 3 seconds or responds incorrectly] The tutor states the correct answer and has the tutee repeat the correct answer. The tutor then presents the next card.	
__ Y __ N	4.	Provides Praise. The tutor praises the tutee immediately following correct answers.	
__ Y __ N	5.	Shuffles Cards. When the tutor and tutee have reviewed all of the math-fact cards, the tutor shuffles them before again presenting cards.	
__ Y __ N	6.	Continues to the Timer. The tutor continues to present math-fact cards for tutee response until the timer rings.	

Peer Tutoring in Math Computation: Intervention Integrity Sheet (Part 2: Progress- Monitoring)

Tutoring Session: Assessment Phase			
Directions: Observe the tutor and tutee during the progress-monitoring phase of the session. Use this checklist to record whether each of the key steps of the assessment were correctly followed.			
Correctly Carried Out?	Step	Tutor Action	NOTES
__Y__N	1.	Presents Cards. The tutor presents each card to the tutee for 3 seconds.	
__Y__N	2.	Remains Silent. The tutor does not provide performance feedback or praise to the tutee, or otherwise talk during the assessment phase.	
__Y__N	3.	Sorts Cards. The tutor sorts cards into 'correct' and 'incorrect' piles based on the tutee's responses.	
__Y__N	4.	Counts Cards and Records Totals. The tutor counts the number of cards in the 'correct' and 'incorrect' piles and records the totals on the tutee's progress-monitoring chart.	

Peer Tutoring in Math Computation: Score Sheet

Math Tutoring: Score Sheet

Tutor 'Coach': _____ Tutee 'Player': _____

Directions to the Tutor: Write down the number of math-fact cards that your partner answered correctly and the number answered incorrectly.

Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:
Date:	Cards Correct:	Cards Incorrect:

Applied Problems: Individualized Self-Correction Checklists

Students can improve their accuracy on particular types of word and number problems by using an 'individualized self-instruction checklist' that reminds them to pay attention to their own specific error patterns.

- The teacher meets with the student. Together they analyze common error patterns that the student tends to commit on a particular problem type (e.g., 'On addition problems that require carrying, I don't always remember to carry the number from the previously added column.').
- For each type of error identified, the student and teacher together describe the appropriate step to take to prevent the error from occurring (e.g., 'When adding each column, make sure to carry numbers when needed.').
- These self-check items are compiled into a single checklist. Students are then encouraged to use their individualized self-instruction checklist whenever they work independently on their number or word problems.

Source: Pólya, G. (1945). *How to solve it*. Princeton University Press: Princeton, N.J.

How Do We Reach Low-Performing Math Students?: Instructional Recommendations

Important elements of math instruction for low-performing students:

- “Providing teachers and students with data on student performance”
- “Using peers as tutors or instructional guides”
- “Providing clear, specific feedback to parents on their children’s mathematics success”
- “Using principles of explicit instruction in teaching math concepts and procedures.” p. 51

Source: Baker, S., Gersten, R., & Lee, D. (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. *The Elementary School Journal*, 103(1), 51-73..

05:00

www.interventioncentral.org

Response to Intervention

Activity: How Do We Reach Low-Performing Students?

- Review the handout on p. 10 of your packet and consider each of the elements found to benefit low-performing math students.
- For each element, brainstorm ways that you could promote this idea in your math classroom.

How Do We Reach Low-Performing Math Students?: Instructional Recommendations <i>Important elements of math instruction for low-performing students</i> (Baker, Gersten, & Lee, 2002; p. 51):	IDEAS FOR IMPLEMENTATION
"Providing teachers and students with data on student performance"	
"Using peers as tutors or instructional guides"	
"Providing clear, specific feedback to parents on their children's mathematics success"	
"Using principles of explicit instruction in teaching math concepts and procedures."	

Math Challenge: The student has acquired math computation skills but is not yet fluent.



Solution: Use these strategies:

- Explicit Time Drills
- Self-Administered Arithmetic Combination Drills With Performance Self-Monitoring & Incentives

Explicit Time Drills:

Math Computational Fluency-Building Intervention

Explicit time-drills are a method to boost students' rate of responding on math-fact worksheets.

The teacher hands out the worksheet. Students are told that they will have 3 minutes to work on problems on the sheet. The teacher starts the stop watch and tells the students to start work. At the end of the first minute in the 3-minute span, the teacher 'calls time', stops the stopwatch, and tells the students to underline the last number written and to put their pencils in the air. Then students are told to resume work and the teacher restarts the stopwatch. This process is repeated at the end of minutes 2 and 3. At the conclusion of the 3 minutes, the teacher collects the student worksheets.

Source: Rhymer, K. N., Skinner, C. H., Jackson, S., McNeill, S., Smith, T., & Jackson, B. (2002). *The 1-minute explicit timing intervention: The influence of mathematics problem difficulty*. *Journal of Instructional Psychology*, 29(4), 305-311.

Fluency Stage: Math Computation

Self-Administered Arithmetic Combination Drills With Performance Self-Monitoring & Incentives

1. The student is given a math computation worksheet of a specific problem type, along with an answer key [Academic Opportunity to Respond].
2. The student consults his or her performance chart and notes previous performance. The student is encouraged to try to 'beat' his or her most recent score.
3. The student is given a pre-selected amount of time (e.g., 5 minutes) to complete as many problems as possible. The student sets a timer and works on the computation sheet until the timer rings. [Active Student Responding]
4. The student checks his or her work, giving credit for each *correct digit* (digit of correct value appearing in the correct place-position in the answer). [Performance Feedback]
5. The student records the day's score of TOTAL number of correct digits on his or her personal performance chart.
6. The student receives praise or a reward if he or she exceeds the most recently posted number of correct digits.

Application of 'Learn Unit' framework from : Heward, W.L. (1996). *Three low-tech strategies for increasing the frequency of active student response during group instruction*. In R. Gardner, D. M.S ainato, J. O. Cooper, T. E. Heron, W. L. Heward, J. W. Eshleman, & T. A. Grossi (Eds.), *Behavior analysis in education: Focus on measurably superior instruction* (pp.283-320). Pacific Grove, CA:Brooks/Cole.

Self-Administered Arithmetic Combination Drills: Examples of Student Worksheet and Answer Key

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe: Student Copy

Student:

Date: _____

$$\begin{array}{r} 8 \\ \times 6 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ \times 8 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \\ \times 3 \\ \hline \end{array}$$

$$\begin{array}{r} 9 \\ \times 5 \\ \hline \end{array}$$

$$\begin{array}{r} 6 \\ \times 5 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \\ \times 3 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ \times 8 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ \times 7 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \\ \times 4 \\ \hline \end{array}$$

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Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe: Examiner Copy

MULTIPLICATION: Multiplication facts: 0 to 9

item 1:
2 Cr/2 Cr total

$$\begin{array}{r} 8 \\ \times 6 \\ \hline 48 \end{array}$$

item 2:
2 Cr/4 Cr total

$$\begin{array}{r} 3 \\ \times 8 \\ \hline 24 \end{array}$$

item 3:
1 Cr/5 Cr total

$$\begin{array}{r} 2 \\ \times 3 \\ \hline 6 \end{array}$$

item 4:
2 Cr/7 Cr total

$$\begin{array}{r} 9 \\ \times 5 \\ \hline 45 \end{array}$$

item 5:
2 Cr/8 Cr total

$$\begin{array}{r} 6 \\ \times 5 \\ \hline 30 \end{array}$$

item 6:
1 Cr/10 Cr total

$$\begin{array}{r} 1 \\ \times 3 \\ \hline 3 \end{array}$$

item 7:
2 Cr/12 Cr total

$$\begin{array}{r} 3 \\ \times 8 \\ \hline 24 \end{array}$$

item 8:
2 Cr/14 Cr total

$$\begin{array}{r} 3 \\ \times 7 \\ \hline 21 \end{array}$$

item 9:
1 Cr/15 Cr total

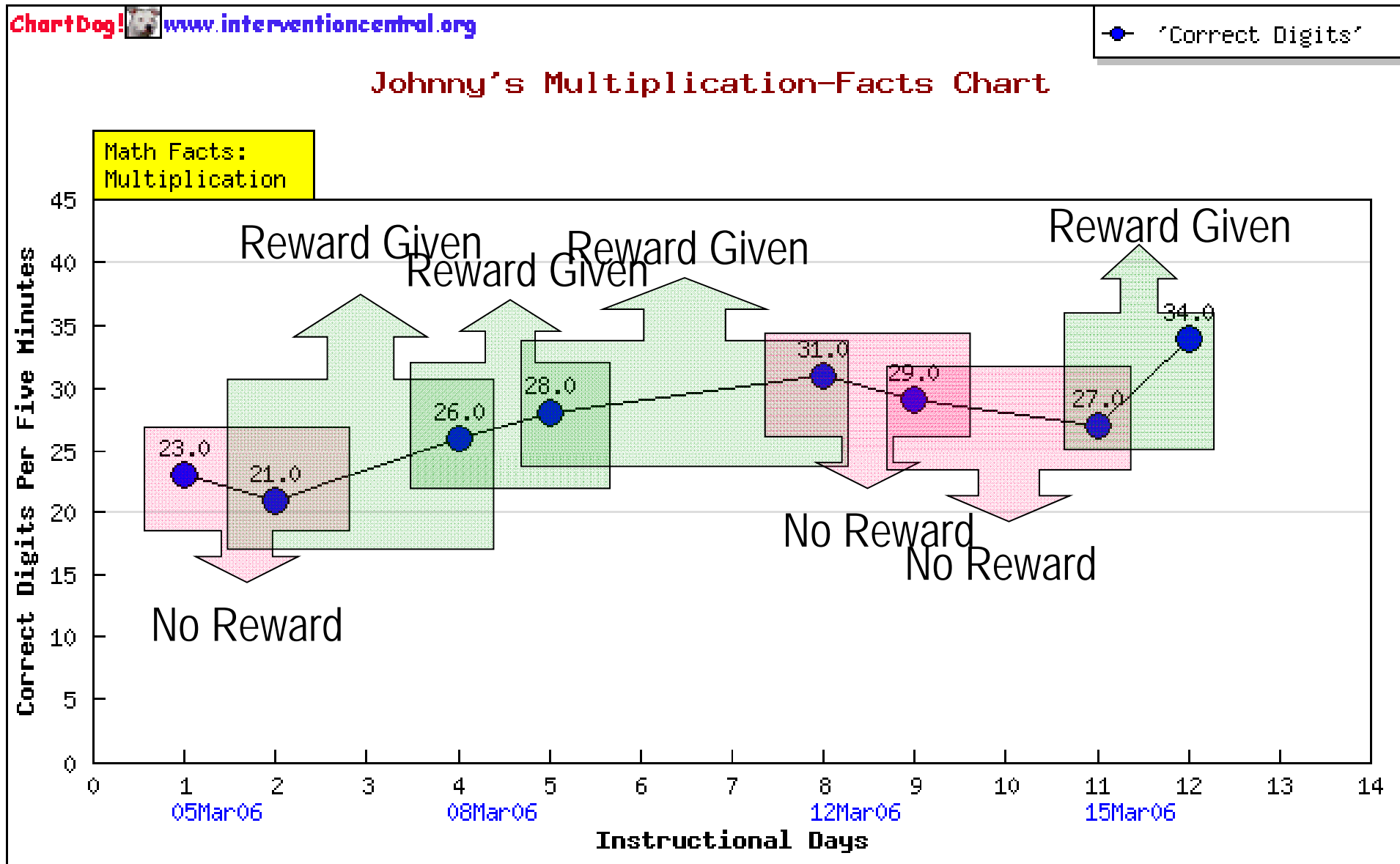
$$\begin{array}{r} 2 \\ \times 4 \\ \hline 8 \end{array}$$

www.interventioncentral.org
[Click for Student Worksheet](#)

Worksheets created using Math Worksheet Generator. Available online at:
<http://www.interventioncentral.org/htmldocs/tools/mathprobe/addsing.php>

Response to Intervention

Self-Administered Arithmetic Combination Drills...



Math Challenge: The student is not motivated to attempt math facts.



Solution: Use these strategies:

- Chunking
- Problem-Interspersal Technique

Motivation: Math Computation: Chunking

- Break longer assignments into shorter assignments with performance feedback given after each shorter 'chunk' (e.g., break a 20-minute math computation worksheet task into 3 seven-minute assignments). Breaking longer assignments into briefer segments also allows the teacher to praise struggling students more frequently for work completion and effort, providing an additional 'natural' reinforcer.

Source: Skinner, C. H., Pappas, D. N., & Davis, K. A. (2005). *Enhancing academic engagement: Providing opportunities for responding and influencing students to choose to respond. Psychology in the Schools, 42, 389-403.*

Motivation: Math Computation: Problem Interspersal Technique

- The teacher first identifies the range of 'challenging' problem-types (number problems appropriately matched to the student's current instructional level) that are to appear on the worksheet.
- Then the teacher creates a series of 'easy' problems that the students can complete very quickly (e.g., adding or subtracting two 1-digit numbers). The teacher next prepares a series of student math computation worksheets with 'easy' computation problems interspersed at a fixed rate among the 'challenging' problems.
- If the student is expected to complete the worksheet independently, 'challenging' and 'easy' problems should be interspersed at a 1:1 ratio (that is, every 'challenging' problem in the worksheet is preceded and/or followed by an 'easy' problem).
- If the student is to have the problems read aloud and then asked to solve the problems mentally and write down only the answer, the items should appear on the worksheet at a ratio of 3 'challenging' problems for every 'easy' one (that is, every 3 'challenging' problems are preceded and/or followed by an 'easy' one).

Source: Hawkins, J., Skinner, C. H., & Oliver, R. (2005). *The effects of task demands and additive interspersal ratios on fifth-grade students' mathematics accuracy. School Psychology Review, 34, 543-555.*

Math Challenge: The student misinterprets math graphics.



Solution:

- Use Question-Answer Relationships (QARs) to interpret information from math graphics

Housing Bubble Graphic: New York Times

23 September 2007

Housing Price
Index = 171 in
2005

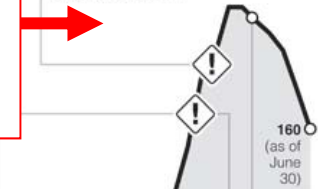
As Prices Soared, Warnings of a Bust...

MAY 2003 The Economist magazine publishes a survey on global property prices, "Another Bubble Fit to Burst."

MAY 2004 The economist and real estate skeptic Dean Baker sells his two-bedroom condo in the Adams Morgan neighborhood in Washington because he believes the gains in home prices are unsustainable.

FEB. 2005 The second edition of Robert J. Shiller's book "Irrational Exuberance" is published. In it, he argues that the American housing market is a bubble.

MAY 2005 Alan Greenspan says: "Without calling the overall national issue a bubble, it's pretty clear that it's an unsustainable underlying pattern."



... But Reassuring Words, Too

FEB. 2005 David Lereah's book, "Are You Missing the Real Estate Boom?," is published.

FEB. 2006 Ben S. Bernanke, the Federal Reserve chairman, says policy makers "expect the housing market to cool but not to change very sharply."

U.S. HOUSING PRICES SINCE 1987 This index is based on sale prices of standard existing single-family homes (not new construction). It has been adjusted for inflation.

The 1987 benchmark is **100** on the chart. If a standard house sold in 1987 for \$100,000 (inflation-adjusted to today's dollars), an equivalent house would have sold for \$92,000 in at the end of 1996 (**92** on the index scale).

The index peaked at **171** at the end of 2005, when the same house would have sold for \$171,000, a gain of 71 percent.

Housing Price
Index = 100 in
1987

Sources: Standard & Poor's/Case-Shiller Home Price Index; Bureau of Labor Statistics

THE NEW YORK TIMES

Classroom Challenges in Interpreting Math Graphics

When encountering math graphics, students may :

- expect the answer to be easily accessible when in fact the graphic may expect the reader to interpret and draw conclusions
- be inattentive to details of the graphic
- treat irrelevant data as 'relevant'
- not pay close attention to questions before turning to graphics to find the answer
- fail to use their prior knowledge both to extend the information on the graphic and to act as a possible 'check' on the information that it presents.

Source: Mesmer, H.A.E., & Hutchins, E.J. (2002). *Using QARs with charts and graphs. The Reading Teacher, 56, 21–27.*

Using Question-Answer Relationships (QARs) to Interpret Information from Math Graphics

Students can be more savvy interpreters of graphics in applied math problems by applying the Question-Answer Relationship (QAR) strategy. Four Kinds of QAR Questions:

- RIGHT THERE questions are fact-based and can be found in a single sentence, often accompanied by 'clue' words that also appear in the question.
- THINK AND SEARCH questions can be answered by information in the text but require the scanning of text and making connections between different pieces of factual information.
- AUTHOR AND YOU questions require that students take information or opinions that appear in the text and combine them with the reader's own experiences or opinions to formulate an answer.
- ON MY OWN questions are based on the students' own experiences and do not require knowledge of the text to answer.

Source: Mesmer, H.A.E., & Hutchins, E.J. (2002). *Using QARs with charts and graphs. The Reading Teacher, 56, 21–27.*

Using Question-Answer Relationships (QARs) to Interpret Information from Math Graphics: 4-Step Teaching Sequence

1. **DISTINGUISHING DIFFERENT KINDS OF GRAPHICS.** Students are taught to differentiate between common types of graphics: e.g., table (grid with information contained in cells), chart (boxes with possible connecting lines or arrows), picture (figure with labels), line graph, bar graph.

Students note significant differences between the various graphics, while the teacher records those observations on a wall chart. Next students are given examples of graphics and asked to identify which general kind of graphic each is.

Finally, students are assigned to go on a 'graphics hunt', locating graphics in magazines and newspapers, labeling them, and bringing to class to review.

Source: Mesmer, H.A.E., & Hutchins, E.J. (2002). *Using QARs with charts and graphs. The Reading Teacher, 56, 21–27.*

Using Question-Answer Relationships (QARs) to Interpret Information from Math Graphics: 4-Step Teaching Sequence

2. INTERPRETING INFORMATION IN GRAPHICS. Students are paired off, with stronger students matched with less strong ones. The teacher spends at least one session presenting students with examples from each of the graphics categories.

The presentation sequence is ordered so that students begin with examples of the most concrete graphics and move toward the more abstract: Pictures > tables > bar graphs > charts > line graphs.

At each session, student pairs examine graphics and discuss questions such as: "What information does this graphic present? What are strengths of this graphic for presenting data? What are possible weaknesses?"

Using Question-Answer Relationships (QARs) to Interpret Information from Math Graphics: 4-Step Teaching Sequence

3. LINKING THE USE OF QARS TO GRAPHICS. Students are given a series of data questions and correct answers, with each question accompanied by a graphic that contains information needed to formulate the answer.

Students are also each given index cards with titles and descriptions of each of the 4 QAR questions: RIGHT THERE, THINK AND SEARCH, AUTHOR AND YOU, ON MY OWN.

Working in small groups and then individually, students read the questions, study the matching graphics, and 'verify' the answers as correct. They then identify the type question being asked using their QAR index cards.

Using Question-Answer Relationships (QARs) to Interpret Information from Math Graphics: 4-Step Teaching Sequence

4. USING QARS WITH GRAPHICS INDEPENDENTLY. When students are ready to use the QAR strategy independently to read graphics, they are given a laminated card as a reference with 6 steps to follow:
 - A. *Read the question,*
 - B. *Review the graphic,*
 - C. *Reread the question,*
 - D. *Choose a QAR,*
 - E. *Answer the question, and*
 - F. *Locate the answer derived from the graphic in the answer choices offered.*

Students are strongly encouraged NOT to read the answer choices offered until they have first derived their own answer, so that those choices don't short-circuit their inquiry.

Math Challenge: The student fails to use a structured approach to solving word problems.



Solution: Train the student to use a cognitive strategy to attack word problems and to use 'self-coaching' (metacognitive techniques) to monitor the problem-solving process.

Importance of Metacognitive Strategy Use...

“Metacognitive processes focus on self-awareness of cognitive knowledge that is presumed to be necessary for effective problem solving, and they direct and regulate cognitive processes and strategies during problem solving... That is, successful problem solvers, consciously or unconsciously (depending on task demands), use self-instruction, self-questioning, and self-monitoring to gain access to strategic knowledge, guide execution of strategies, and regulate use of strategies and problem-solving performance.” p. 231

Source: Montague, M. (1992). *The effects of cognitive and metacognitive strategy instruction on the mathematical problem solving of middle school students with learning disabilities*. *Journal of Learning Disabilities*, 25, 230-248.

Elements of Metacognitive Processes

“**Self-instruction** helps students to identify and direct the problem-solving strategies prior to execution. **Self-questioning** promotes internal dialogue for systematically analyzing problem information and regulating execution of cognitive strategies. **Self-monitoring** promotes appropriate use of specific strategies and encourages students to monitor general performance. [Emphasis added].”
p. 231

Source: Montague, M. (1992). *The effects of cognitive and metacognitive strategy instruction on the mathematical problem solving of middle school students with learning disabilities*. *Journal of Learning Disabilities*, 25, 230-248.

Combining Cognitive & Metacognitive Strategies to Assist Students With Mathematical Problem Solving

Solving an advanced math problem independently requires the coordination of a number of complex skills. The following strategies combine both cognitive and metacognitive elements (Montague, 1992; Montague & Dietz, 2009). First, the student is taught a 7-step process for attacking a math word problem (cognitive strategy). Second, the instructor trains the student to use a three-part self-coaching routine for each of the seven problem-solving steps (metacognitive strategy).

Cognitive Portion of Combined Problem Solving Approach

In the cognitive part of this multi-strategy intervention, the student learns an explicit series of steps to analyze and solve a math problem. Those steps include:

1. **Reading the problem.** The student reads the problem carefully, noting and attempting to clear up any areas of uncertainty or confusion (e.g., unknown vocabulary terms).
2. **Paraphrasing the problem.** The student restates the problem in his or her own words.
3. **'Drawing' the problem.** The student creates a drawing of the problem, creating a visual representation of the word problem.
4. **Creating a plan to solve the problem.** The student decides on the best way to solve the problem and develops a plan to do so.
5. **Predicting/Estimating the answer.** The student estimates or predicts what the answer to the problem will be. The student may compute a quick approximation of the answer, using rounding or other shortcuts.
6. **Computing the answer.** The student follows the plan developed earlier to compute the answer to the problem.
7. **Checking the answer.** The student methodically checks the calculations for each step of the problem. The student also compares the actual answer to the estimated answer calculated in a previous step to ensure that there is general agreement between the two values.

Metacognitive Portion of Combined Problem Solving Approach

The metacognitive component of the intervention is a three-part routine that follows a sequence of 'Say', 'Ask', 'Check'. For each of the 7 problem-solving steps reviewed above:

- The student first self-instructs by stating, or 'saying', the purpose of the step (**'Say'**).
- The student next self-questions by 'asking' what he or she intends to do to complete the step (**'Ask'**).
- The student concludes the step by self-monitoring, or 'checking', the successful completion of the step (**'Check'**).

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
1. Read the problem.	<p>'Say' (Self-Instruction) Target: <i>The student reads and studies the problem carefully before proceeding.</i></p> <p>'Ask' (Self-Question) Target: <i>Does the student fully understand the problem?</i></p> <p>'Check' (Self-Monitor) Target: <i>Proceed only if the problem is understood.</i></p>	<p>Say: "I will read the problem. I will reread the problem if I don't understand it."</p> <p>Ask: "Now that I have read the problem, do I fully understand it?"</p> <p>Check: "I understand the problem and will move forward."</p>

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
<p>2. Paraphrase the problem.</p>	<p>'Say' (Self-Instruction) Target: <i>The student restates the problem in order to demonstrate understanding.</i></p> <p>'Ask' (Self-Question) Target: <i>Is the student able to paraphrase the problem?</i></p> <p>'Check' (Self-Monitor) Target: <i>Ensure that any highlighted key words are relevant to the question.</i></p>	<p>Say: "I will highlight key words and phrases that relate to the problem question." "I will restate the problem in my own words." Ask: "Did I highlight the most important words or phrases in the problem?" Check: "I found the key words or phrases that will help to solve the problem."</p>

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
3. 'Draw' the problem.	<p>'Say' (Self-Instruction) Target: <i>The student creates a drawing of the problem to consolidate understanding.</i></p> <p>'Ask' (Self-Question) Target: <i>Is there a match between the drawing and the problem?</i></p> <p>'Check' (Self-Monitor) Target: <i>The drawing includes in visual form the key elements of the math problem.</i></p>	<p>Say: "I will draw a diagram of the problem."</p> <p>Ask: "Does my drawing represent the problem?"</p> <p>Check: "The drawing contains the essential parts of the problem."</p>

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
<p>4. Create a plan to solve the problem.</p>	<p>'Say' (Self-Instruction) Target: <i>The student generates a plan to solve the problem.</i></p> <p>'Ask' (Self-Question) Target: <i>What plan will help the student to solve this problem?</i></p> <p>'Check' (Self-Monitor) Target: <i>The plan is appropriate to solve the problem.</i></p>	<p>Say: "I will make a plan to solve the problem."</p> <p>Ask: "What is the first step of this plan? What is the next step of the plan?"</p> <p>Check: "My plan has the right steps to solve the problem."</p>

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
<p>5. Predict/estimate the Answer.</p>	<p>'Say' (Self-Instruction) Target: <i>The student uses estimation or other strategies to predict or estimate the answer.</i></p> <p>'Ask' (Self-Question) Target: <i>What estimating technique will the student use to predict the answer?</i></p> <p>'Check' (Self-Monitor) Target: <i>The predicted/estimated answer used all of the essential problem information.</i></p>	<p>Say: "I will estimate what the answer will be."</p> <p>Ask: "What numbers in the problem should be used in my estimation?"</p> <p>Check: "I did not skip any important information in my estimation."</p>

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
6. Compute the answer.	<p>'Say' (Self-Instruction) Target: <i>The student follows the plan to compute the solution to the problem.</i></p> <p>'Ask' (Self-Question) Target: <i>Does the answer agree with the estimate?</i></p> <p>'Check' (Self-Monitor) Target: <i>The steps in the plan were followed and the operations completed in the correct order.</i></p>	<p>Say: "I will compute the answer to the problem." Ask: "Does my answer sound right?" "Is my answer close to my estimate?" Check: "I carried out all of the operations in the correct order to solve this problem."</p>

Combined Cognitive & Metacognitive Elements of Strategy

Table 1: 'Say-Ask-Check' Metacognitive Prompts Tied to a Word-Problem Cognitive Strategy (Montague, 1992)

Cognitive Strategy Step	Metacognitive 'Say-Ask-Check' Prompt Targets	Sample Metacognitive 'Say-Ask-Check' Prompts
7. Check the answer.	<p>'Say' (Self-Instruction) Target: <i>The student reviews the computation steps to verify the answer.</i></p> <p>'Ask' (Self-Question) Target: <i>Did the student check all the steps in solving the problem and are all computations correct?</i></p> <p>'Check' (Self-Monitor) Target: <i>The problem solution appears to have been done correctly.</i></p>	<p>Say: "I will check the steps of my answer."</p> <p>Ask: "Did I go through each step in my answer and check my work?"</p> <p>Check: ""</p>

Applied Problems: Pop Quiz

7-Step Problem-Solving Process

1. Reading the problem.
2. Paraphrasing the problem.
3. 'Drawing' the problem.
4. Creating a plan to solve the problem.
5. Predicting/Estimating the answer.
6. Computing the answer.
7. Checking the answer.

Directions: As a team, read the following problem. At your tables, apply the 7-step problem-solving (cognitive) strategy to complete the problem. As you complete each step of the problem, apply the 'Say-Ask-Check' metacognitive sequence. Try to complete the entire 7 steps within the time allocated for this exercise.

"To move their armies, the Romans built over 50,000 miles of roads. Imagine driving all those miles! Now imagine driving those miles in the first gasoline-driven car that has only three wheels and could reach a top speed of about 10 miles per hour. For safety's sake, let's bring along a spare tire. As you drive the 50,000 miles, you load the spare with the sequence. Try to complete the entire 7 amount of wear. Can you figure out how many miles of wear each tire accumulates?"

A: "Since the four wheels of the three-wheeled car share the journey equally, simply take three-fourths of the total distance (50,000 miles) and you'll get 37,500 miles for each tire."



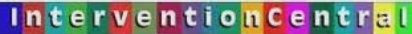
Source: The Math Forum @ Drexel: Critical Thinking Puzzles/Spare My Brain. Retrieved from <http://mathforum.org/k12/k12puzzles/critical.thinking/puzz2.html>

Response to Intervention

Activity: Benchmarks for the Critical Foundations of Algebra

Review the algebra benchmarks on p. 11 and select one topic to discuss:

1. **Screenings/Criteria:** Brainstorm ideas in your school or district to develop specific screening or assessment tools and criteria to measure these benchmarks.
2. **Curriculum Alignment:** Brainstorm ideas in your school or district to ensure that the majority of students (at least 80 percent) successfully attain the benchmarks at the appropriate grade.
3. **Diagnostic Assessment:** Brainstorm ideas to develop diagnostic assessments for individual students (e.g., in grade 9) to ensure that they have attained these benchmarks.

Benchmarks for the Critical Foundations of Algebra (National Math Advisory Panel, 2008)	
<i>Fluency with Whole Numbers</i>	<i>NOTES</i>
By the end of Grade 3, students should be proficient with the addition and subtraction of whole numbers.	
By the end of Grade 5, students should be proficient with multiplication and division of whole numbers.	
<i>Fluency with Fractions</i>	<i>NOTES</i>
By the end of Grade 4, students should be able to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals.	
By the end of Grade 5, students should be proficient with comparing fractions and decimals and common percents, and with the addition and subtraction of fractions and decimals.	
By the end of Grade 6, students should be proficient with multiplication and division of fractions and decimals.	
By the end of Grade 6, students should be proficient with all operations involving positive and negative integers.	
By the end of Grade 7, students should be proficient with all operations involving positive and negative fractions.	
By the end of Grade 7, students should be able to solve problems involving percent, ratio, and rate, and extend this work to proportionality.	
<i>Particular Aspects of Geometry and Measurement</i>	<i>NOTES</i>
 5-Minute 'Count Down' Timer	olving pair of parallel
05:00	ties of two- s, and analyze ing surface
www.interventioncentral.org	ip between

RTI Challenge : Screening and Progress-Monitoring for Students With Math Difficulties



Educational Decisions and Corresponding Types of Assessment

- **SCREENING/BENCHMARKING DECISIONS:** Tier 1: Brief screenings to quickly indicate whether students in the general-education population are academically proficient or at risk.
- **PROGRESS-MONITORING DECISIONS:** At Tiers 1, 2, and 3, ongoing 'formative' assessments to judge whether students on intervention are making adequate progress.
- **INSTRUCTIONAL/DIAGNOSTIC DECISIONS:** At any Tier, detailed assessment to map out specific academic deficits , discover the root cause(s) of a student's academic problem.
- **OUTCOME DECISIONS:** Summative assessment (e.g., state tests) to evaluate the effectiveness of a program.

Source: Hosp, M. K., Hosp, J. L., & Howell, K. W. (2007). *The ABCs of CBM: A practical guide to curriculum-based measurement*. New York: Guilford Press.

Response to Intervention

Clearinghouse for RTI Screening and Progress-Monitoring Tools

- The National Center on RTI (www.rti4success.org) maintains pages rating the technical adequacy of RTI screening and progress-monitoring tools.

Tools ▼ ▲	Area ▼ ▲	Reliability of the Performance Level Score ▼ ▲	Reliability of the Slope ▼ ▲	Validity of the Performance Level Score ▼ ▲	Predictive Validity of the Slope of Improvement ▼ ▲	Alternate Forms ▼ ▲	Sensitive to Student Improvement ▼ ▲	End-of-Year Bench - marks ▼ ▲	Rates of Improvement Specified ▼ ▲	Norms Disaggregated for Diverse Populations ▼ ▲	Disaggregated Reliability and Validity Data ▼ ▲	COMPARE RESET
AIMSweb	Math	●	●	●	●	◐	◐	●	●	No	●	<input type="checkbox"/>
AIMSweb	Oral Reading	●	●	●	●	●	◐	●	●	No	●	<input type="checkbox"/>
AIMSweb	Test of Early Literacy - Letter Naming Fluency	●	●	●	●	●	◐	●	●	No	●	<input type="checkbox"/>
AIMSweb	Test of Early Literacy - Letter Sound Fluency	●	●	●	●	●	◐	●	●	No	●	<input type="checkbox"/>

Curriculum-Based Measurement: Advantages as a Set of Tools to Monitor RTI/Academic Cases

- **Aligns** with curriculum-goals and materials
- Is **reliable** and **valid** (has 'technical adequacy')
- Is **criterion-referenced**: sets specific performance levels for specific tasks
- Uses **standard procedures** to prepare materials, administer, and score
- Samples student performance to give objective, observable '**low-inference**' information about student performance
- Has **decision rules** to help educators to interpret student data and make appropriate instructional decisions
- Is **efficient** to implement in schools (e.g., training can be done quickly; the measures are brief and feasible for classrooms, etc.)
- Provides data that can be converted into **visual displays** for ease of communication

Source: Hosp, M.K., Hosp, J. L., & Howell, K. W. (2007). *The ABCs of CBM*. New York: Guilford.

Collective Formative Math Assessment Data to Inform Instruction/Intervention

- Formative math measures have been developed to measure various aspects of math proficiency:
 - CBM: Math Computation Fluency: Math Facts
 - CBM: Math Concepts & Applications
 - CBM: Math Vocabulary
 - Checklist: Cognitive Strategies

Response to Intervention



Assessing Basic Academic Skills: Curriculum-Based Measurement

Mathematics: Single-skill basic arithmetic combinations are an 'adequate measure of performance' for low-achieving elementary & middle school students.

Websites to create CBM math computation probes:

- www.interventioncentral.org

$$\begin{array}{r} \underline{49} \text{ r}31 \\ 47 \overline{)2334} \\ \underline{-188} \\ 454 \\ \underline{-423} \\ 31 \end{array}$$

- www.superkids.com

$$\frac{9}{18} \times \frac{19}{20} = \frac{19}{40}$$

Source: Espin, C. A., & Tindal, G. (1998). Curriculum-based measurement for secondary students. In M. R. Shinn (Ed.) *Advanced applications of curriculum-based measurement*. New York: Guilford Press.

CBM Math Computation Sample Goals

- Addition: Add two one-digit numbers: sums to 18
- Addition: Add 3-digit to 3-digit with regrouping from ones column only
- Subtraction: Subtract 1-digit from 2-digit with no regrouping
- Subtraction: Subtract 2-digit from 3-digit with regrouping from ones and tens columns
- Multiplication: Multiply 2-digit by 2-digit-no regrouping
- Multiplication: Multiply 2-digit by 2-digit with regrouping

CBM Math Computation Assessment: Preparation

- Select either single-skill or multiple-skill math probe format.
- Create student math computation worksheet (including enough problems to keep most students busy for 2 minutes)
- Create answer key

CBM Math Computation Assessment: Preparation

- Advantage of single-skill probes:
 - Can yield a more 'pure' measure of student's computational fluency on a particular problem type

CBM Math Computation Assessment: Preparation

- Advantage of multiple-skill probes:
 - Allow examiner to gauge student's adaptability *between* problem types (e.g., distinguishing operation signs for addition, multiplication problems)
 - Useful for including previously learned computation problems to ensure that students retain knowledge.

Response to Intervention

Curriculum-Based Assessment Mathematics Multiple-Skills Computation Probe: Examiner Copy

Item 1:
4 CD/4 CD Total
ADDITION: Three to five 3-digit numbers; Regrouping in any column

$$\begin{array}{r} 663 \\ +208 \\ +628 \\ +411 \\ \hline 1910 \end{array}$$

Item 2:
16 CD/20 CD Total
DIVISION: 4-digit number divided by 2-digit number; no remainder

$$\begin{array}{r} 193 \\ 23 \overline{)4439} \\ \underline{-23} \\ 213 \\ \underline{-207} \\ 69 \\ \underline{-69} \\ 0 \end{array}$$

Item 3:
14 CD/34 CD Total
MULTIPLICATION: 4-digit number times 2-digit number; no regrouping

$$\begin{array}{r} 2213 \\ \times 12 \\ \hline 4426 \\ \underline{22130} \\ 26,556 \end{array}$$

Item 4:
5 CD/39 CD Total
SUBTRACTION: 5-digit number from a 5-digit number; regrouping from 1's & 10's columns

$$\begin{array}{r} 36,841 \\ - 15,765 \\ \hline 21,076 \end{array}$$

Item 5:
4 CD/43 CD Total
ADDITION: Three to five 3-digit numbers; Regrouping in any column

$$\begin{array}{r} 290 \\ +731 \\ +672 \\ \hline 1693 \end{array}$$

Item 6:
12 CD/55 CD Total
DIVISION: 4-digit number divided by 2-digit number; no remainder

$$\begin{array}{r} 22 \\ 68 \overline{)1496} \\ \underline{-136} \\ 136 \\ \underline{-136} \\ 0 \end{array}$$

CBM Math Computation Assessment: Scoring

Unlike more traditional methods for scoring math computation problems, CBM gives the student credit for *each correct digit* in the answer. This approach to scoring is more sensitive to short-term student gains and acknowledges the child's partial competencies in math.

Math Computation: Scoring Examples

$$\begin{array}{r} 105 \\ 56 \overline{) 5880} \\ \underline{-56} \\ 280 \\ \underline{-280} \\ 0 \end{array}$$

12 CDs

Curriculum-Based Measurement: Math Computation (Adapted from Deno & Mirkin, 1977)

Grade	Digits Correct in 2 Minutes	Digits Incorrect in 2 Minutes
1-3	20-38	6-14
4 & Up	40-78	6-14

Response to Intervention

CBM Math Computation Norms (Fuchs, Fuchs, Hintze, & Lembke, 2007)		
Grade	Assessment Time	End of Year Benchmark
Kindergarten	—	—
Grade 1	2 minutes	20 digits
Grade 2	2 minutes	20 digits
Grade 3	3 minutes	30 digits
Grade 4	3 minutes	40 digits
Grade 5	5 minutes	30 digits
Grade 6	6 minutes	35 digits

Source: Fuchs, D., Fuchs, L., Hintze, J., & Lembke, E. (2007). *Using curriculum-based measurement to determine response to intervention*. National Center on Student Progress Monitoring. Retrieved from http://www.studentprogress.org/summer_institute

Question: How can a school use CBM Math Computation probes if students are encouraged to use one of several methods to solve a computation problem—and have no fixed algorithm?

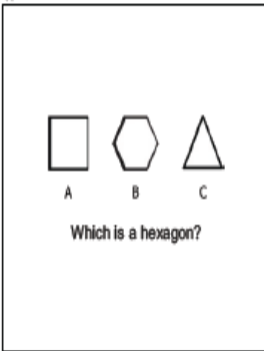
Answer: Students should know their 'math facts' automatically. Therefore, students can be given math computation probes to assess the speed and fluency of basic math facts—even if their curriculum encourages a variety of methods for solving math computation problems.

Math: Concepts & Applications


- The Math Concepts and Applications assessments (www.easycbm.com) were developed using as a guide the Math Curriculum Focal Points from the National Council of Teachers of Mathematics (NCTM). They include items sampling:
 - Algebra
 - Geometry & Measurement
 - Data Analysis & Number Operations

Math Numbers and Operations 3_3

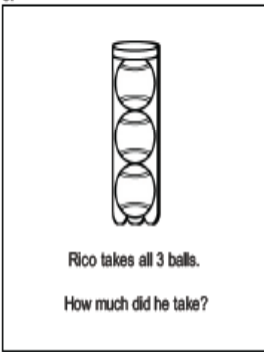
Student Name: _____ Date: _____


1. 
Which is a hexagon?

A. A
B. B
C. C

2. 
How many parts in all?

A. 6
B. 7
C. 3

3. 
Rico takes all 3 balls.
How much did he take?

4. 
gray part = ___

Math Vocabulary Probes

Curriculum-Based Evaluation: Math Vocabulary

Format Option 1

- 20 vocabulary terms appear alphabetically in the right column. Items are drawn randomly from a 'vocabulary pool'
- Randomly arranged definitions appear in the left column.
- The student writes the letter of the correct term next to each matching definition.
- The student receives 1 point for each correct response.
- Each probe lasts 5 minutes.
- 2-3 probes are given in a session.

Name: _____ Date: _____

Directions: Next to each definition in the left column, write the letter of the term from the right column that matches it.

Definition

 B 1. A property of some sets and binary operations in which the order of the objects is not important.

 2. Combines two objects of one type to form another object of the same type.

 3. A function in which the output changes in a reciprocal relationship to the input. In other words, if the input doubles, the output is cut in half.

 4. Any number which is a counting number, zero, or the opposite of a counting number.

Term

A. binary operation

B. commutativity

C. Integer

D. inverse proportion

Source: Howell, K. W. (2008). Best practices in curriculum-based evaluation and advanced reading. In A. Thomas & J. Grimes (Eds.), Best practices in school psychology V (pp. 397-418).

Curriculum-Based Evaluation: Math Vocabulary

Format Option 2

- 20 randomly arranged vocabulary definitions appear in the right column. Items are drawn randomly from a 'vocabulary pool'
- The student writes the name of the correct term next to each matching definition.
- The student is given 0.5 point for each correct term and another 0.5 point if the term is spelled correctly.
- Each probe lasts 5 minutes.
- 2-3 probes are given in a session.

Name: _____ Date: _____

Directions: Write the name of the term that completes each math definition.

Term

Definition

1. A property of some sets and binary operations in which the order of the objects is not important.
2. Combines two objects of one type to form another object of the same type.
3. A function in which the output changes in a reciprocal relationship to the input. In other words, if the input doubles, the output is cut in half.
4. Any number which is a counting number, zero, or the opposite of a counting number.

Source: Howell, K. W. (2008). *Best practices in curriculum-based evaluation and advanced reading*. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp. 397-418).

'Academic Enabler' Observational Checklists:
Measuring Students' Ability to Manage Their
Own Learning

'Academic Enabler' Skills: Why Are They Important?

Student academic success requires more than content knowledge or mastery of a collection of cognitive strategies. Academic accomplishment depends also on a set of ancillary skills and attributes called 'academic enablers' (DiPerna, 2006). Examples of academic enablers include:

- Study skills
- Homework completion
- Cooperative learning skills
- Organization
- Independent seatwork

Source: DiPerna, J. C. (2006). Academic enablers and student achievement: Implications for assessment and intervention services in the schools. *Psychology in the Schools*, 43, 7-17.

'Academic Enabler' Skills: Why Are They Important? (Cont.)

Because academic enablers are often described as broad skill sets, however, they can be challenging to define in clear, specific, measureable terms. A useful method for defining a global academic enabling skill is to break it down into a checklist of component sub-skills--a process known as 'discrete categorization' (Kazdin, 1989). An observer can then use the checklist to note whether a student successfully displays each of the sub-skills.

Source: Kazdin, A. E. (1989). *Behavior modification in applied settings* (4th ed.). Pacific Grove, CA: Brooks/Cole.

'Academic Enabler' Skills: Why Are They Important? (Cont.)

Observational checklists that define academic enabling skills have several uses in Response to Intervention:

- Classroom teachers can use these skills checklists as convenient tools to assess whether a student possesses the minimum 'starter set' of academic enabling skills needed for classroom success.
- Teachers or tutors can share examples of academic-enabler skills checklists with students, training them in each of the sub-skills and encouraging them to use the checklists independently to take greater responsibility for their own learning.
- Teachers or other observers can use the academic enabler checklists periodically to monitor student progress during interventions--assessing formatively whether the student is using more of the sub-skills.

Source: Kazdin, A. E. (1989). *Behavior modification in applied settings* (4th ed.). Pacific Grove, CA: Brooks/Cole.

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Study Skills. The student:				
<input type="checkbox"/> takes complete, organized class notes in legible form and maintains them in one accessible note book	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> reviews class notes frequently (e.g., after each class) to ensure understanding	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> When reviewing notes, uses highlighters, margin notes, or other strategies to note questions or areas of confusion for later review with teacher or tutor	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> follows an efficient strategy to study for tests and quizzes	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> allocates enough time to study for tests and quizzes	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> is willing to seek help from the teacher to answer questions or clear up areas of confusion	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> Other: _____				
Comments: _____ _____				

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Organization Skills. The student:				
<input type="checkbox"/> arrives to class on time.	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> maintains organization of locker to allow student to efficiently store and retrieve needed books, assignments, work materials, and personal belongings	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> maintains organization of backpack or book bag to allow student to efficiently store and retrieve needed books, assignments, work materials, and personal belongings	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> brings to class the necessary work materials expected for the course (e.g., pen, paper, calculator, etc.)	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> is efficient in switching work materials when transitioning from one in-class learning activity to another	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> Other: _____	Poor 1	Fair 2	Good 3	NA –
Comments: _____ _____				

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Homework Completion. The student:				
<input type="checkbox"/> writes down homework assignments accurately and completely	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> makes use of available time in school (e.g., study halls, homeroom) to work on homework	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> has an organized, non-distracting workspace available at home to do homework	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> creates a work plan before starting homework (e.g., sequencing the order in which assignments are to be completed; selecting the most challenging assignment to start first when energy and concentration are highest)	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> when completing homework, uses highlighters, margin notes, or other strategies to note questions or areas of confusion for later review with teacher or tutor	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> turns in homework on time	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> Other: _____	Poor 1	Fair 2	Good 3	NA –
Comments: _____ _____ _____				

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Cooperative Learning Skills. The student:				
<input type="checkbox"/> participates in class discussion	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> gets along with others during group/pair activities	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> participates fully in group/pair activities	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> does his or her 'fair share' of work during group/pair activities	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> is willing to take a leadership position during group/pair activities	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> Other: _____	Poor 1	Fair 2	Good 3	NA –
Comments: _____ _____				

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Independent Seat Work. The student:				
<input type="checkbox"/> has necessary work materials for the assignment	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> is on-task during the assignment at a level typical for students in the class	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> refrains from distracting behaviors (e.g., talking with peers without permission, pen tapping, vocalizations such as loud sighs or mumbling, etc.)	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> recognizes when he or she needs teacher assistance and is willing to that assistance	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> requests teacher assistance in an appropriate manner	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> requests assistance from the teacher only when really needed	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> if finished with the independent assignment before time expires, uses remaining time to check work or engage in other academic activity allowed by teacher	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> takes care in completing work—as evidenced by the quality of the finished assignment	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> is reliable in turning in assignments done in class.	Poor 1	Fair 2	Good 3	NA –
<input type="checkbox"/> Other: _____	Poor 1	Fair 2	Good 3	NA –
Comments: _____ _____				

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Motivation. The student:					
<input type="checkbox"/>	has a positive sense of 'self-efficacy' about the academic content area (self-efficacy can be defined as the confidence that one can be successful in the academic discipline or subject matter if one puts forth reasonable effort)	Poor 1	Fair 2	Good 3	NA —
<input type="checkbox"/>	displays some apparent <i>intrinsic</i> motivation to engage in course work (e.g., is motivated by topics and subject matter discussed or covered in the course; finds the act of working on course assignments to be reinforcing in its own right)	Poor 1	Fair 2	Good 3	NA —
<input type="checkbox"/>	displays apparent <i>extrinsic</i> motivation to engage in course work (e.g., is motivated by grades, praise, public recognition of achievement, access to privileges such as sports eligibility, or other rewarding outcomes)	Poor 1	Fair 2	Good 3	NA —
<input type="checkbox"/>	Other: _____	Poor 1	Fair 2	Good 3	NA —
Comments: _____ _____					

Response to Intervention

'Academic Enabler' Skills: Sample Observational Checklists

Teacher-Defined Academic Enabling Skill:					
Skill Name: _____					
Essential Subskills: The student::					
<input type="checkbox"/> _____ _____		Poor 1	Fair 2	Good 3	NA -
<input type="checkbox"/> _____ _____		Poor 1	Fair 2	Good 3	NA -
<input type="checkbox"/> _____ _____		Poor 1	Fair 2	Good 3	NA -
<input type="checkbox"/> _____ _____		Poor 1	Fair 2	Good 3	NA
<input type="checkbox"/> _____ _____		Poor 1	Fair 2	Good 3	NA
Comments: _____ _____					

Team Activity: Using Formative Math Assessments to Inform Instruction/Intervention

- Review the free math measures just discussed for screening and monitoring the progress of students in math skills:
 - CBM: Math Computation Fluency: Math Facts
 - CBM: Math Concepts & Applications
 - CBM: Math Vocabulary
 - Checklist: Academic Enablers
- Have a discussion about how you or others in your school might explore/pilot/use these or similar math assessment tools.



Finding the Right
Spark: Strategies for
Motivating the
Resistant Learner



Student Motivation: Reframing the Issue in Observable (and Fixable) Terms

Step 1: Redefine 'motivation' as academic engagement: e.g., The student chooses "to engage in active accurate academic responding" (Skinner, Pappas, & Davis, 2005).

Step 2: Build staff support for this mission statement: "When a student appears unmotivated, it is the school's job to figure out why the student is unmotivated and to find a way to get that student motivated."

Source: Skinner, C. H., Pappas, D. N., & Davis, K. A. (2005). Enhancing academic engagement: Providing opportunities for responding and influencing students to choose to respond. *Psychology in the Schools, 42*, 389-403.

Motivation Challenge:
Analyzing Why a Student
Lacks Motivation and
Selecting Appropriate
Strategies



Six Reasons That Students Are Unmotivated (And What Teachers Can Do)

- The student is unmotivated because he or she cannot do the assigned work.
- The student is unmotivated because the 'response effort' needed to complete the assigned work seems too great.
- The student is unmotivated because classroom instruction does not engage.
- The student is unmotivated because he or she fails to see an adequate pay-off to doing the assigned work.
- The student is unmotivated because of low self-efficacy—lack of confidence that he or she can do the assigned work.
- The student is unmotivated because he or she lacks a positive relationship with the teacher.

Six Reasons Why Students Are Unmotivated (And What Teachers Can Do)

- This handout provides guidance to teachers in identifying why a student lacks motivation and what general strategies are recommended in the research.
- The teacher then has latitude to use the general guidelines and the research that supports them as a starting-point for their own intervention ideas to boost motivation.



INTERVENTION
CENTRAL

RTI Toolkit: A Practical Guide for Schools

Six Reasons Why Students Are Unmotivated (and What Teachers Can Do)

Jim Wright, Presenter

22 September 2011

South Dakota Association of School Psychologists
Aberdeen, SD

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Motivation Deficit 1: *The student is unmotivated because he or she cannot do the assigned work.*



- **Profile of a Student with This Motivation Problem:**
The student lacks essential skills required to do the task.

Motivation Deficit 1: Cannot Do the Work

- **Profile of a Student with This Motivation Problem (Cont.):**
Areas of deficit might include:
 - *Basic academic skills.* Basic skills have straightforward criteria for correct performance (e.g., the student defines vocabulary words or decodes text or computes 'math facts') and comprise the building-blocks of more complex academic tasks (Rupley, Blair, & Nichols, 2009).
 - *Cognitive strategies.* Students employ specific cognitive strategies as "guiding procedures" to complete more complex academic tasks such as reading comprehension or writing (Rosenshine, 1995)
 - *Academic-enabling skills.* Skills that are 'academic enablers' (DiPerna, 2006) are not tied to specific academic knowledge but rather aid student learning across a wide range of settings and tasks (e.g., organizing work materials, time management).

Motivation Deficit 1: Cannot Do the Work (Cont.)

- **What the Research Says:** When a student lacks the capability to complete an academic task because of limited or missing basic skills, cognitive strategies, or academic-enabling skills, that student is still in the acquisition stage of learning (Haring et al., 1978). That student cannot be expected to be motivated or to be successful as a learner unless he or she is first explicitly taught these weak or absent essential skills (Daly, Witt, Martens & Dool, 1997).

Motivation Deficit 1: Cannot Do the Work (Cont.)

- **How to Verify the Presence of This Motivation Problem:**
The teacher collects information (e.g., through observations of the student engaging in academic tasks; interviews with the student; examination of work products, quizzes, or tests) demonstrating that the student lacks basic skills, cognitive strategies, or academic-enabling skills essential to the academic task.

Motivation Deficit 1: Cannot Do the Work (Cont.)

- **How to Fix This Motivation Problem:** Students who are not motivated because they lack essential skills need to be taught those skills.

Direct-Instruction Format. Students learning new material, concepts, or skills benefit from a 'direct instruction' approach. (Burns, VanDerHeyden & Boice, 2008; Rosenshine, 1995; Rupley, Blair, & Nichols, 2009).

RTI Interventions: What If There is No Commercial Intervention Package or Program Available?

“Although commercially prepared programs and the subsequent manuals and materials are inviting, they are not necessary. ... A recent review of research suggests that interventions are research based and likely to be successful, if they are correctly targeted and provide explicit instruction in the skill, an appropriate level of challenge, sufficient opportunities to respond to and practice the skill, and immediate feedback on performance... Thus, these [elements] could be used as criteria with which to judge potential ... interventions.” p. 88

Source: Burns, M. K., & Gibbons, K. A. (2008). Implementing response-to-intervention in elementary and secondary schools. Routledge: New York.

How to Fix This Motivation Problem: Students who are not motivated because they lack essential skills need to be taught those skills.

Direct-Instruction Format. Students learning new material, concepts, or skills benefit from a 'direct instruction' approach. (Burns, VanDerHeyden & Boice, 2008; Rosenshine, 1995; Rupley, Blair, & Nichols, 2009). When following a direct-instruction format, the teacher:

- ensures that the lesson content is appropriately matched to students' abilities.
- opens the lesson with a brief review of concepts or material that were previously presented.
- states the goals of the current day's lesson.
- breaks new material into small, manageable increments, or steps.
- throughout the lesson, provides adequate explanations and detailed instructions for all concepts and materials being taught. NOTE: Verbal explanations can include 'talk-alouds' (e.g., the teacher describes and explains each step of a cognitive strategy) and 'think-alouds' (e.g., the teacher applies a cognitive strategy to a particular problem or task and verbalizes the steps applying the strategy).
- regularly checks for student understanding by posing frequent questions and eliciting group responses.
- verifies that students are experiencing sufficient success in the lesson content to shape their learning in the desired direction and to maintain student motivation and engagement.
- provides timely and regular performance feedback and corrections throughout the lesson as needed to guide student learning.
- allows students the chance to engage in practice activities distributed throughout the lesson (e.g., through teacher demonstration; then group practice with teacher supervision and feedback; then independent, individual student practice).
- ensures that students have adequate support (e.g., clear and explicit instructions; teacher monitoring) to be successful during independent seatwork practice activities.

Motivation Deficit 1: Cannot Do the Work (Cont.)

- **How to Fix This Motivation Problem:** When following a direct-instruction format, the teacher:
 - ensures that the lesson content is appropriately matched to students' abilities.
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Motivation Deficit 1: Cannot Do the Work (Cont.)

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 - ❑ throughout the lesson, provides adequate explanations and detailed instructions for all concepts and materials being taught. NOTE: Verbal explanations can include 'talk-alouds' (e.g., the teacher describes and explains each step of a cognitive strategy) and 'think-alouds' (e.g., the teacher applies a cognitive strategy to a particular problem or task and verbalizes the steps in applying the strategy).
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Motivation Deficit 1: Cannot Do the Work (Cont.)

- **How to Fix This Motivation Problem:** When following a direct-instruction format, the teacher:
 - ❑ verifies that students are experiencing sufficient success in the lesson content to shape their learning in the desired direction and to maintain student motivation and engagement.
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Motivation Deficit 1: Cannot Do the Work (Cont.)

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- ensures that students have adequate support (e.g., clear and explicit instructions; teacher monitoring) to be successful during independent seatwork practice activities.

Motivation Deficit 2: *The student is unmotivated because the 'response effort' needed to complete the assigned work seems too great.*



- **Profile of a Student with This Motivation Problem:**
Although the student has the required skills to complete the assigned work, he or she perceives the 'effort' needed to do so to be so great that the student loses motivation.

Motivation Deficit 2: Response Effort (Cont.)

- **What the Research Says:** Research indicates that (1) as the perceived effort to complete an academic task or other behavior ('response effort') *increases*, people are *less* likely to engage in that behavior, while (2) as the effort to complete the same behavior *decreases*, people are *more* likely to engage in it (Friman & Poling, 1995).

Motivation Deficit 2: Response Effort (Cont.)

- **How to Verify the Presence of This Motivation Problem:**
The teacher first checks to see that the student has the requisite skills needed for academic success. The teacher then looks for evidence that, in specific situations, the student is reluctant to undertake academic tasks because they are perceived to require too much effort.

Tell-tale signs that a student may be unmotivated because of the required response effort include procrastination, verbal complaining, frequent seeking of teacher help, and other avoidant behaviors.

Motivation Deficit 2: Response Effort (Cont.)

- **How to Fix This Motivation Problem:** Teachers can increase student motivation through any method that reduces the apparent 'response effort' of an academic task (Friman & Poling, 1995). - so long as that method does not hold the student to a lesser academic standard than classmates (Skinner, Pappas, & Davis, 2005).

Motivation Deficit 2: Response Effort (Cont.)

Try These Ideas to Improve Motivation by Reducing Response Effort :

- *Start Assigned Readings in Class.* Whenever the teacher assigns a challenging text for students to read independently (e.g., as homework), the teacher (or perhaps a skilled student reader) reads the first few paragraphs of the assigned reading aloud while the class follows along silently in their own texts. Students are then expected to read the remainder of the text on their own.

Motivation Deficit 2: Response Effort (Cont.)

Try These Ideas to Improve Motivation by Reducing Response Effort :

- *Begin Challenging Homework Assignments in Class.* When assigned challenging homework, students are paired off or divided into groups and given a small amount of class time to begin the homework together, develop a plan for completing the homework, formulate questions about the homework, or engage in other activities that will create the necessary momentum to motivate students then to complete the work independently.

Motivation Deficit 2: Response Effort (Cont.)

Try These Ideas to Improve Motivation by Reducing Response Effort :

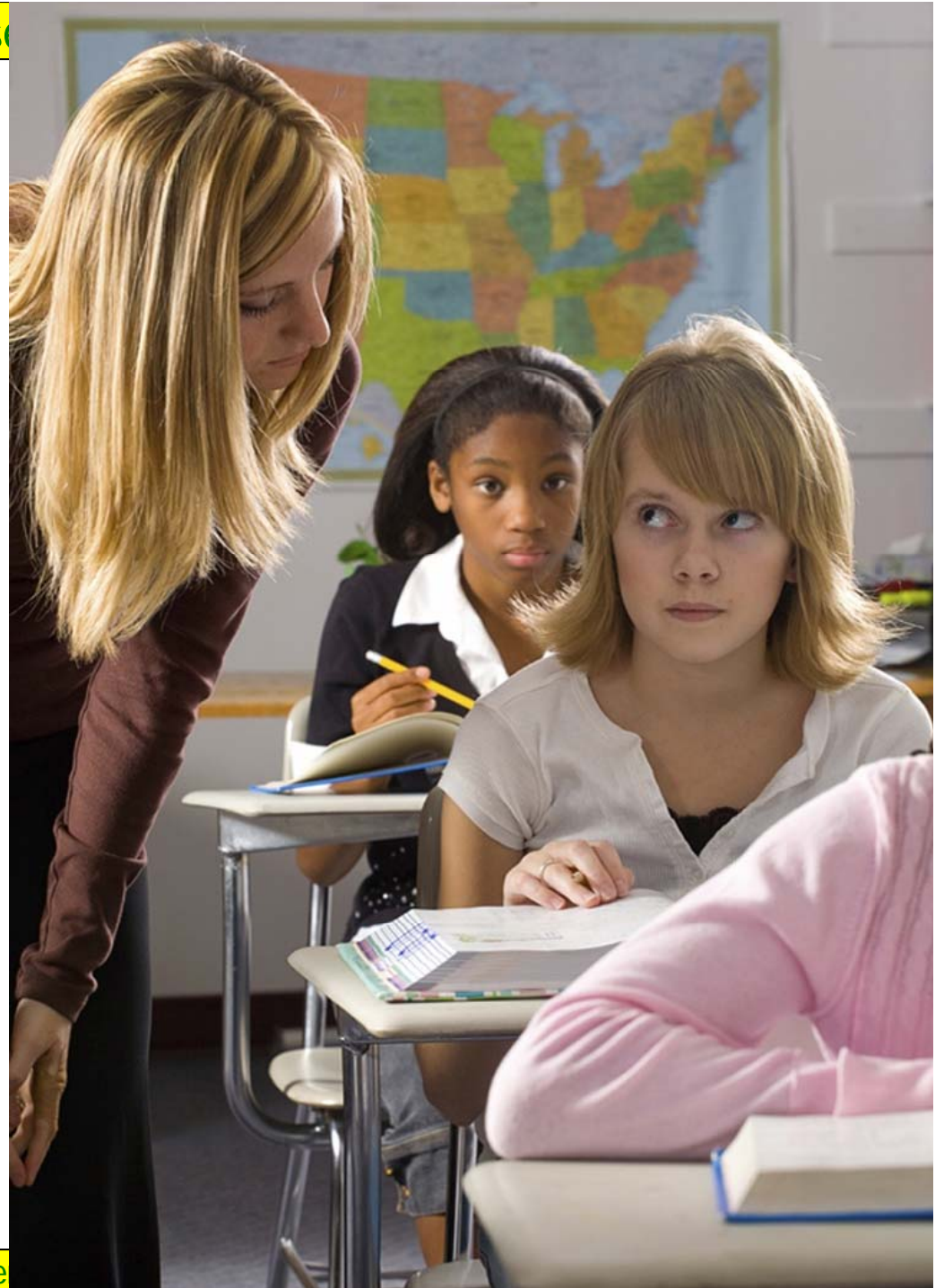
- *'Chunk' Assignments.* The teacher breaks a larger student assignment into smaller 'chunks'. The teacher provides the student with performance feedback and praise for each completed 'chunk' of assigned work (Skinner, Pappas, & Davis, 2005).
- *Select a Supportive Peer or Adult to Get a Student Started on Assignments.* If a student finds it difficult to get organized and begin independent seatwork activities, a supportive peer or adult in the classroom can get the student organized and started on the assignment.

Motivation Deficit 2: Response Effort (Cont.)

Try These Ideas to Improve Motivation by Reducing Response Effort :

- *Provide a Formal Work Plan.* For more complex assignments such as research papers, the teacher gives the student an outline of a work plan for completing those assignments. The plan breaks a larger assignment into appropriate sub-steps (e.g., 'find five research articles for the paper', 'summarize key information from research articles into notes', etc.). For each sub-step, the plan provides (1) an estimate of the minimum 'seat time' required to complete it and (2) sets a calendar-date deadline for completion. The teacher then touches base with the student at least weekly about his or her progress.

Helping the Student
Who is 'Under Water'
With Late
Assignments: A
Structure for
Teacher-Student
Conferences



Negotiating Missing Work: Student-Teacher Conference

When students fall behind in their classwork, they can quickly enter a downward spiral. Some students become overwhelmed and simply give up.

In such cases, the teacher may want to meet with the student –and if possible, a parent--to help that student to create a work plan to catch up with late work.

At the meeting, the teacher and student inventory what work is missing, negotiate a plan to complete that overdue work, and perhaps agree on a reasonable penalty when late work is turned in. All attending then sign off on the work plan. The teacher also ensures that the atmosphere at the meeting is supportive.

Negotiating Missing Work: Student-Teacher Conference (Cont.)

Here in greater detail are the steps that the teacher and student would follow at a meeting to renegotiate missing work:

1. *Inventory All Missing Work.* The teacher reviews with the student all late or missing work. The student is given the opportunity to explain why the work has not yet been submitted.

Negotiating Missing Work: Student-Teacher Conference (Cont.)

- 2. Negotiate a Plan to Complete Missing Work.* The teacher and student create a log with entries for all missing assignments. Each entry includes a description of the missing assignment and a due date by which the student pledges to submit that work. This log becomes the student's work plan. Submission dates for late assignments should be realistic--particularly for students who owe a considerable amount of late work and are also trying to keep caught up with current assignments.

Student Late-Work Planning Form: Middle & High School

Teacher: _____ Course: _____

Student: _____ Date: ____/____/____

Directions: At a teacher-student conference, use this form to create a plan for the student to complete and submit missing or late work.

Assignment	Target Date for Completion	NOTES

What penalty—if any—will be imposed for these late assignments? _____

Student Signature

Teacher Signature

Parent Signature

Negotiating Missing Work: Student-Teacher Conference (Cont.)

3. *[Optional] Impose a Penalty for Missing Work.* The teacher may decide to impose a penalty for the work being submitted late. Examples of possible penalties are a reduction of points (e.g., loss of 10 points per assignment) or the requirement that the student do additional work on the assignment than was required of his or her peers who turned it in on time. If imposed, such penalties would be spelled out at this teacher-student conference. Any penalties should be balanced and fair, permitting the teacher to impose appropriate consequences while allowing the student to still see a path to completing missing work and passing the course.

Negotiating Missing Work: Student-Teacher Conference (Cont.)

4. *Periodically Check on the Status of the Missing-Work Plan.* If the schedule agreed upon by teacher and student to complete and submit all late work exceeds two weeks, the teacher (or other designated school contact, such as a counselor) should meet with the student weekly while the plan is in effect. At these meetings, the teacher checks in with the student to verify that he or she is attaining the plan milestones on time and still expects to meet the submission deadlines agreed upon. If obstacles to emerge, the teacher and student engage in problem-solving to resolve them.

Motivation Deficit 5: *The student is unmotivated because of low self-efficacy—lack of confidence that he or she can do the assigned work.*



- **Profile of a Student with This Motivation Problem:** The student has a low sense of self-efficacy in a subject area, activity, or academic task and that lack of confidence reduces the student's motivation to apply his or her best effort. NOTE: Self-efficacy is the student's view of his or her own abilities specific to a particular academic area (e.g., mathematics) and should not be confused with self-esteem, which represents the student's global view of his or her self-worth.

Motivation Deficit 5: Low Self-Efficacy (Cont.)

- **What the Research Says:** Students often sabotage their academic performance by engaging in negative self-talk about their abilities and by making faulty attributions to explain poor academic performance (Linnenbrink & Pintrich, 2002).

Motivation Deficit 5: Low Self-Efficacy (Cont.)

- **How to Verify the Presence of This Motivation Problem:**
Teachers can tap students' impressions of self-efficacy by asking them to 'think aloud' about their abilities in the academic area of interest, encouraging the student to:
 - talk about their perceived strengths and weaknesses as learners in particular subject areas
 - give examples (with details) about specific successes and failures that they have experienced on academic assignments present strategies (if any) that they typically use to
 - Discuss how they complete a range of common academic tasks (e.g., undertaking a term paper, completing a chemistry lab exercise, doing homework)
 - disclose their routine for preparing for quizzes and tests.

Motivation Deficit 5: Low Self-Efficacy (Cont.)

- **How to Fix This Motivation Problem:**
Challenge Faulty Student Attributions about Ability. As a student articulates attitudes toward learning and describes techniques that he or she uses as an independent learner, the teacher can use this information to identify whether a low sense of academic self-efficacy may be holding the student back.

A useful framework for analyzing student views about their academic abilities is presented by Linnenbrink & Pintrich (2002). The authors analyze student attributions along three dimensions: internal/external; stable/unstable; and controllable/uncontrollable.

How Attributions About Learning Contribute to Academic Outcomes

Attribution Theory: Dimensions Affecting Student Interpretation of Academic Successes & Failures

(Linnenbrink & Pintrich, 2002)

The situation or event is...

- Unstable (changes often)

- Stable (can be counted on to remain relatively unchanged)

- Internal (within the student)

- External (occurring in the surrounding environment)

- Uncontrollable (beyond the ability of the student to influence)

- Controllable (within the student's ability to influence)

How Attributions About Learning Contribute to Academic Outcomes

*Some people are born mathematicians.
and picks questions that are impossible to study for!
I was born to watch TV.*

The situation or event is...

- Unstable (changes often)

- Stable (can be counted on to remain relatively unchanged)

- Internal (within the student)

- External (occurring in the surrounding environment)

- Uncontrollable (beyond the ability of the student to influence)

- Controllable (within the student's ability to influence)

Motivation Deficit 5: Low Self-Efficacy (Cont.)

- Examples of Faulty Student Attributions and 'Teacher Corrections': External vs. Internal

A student blames the teacher for giving unannounced quizzes that catch the student unprepared (**external** explanation of the problem).

In response, the instructor points out that the student has the option to review course content regularly and thus always be prepared for quizzes (shifting the focus by tying the **internal** explanation of student preparation to the goal of improving academic performance).

Motivation Deficit 5: Low Self-Efficacy (Cont.)

- Examples of Faulty Student Attributions and 'Teacher Corrections': Stable vs. Unstable

A student laments to her math teacher that her difficulty in grasping concepts relating to negative numbers shows that she 'will never get a good grade in math' (a view that the problem is long-term and therefore **stable**).

The teacher helps the student to reframe the problem as **unstable** and likely to improve soon by noting that many students struggle with negative-number concepts but that the student should find upcoming math instructional modules to be much easier to comprehend.

Motivation Deficit 5: Low Self-Efficacy (Cont.)

- Examples of Faulty Student Attributions and 'Teacher Corrections': Controllable vs. Uncontrollable

A teacher points out to a student who complains about the requirements of a particular course as arbitrary and unfair (**uncontrollable**) that the student was given a syllabus at the start of the semester spelling out all academic requirements to be used as a roadmap for the course, that the syllabus will allow the student to complete assignments ahead of time if he wishes, and that furthermore the student is welcome to seek help from the teacher whenever he chooses (**controllable** factors).

Challenging 'Faulty' Student Attributions: Example

A student says 'I am just not wired to be a writer' (faulty attribution: stable, internal, uncontrollable). The teacher shows the student evidence to disconfirm her attribution: examples of the student's own writing from a portfolio that are of high quality because the topics had interested the student.

The instructor demonstrates that when the student puts effort into her writing, the product is reliably and predictably improved--reframe: unstable/changeable (quality of the writing product depends on student effort), internal (the student has the necessary skill set to produce good writing), controllable (student effort is the key factor in producing a quality writing product).

Source: Linnenbrink, E. A., & Pintrich, P. R. (2002). Motivation as an enabler for academic success. *School Psychology Review*, 31, 313-327.

Motivation Deficit **6**: *The student is unmotivated because he or she lacks a positive relationship with the teacher.*



- **Profile of a Student with This Motivation Problem:** The student appears indifferent or even hostile toward the instructor and thus may lack motivation to follow teacher requests or to produce work.

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

- **What the Research Says:** Because humans are highly social beings, positive teacher attention can be a very powerful motivator for students (e.g., Kazdin, 1989).

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

- **What the Research Says (Cont.):** At times, however, instructors and students can fall into a 'negative reinforcement trap' (Maag, 2001; p. 176) that actively undercuts positive relationships: A student who has difficulty with the classwork misbehaves and is then sent by the teacher to the principal's office. Both teacher and student are reinforced by the student's exclusion from the classroom: The teacher is negatively reinforced by having a difficult student removed from the room and the student is *also* negatively reinforced by being allowed to escape the challenging classwork. Because this scenario is reinforcing to both parties, it is very likely to be repeated with increasing frequency unless the teacher intervenes to break the negative cycle.

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

- **How to Verify the Presence of This Motivation Problem:**

The teacher looks for evidence that the student lacks a positive relationship with the teacher, such as:

- the student's apparent avoidance of opportunities to talk to the teacher
- a lack of eye contact, sarcastic or defiant student comments
- a general pattern of defiant or non-compliant behavior.

NOTE: Because teachers as well as students are social beings, an instructor's impression of whether a student 'likes' them or not can often be a good predictor of the actual state of the teacher-student relationship.

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

- **How to Fix This Motivation Problem:** The teacher provides the student with increased doses of positive attention at times when the student is engaging in appropriate behavior. (At the same time, the teacher keeps interactions with the student brief and neutral when that student misbehaves—although the student otherwise is held to the same behavioral expectations as his or her peers.)

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

Try These Ideas to Improve the Student-Teacher Relationship:

- *Strive for a High Ratio of Positive Interactions with Students* (Sprick, Borgmeier, & Nolet, 2002). A general, proactive rule of thumb to promote positive teacher-student relationships is for instructors to maintain a ratio of at least three positive interactions with any student for every negative (disciplinary) interaction that they have that student.

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

Try These Ideas to Improve the Student-Teacher Relationship:

- *Commit to a Short Series of Positive 'Micro-Conversations'* (Mendler, 2000). The teacher selects a student with whom that instructor wants to build a more positive relationship. The instructor makes a commitment to spend 2 minutes per day for ten consecutive days engaging the student in a positive conversation about topics of interest to that student. NOTE: During those two-minute daily conversations, the teacher maintains a positive tone and avoids talking about the student's problem behaviors or poor academic performance.

Motivation Deficit 6: Lack of Positive Relationship (Cont.)

Try These Ideas to Improve the Student-Teacher Relationship:

- *Emphasize the Positive in Teacher Requests* (Braithwaite, 2001). The teacher avoids using negative phrasing (e.g., "If you don't return to your seat, I can't help you with your assignment") when making a request of a student. Instead, the teacher request is stated in positive terms (e.g., "I will be over to help you on the assignment just as soon as you return to your seat"). When a request has a positive 'spin', that teacher is less likely to trigger a power struggle and more likely to gain student compliance.



Motivating the Reluctant Student: Activity

- Review the two reasons for poor student motivation presented.
 - Discuss how your school might identify and support students who lack motivation for these reasons.
- **Motivation Deficit 5: The student is unmotivated because of low self-efficacy—lack of confidence that he or she can do the assigned work.**
 - **Motivation Deficit 6: The student is unmotivated because he or she lacks a positive relationship with the teacher.**

Anticipating the Unmotivated Student

Teachers can proactively use the checklist of reasons for poor motivation (and related strategies to address them).

The teacher reviews each motivation blocker and verifies that he or she has procedures in place at the group level to address them.

- The student is unmotivated because he or she cannot do the assigned work.
- The student is unmotivated because the 'response effort' needed to complete the assigned work seems too great.
- The student is unmotivated because classroom instruction does not engage.
- The student is unmotivated because he or she fails to see an adequate pay-off to doing the assigned work.
- The student is unmotivated because of low self-efficacy—lack of confidence that he or she can do the assigned work.
- The student is unmotivated because he or she lacks a positive relationship with the teacher.

05:00

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Activity: Essential Elements of Direct Instruction

Direct-Instruction Format. Students learning new material, concepts, or skills benefit from a 'direct instruction' approach. (Burns, VanDerHeyden & Boice, 2008; Rosenshine, 1995; Rupley, Blair, & Nichols, 2009). When following a direct-instruction format, the teacher:

- ensures that the lesson content is appropriately matched to students' abilities.
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- breaks new material into small, manageable increments, or steps.
- throughout the lesson, provides adequate explanations and detailed instructions for all concepts and materials being taught. NOTE: Verbal explanations can include 'talk-alouds' (e.g., the teacher describes and explains each step of a cognitive strategy) and 'think-alouds' (e.g., the teacher applies a cognitive strategy to a particular problem or task and verbalizes the steps in applying the strategy).
- regularly checks for student understanding by posing frequent questions and eliciting group responses.
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- provides timely and regular performance feedback and corrections throughout the lesson as needed to guide student learning.
- allows students the chance to engage in practice activities distributed throughout the lesson (e.g., through teacher demonstration; then group practice with teacher supervision and feedback; then independent, individual student practice).
- ensures that students have adequate support (e.g., clear and explicit instructions; teacher monitoring) to be successful during independent seatwork practice activities.

- Read through the essential elements of direct instruction that appear on p. 8 of your packet.
- Identify the element(s) that you believe would present the greatest challenge to implement on a regular basis.
- Brainstorm ideas to overcome these challenges.

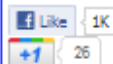
Secondary Group-
Based Math
Intervention
Example



Math Mentors: Training Students to Independently Use On-Line Math-Help Resources

1. Math mentors are recruited (school personnel, adult volunteers, student teachers, peer tutors) who have a good working knowledge of algebra.
2. The school meets with each math mentor to verify mentor's algebra knowledge.
3. The school trains math mentors in 30-minute tutoring protocol, to include:
 - A. Requiring that students keep a math journal detailing questions from notes and homework.
 - B. Holding the student accountable to bring journal, questions to tutoring session.
 - C. Ensuring that a minimum of 25 minutes of 30 minute session are spent on tutoring.
4. Mentors are introduced to online algebra resources (e.g., www.algebrahelp.com, www.math.com) and encouraged to browse them and become familiar with the site content and navigation.

Response to Intervention



Algebrahelp.com is a collection of lessons, calculators, and worksheets created to assist students and teachers of algebra. Here are a few of the ways you can learn here...

Lessons

Explore one of our dozens of lessons on key algebra topics like [Equations](#), [Simplifying](#) and [Factoring](#). [Check out the entire list of lessons...](#)

Calculators

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Lessons		Calculators	
Basic Algebra Concepts <ul style="list-style-type: none">EquationsProportionsWord Problems	Substitution and Evaluating	Equations <ul style="list-style-type: none">SolvingSimplifyingSolve by FactoringCompleting the SquareGraphing3D GraphingSubstitution	Functions <ul style="list-style-type: none">Graphing
Simplifying <ul style="list-style-type: none">Multiple SignsCombining Like TermsMultiplicationDistributionFOIL MethodExponents of NumbersExponents of VariablesExponents of ParenthesesOrder of Operations	Factoring <ul style="list-style-type: none">NumbersGreatest Common Factors (GCF)GCF From an ExpressionDifference Between Two SquaresTrinomialsCompletely	Expressions: <ul style="list-style-type: none">SimplifyingCombining Like TermsFactoringSubstitutionEvaluating	Numbers <ul style="list-style-type: none">FactoringPrime FactoringPercentages
Negative Exponents <ul style="list-style-type: none">Of Numbers	Equations - Advanced <ul style="list-style-type: none">Solve By FactoringCompleting the SquareQuadratic Formula		Fractions <ul style="list-style-type: none">SimplifyingAddition, Subtraction, Multiplication, DivisionComparison
			Other <ul style="list-style-type: none">ProportionsOrder of Operations
Index with Descriptions			

http://algebrahelp.com/redirect?eventId=88090fae-813b-44e4-9cf3-46cf4b5e...

Math Mentors: Training Students to Independently Use On-Line Math-Help Resources

5. Mentors are trained during 'math mentor' sessions to:
 - A. Examine student math journal
 - B. Answer student algebra questions
 - C. Direct the student to go online to algebra tutorial websites while mentor supervises. Student is to find the section(s) of the websites that answer their questions.
6. As the student shows increased confidence with algebra and with navigation of the math-help websites, the mentor directs the student to:
 - A. Note math homework questions in the math journal
 - B. Attempt to find answers independently on math-help websites
 - C. Note in the journal any successful or unsuccessful attempts to independently get answers online
 - D. Bring journal and remaining questions to next mentoring meeting.