RTI Toolkit: A Practical Guide for Schools

RTI: Best Practices in Elementary Math Interventions

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Content-Area Vocabulary Instruction: Selected Intervention Ideas & Graphic Displays

Classroom Literacy Strategies: Academic & Content-Area Vocabulary

Why This Instructional Goal is Important

The explicit teaching of instructional vocabulary is a central literacy-building goal in secondary classrooms. As vocabulary terms become more specialized in content area courses, students are less able to derive the meaning of unfamiliar words incidentally simply by relying on the context in which they appear. Students must instead learn vocabulary through more direct means, including having opportunities to explicitly memorize words and their definitions. On average, students expand their reading vocabularies by 2000 to 3000 new words per year (Texas Reading Initiative, 2002).

While the typical student can master a new word after about 12 meaningful exposures to the term; some students may require as many as 17 exposures to learn a word. (Kamil, et al., 2008). In secondary courses with a substantial number of specialized terms, time should be set aside each period to explicitly teach and review vocabulary.

There are two general approaches to vocabulary instruction: 'additive' and 'generative' (Kamil et al., 2008). Additive strategies are the range of techniques used to teach specific words. For example, having students create flashcards to review vocabulary with the term on one side and its definition on the other would be one additive strategy. Generative strategies are those that teach students how to derive the meaning of words independently. Teaching students to identify word roots and affixes is one generative approach to vocabulary instruction.

Strategies to Promote This Instructional Goal

Provide Dictionary Training. The student is trained to use an Internet lookup strategy to better understand dictionary or glossary definitions of key vocabulary items. The student first looks up the word and its meaning(s) in the dictionary/glossary. If necessary, the student isolates the specific word meaning that appears to be the appropriate match for the term as it appears in course texts and discussion. The student goes to an Internet search engine (e.g., Google) and locates at least five text samples in which the term is used in context and appears to match the selected dictionary definition. Optional: Have students meet in pairs or cooperative groups to review their written definitions and context examples of target vocabulary

Enhance Vocabulary Instruction Through Use of Graphic Organizers or Displays: A Sampling. Teachers can use graphic displays to structure their vocabulary discussions and activities (Boardman et al., 2008; Fisher, 2007; Texas Reading Initiative, 2002). Four graphic display formats are described briefly below—and examples of each appear in the next few pages of this handout:

- *4-Square Word Activity.* The student divides a page into four quadrants. In the upper left section, the student writes the target word. In the lower left section, the student writes the word definition. In the upper right section, the student generates a list of examples that illustrate the term, and in the lower right section, the student writes 'non-examples' (e.g., terms that are the opposite of the target vocabulary word):

- *Semantic/Word Definition Map*. The graphic display contains sections in which the student writes the word, its definition ('what is this?'), additional details that extend its meaning ('What is it like?'), as well as a listing of examples and 'non-examples' (e.g., terms that are the opposite of the target vocabulary word).
- *Semantic Feature Analysis*. A target vocabulary term is selected for analysis in this grid-like graphic display. Possible features or properties of the term appear along the top margin, while examples of the term are listed ion the left margin. The student considers the vocabulary term and its definition. Then the student evaluates each example of the term to determine whether it does or does not match each possible term property or element.
- *Comparison/Contrast (Venn) Diagram)*. Two terms are listed and defined. For each term, the student brainstorms qualities or properties or examples that illustrate the term's meaning. Then the student groups those qualities, properties, and examples into 3 sections: A. items unique to Term 1; B. items unique to Term 2; and C. items shared by both terms.

Promote 'Wide Reading' (Fisher, 2007). Students are encouraged to read widely in the content area, using texts that supplement and extend information supplied by the textbook. 'Wide reading' results in substantial increases in student vocabulary over time due to incidental learning. The effects of wide reading accumulate over time and result in increases in general academic vocabulary as well as vocabulary in specific content areas. Wide reading should be encouraged at the earliest possible grades, so that students can benefit from their expanded vocabulary knowledge 'downstream' (in later, higher grade levels). To strengthen the positive impact of wide reading on vocabulary development, have student texts available that vary in difficulty and that are of high interest. Discuss readings in class. Experiment with ways to document student independent reading and integrate that 'wide reading' into an effort grade for the course. If needed, build time into the student's school schedule for supervised 'wide reading' time.

Hold 'Read-Alouds' (Fisher, 2008). Select texts that supplement the course textbook and that illustrate central concepts and contain important vocabulary covered in the course. Read those texts aloud for 3 to 5 minutes per class session--while students follow along silently. Read-alouds provide students with additional exposure to vocabulary items in context. They can also lower the threshold of difficulty: Students may be more likely to attempt to read an assigned text independently if they have already gotten a start in the text by listening to a more advanced reader read the first few pages aloud. Read-alouds can support other vocabulary-building activities such as guided discussion, vocabulary review, and wide reading. Teachers are cautioned not to simply read the textbook aloud when using this strategy, however, as students will probably find that activity to be uninteresting.

Provide Regular In-Class Instruction and Review of Vocabulary Terms, Definitions (Texas Reading Initiative, 2002). Present important new vocabulary terms in class, along with student-friendly definitions. Provide 'example sentences' to illustrate the use of the term. Assign students to write example sentences employing new vocabulary to illustrate their mastery of the terms.

Generate 'Possible Sentences' (Texas Reading Initiative, 2002). The teacher selects vocabulary that applies to the day's text selection, including 6 to 8 challenging new vocabulary terms and 4 to 6 easier, more familiar vocabulary items. Introduce the vocabulary terms to the class. Provide definitions of the words (or better yet elicit those definitions from students if possible). Direct students individually, in pairs, or in small groups to write sentences that contain at least two words from the posted vocabulary list. In large group, have students share their composed sentences and write these examples on the board. Do not evaluate sentences as being 'correct' or 'incorrect' during this stage.

Next, direct students to read the text selection. After students have completed their reading, review the 'possible sentences' that were previously generated For each sentence, evaluate as a group whether, based on the passage just read, the sentence is 'possible' (true) in its current form. If needed, have the group recommend how to change the sentence to make it 'possible'.

Troubleshooting Tips

Students Lack Basic Academic Vocabulary. Some students may have deficits in their grasp of more general academic terms, such as *discourse* or *hypothesis*. The school may want to develop a list of the most crucial of these more general academic terms and make this shared list available to all teachers to better allow those instructors to regularly use and model this more general academic vocabulary. As a starting point, teachers can view a comprehensive list of academic words and the frequency with which they are used in English at: http://language.massey.ac.nz/staff/awl/

Building Capacity

Develop Content-Area Vocabulary Lists for Each Course. Whether working alone or with their instructional departments, secondary teachers should develop a list of the most important vocabulary items that students should master in each content-area course. When teachers have identified essential vocabulary in advance, they can more easily integrate vocabulary instruction into their lessons.

Measure Student Acquisition of Target Vocabulary. Teachers can informally track student vocabulary acquisition by listening to student use of vocabulary during guided discussions and monitoring vocabulary terms that appear in student journal entries.

More formally, teachers can track student acquisition of specialized vocabulary by using brief, timed vocabulary matching probes (Espin, Shin, & Busch, 2005). The student is given a worksheet with vocabulary items appearing on the left side of the page. Definitions that correspond to each of the terms appear on the right side of the page, in scrambled order. The student matches terms to their correct definitions.

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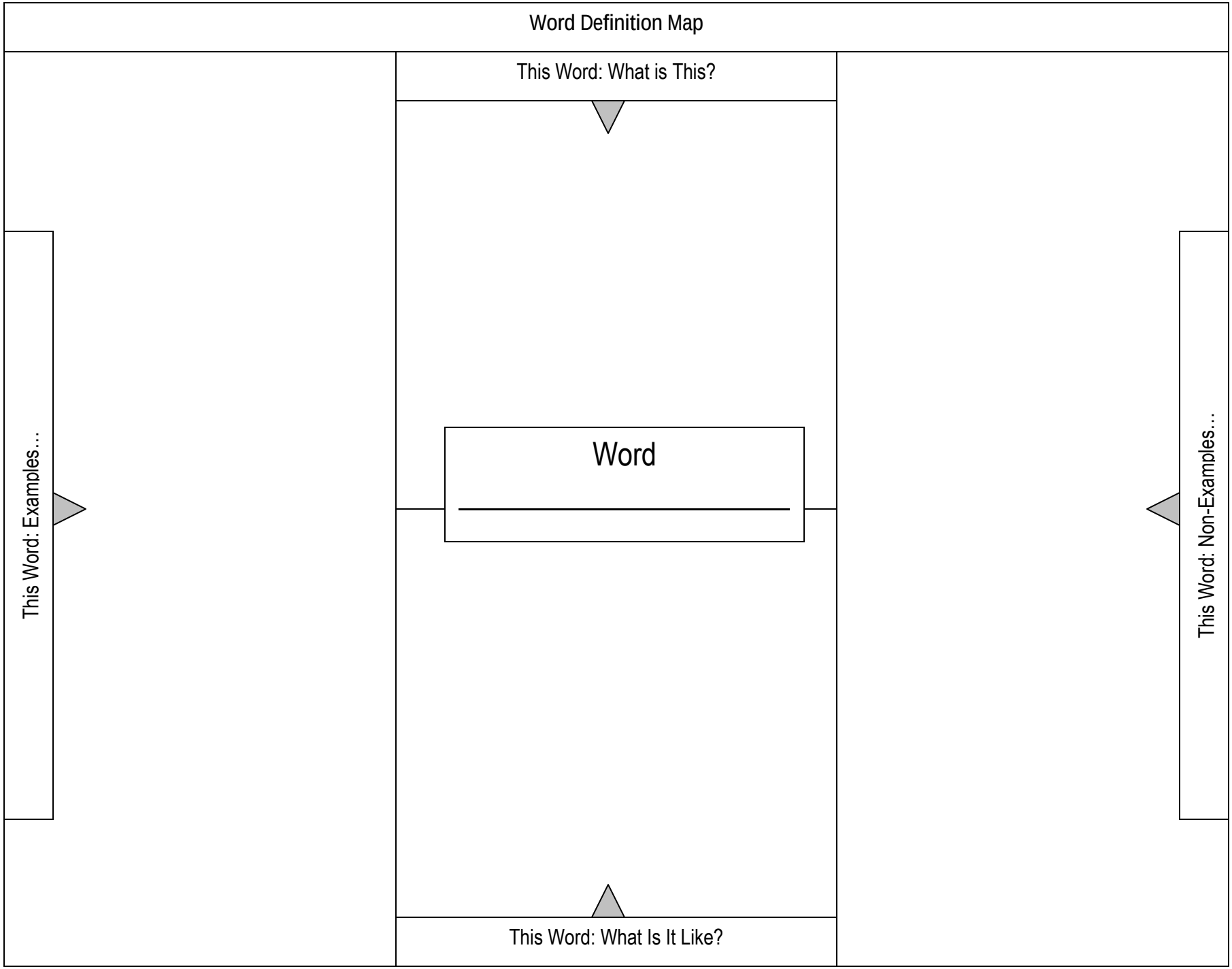
This Word	Examples of This Word

4-Square Word Activity

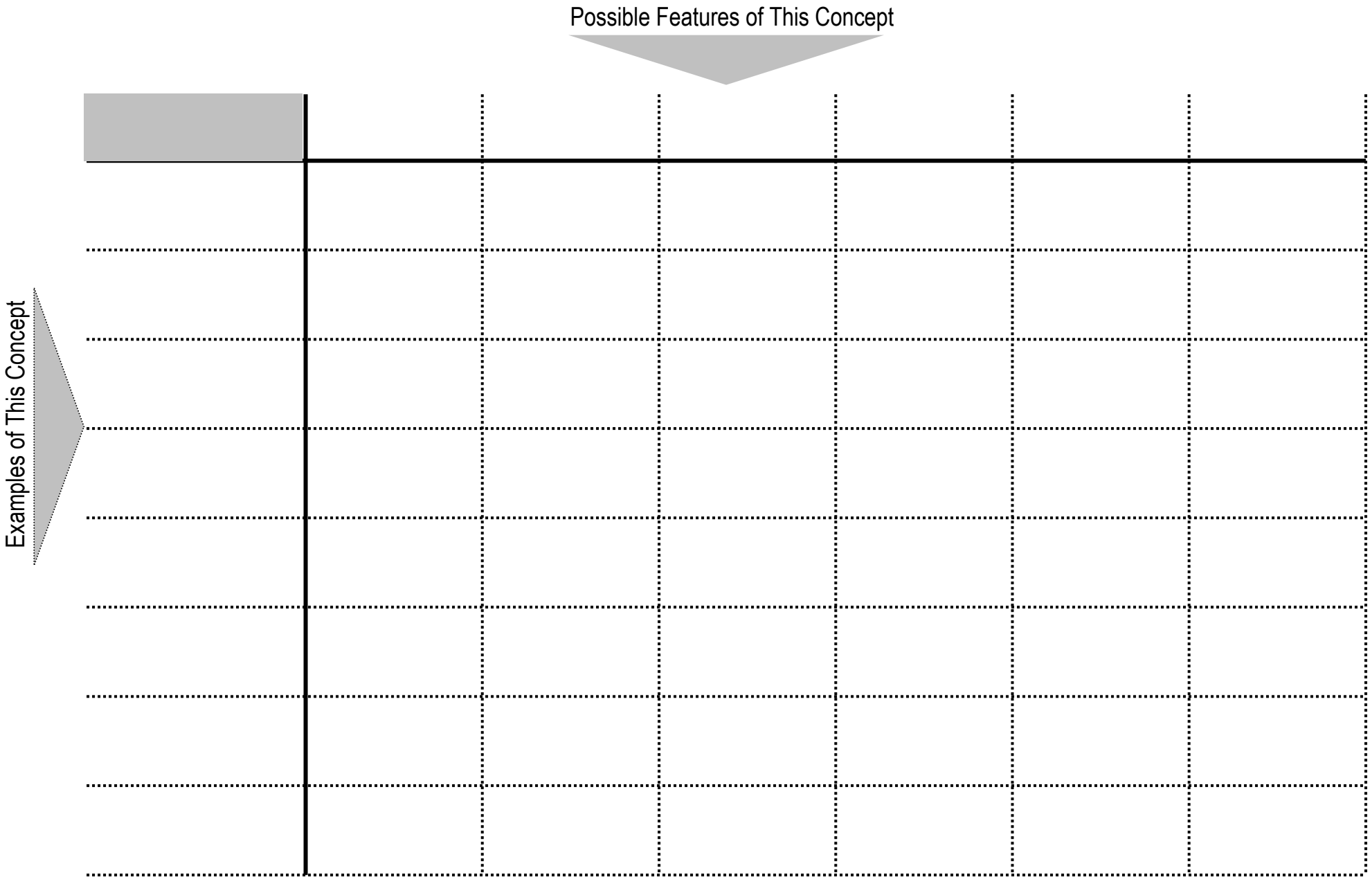
Definition of This Word	Non-Examples of This Word

Adapted from: Texas Reading Initiative. (2002). *Promoting vocabulary development: Components of effective vocabulary instruction*. Austin, TX: Author. Retrieved November 15, 2008, from http://www.tea.state.tx.us/reading/practices/redbk5.pdf



Adapted from: Texas Reading Initiative. (2002). *Promoting vocabulary development: Components of effective vocabulary instruction*. Austin, TX: Author. Retrieved November 15, 2008, from http://www.tea.state.tx.us/reading/practices/redbk5.pdf

Semantic Feature Analysis for This Concept: _____



Adapted from: Fisher, D. (2007). Creating a schoolwide vocabulary initiative in an urban high school. *Journal of Education for Students Placed at Risk, 12*, 337-351.

Texas Reading Initiative. (2002). *Promoting vocabulary development: Components of effective vocabulary instruction*. Austin, TX: Author. Retrieved November 15, 2008, from http://www.tea.state.tx.us/reading/practices/redbk5.pdf

Term 1 & Definition: _____

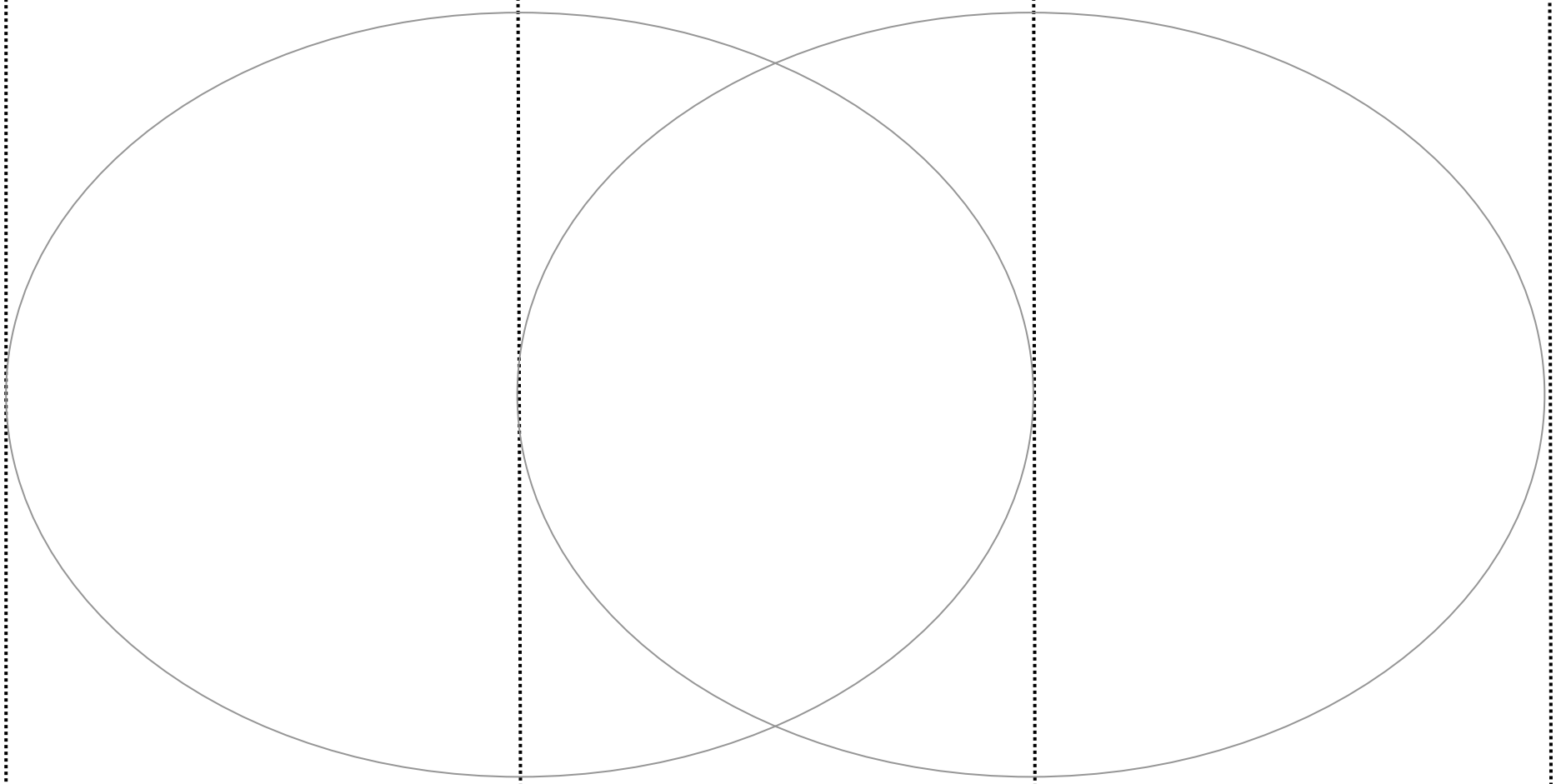
_____

Term 2 & Definition: _____

_____

Comparison/Contrast/Venn Diagram Display

Term 1: _____	Terms 1 & 2	Term 2: _____
Unique Qualities, Properties, Examples	Shared Qualities, Properties, Examples	Unique Qualities, Properties, Examples



Math Interventions

Benchmarks for 'Critical Foundation Skills': Proficiency Chart (National Mathematics Advisory Panel, 2008)		
Benchmark Grade	Math Skill	NOTES
3/Spring	☐ Whole numbers: Addition and subtraction	
4/Spring	☐ Fractions: Identification and representation of fractions as decimals	
5/Spring	☐ Whole numbers: Multiplication and division of whole numbers ☐ Fractions: Comparison of fractions, decimals, common percent ☐ Fractions: Addition and subtraction of fractions and decimals ☐ Geometry/measurement: Problems related to perimeter and area of triangles; quadrilaterals with minimum of one pair of parallel sides	
6/Spring	☐ Fractions: Multiplication and division of fractions and decimals ☐ Integers: All operations with positive and negative integers ☐ Geometry/measurement: Analysis of the properties of two-dimensional shapes ☐ Geometry/measurement: Analysis of the properties of three-dimensional shapes ☐ Geometry/measurement: Problems related to perimeter and area ☐ Geometry/measurement: Problems related to surface and volume	
7/Spring	☐ Fractions: All operations with positive and negative fractions ☐ Fractions: Problems related to percent, ratio, rate, proportionality ☐ Geometry/measurement: Relationship between similar triangles ☐ Geometry/measurement: Concept of the slope of a line	

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School-Wide Strategies for Managing... MATHEMATICS

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Mathematics instruction is a lengthy, incremental process that spans all grade levels. As children begin formal schooling in kindergarten, they develop 'number sense', an intuitive understanding of foundation number concepts and relationships among numbers. A central part of number sense is the student's ability to internalize the number line as a precursor to performing mental arithmetic. As students progress through elementary school, they must next master common math operations (addition, subtraction, multiplication, and division) and develop fluency in basic arithmetic combinations ('math facts'). In later grades, students transition to applied, or 'word', problems that relate math operations and concepts to real-world situations. Successful completion of applied problems requires that the student understand specialized math vocabulary, identify the relevant math operations needed to solve the problem while ignoring any unnecessary information also appearing in that written problem, translate the word problem from text format into a numeric equation containing digits and math symbols, and then successfully solve. It is no surprise, then, that there are a number of potential blockers to student success with applied problems, including limited reading decoding and comprehension skills, failure to acquire fluency with arithmetic combinations (math facts), and lack of proficiency with math operations. Deciding what specific math interventions might be appropriate for any student must therefore be a highly individualized process, one that is highly dependent on the student's developmental level and current math skills, the requirements of the school district's math curriculum, and the degree to which the student possesses or lacks the necessary auxiliary skills (e.g., math vocabulary, reading comprehension) for success in math. Here are some wide-ranging classroom (Tier I RTI) ideas for math interventions that extend from the primary through secondary grades.

Applied Problems: Encourage Students to Draw to Clarify Understanding *(Van Essen & Hamaker, 1990; Van Garderen, 2006)*. Making a drawing of an applied, or 'word', problem is one easy heuristic tool that students can use to help them to find the solution. An additional benefit of the drawing strategy is that it can reveal to the teacher any student misunderstandings about how to set up or solve the word problem. To introduce students to the drawing strategy, the teacher hands out a worksheet containing at least six word problems. The teacher explains to students that making a picture of a word problem sometimes makes that problem clearer and easier to solve. The teacher and students then independently create drawings of each of the problems on the worksheet. Next, the students show their drawings for each problem, explaining each drawing and how it relates to the word problem. The teacher also participates, explaining his or her drawings to the class or group. Then students are directed independently to make drawings as an intermediate problem-solving step when they are faced with challenging word problems. NOTE: This strategy appears to be more effective when used in later, rather than earlier, elementary grades.

Applied Problems: Improving Performance Through a 4-Step Problem-Solving Approach *(Pólya, 1957; Williams, 2003)*. Students can consistently perform better on applied math problems if they follow an efficient 4-step plan of understanding the problem, devising a plan, carrying out the plan, and looking back. (1) UNDERSTAND THE PROBLEM. To fully grasp the problem, the student may restate the problem in his or her own words, note key information, and identify missing information. (2) DEVISE A PLAN. In mapping out a strategy to solve the problem, the student may make a table, draw a diagram, or translate the verbal problem into an equation. (3) CARRY OUT THE PLAN. The student implements the steps in the plan, showing work and checking work for each step. (4) LOOK BACK. The student checks the results. If the answer is written as an equation, the student puts the results in words and checks whether the answer addresses the question posed in the original word problem.

Math Computation: Boost Fluency Through Explicit Time-Drills *(Rhymer, Skinner, Jackson, McNeill, Smith & Jackson, 2002; Skinner, Pappas & Davis, 2005; Woodward, 2006)*. 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. TIPS: Explicit time-drills work best on 'simple' math facts requiring few computation steps. They are less effective on more complex math facts. Also, a less intrusive and more flexible version of this intervention is to use time-prompts while students are working independently on math facts to speed their rate of responding. For example, at the end of every minute of seatwork, the teacher can call the time and have students draw a line under the item that they are working on when that minute expires.

Math Computation: Motivate With 'Errorless Learning' Worksheets *(Caron, 2007)*. Reluctant students can be motivated to practice math number problems to build computational fluency when given worksheets that include an answer key (number problems with correct answers) displayed at the top of the page. 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. 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.

Math Computation: Two Ideas to Jump-Start Active Academic Responding *(Skinner, Pappas & Davis, 2005)*. Research shows that when teachers use specific techniques to motivate their classes to engage in higher rates of active and accurate academic responding, student learning rates are likely to go up. Here are two ideas to accomplish increased academic responding on math tasks. First, 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. Second, allow students to respond to easier practice items orally rather than in written form to speed up the rate of correct responses.

Math Homework: Motivate Students Through Reinforcers, Interesting Assignments, Homework Planners, and Self-Monitoring *(Bryan & Sullivan-Burstein, 1998)*. Improve students' rate of homework completion and quality by using reinforcers, motivating 'real-life' assignments, a homework planner, and student self-monitoring. (1) Reinforcers: Allow students to earn a small reward (e.g., additional free time) when they turn in all homework assignments for the week. (2) 'Real-life' Assignments: Make homework meaningful by linking concepts being taught to students' lives. In a math lesson on estimating area, for example, give students the homework task of calculating the area of their bedroom and estimating the amount of paint needed to cover the walls. (3) Homework Planner: Teach students to use a homework planner to write down assignments, organize any materials (e.g., worksheets) needed for homework, transport completed homework safely back to school, and provide space for parents and teachers to communicate about homework via written school-home notes. (4) Student Self-Monitoring: Direct students to chart their homework completion each week. Have students plot the number of assignments turned in on-time in green, assignments not turned in at all in red, and assignments turned in late in yellow.

Math Instruction: Consolidate Student Learning During Lecture Through the Peer-Guided Pause *(Hawkins, & Brady, 1994)*. During large-group math lectures, teachers can help students to retain more instructional content by incorporating brief Peer Guided Pause sessions into lectures. Students are trained to work in pairs. At one or more appropriate review points in a lecture period, the instructor directs students to pair up to work together for 4 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 as a convenient way to monitor student understanding.

Math Instruction: Increase Student Engagement and Improve Group Behaviors With Response Cards *(Armendariz & Umbreit, 1999; Lambert, Cartledge, Heward & Lo, 2006)*. Response cards can increase student active engagement in group math activities while reducing disruptive behavior. In the group-response technique, all students in the classroom are supplied with an erasable tablet ('response card'), such as a chalk slate or laminated white board with erasable marker. The teacher instructs at a brisk pace. The instructor first poses a question to the class. Students are given sufficient wait time for each to write a response on his or her response card. The teacher then directs students to present their cards. If most or all of the class has the correct answer, the teacher praises the group. If more than one quarter of the students records an incorrect answer on their cards, however, the teacher uses guided questions and demonstration to steer students to the correct answer.

Math Instruction: Maintain a Supportive Atmosphere for Classroom "Math Talk" *(Cooke & Adams, 1998)*. Teachers can promote greater student 'risk-taking' in mathematics learning when they cultivate a positive classroom atmosphere for math discussions while preventing peers from putting each other down. The teacher models behavioral expectations for open, interactive discussions, praises students for their class participation and creative attempts at problem-solving, and regularly points out that incorrect answers and misunderstandings should be celebrated—as they often lead to breakthroughs in learning. The teacher uses open-ended comments (e.g., "What led you to that answer?") as tools to draw out students and encourage them to explore and apply math concepts in group discussion. Students are also encouraged in a supportive manner to evaluate each other's reasoning. However, the teacher intervenes immediately to prevent negative student comments or 'put-downs' about peers. As with any problem classroom behavior, a first offense requires that the student meet privately with the instructor to discuss teacher expectations for positive classroom behavior. If the student continues to put down peers, the teacher imposes appropriate disciplinary consequences.

Math Instruction: Support Students Through a Wrap-Around Instruction Plan *(Montague, 1997; Montague, Warger & Morgan, 2000)*. When teachers instruct students in more complex math cognitive strategies, they must support struggling learners with a 'wrap-around' instructional plan. That plan incorporates several elements: (a) Assessment of the student's problem-solving skills. The instructor first verifies that the student has the necessary academic competencies to learn higher-level math content, including reading and writing skills, knowledge of basic math operations, and grasp of required math vocabulary. (b) Explicit instruction. The teacher presents new math content in structured, highly organized lessons. The instructor also uses teaching tools such as Guided Practice (moving students from known material to new concepts through a thoughtful series of teacher questions) and 'overlearning' (teaching and practicing a skill with the class to the point at which students develop automatic recall and control of it). (c) Process modeling. The teacher adopts a 'think aloud' approach, or process modeling, to verbally reveal his or her cognitive process to the class while using a cognitive strategy to solve a math problem. In turn, students are encouraged to think aloud when applying the same strategy—first as part of a whole-class or cooperative learning group, then independently. The teacher observes students

during process modeling to verify that they are correctly applying the cognitive strategy. (d) Performance feedback. Students get regular performance feedback about their level of mastery in learning the cognitive strategy. That feedback can take many forms, including curriculum-based measurement, timely corrective feedback, specific praise and encouragement, grades, and brief teacher conferences. (e) Review of mastered skills or material. Once the student has mastered a cognitive strategy, the teacher structures future class lessons or independent work to give the student periodic opportunities to use and maintain the strategy. The teacher also provides occasional brief 'booster sessions', reteaching steps of the cognitive strategy to improve student retention.

Math Instruction: Unlock the Thoughts of Reluctant Students Through Class Journaling *(Baxter, Woodward & Olson, 2005)*. Students can effectively clarify their knowledge of math concepts and problem-solving strategies through regular use of class 'math journals'. Journaling is a valuable channel of communication about math issues for students who are unsure of their skills and reluctant to contribute orally in class. At the start of the year, the teacher introduces the journaling assignment, telling students that they will be asked to write and submit responses at least weekly to teacher-posed 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 on the general quality and content of class journal responses. Regular math journaling can prod students to move beyond simple 'rote' mastery of the steps for completing various math problems toward a deeper grasp of the math concepts that underlie and explain a particular problem-solving approach. 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.

Math Problem-Solving: Help Students Avoid Errors With the 'Individualized Self-Correction Checklist' *(Zrebiec Uberti, Mastropieri & Scruggs, 2004)*. 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. To create such a checklist, 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. As older students become proficient in creating and using these individualized error checklists, they can begin to analyze their own math errors and to make their checklists independently whenever they encounter new problem types.

Math Review: Balance Massed & Distributed Practice *(Carnine, 1997)*. Teachers can best promote students acquisition and fluency in a newly taught math skill by transitioning from massed to distributed practice. When students have just acquired a math skill but are not yet fluent in its use, they need lots of opportunities to try out the skill under teacher supervision—a technique sometimes referred to as 'massed practice'. Once students have developed facility and independence with that new math skill, it is essential that they then be required periodically to use the skill in order to embed and retain it—a strategy also known as 'distributed practice'. Teachers can program distributed practice of a math skill such as reducing fractions to least common

denominators into instruction either by (a) regularly requiring the student to complete short assignments in which they practice that skill in isolation (e.g., completing drill sheets with fractions to be reduced), or (b) teaching a more advanced algorithm or problem-solving approach that incorporates--and therefore requires repeated use of--the previously learned math skill (e.g., requiring students to reduce fractions to least-common denominators as a necessary first step to adding the fractions together and converting the resulting improper fraction to a mixed number).

Math Review: Teach Effective Test-Preparation Strategies *(Hong, Sas, & Sas, 2006)*. A comparison of the methods that high and low-achieving math students typically use to prepare for tests suggests that struggling math students need to be taught (1) specific test-review strategies and (2) time-management and self-advocacy skills. Among review-related strategies, deficient test-takers benefit from explicit instruction in how to take adequate in-class notes; to adopt a systematic method to review material for tests (e.g., looking over their notes each night, rereading relevant portions of the math text, reviewing handouts from the teacher, etc.), and to give themselves additional practice in solving problems (e.g., by attempting all homework items, tackling additional problems from the text book, and solving problems included in teacher handouts). Deficient test-takers also require pointers in how to allocate and manage their study time wisely, to structure their study environment to increase concentration and reduce distractions, as well as to develop 'self-advocacy' skills such as seeking additional help from teachers when needed. Teachers can efficiently teach effective test-preparation methods as a several-session whole-group instructional module.

Math Vocabulary: Preteach, Model, and Use Standard Math Terms *(Chard, D., n.d.)*. Three strategies can help students to learn essential math vocabulary: preteaching key vocabulary items, modeling those vocabulary words, and using only universally accepted math terms in instruction. (1) Preteach key 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. (2) 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. (3) 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.

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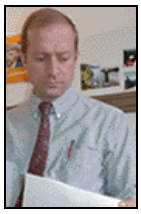
Cover-Copy-Compare

Visit the Math Computation Sheet Generator to Create Math Worksheets In CCC Format

View an Adobe Acrobat file of this page

Students who can be trusted to work independently and need extra drill and practice with math computational problems, spelling, or vocabulary words will benefit from Cover-Copy-Compare.

Jim's Hints for Using...
Cover-Copy-Compare



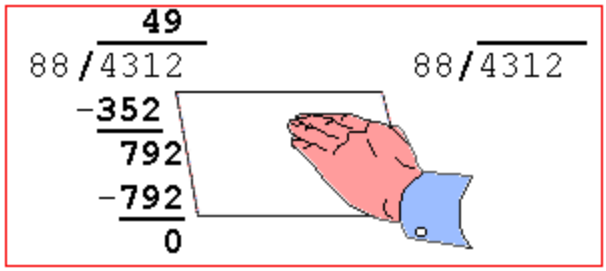
When using CCC worksheets, add an occasional item (e.g., vocabulary word, math problem) that the student has already mastered. These review items are great for refreshing student skills on learned material and can also give the teacher an indication of how well the student is retaining academic skills.

You can boost student motivation by praising the student for his or her efforts in completing the worksheets. You might also want to have the student build a portfolio of completed CCC worksheets. In reviewing this portfolio of work periodically, the student can see tangible evidence of improvement in his or her academic skills.

Preparing Cover-Copy-Compare Worksheets:

The teacher prepares worksheets for the student to use independently:

For math worksheets, computation problems with answers appear on the left side of the sheet. The same computation problems appear on the right side of the page, unsolved. Here is a sample CCC item for math:



For spelling words, correctly spelled words are listed on the left of the page, with space on the right for the student to spell each word.

For vocabulary items, words and their definitions are listed on the left side of the page, with space on the right for the student to write out each word and a corresponding definition for that word.

Using Cover-Copy-Compare Worksheets for Student Review:

When first introducing Cover-Copy-Compare worksheets to the student, the teacher gives the student an index card. The student is directed to look at each correct item (e.g., correctly spelled word, computation problem with solution) on the left side of the page.

- (For math problems.) The student is instructed to cover the correct model on the left side of the page with an index card and to copy the problem and compute the correct answer

in the space on the right side of the sheet. The student then uncovers the correct answer on the left and checks his or her own work.

- (For spelling problems.) The student is instructed to cover the correct model on the left side of the page with an index card and to spell the word in the space on the right of the sheet. The student then uncovers the correct answer on the left to check his or her work.

- (For vocabulary items.) The student is instructed to cover the correct model on the left side of the page with an index card and to write both the word and its definition in the space on the right side of the sheet. The student then uncovers the correct model on the left to check his or her work.

Troubleshooting: How to Deal With Common Problems in Using 'Cover-Copy-Compare'

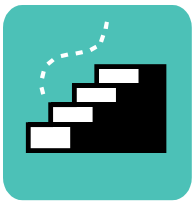
Q: *How do I respond if the student simply copies the correct answers from the models into the answer blanks and tries to pass this off as his or her own work?*

An essential requirement of Cover-Copy-Compare is that the student cover the correct model and attempt independently to solve the item using his or her own skills. if the student simply copies the correct answer from the model math problem or spelling word, the review process is short-circuited and the student will not benefit. If you suspect a student will copy rather than attempt to solve items on a CCC worksheet, arrange to have a peer tutor, adult in the classroom, or parent sit with the student to provide encouragement and monitoring.

Q: *I have a student who is so disorganized that he will lose the index card before he can complete a CCC worksheet. Any suggestions?*

Here is an idea for getting rid of that index card: You can fold the worksheet in half length-wise so that the answers appear on one side of the folded worksheet and the answer blanks appear on the other side. For each item, the student will peer at the correct model, then flip the folded sheet over to the right side to independently solve the item (with the correct model neatly folded out of sight).

Math Review: Promote Mastery of Math Facts Through Incremental Rehearsal



Incremental rehearsal builds student fluency in basic math facts ('arithmetic combinations') by pairing unknown computation items with a steadily increasing collection of known items. This intervention makes use of repeated, or massed, practice to promote fluency and guarantees that the student will experience a high rate of success..

Materials

- Index cards and pen

Steps to Implementing This Intervention

In preparation for this intervention:

1. The tutor first writes down on an index card in ink each math fact that a student is expected to master-but without the answer. NOTE: Educators can use the A-Plus Math Flashcard Creator, an on-line application, to make and print flashcards in addition, subtraction, multiplication, and division. The web address for the flashcard creator is: *http://www.aplusmath.com/Flashcards/Flashcard_Creator.html*

2. The tutor reviews the collection of math-fact cards with the student. Any of the math facts that the student can orally answer correctly within two seconds are considered to be known problems and are separated into one pile. Math facts that the student cannot yet answer correctly within two seconds are considered 'unknown' and collected in a second pile -- the 'unknown facts' deck.

3. The tutor next randomly selects 9 cards from the pile of known math facts and sets this subset of cards aside as the 'known facts' deck. The rest of the pile of cards containing known math facts is put away ('discard deck'), not to be used further in this intervention.

During the intervention:

The tutor follows an incremental-rehearsal sequence each day when working with the student:

1. First, the tutor takes a single card from the 'unknown facts' deck. The tutor reads the math fact on the card aloud, provides the answer, and prompts the student to read off and answer the same unknown problem.

2. Next the tutor takes one math fact from the 'known facts' deck and pairs it with the unknown problem. When shown the two problems in sequence, the student is asked during the presentation of each math fact to read off the problem and answer it. The student is judged to be successful on a problem if he or she orally provides the correct answer to that problem within 2 seconds. If the student commits an error on any card or hesitates for longer than two seconds, the tutor reads the math fact on the card aloud, gives the answer, then prompts the

student to read off the same unknown problem and provide the answer. This review sequence continues until the student answers all cards within two seconds without errors.

3. The tutor then repeats the sequence--taking yet another problem from the 'known facts' deck to add to the expanding collection of math facts being reviewed ('review deck'). Each time, the tutor prompts the student to read off and answer the whole series of math facts in the review deck, beginning with the unknown fact and then moving through the growing series of known facts that follow it.

4. When the review deck has expanded to include one 'unknown' math fact followed by nine 'known' math facts (a ratio of 90 percent 'known' material to 10 percent 'unknown' material), the last 'known' math fact that was added to the student's review deck is discarded (put away with the 'discard deck'). The previously 'unknown' math fact that the student has just successfully practiced in multiple trials is now treated as a 'known' math fact and is included as the first item in the nine-card 'known facts' deck for future drills.

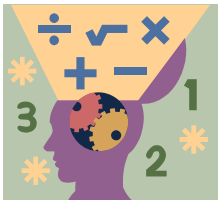
5. The student is then presented with a new math fact to answer, taken from the 'unknown facts' deck. With each new 'unknown' math fact, the review sequence is again repeated as described above until the 'unknown' math fact is grouped incrementally with nine math facts from the 'known facts' deck—and on and on.

Daily review sessions are discontinued either when time runs out or when the student answers an 'unknown' math fact incorrectly three times.

Reference

Burns, M. K. (2005). Using incremental rehearsal to increase fluency of single-digit multiplication facts with children identified as learning disabled in mathematics computation. *Education and Treatment of Children, 28*, 237-249.

Math Computation: Increase Accuracy By Intermixing Easy and Challenging Problems



Teachers can improve accuracy and positively influence the attitude of students when completing math-fact worksheets by intermixing 'easy' problems among the 'challenging' problems. Research shows that students are more motivated to complete computation worksheets when they contain some very easy problems interspersed among the more challenging items.

Materials

- Math computation worksheets & answer keys with a mixture of difficult and easy problems

Steps to Implementing This Intervention

1. The teacher first identifies one or more 'challenging' problem-types that are matched to the student's current math-computation abilities (e.g., multiplying a 2-digit number by a 2-digit number with regrouping).

2. The teacher next identifies an 'easy' problem-type that the students can complete very quickly (e.g., adding or subtracting two 1-digit numbers).

3. The teacher then creates a a series of student math computation worksheets with 'easy' computation problems interspersed at a fixed rate among the 'challenging' problems. (NOTE: Instructions are included below for creating interspersal worksheets using a free online application from *www.interventioncentral.org*.)

    - If the student is expected to complete the worksheet independently as seat work or homework, 'challenging' and 'easy' problems should be interspersed at a 1:1 ratio (that is, every 'challenging' problem in the worksheet is 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 3:1 (that is, every third 'challenging' problem is followed by an 'easy' one).

Directions for On-Line Creation of Worksheets With a Mix of Easy and Challenging Computation Problems ('Interspersal Worksheets')

By following the directions below, teachers can use a free on-line Math Worksheet Generator to create computation worksheets with easy problems interspersed among more challenging ones:

- The teacher goes to the following URL for the Math Worksheet Generator: http://www.interventioncentral.org/htmdocs/tools/mathprobe/allmult.php

- Displayed on that Math Worksheet Generator web page is a series of math computation goals for addition, subtraction, multiplication, and division. Teachers can select up to five different problem types to appear on a student worksheet. Each problem type is selected by clicking on the checkbox next to it.

- It is simple to create a worksheet with a 1:1 ratio of challenging and easy problems (that is, with an easy problem following every challenging problem). First, the teacher clicks the checkbox next to an 'easy' problem type that the student can compute very quickly (e.g., adding or subtracting two 1-digit numbers). Next the teacher selects a 'challenging' problem type that is instructionally appropriate for the student (e.g., multiplying a 2-digit number by a 2-digit number with regrouping). Then the teacher clicks the 'Multiple Skill Computation Probe' button. The computer program will then automatically create a student computation worksheet and teacher answer key with alternating easy and challenging problems.

- It is also no problem to create a worksheet with a higher (e.g., 2:1, 3:1, or 4:1) ratio of challenging problems to easy problems. The teacher first clicks the checkbox next to an 'easy' problem type that the student can compute very quickly (e.g., adding or subtracting two 1-digit numbers). The teacher then selects up to four different challenging problem types that are instructionally appropriate to the student. Depending on the number of challenging problem-types selected, when the teacher clicks the 'Multiple Skill Computation Probe' button, the computer program will create a student computation worksheet and teacher answer key that contain 2 (or 3 or 4) challenging problems for every easy problem.

Because the computer program generates new worksheets each time it is used, the teacher can enter the desired settings and –in one sitting-- create and print off enough worksheets and answer keys to support a six- or eight-week intervention.

Reference

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.

Applied Math Problems: Using Question-Answer Relationships (QARs) to Interpret Math Graphics

Students must be able to correctly interpret math graphics in order to correctly answer many applied math problems. Struggling learners in math often misread or misinterpret math graphics. For example, students may:

- overlook important details of the math graphic.
- treat irrelevant data on the math graphic as 'relevant'.
- fail to pay close attention to the question before turning to the math graphic to find the answer
- not engage their prior knowledge both to extend the information on the math graphic and to act as a possible 'reality check' on the data that it presents.
- expect the answer to be displayed in plain sight on the math graphic, when in fact the graphic may require that readers first to interpret the data, then to plug the data into an equation to solve the problem.

Teachers need an instructional strategy to encourage students to be more savvy interpreters of graphics in applied math problems. One idea is to have them apply a reading comprehension strategy, Question-Answer Relationships (QARs) as a tool for analyzing math graphics. The four QAR question types (Raphael, 1982, 1986) are as follows:

- 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 the making of connections between disparate pieces of factual information found in different sections of the reading.
- 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.

Steps to Implementing This Intervention

Teachers use a 4-step instructional sequence to teach students to use Question-Answer Relationships (QARs) to better interpret math graphics:

1. Step 1: Distinguishing Among Different Kinds of Graphics

   Students are first taught to differentiate between five common types of math graphics: 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 types of graphics, while the teacher

records those observations on a wall chart. Next students are shown examples of graphics and directed to identify the general graphic type (table, chart, picture, line graph, bar graph) that each sample represents.

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

2. Interpreting Information in Graphics

Over several instructional sessions, students learn to interpret information contained in various types of math graphics. For these activities, students are paired off, with stronger students matched with less strong ones.

The teacher sets aside a separate session to introduce 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. The graphics sequence in order of increasing difficulty is: Pictures > tables > bar graphs > charts > line graphs.

At each session, student pairs examine examples of graphics from the category being explored that day and discuss questions such as: "What information does this graphic present? What are strengths of this type of graphic for presenting data? What are possible weaknesses?" Student pairs record their findings and share them with the large group at the end of the session.

3. Linking the Use of Question-Answer Relations (QARs) to Graphics

In advance of this lesson, the teacher prepares a series of data questions and correct answers. Each question and answer is paired with a math graphic that contains information essential for finding the answer.

At the start of the lesson, students are each given a set of 4 index cards with titles and descriptions of each of the 4 QAR questions: RIGHT THERE, THINK AND SEARCH, AUTHOR AND YOU, ON MY OWN. (TMESAVING TIP: Students can create their own copies of these QAR review cards as an in-class activity.)

Working first in small groups and then individually, students read each teacher-prepared question, study the matching graphic, and 'verify' the provided answer as correct. They then identify the type of question being posed in that applied problem, using their QAR index cards as a reference.

4. Using Question-Answer Relationships (QARs) Independently to Interpret Math Graphics

Students are now ready to use the QAR strategy independently to interpret graphics. They are given a laminated card as a reference with 6 steps to follow whenever they attempt to solve an

applied problem that includes a math graphic:

- ✓ Read the question,
- ✓ Review the graphic,
- ✓ Reread the question,
- ✓ Choose a Question-Answer Relationship that matches the question in the applied problem
- ✓ Answer the question, and
- ✓ Locate the answer derived from the graphic in the answer choices offered.

Students are strongly encouraged NOT to read the answer choices offered on a multiple-choice item until they have first derived their own answer—to prevent those choices from short-circuiting their inquiry.

References

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

Raphael, T. (1982). Question-answering strategies for children. The Reading Teacher, 36, 186-190.

Raphael, T. (1986). Teaching question answer relationships, revisited. The Reading Teacher, 39, 516-522.

Math Computation: Increase Accuracy and Productivity Rates Via Self-Monitoring and Performance Feedback

Students can improve both their accuracy and fluency on math computation worksheets by independently self-monitoring their computation speed, charting their daily progress, and earning rewards for improved performance.

Materials

- Collection of student math computation worksheets & matching answer keys (NOTE: Educators can use a free online application to create math computation worksheets and answer keys at http://www.interventioncentral.org/htmdocs/tools/mathprobe/addsing.php)

- Student self-monitoring chart

Steps to Implementing This Intervention

In preparation for this intervention:

- the teacher selects one or more computation problem types that the student needs to practice. Using that set of problem types as a guide, the teacher creates a number of standardized worksheets with similar items to be used across multiple instructional days. (A Math Worksheet Generator that will create these worksheets automatically can be accessed at http://www.interventioncentral.org).

- the teacher prepares a progress-monitoring chart. The vertical axis of the chart extends from 0 to 100 and is labeled 'Correct Digits' The horizontal axis of the chart is labeled 'Date'.

- the teacher creates a menu of rewards that the student can choose from on a given day if the student was able to exceed his or her previously posted computation fluency score.

At the start of the intervention, the teacher meets with the student. The teacher shows the student a sample math computation worksheet and answer key. The teacher tells the student that the student will have the opportunity to complete similar math worksheets as time drills and chart the results. The student is told that he or she will win a reward on any day when the student's number of correctly computed digits on the worksheet exceeds that of the previous day.

During each day of the intervention:

1. The student is given one of the math computation worksheets previously created by the teacher, along with an answer key. The student first consults his or her progress-monitoring chart and notes the most recent charted computation fluency score previously posted. The student is encouraged to try to exceed that score.

2. When the intervention session starts, the student is given a pre-selected amount of time (e.g., 5 minutes) to complete as many problems on the computation worksheet as possible. The student sets a timer for the allocated time and works on the computation sheet until the timer rings.

3. The student then uses the answer key to check his or her work, giving credit for each correct digit in an answer. (A 'correct digits' is defined as a digit of the correct value that appears in the correct place-value location in an answer. In this scoring method, students can get partial credit even if some of the digits in an answer are correct and some are incorrect.).

4. The student plots his or her computational fluency score on the progress-monitoring chart and writes the current date at the bottom of the chart below the plotted data point. The student is allowed to select a choice from the reward menu if he or she exceeds his or her most recent, previously posted fluency score.

References

Bennett, K., & Cavanaugh, R. A. (1998). Effects of immediate self-correction, delayed self-correction, and no correction on the acquisition and maintenance of multiplication facts by a fourth-grade student with learning disabilities. *Journal of Applied Behavior Analysis, 31*, 303-306.

Shimabukuro, S. M., Prater, M. A., Jenkins, A., & Edelen-Smith, P. (1999). The effects of self-monitoring of academic performance on students with learning disabilities and ADD/ADHD. *Education and Treatment of Children, 22*, 397-414.

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 student must have the capacity to reliably implement the specific steps of a particular problem-solving process, or cognitive strategy. At least as important, though, is that the student must also possess the necessary metacognitive skills to analyze the problem, select an appropriate strategy to solve that problem from an array of possible alternatives, and monitor the problem-solving process to ensure that it is carried out correctly.

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).

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 uncertainly 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.

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').

While the Say-Ask-Check sequence is repeated across all 7 problem-solving steps, the actual content of the student self-coaching comments changes across the steps.

Table 1 shows how each of the steps in the word problem cognitive strategy is matched to the three-part Say-Ask-Check sequence:

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.	'Say' (Self-Instruction) Target: *The student reads and studies the problem carefully before proceeding.* *'Ask' (Self-Question) Target: Does the student fully understand the problem?* *'Check' (Self-Monitor) Target: Proceed only if the problem is understood.*	Say: "I will read the problem. I will reread the problem if I don't understand it." Ask: "Now that I have read the problem, do I fully understand it?" Check: "I understand the problem and will move forward."
2. Paraphrase the problem.	'Say' (Self-Instruction) Target: *The student restates the problem in order to demonstrate understanding.* *'Ask' (Self-Question) Target: Is the student able to paraphrase the problem?* *'Check' (Self-Monitor) Target: Ensure that any highlighted key words are relevant to the question.*	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."
3. 'Draw' the problem.	'Say' (Self-Instruction) Target: *The student creates a drawing of the problem to consolidate understanding.* *'Ask' (Self-Question) Target: Is there a match between the drawing and the problem?* *'Check' (Self-Monitor) Target: The drawing includes in visual form the key elements of the math problem.*	Say: "I will draw a diagram of the problem." Ask: "Does my drawing represent the problem?" Check: "The drawing contains the essential parts of the problem."
4. Create a plan to solve the problem.	'Say' (Self-Instruction) Target: *The student generates a plan to solve the problem.* *'Ask' (Self-Question) Target: What plan will help the student to solve this problem?* *'Check' (Self-Monitor) Target: The plan is appropriate to solve the problem.*	Say: "I will make a plan to solve the problem." Ask: "What is the first step of this plan? What is the next step of the plan?" Check: "My plan has the right steps to solve the problem."
5. Predict/estimate the	'Say' (Self-Instruction) Target: *The student uses estimation or other strategies to predict or*	Say: "I will estimate what the answer will be."

Answer.	*estimate the answer.* *'Ask' (Self-Question) Target: What estimating technique will the student use to predict the answer?* *'Check' (Self-Monitor) Target: The predicted/estimated answer used all of the essential problem information.*	Ask: "What numbers in the problem should be used in my estimation?" Check: "I did not skip any important information in my estimation."
6. Compute the answer.	'Say' (Self-Instruction) Target: *The student follows the plan to compute the solution to the problem.* *'Ask' (Self-Question) Target: Does the answer agree with the estimate?* *'Check' (Self-Monitor) Target: The steps in the plan were followed and the operations completed in the correct order.*	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."
7. Check the answer.	'Say' (Self-Instruction) Target: *The student reviews the computation steps to verify the answer.* *'Ask' (Self-Question) Target: Did the student check all the steps in solving the problem and are all computations correct?* *'Check' (Self-Monitor) Target: The problem solution appears to have been done correctly.*	Say: "I will check the steps of my answer." Ask: "Did I go through each step in my answer and check my work?" Check: ""

Students will benefit from close teacher support when learning to combine the 7-step cognitive strategy to attack math word problems with the iterative 3-step metacognitive Say-Ask-Check sequence. Teachers can increase the likelihood that the student will successfully acquire these skills by using research-supported instructional practices (Burns, VanDerHeyden, & Boice, 2008), including:

- Verifying that the student has the necessary foundation skills to solve math word problems
- Using explicit instruction techniques to teach the cognitive and metacognitive strategies
- Ensuring that all instructional tasks allow the student to experience an adequate rate of success
- Providing regular opportunities for the student to be engaged in active accurate academic responding
- Offering frequent performance feedback to motivate the student and shape his or her learning.

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STUDY SKILLS / ORGANIZATION

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As students transition to middle and high school, they are expected to depend less on the teacher to manage their instruction and to put increasing energy into becoming self-managing learners. But students must master essential study and organizational skills before they can function as independent learners. Individuals with strong study and organization skills are able to break class and homework assignments into subtasks and use time efficiently to complete those assignments, save and store graded papers and handouts for later retrieval, regularly review class notes and course readings, and practice effective study techniques. Instructors can accelerate the development of students into self-managing learners by explicitly teaching and evaluating study and organization skills and by delivering structured lessons that students can easily follow and capture in notes. Here are a range of ideas that can assist students to study more effectively and become more organized:

Independent Work. Create Customized 'Common Mistakes' Checklists *(U.S. Department of Education, 2004)*. Students can develop an individualized checklist of the kinds of errors that they commonly commit on independent assignments and use this checklist to reduce or eliminate mistakes before turning in those assignments. As a class exercise, give several examples to your students of common mistakes that you find on their assignments (e.g., failure to show all work on math problems; incomplete entries on term-paper outlines). Next, have the class brainstorm a list of mistakes that they are most likely to make. Then direct each student to review the class list and create a customized checklist by selecting the 4-5 mistakes that he or she is most likely to commit. Direct students to keep their customized error checklists and use them to review their assignments before turning in.

Independent Work: Assign an Adult Advisor *(U.S. Department of Education, 2004)*. Struggling students will do a better job of managing their many academic work and study requirements when they can have informal weekly meetings with an adult advisor. The advisor can be any school staff member who has a good relationship with the student. The role of the advisor is to communicate with other members of the student's team to ensure that the student is caught up with all homework and classwork assignments and is doing a satisfactory job of preparing for tests and quizzes. The advisor should plan to meet with the student at a fixed time at the start of each week for a brief meeting (1) to review academic progress, (2) help the student to get organized for upcoming assignments and prepare for tests, and (3) provide the student with encouragement and 'mini-skills' lessons in organization and study skills as needed.

Independent Work: Have Students Break Larger Tasks into Smaller Sub-Tasks *(U.S. Department of Education, 2004)*. Students who easily become overwhelmed when given a large assignment to do independently can boost their confidence when taught first to break that assignment down into smaller, more manageable sub-tasks. Select an upcoming assignment that students are expected to complete on their own (e.g., term paper, homework assignment with multiple math problems). Demonstrate for the class or to the individual student how to partition the larger assignment into smaller steps or 'chunks'. Have the student(s) complete the assignment independently, one sub-task at a time, using your work plan. On the next assignment, have the student(s) subdivide the task into chunks to create their own work plan while you observe and provide feedback.

Independent Work: Teach Students to Adapt Worksheets *(U.S. Department of Education, 2004)*. If students seem to struggle with the format of complex worksheets, teach them tricks to reduce the complexity or 'busyness' of the sheet. If students appear to become anxious or to lose their place when given a worksheet with a large number of math problems, for example, suggest that they

fold the page or use a blank piece of paper to hide all problems except the one on which they are currently working. Or if a double-sided worksheet has a complex informational graphic (e.g., a map) on one side of the page and questions to be answered on the flip side of the worksheet, give the student an extra copy of that worksheet so that the student can look at the questions and the graphic at the same time.

Instruction: Preview & Review Lesson Objectives *(Beyda, Zentall, & Ferko, 2002; U.S. Department of Education, 2004)*. Teachers can help students to retain the key points of a lesson by previewing the important learning objectives, labeling important points during the lesson, and reviewing those points at the close of the instructional session. Open the lesson by telling students what they will be learning that day and the materials that they will need to accomplish the lesson. During the lesson, emphasize important information that students should write into their class notes. At the end of the lesson, briefly review the central points again to improve student retention.

Instruction: Signal Key Words or Concepts That Will Be on the Test *(Sprick, Borgmeier, & Nolet, 2002)*. Teachers can improve students' motivation and boost their performance on tests by writing the examinations first and then structuring course content and review activities to help students to successfully pass these tests. The instructor constructs the test in advance so that it contains the essential elements of course content that students must master. During instruction, whenever the teacher presents to the class any concept, fact, or operation that will appear on the test, the instructor announces that 'this will be on the test' as a cue to alert students to attend closely to the information. The teacher also selects review activities that allow students to practice and master course material before they are tested on that material.

Study Skills: Effective Studying Requires Preparation & Follow-Through *(University of North Dakota Learning Center, n.d.)*. Effective study habits require that the student prepare before class to more fully understand the instructional content, attend carefully during class for clues about what facts or concepts the teacher views as most important, and quickly review notes after class to fill in any missing information and to cement understanding. In preparation for the class period, the student completes any assigned reading, and looks over notes and quickly skims the reading from the previous class session. During class, the student focuses on the instructor, listening carefully to how the instructor 'cues' the class that information is important (e.g., tone of voice, repetition, notes written on the board). If the teacher announces that a particular fact, concept, or idea will appear on a future test, the student records this information in his or her notes. Within 24 hours after class, the student reviews the class notes to help him or her to capture this course information in long-term memory .The student also uses this review opportunity to additional any additional details, to reword notes to clarify their meaning, or to check with other students or the teacher to fill in any gaps in the notes.

Study Skills: Study Actively *(University of North Dakota Learning Center, n.d.; Wright, 2002)*. Students get much more out of study sessions when they use strategies to actively review the material--such as summarizing main ideas from passages, formulating possible test questions from class notes, reciting information aloud, and studying with others. When reviewing readings from the course, the student should pause after important passages to attempt to summarize the main idea, or 'gist sentence' of each passage. While reviewing class notes, the student should attempt to identify concepts or facts from the notes that are likely to appear on an upcoming quiz or test. The student then formulates a possible test question that would be answered by the selection from his or her notes. Some students also find that they retain information more effectively during review when they occasionally read aloud sections from their course readings or class notes. Studying with others is another good method for reviewing course material, as students can motivate and encourage one another during the study session.

Study Skills: Teach a Structured Note-Taking Process *(Pauk, 1989)*. Students benefit in two ways when using a highly structured note-taking process such as the Cornell System: Not only do they recall more information from lectures because they made the effort to capture it in the form

of notes, but students also have a more complete set of notes to which they can refer when studying for quizzes and tests. The Cornell Notetaking System is organized into the following steps: (1) The student draws a vertical line on blank lined note paper. The line separates the page into a left-margin section that is 2.5 inches in width and another on the right that is 6 inches in width. (2) During reading or lectures, the student jots all notes in the 6-inch section of the page. (3) After leaving class or finishing the reading, the student reduces the notes into key words or key phrases. These condensed words or phrases are jotted into the 2.5-inch left margin of the page. (4) When reviewing course material, the student looks over his or her notes and jots down possible questions from the content that might appear on a test. The student then covers the notes (6-inch section of the page) and attempts to recite answers to the questions that he or she has created--using the key words or phrases in the left margin as prompts. (5) The student reviews notes periodically (e.g., 2-3 times per week), repeating the procedure outlined in step 4.

Study Skills: Use Student Study Schedule *(Wright, 2002)*. A daily study schedule can ensure that the student makes the most efficient use of study time. Each day, the student makes a written schedule for homework and study. The study schedule should also include time for leisure activities—and the student should be sure to limit leisure activities to the time allotted. A study schedule has greater weight if the student's parent(s) monitor the student's adherence to the daily schedule.

Work Materials: Organize the Backlog of Old Papers *(Sirotowitz, Davis, & Parker, 2003)*. Students are much better organized when they can identify old papers that should be saved for later review, have a system for labeling and filing these archived papers, and stay caught up by filing papers promptly. The teacher or parent (helping adult) first assists the student in carrying out a 'paper search', rummaging through the student's backpack, school locker, bedroom, notebook, or any other location where old papers may have collected. Next, student and helping adult sort through the pile of amassed papers, deciding which should be tossed in the trash and which should be saved. (Candidate papers to save include old tests, teacher handouts, and graded homework.) Then student and adult write at the top of each saved page the subject, the approximate date that the paper was created or handed out, and any other important identifying information (e.g., the textbook chapter or page that a series of handwritten notes were drawn from or are linked to). For each subject, label a manila folder. File all old papers for that subject in the folder, organized by date or by chapter/page number (depending on which scheme seems a more useful way to group the material). Put all folders of sorted papers into a single file cabinet drawer, crate, or other easily accessible location. Then encourage the student to sort through old papers each day and file those that are to be saved away in the appropriate folder. Also, remind the student to review the contents of folders when studying for quizzes and tests.

Work Materials: Schedule Regular 'Clean Outs' *(Gleason, Colvin, & Archer, 1991; U.S. Department of Education, 2004)*. Students are most productive when they are periodically given time and guidance to organize their work- and storage spaces to better manage the 'paperflow' of school work. Prepare a class mini-lesson to present suggestions on how your students should organize their desk or other class workspace, backpack, and/or locker. Work with your class to develop organizational tips (e.g., what does belong in a locker and what does not) and a rubric to judge the degree to which each student's work- and storage spaces are appropriately organized. Schedule time periodically for the entire class or selected students to organize their work and storage spaces under your supervision. Have students refer to the class rubric and provide teacher feedback as they organize their spaces.

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RTI-Ready Methods to Monitor Student Academics
Math: Early Math Fluency

☐ Quantity Discrimination Fluency	⏳: 1 minute	Administration: 1:1
Description: The student is given a sheet with number pairs. For each number pair, the student must name the larger of the two numbers.		
Where to get materials: • AimsWeb http://www.aimsweb.com/ • Intervention Central http://www.interventioncentral.org (Numberfly Early Math Fluency Probe Creator)		

☐ Missing Number Fluency	⏳: 1 minute	Administration: 1:1
Description: The student is given a sheet containing numerous sets of 3 or 4 sequential numbers. For each number series, one of the numbers is missing. The student must name the missing number.		
Where to get materials: • AimsWeb http://www.aimsweb.com/ • Intervention Central http://www.interventioncentral.org (Numberfly Early Math Fluency Probe Creator)		

☐ Number Identification Fluency	⏳: 1 minute	Administration: 1:1
Description: The student is given a sheet with numbers in random order. The student gives the name of each number.		
Where to get materials: • AimsWeb http://www.aimsweb.com/ • Intervention Central http://www.interventioncentral.org (Numberfly Early Math Fluency Probe Creator)		

☐ Oral Counting Fluency	⏳: 1 minute	Administration: 1:1
Description: The student counts aloud as many words in sequence as possible, starting from zero or one.		
Where to get materials: • The student does not require materials for this assessment. The examiner can make a sheet with numbers listed sequentially from 0-100 to record those numbers that the student can recite in sequence.		

Math: Computation

□ Math Computation Fluency	⏳: 2 minutes	Administration: Group
Description: The student is given a worksheet with single-skill or mixed-skill math computation problems. The student works independently to complete as many problems as possible. The student receives credit for each correct digit appearing in his or her answer.		
Where to get materials: • AimsWeb http://www.aimsweb.com/ • Intervention Central http://www.interventioncentral.org (Math Worksheet Generator) • SuperKids http://www.superkids.com/aweb/tools/math/ (This website allows you to create math computation worksheets for more advanced areas such as fractions, percentages, decimals, and more)		

Math: Applied Problems

□ Math Concepts & Applications	⏳: 6-8 minutes	Administration: Group
Description: Students are given assessment booklets with a mix of applied problem types appropriate to that grade level. (Assessments are available for grades 2-6). A mix of applied problems is included in each assessment, sampling the typical math curriculum for the student's grade (e.g., money skills, time-telling, etc.)		
Where to get materials: • MBSP: Monitoring Basic Skills Progress: Basic Math Kit – Second Edition developed by Drs. Lynn & Dough Fuchs, Vanderbilt University. Available through Pro-Ed: http://www.proedinc.com/		

Math: Vocabulary

□ Math Vocabulary Probes (Howell, 2008)	⏳: 5 minutes	Administration: Group
Description: Students are given a math vocabulary probe consisting of 20 vocabulary items. There are two versions commonly used: (1) The sheet contains vocabulary terms on one side of the sheet and the definitions of those terms—in scrambled order—on the other. The student connects term to its correct definition; (2) The sheet contains only definitions. The student must read each definition and write the correct corresponding vocabulary term.		
Where to get materials: • Math vocabulary probes are developed by the school. Teachers create 'vocabulary pools' that contain the key vocabulary items to be included in probes. From that larger pool, vocabulary items are randomly sampled to create individual probes.		

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Defining Academic Problems: Do It Right and Interventions Are More Likely to Be Effective

Students who struggle with academic deficits do not do so in isolation. Their difficulties are played out in the larger context of the school environment and curriculum—and represent a 'mismatch' between the characteristics of the student and the instructional demands of the classroom (Foorman & Torgesen, 2001). It may surprise educators to learn that the problem-identification step is the most critical for matching the student to an effective intervention (Bergan, 1995). Problem identification statements should be defined in clear and specific terms sufficient to pass 'the stranger test' (Howell, Hosp, & Kurns, 2008). That is, the student problem can be judged as adequately defined if a person with no background knowledge of the case and equipped only with a copy of the problem-identification statement can observe the student in the academic setting and know with confidence when the problem behavior is displayed and when it is not.

Here are recommendations for increasing teacher capacity to frame student skills in relation to curriculum requirements, describe student academic problems in specific terms, and place student academic deficits in the context of task demands and peer expectations.

1. Be knowledgeable of the school academic curriculum and key student academic skills that are taught. The teacher should have a good survey-level knowledge of the key academic skills outlined in the school's curriculum—for the grade level of their classroom as well as earlier grade levels. If the curriculum alone is not adequate for describing a student's academic deficit, the instructor can make use of research-based definitions or complete a task analysis to further define the academic problem area. Here are guidelines for consulting curriculum and research-based definitions and for conducting a task analysis for more global skills:

   - *Curriculum*. The teacher can review the school's curriculum and related documents (e.g., score-and-sequence charts; curriculum maps) to select specific academic skill or performance goals. Of course, if the student is performing well below grade-level, the teacher should be prepared to go 'off-level' by reviewing curriculum goals from earlier grades. First, determine the approximate grade or level in the curriculum that matches the student's skills. Then, review the curriculum at that alternate grade level to find appropriate descriptions of the student's relevant academic deficit.

     For example, a teacher noted that her second-grade student had limited phonemic awareness: the student was not able accurately to deconstruct a spoken word into its component sound-units, or phonemes. In her school's curriculum, children were expected to attain proficiency in phonemic awareness by the close of grade 1. The teacher went 'off level' to review the grade 1 curriculum and found a specific description of phonemic awareness that she could use as a starting point in defining the student's skill deficit.

   - *Research-Based Skill Definitions.* Even when a school's curriculum identifies key skills, schools may find it useful to corroborate or elaborate those skill definitions by reviewing alternative definitions published in research journals or other trusted sources.

     For example, an algebra teacher had a student with delays in solving quadratic equations. The

instructor found that the school's math curriculum did not provide a detailed description of the various skills required to successfully complete quadratic equations. So the teacher reviewed the report issued by the National Mathematics Advisory Panel (Fennell et al., 2008) The teacher discovered in that document a detailed description of the component skills for solving quadratic equations, including "factors and factoring of quadratic polynomials with integer coefficients" , "completing the square in quadratic expressions" and "quadratic formula and factoring of general quadratic polynomials". By combining the skill definitions from the school curriculum with the more detailed descriptions taken from the research-based document, the teacher was better able to pinpoint the student's area of academic deficit in specific terms.

- *Task Analysis.* Students sometimes possess deficits in more global 'academic enabling' skills that are not specifically outlined in the curriculum but are nonetheless essential for academic success. In such cases, teachers can complete an analysis of the relevant skill by breaking that more global skill down into a checklist of constituent subskills. This process is known as 'discrete categorization' (Kazdin, 1989) or task analysis. An instructor can use the resulting checklist to verify that the student can or cannot perform each of the subskills that make up the global 'academic enabling' skill.

  For example, teachers at a middle school noted that many of their students seemed to have poor 'organization' skills when completing in-class assignments. Yet none of the teachers initially agreed on just how to define the term 'organization'. So those instructors worked together to complete a task analysis and determined that--in their classrooms--the essential subskills of 'student organization' included (a) arriving to class on time; (b) bringing work materials to class; (c) following teacher directions in a timely manner; (d) knowing how to request teacher assistance when needed; and (e) having an uncluttered desk with only essential work materials. The teachers found this task analysis to be useful, as it allowed them to agree on the essential ingredients of 'good organization' and also yielded a useful checklist to verify that students possessed every one of the important subskills that make up the larger skill.

2. Describe the academic problem in specific, skill-based terms (Batsche et al., 2008; Upah, 2008). Write a clear, brief description of the academic skill or performance deficit that focuses on a specific skill or performance area. Here are sample problem-identification statements:

   - John's reads aloud from grade-appropriate text much more slowly than his classmates.
   - Ann lacks proficiency with multiplication math problems (double-digit times double-digit with no regrouping).
   - Tye does not turn in homework assignments.
   - Angela produces limited text on in-class writing assignments.

3. Develop a fuller description of the academic problem to provide a meaningful instructional context. When the teacher has described the student's academic problem, the next step is to expand the problem definition to put it into a meaningful context. This expanded definition includes information about the conditions under which the academic problem is observed and typical or expected level of performance.

- *Conditions*. Describe the environmental conditions or task demands in place when the academic problem is observed.
- *Problem Description*. Describe the actual observable academic behavior in which the student is engaged. Include rate, accuracy, or other quantitative information of student performance.
- *Typical or Expected Level of Performance*. Provide a typical or expected performance criterion for this skill or behavior. Typical or expected academic performance can be calculated using a variety of sources,

Academic Problems: Sample Definitions		
Environmental Conditions or Task Demands	Problem Description	Typical or Expected Level of Performance
When given a passage from the 3rd grade reading series book…	…John reads 56 words per minutes…	… compared to DIBELS mid-year 3rd-grade benchmark norms of 78 words per minute.
On a math computation worksheet (double-digit times double-digit with no regrouping)…	…Ann computes 45 digits per minute…	…while peers in her 3rd grade compute an average of 67 correct digits.
During social studies large-group instruction…	…Franklin attends to instruction an average of 45% of the time…	… while peers in the same room attend to instruction an average of 85% of the time.
For science homework…	… Tye turns in assignments an average of 50% of the time…	… while the classroom median rate of homework turned in is 90%.
On weekly 30-minute in-class writing assignments…	… Angela produces compositions that average 145 words…	…while a sampling of peer compositions shows that the typical student writes an average of 254 words.

4. Develop a hypothesis statement to explain the academic skill or performance problem. The hypothesis states the assumed reason(s) or cause(s) for the student's academic problems. Once it has been developed, the hypothesis statement acts as a compass needle, pointing toward interventions that most logically address the student academic problems.

Academic Problems: Possible Hypotheses & Recommendations	
Hypothesis	Recommendation
☐ *Skill Deficit.* The student has not yet acquired the skill.	Provide direct, explicit instruction to acquire the skill. Reinforce the student for effort and accuracy.
☐ *Fluency Deficit.* The student has acquired the basic skill but is not yet proficient.	Provide opportunities for the student to practice the skill and give timely performance feedback. Reinforce the student for fluency as well as accuracy.

☐ *Generalization Deficit.* The student possesses the basic skill but fails to use it across appropriate situations or settings.	Train the student to identify the relevant characteristics of situations or settings when the skill should be used. Provide incentives for the student to use the skill in the appropriate settings.
☐ *Motivation (Performance) Deficit.* The student is capable of performing the skill and can identify when use of the skill is appropriate—but nonetheless fails to use the skill.	Use various strategies to engage the student in the skill (e.g., select high-interest learning activities; offer incentives to the student for successful use of the skill, etc.).
☐ *Escape or Avoidance.* The student behavior is intended to allow them to stop an academic activity (escape) or to prevent them from participating in the activity (avoidance).	Check for appropriate instructional match to ensure that the student experiences sufficient success in the activity. Use motivation strategies (see above) to promote student interest and engagement. Offer the student opportunities for choice in the academic activity.

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