RTI Toolkit: A Practical Guide for Schools

RTI: Best Practices in Reading and Math Interventions

Jim Wright, Presenter

27 July 2011
Marathon County Consortium Summer Academy
Holiday Inn – Cedar Creek/Rothschild, WI

Jim Wright
364 Long Road
Tully, NY 13159
Email: jim@jimwrightonline.com
Website: www.interventioncentral.org

Resources from this workshop are available at:
http://www.jimwrightonline.com/marathoncounty.php

Intervention & Related RTI Terms: Definitions

Educators who serve as interventionists should be able to define and distinguish among the terms *core instruction*, *intervention*, *accommodation*, and *modification*. (In particular, interventionists should avoid using modifications as part of an RTI plan for a general education student, as they can be predicted to undermine the student's academic performance.) Here are definitions for these key terms.

- Core Instruction. Those instructional strategies that are used routinely with all students in a general-education setting are considered 'core instruction'. High-quality instruction is essential and forms the foundation of RTI academic support. NOTE: While it is important to verify that a struggling student receives good core instructional practices, those routine practices do not 'count' as individual student interventions.

- Intervention. An academic *intervention* is a strategy used to teach a new skill, build fluency in a skill, or encourage a child to apply an existing skill to new situations or settings. An intervention can be thought of as "a set of actions that, when taken, have demonstrated ability to change a fixed educational trajectory" (Methe & Riley-Tillman, 2008; p. 37). As an example of an academic intervention, the teacher may select question generation (Davey & McBride,1986.; Rosenshine, Meister & Chapman, 1996), a strategy in which the student is taught to locate or generate main idea sentences for each paragraph in a passage and record those 'gist' sentences for later review.

- Accommodation. An accommodation is intended to help the student to fully access and participate in the general-education curriculum without changing the instructional content and without reducing the student's rate of learning (Skinner, Pappas & Davis, 2005). An accommodation is intended to remove barriers to learning while still expecting that students will master the same instructional content as their typical peers. An accommodation for students who are slow readers, for example, may include having them supplement their silent reading of a novel by listening to the book on tape. An accommodation for unmotivated students may include breaking larger assignments into smaller 'chunks' and providing students with performance feedback and praise for each completed 'chunk' of assigned work (Skinner, Pappas & Davis, 2005).

- Modification. A modification changes the expectations of what a student is expected to know or do—typically by lowering the academic standards against which the student is to be evaluated. Examples of modifications are giving a student five math computation problems for practice instead of the 20 problems assigned to the rest of the class or letting the student consult course notes during a test when peers are not permitted to do so. Instructional modifications are essential elements on the Individualized Education Plans (IEPs) or Section 504 Plans of many students with special needs. Modifications are generally not included on a general-education student's RTI intervention plan, however, because the assumption is that the student can be successful in the curriculum with appropriate interventions and accommodations alone. In fact, modifying the work of struggling general education students is likely to have a negative effect that works *against* the goals of RTI. Reducing academic expectations will result in these students falling further behind rather than closing the performance gap with peers

References

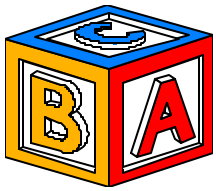
Davey, B., & McBride, S. (1986). Effects of question-generation training on reading comprehension. *Journal of Educational Psychology, 78,* 256-262.

Methe, S. A., & Riley-Tillman, T. C. (2008). An informed approach to selecting and designing early mathematics interventions. School Psychology Forum: Research into Practice, 2, 29-41.

Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research, 66*, 181-221.

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

Building Blocks of Effective Instruction



Good classroom instruction is no accident. Two powerful tools for analyzing the quality of student instruction are the *Instructional Hierarchy* and the *Learn Unit*.

Instructional Hierarchy. As students are taught new academic skills, they go through a series of predictable learning stages. At the start, a student is usually halting and uncertain as he or she tries to use the target skill. With teacher feedback and lots of practice, the student becomes more fluent, accurate, and confident in using the skill. It can be very useful to think of these phases of learning as a *hierarchy* (See chart on page 2). The learning hierarchy (Haring, Lovitt, Eaton, & Hansen, 1978) has four stages: *acquisition*, *fluency*, *generalization*, and *adaptation*:

1. **Acquisition.** The student has begun to learn how to complete the target skill correctly but is not yet accurate or fluent in the skill. The goal in this phase is to improve accuracy.
2. **Fluency.** The student is able to complete the target skill accurately but works slowly. The goal of this phase is to increase the student's speed of responding (fluency).
3. **Generalization.** The student is accurate and fluent in using the target skill but does not typically use it in different situations or settings. Or the student may confuse the target skill with 'similar' skills. The goal of this phase is to get the student to use the skill in the widest possible range of settings and situations, or to accurately discriminate between the target skill and 'similar' skills.
4. **Adaptation.** The student is accurate and fluent in using the skill. He or she also uses the skill in many situations or settings. However, the student is not yet able to modify or adapt the skill to fit novel task demands or situations.

The 'Learn Unit'. At the core of good instruction lies the ''Learn Unit', a 3-step process in which the student is invited to engage in an academic task, delivers a response, and then receives immediate feedback about how he or she did on the task (Heward, 1996). Here is an explanation of the stages of the 'Learn Unit':

1. **Academic Opportunity to Respond**. The student is presented with a meaningful opportunity to respond to an academic task. A question posed by the teacher, a math word problem, and a spelling item on an educational computer 'Word Gobbler' game could all be considered academic opportunities to respond.
2. **Active Student Response**. The student answers the item, solves the problem presented, or completes the academic task. Answering the teacher's question, computing the answer to a math word problem (and showing all work), and typing in the correct spelling of an item when playing an educational computer game are all examples of active student responding.
3. **Performance Feedback**. The student receives timely feedback about whether his or her response is correct—often with praise and encouragement. A teacher exclaiming 'Right! Good job!' when a student gives an response in class, a student using an answer key to check her answer to a math word problem, and a computer message that says 'Congratulations! You get 2 points for correctly spelling this word!" are all examples of corrective feedback.

The more frequently a student cycles through complete 'Learn Unit' trials, the faster that student is likely to make learning progress. If any one of these steps is missing, the quality of instruction will probably be compromised.

References

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

Heward, W.L. (1996). Three low-tech strategies for increasing the frequency of active student response during group instruction. In R.Gardner, D.M.Sainato, J.O.Cooper, T.E.Heron, W.L.Heward, J.W.Eshleman,& T.A.Grossi (Eds.), *Behavior analysis in education: Focus on measurably superior instruction* (pp.283-320). Pacific Grove, CA: Brooks/Cole.

Instructional Hierarchy: Matching Interventions to Student Learning Stage (Haring, et al., 1978)

Learning Stage	*Student 'Look-Fors'…*	*What strategies are effective…*
Acquisition: Exit Goal: The student can perform the skill accurately with little adult support.	• Is just beginning to learn skill • Not yet able to perform learning task reliably or with high level of accuracy	• Teacher actively demonstrates target skill • Teacher uses 'think-aloud' strategy-- especially for thinking skills that are otherwise covert • Student has models of correct performance to consult as needed (e.g., correctly completed math problems on board) • Student gets feedback about correct performance • Student receives praise, encouragement for *effort*
Fluency: Exit Goals: The student (a) has learned skill well enough to retain (b) has learned skill well enough to combine with other skills, (c) is as fluent as peers.	• Gives accurate responses to learning task • Performs learning task slowly, haltingly	• Teacher structures learning activities to give student opportunity for active (observable) responding • Student has frequent opportunities to *drill* (direct repetition of target skill) and *practice* (blending target skill with other skills to solve problems) • Student gets feedback on *fluency* and *accuracy* of performance • Student receives praise, encouragement for *increased fluency*
Generalization: Exit Goals: The student (a) uses the skill across settings, situations; (b) does not confuse target skill with similar skills	• Is accurate and fluent in responding • May fail to apply skill to new situations, settings • May confuse target skill with similar skills (e.g., confusing '+' and 'x' number operation signs)	• Teacher structures academic tasks to require that the student use the target skill regularly in assignments. • Student receives encouragement, praise, reinforcers for using skill in new settings, situations • If student confuses target skill with similar skill(s), the student is given practice items that force him/her to correctly discriminate between similar skills • Teacher works with parents to identify tasks that the student can do outside of school to practice target skill • Student gets periodic opportunities to review, practice target skill to ensure maintenance
Adaptation: Exit Goal: The Adaptation phase is continuous and has no exit criteria.	• Is fluent and accurate in skill • Applies skill in novel situations, settings without prompting • Does not yet modify skill as needed to fit new situations (e.g., child says 'Thank you' in all situations, does not use modified, equivalent phrases such as "I appreciate your help.")	• Teacher helps student to articulate the *'big ideas'* or core element(s) of target skill that the student can modify to face novel tasks, situations (e.g., fractions, ratios, and percentages link to the 'big idea' of *the part in relation to the whole*; 'Thank you' is part of a larger class of *polite speech*) • Train for adaptation: Student gets opportunities to practice the target skill with modest modifications in new situations, settings with encouragement, corrective feedback, praise, other reinforcers. • Encourage student to set own goals for adapting skill to new and challenging situations.

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

Profile of a Student with This Motivation Problem: The student lacks essential skills required to do the task. Areas of deficit might include basic academic skills, cognitive strategies, and academic-enabler skills. Here are definitions of these skill areas:

- *Basic academic skills.* Basic skills have straightforward criteria for correct performance (e.g., the student defines vocabulary words or decodes text or computes 'math facts') and comprise the building-blocks of more complex academic tasks (Rupley, Blair, & Nichols, 2009). The instructional goal in basic skills is for students to become 'automatic' in the skill(s) being taught.

- *Cognitive strategies.* Students employ specific cognitive strategies as "guiding procedures" to complete more complex academic tasks such as reading comprehension or writing (Rosenshine, 1995). Cognitive strategies are "intentional and deliberate procedures" that are under the conscious control of the student (Rupley, Blair, & Nichols, 2009; p. 127). The instructional goals are to train students to use specific cognitive instruction strategies, to reliably identify the conditions under which they should employ these strategies, and to actually use them correctly and consistently.

  Question generation is an example of a cognitive strategy to promote reading comprehension (Rosenshine, Meister, & Chapman, 1996); the student is trained to locate or write main-idea sentences for each paragraph in a passage, then write those main ideas onto separate note cards with corresponding questions.

- *Academic-enabling skills.* Skills that are 'academic enablers' (DiPerna, 2006) are not tied to specific academic knowledge but rather aid student learning across a wide range of settings and tasks. Examples of academic-enabling skills include organizing work materials, time management, and making and sticking to a work plan. The instructional goal is to train students to acquire these academic-support skills and to generalize their use to become efficient, self-managing learners.

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

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

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

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

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

References:

Burns, M. K., VanDerHeyden, A. M., & Boice, C. H. (2008). Best practices in intensive academic interventions. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp.1151-1162). Bethesda, MD: National Association of School Psychologists.

Daly, E. J., Witt, J. C., Martens, B. K., & Dool, E. J. (1997). *A model for conducting a functional analysis of academic performance problems.* School Psychology Review, 26, 554-574.

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

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

Rosenshine, B. (1995). Advances in research on instruction. *The Journal of Educational Research, 88,* 262-288.

Rosenshine, B., Meister, C., & Chapman, S. (1996). *Teaching students to generate questions: A review of the intervention studies.* Review of Educational Research, 66, 181-221.

Rupley, W. H., Blair, T. R., & Nichols, W. D. (2009). Effective reading instruction for struggling readers: The role of direct/explicit teaching. *Reading & Writing Quarterly, 25*:125–138.

School-Wide Strategies for Managing...
READING

A service of www.interventioncentral.org

The ability to read allows individuals access to the full range of a culture's artistic and scientific knowledge. Reading is a complex act. Good readers are able fluently to decode the words on a page, to organize and recall important facts in a text, to distill from a reading the author's opinions and attitudes, and to relate the content of an individual text to a web of other texts previously read. As the act of decoding becomes more effortless and automatic, the developing reader is able to devote a greater portion of cognitive energy to understanding the meaning of the text. Reading comprehension is not a single skill but consists of a cluster of competencies that range from elementary strategies for identifying and recalling factual content to highly sophisticated techniques for inferring an author's opinions and attitudes. As researcher Michael Pressley points out, reading comprehension skills can be thought of as unfolding along a timeline. Before beginning to read a particular selection, the skilled student reader must engage prior knowledge, predict what the author will say about the topic, and set specific reading goals. While reading, the good reader self-monitors his or her understanding of the text, rereads sentences and longer passages that are unclear, and updates predictions about the text based on what he or she has just read. After completing a text, the good reader summarizes its main points (perhaps writing them down), looks back in the text to clarify any points that are unclear, and continues to think about the text and its implications for a period of time. Reading comprehension can also be thought of as a bundle of interdependent skills that range from basic to more advanced. Teachers should ensure that students understand and appropriately use simple comprehension strategies (such as looking back in a text to clarify factual information) before teaching them advanced comprehension strategies such as SQ3R ('Survey, Question, Read, Recite, Review'). Ultimately, reading is a competency that is continually honed and improved over a lifetime. The teacher's goal is to build students into independent readers whose skills improve with self-guided practice. Below are a number of instructional strategies to promote word decoding, reading decoding, and reading comprehension.

Reading Comprehension: Activating Prior Knowledge *(Hansen, & Pearson, 1983)*. The instructor demonstrates to students how they can access their prior knowledge about a topic to improve comprehension of an article or story. The instructor first explains the benefit of using prior knowledge. The instructor tells students that recalling their prior experiences (“their own life”) can help them to understand the content of their reading--because new facts make sense only when we connect them to what we already know. Next, the instructor demonstrates the text prediction strategy to the class by selecting a sample passage (displayed as an overhead) and using a “think-aloud” approach to illustrate the strategy steps: STEP 1: THINK ABOUT WHAT AND WHY: The teacher connects the article to be read with the instructor's own prior knowledge about the topic. The teacher might say, for example, “I am about to read a short article about [topic]. Before I read the article, though, I should think about my life experiences and what they might tell me about [topic]. By thinking about my own life, I will better understand the article.” STEP 2: SELECT MAIN IDEAS FROM THE ARTICLE TO POSE PRIOR-KNOWLEDGE AND PREDICTION QUESTIONS. The teacher chooses up to 3 main ideas that appear in the article or story. For each key idea, the instructor poses one question requiring that readers tap their own prior knowledge of the idea (e.g., “What are your own attitudes and experiences about [idea]?”) and another that prompts them to predict how the article or story might deal with the idea (e.g., "What do you think the article will say about [idea]?"). STEP 3: HAVE STUDENTS READ THE ARTICLE INDEPENDENTLY. Once the teacher has primed students' prior knowledge by having them respond to the series of prior-knowledge and prediction questions, students read the selection independently.

Reading Comprehension: Anticipation Reading Guide *(Duffelmeyer, 1994; Merkley, 1996)*. To activate their prior knowledge of a topic, students complete a brief questionnaire on which they must

express agreement or disagreement with 'opinion' questions tied to the selection to be read; students then engage in a class discussion of their responses. The instructor first constructs the questionnaire. Each item on the questionnaire is linked to the content of the article or story that the students will read. All questionnaire items use a 'forced-choice' format in which the student must simply agree or disagree with the item. After students have completed the questionnaire, the teacher reviews responses with the class, allowing students an opportunity to explain their rationale for their answers. Then students read the article or story.

Reading Comprehension: Building Comprehension of Textbook Readings Through SQ3R *(Robinson, 1946)*. Students grasp a greater amount of content from their textbook readings when they use the highly structured SQ3R ('Survey, Question, Read, Recite, Review') process. (1) SURVEY: Prior to reading a section of the textbook, the reader surveys the selection by examining charts, tables, or pictures, looking over chapter headings and subheadings, and reading any individual words or blocks of text highlighted by the publisher. (2) QUESTION: In preparation for reading, the reader next generates and writes down a series of key 'questions' about the content based on the material that he or she has surveyed. (3) READ: As the reader reads through the selection, he or she seeks answers to the questions posed. (4) RECITE: After finishing the selection, the reader attempts to recite from memory the answers to the questions posed. If stuck on a question, the reader scans the text to find the answer. (5) REVIEW: At the end of a study session, the reader reviews the list of key questions and again recites the answers. If the reader is unable to recall an answer, he or she goes back to the text to find it.

Reading Comprehension: Conversing With the Writer Through Text Annotation *(Harris, 1990; Sarkisian, Toscano, Tomkins-Tinch, & Casey, 2003)*. Students are likely to increase their retention of information when they interact actively with their reading by jotting comments in the margin of the text. Students are taught to engage in an ongoing 'conversation' with the writer by recording a running series of brief comments in the margins of the text. Students may write annotations to record their opinions of points raised by the writer, questions triggered by the reading, or vocabulary words that the reader does not know and must look up. NOTE: Because this strategy requires that students write in the margins of a book or periodical, text annotation is suitable for courses in which students have either purchased the textbook or have photocopies of the reading available on which to write.

Reading Comprehension: Mining Information from the Text Book *(Garner, Hare, Alexander, Haynes, & Vinograd, 1984)*. With ‘text lookback’ the student increases recall of information by skimming previously read material in the text in a structured manner to look that information up. First, define for the student the difference between ‘lookback’ and ‘think’ questions. ‘Lookback’ questions are those that tell us that the answer can be found right in the article, while ‘think’ questions are those that ask you to give your own opinion, belief, or ideas. When faced with a lookback question, readers may need to look back in the article to find the information that they need. But readers can save time by first skimming the article to get to the general section where the answer to the question is probably located. To skim efficiently, the student should (1) read the text-lookback question carefully and highlight the section that tells the reader what to look for (e.g., “What does the article say are the FIVE MOST ENDANGERED SPECIES of whales today?”), (2) look for titles, headings, or illustrations in the article that might tell the reader where the information that he or she is looking for is probably located, (3) read the beginning and end sentences in individual paragraphs to see if that paragraph might contain the desired information.

Reading Comprehension: Previewing the Chapter *(Gleason, Archer, & Colvin, 2002)*. The student who systematically previews the contents of a chapter before reading it increases comprehension--by creating a mental map of its contents, activating prior knowledge about the topic, and actively forming predictions about what he or she is about to read. In the previewing technique, the student browses the chapter headings and subheadings. The reader also studies any important graphics and looks over review questions at the conclusion of the chapter. Only then does the student begin reading the selection.

Reading Comprehension: Question-Answer Relationships (QAR) *(Raphael, 1982; Raphael, 1986)*. Students are taught to identify 'question-answer relationships', matching the appropriate strategy to comprehension questions based on whether a question is based on fact, requires inferential thinking, or draws upon the reader's own experience. Students learn that answers to 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. Students are informed that they will also find answers to THINK AND SEARCH questions in the text--but must piece those answers together by scanning the text and making connections between different pieces of factual information. AUTHOR AND YOU questions require that students take information or opinions that appear in the text and combine them with the reader's own experiences or opinions to formulate an answer. ON MY OWN questions are based on the students' own experiences and do not require knowledge of the text to answer. Students are taught to identify question-answer relationships in class discussion and demonstration. They are then given specific questions and directed to identify the question type and to use the appropriate strategy to answer.

Reading Comprehension: Reading Actively *(Gleason, Archer, & Colvin, 2002)*. By reading, recalling, and reviewing the contents of every paragraph, the student improves comprehension of the longer passage. The instructor teaches students to first read through the paragraph, paying particular attention to the topic and important details and facts. The instructor then directs students to cover the paragraph and state (or silently recall) the key details of the passage from memory. Finally, the instructor prompts students to uncover the passage and read it again to see how much of the information in the paragraph the student had been able to accurately recall. This process is repeated with all paragraphs in the passage.

Reading Fluency: Listening, Reading, And Receiving Corrective Feedback *(Rose & Sherry, 1984; Van Bon, Boksebeld, Font Freide, & Van den Hurk, J.M., 1991)*. The student 'rehearses' a text by first following along silently as a more accomplished reader (tutor) reads a passage aloud; then the student reads the same passage aloud while receiving corrective feedback as needed. The student and tutor sit side-by-side at a table with a book between them. The tutor begins by reading aloud from the book for about 2 minutes while the student reads silently. If necessary, the tutor tracks his or her progress across the page with an index finger to help the student to keep up. At the end of the 2 minutes, the tutor stops reading and asks the student to read aloud. If the student commits a reading error or hesitates for longer than 3-5 seconds, the tutor tells the student the correct word and has the student continue reading. For each new passage, the tutor first reads the passage aloud before having the student read aloud.

Reading Fluency: Repeated Reading *(Herman, 1985; Rashotte & Torgesen, 1985; Rasinski, 1990)*. The student increases fluency in decoding by repeatedly reading the same passage while receiving help with reading errors. A more accomplished reader (tutor) sits with the student in a quiet location with a book positioned between them. The tutor selects a passage in the book of about 100 to 200 words in length. The tutor directs the student to read the passage aloud. If the student misreads a word or hesitates for longer than 5 seconds, the tutor reads the word aloud and has the student repeat the word correctly before continuing through the passage. If the student asks for help with any word, the tutor reads the word aloud. If the student requests a word definition, the tutor gives the definition. When the student has completed the passage, the tutor directs the student to read the passage again. The tutor directs the student to continue rereading the same passage until either the student has read the passage a total of 4 times or the student reads the passage at the rate of at least 85 to 100 words per minute. Then tutor and student select a new passage and repeat the process.

Word Decoding: Teach a Hierarchy of Strategies *(Haring, Lovitt, Eaton & Hansen, 1978)*. The student has a much greater chance of successfully decoding a difficult word when he or she uses a 'Word Attack Hierarchy'--a coordinated set of strategies that move from simple to more complex. The student uses successive strategies until solving the word. (1) When the student realizes that he or she has misread a word, the student first attempts to decode the word again. (2) Next, the

student reads the entire sentence, using the context of that sentence to try to figure out the word's meaning--and pronunciation. (3) The student breaks the word into parts, pronouncing each one. (4) If still unsuccessful, the student uses an index card to cover sections of the word, each time pronouncing only the part that is visible. The student asks 'What sound does ___ make?, using phonics information to sound out the word. (5) If still unsuccessful, the student asks a more accomplished reader to read the word.

References

Duffelmeyer, F.A. (1994). Effective anticipation guide statements for learning from expository prose. Journal of Reading, 37, 452 - 457.

Florida Center for Reading Research (2005). Student center activities: Teacher resource guide. Retrieved August 20, 2006, from http://www.fcrr.org/Curriculum/pdf/TRG_Final_Part1.pdf

Garner, R., Hare, V.C., Alexander, P., Haynes, J., & Vinograd, P. (1984). Inducing use of a text lookback strategy among unsuccessful readers. American Educational Research Journal, 21, 789-798.

Gleason, M. M., Archer, A. L., & Colvin, G. (2002). Interventions for improving study skills. In M. A. Shinn, H. M. Walker & G. Stoner (Eds.), Interventions for academic and behavior problems II: Preventive and remedial approaches (pp.651-680). Bethesda, MD: National Association of School Psychologists.

Hansen, J. & Pearson, P.D. (1983). An instructional study: Improving the inferential comprehension of good and poor fourth-grade readers. Journal of Educational Psychology, 75, 821-829.

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

Harris, Jane (1990). Text annotation and underlining as metacognitive strategies to improve comprehension and retention of expository text. Paper presented at the Annual Meeting of the National Reading Conference (Miami).

Herman, P.A. (1985). The effects of repeated readings on reading rate, speech pauses, and word recognition accuracy. Reading Research Quarterly, 20, 553-565.

Jenkins, J. & Larsen, D. (1979). Evaluation of error-correction procedures for oral reading. Journal of Special Education, 13, 145-156.

Merkley, D.J. (1996). Modified anticipation guide. Reading Teacher, 50, 365-368.

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.

Rashotte, C.A. & Torgesen, J.K. (1985). Repeated reading and reading fluency in learning disabled children. Reading Research Quarterly, 20, 180-188.

Rasinski, T.V. (1990). Effects of repeated reading and listening-while-reading on reading fluency. Journal of Educational Research, 83(3), 147-150.

Robinson, F. P. (1946). Effective study. New York: Harper & Row

Rose, T.L., & Sherry, L. (1984). Relative effects of two previewing procedures on LD adolescents' oral reading performance. Learning Disabilities Quarterly, 7, 39-44.

Sarkisian V., Toscano, M., Tomkins-Tinch, K., & Casey, K. (2003). Reading strategies and critical thinking. Retrieved October 15, 2006, from http://www.academic.marist.edu/alcuin/ssk/stratthink.html

Topping, K. (1987). Paired reading: A powerful technique for parent use. Reading Teacher, 40, 608-614.

Van Bon, W.H.J., Boksebeld, L.M., Font Freide, T.A.M., & Van den Hurk, J.M. (1991).

A comparison of three methods of reading-while-listening. Journal of Learning Disabilities, 24, 471-476.

Core Instructional Ideas to Promote Literacy Skills in Secondary Classrooms

Middle and high school teachers can incorporate activities into their instruction that both promote learning of course content and also strengthen students' literacy skills. The guides below offer classwide ideas for (1) boosting vocabulary knowledge; (2) modeling critical thinking skills through extended discussion; and (3) reinforcing reading comprehension skills.

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). The teacher selects texts that supplement the course textbook, illustrate central concepts, and contain important vocabulary covered in the course. The instructor or another accomplished reader reads aloud selections from those texts 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.

Provide Regular In-Class Instruction and Review of Vocabulary Terms, Definitions (Texas Reading Initiative, 2002). The teacher presents important new vocabulary terms in class, along with student-friendly definitions. The instructor also provides 'example sentences' to illustrate the use of each term. Students are then assigned 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. First, the instructor introduces the vocabulary terms to the class. Then, the teacher provides definitions of the words (or better yet elicits those definitions from students if possible). Then students are directed individually, in pairs, or in small groups to write sentences that contain at least two words from the posted vocabulary list. Next, in large group, students share their composed sentences, which are written on the board. This report-out continues until all words from the original list have been put into sentences. NOTE: Students and the instructor refrain from evaluating sentences as being 'correct' or 'incorrect' during this stage.

Next, students are directed to read the text selection. After students have completed their reading, they review the 'possible sentences' that were previously generated and written on the board. For each sentence, the class evaluates whether, based on the passage just read, the sentence is 'possible' (true) in its current form. If a sentence is found to be untrue ('not possible'), the group recommends 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.

References

Boardman, A. G., Roberts, G., Vaughn, S., Wexler, J., Murray, C. S., & Kosanovich, M. (2008). *Effective instruction for adolescent struggling readers: A practice brief*. Portsmouth, NH: RMC Research Corporation, Center on Instruction.

Carnine, L., & Carnine, D. (2004). The interaction of reading skills and science content knowledge when teaching struggling secondary students. *Reading & Writing Quarterly, 20*, 203-218.

Espin, C. A., Shin, J., & Busch, T. W. (2005). Curriculum-based measurement in the content areas: Vocabulary matching as an indicator of progress in social studies learning. *Journal of Learning Disabilities, 38,* 353-363.

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

Kamil, M. L., Borman, G. D., Dole, J., Kral, C. C., Salinger, T., & Torgesen, J. (2008). *Improving adolescent literacy: Effective classroom and intervention practices: A practice guide* (NCEE #2008-4027). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc.

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

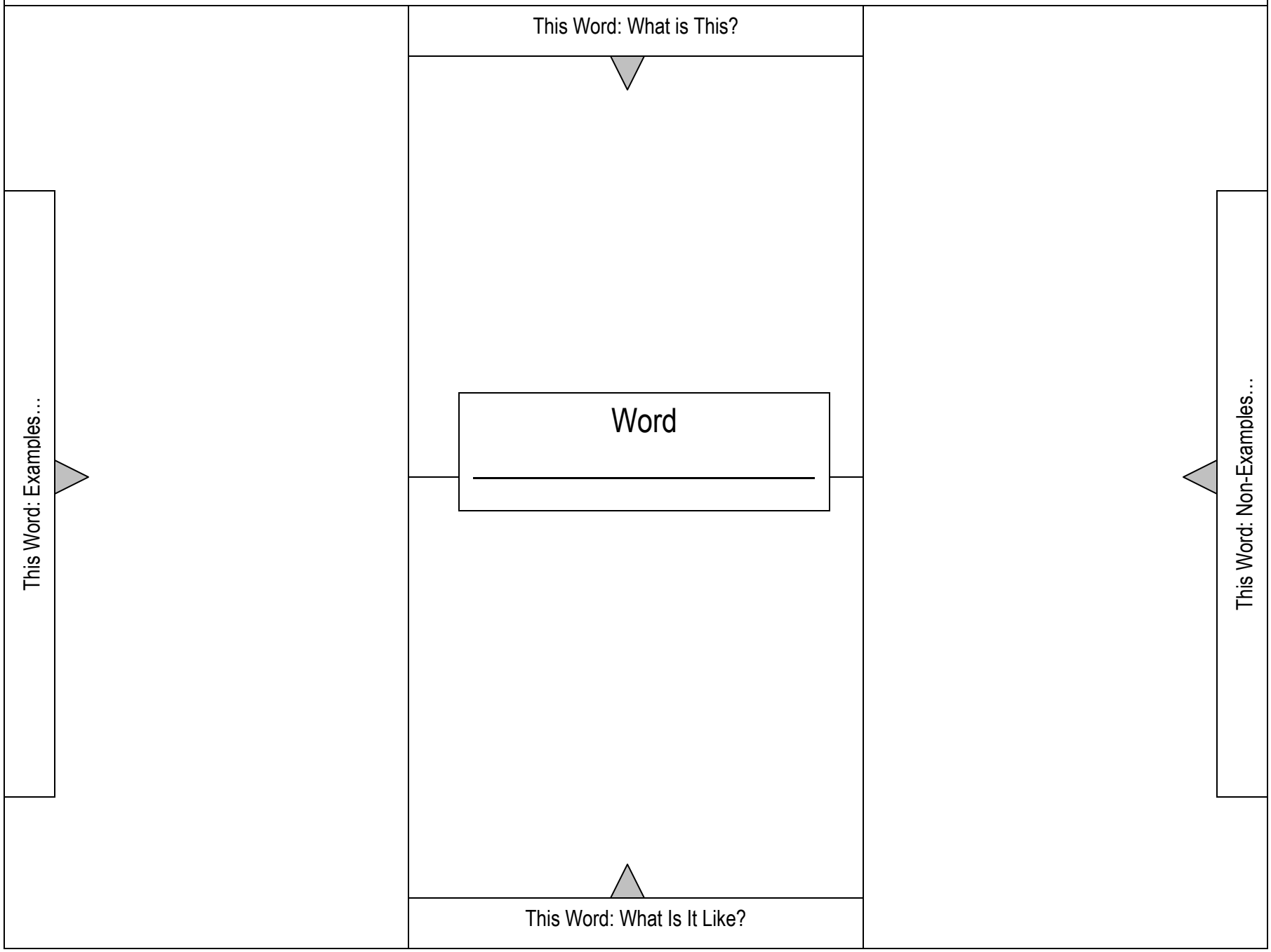
This Word	Examples of This Word

4-Square Word Activity

Definition of This Word	Non-Examples of This Word

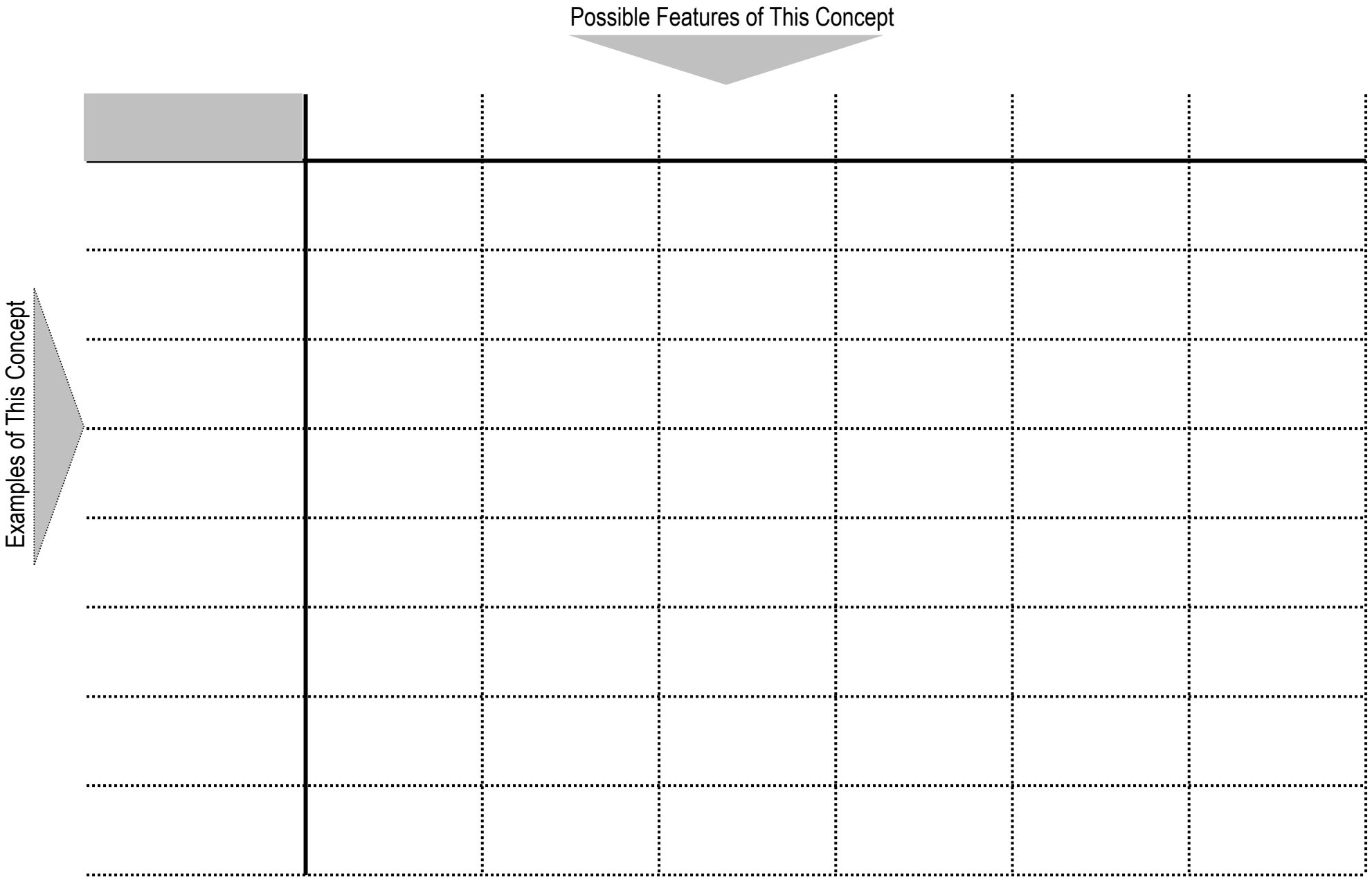
Adapted from: Texas Reading Initiative. (2002). *Promoting vocabulary development: Components of effective vocabulary instruction*. Austin, TX: Author. Retrieved November 15, 2008, from http://www.tea.state.tx.us/reading/practices/redbk5.pdf

Word Definition Map



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: _____

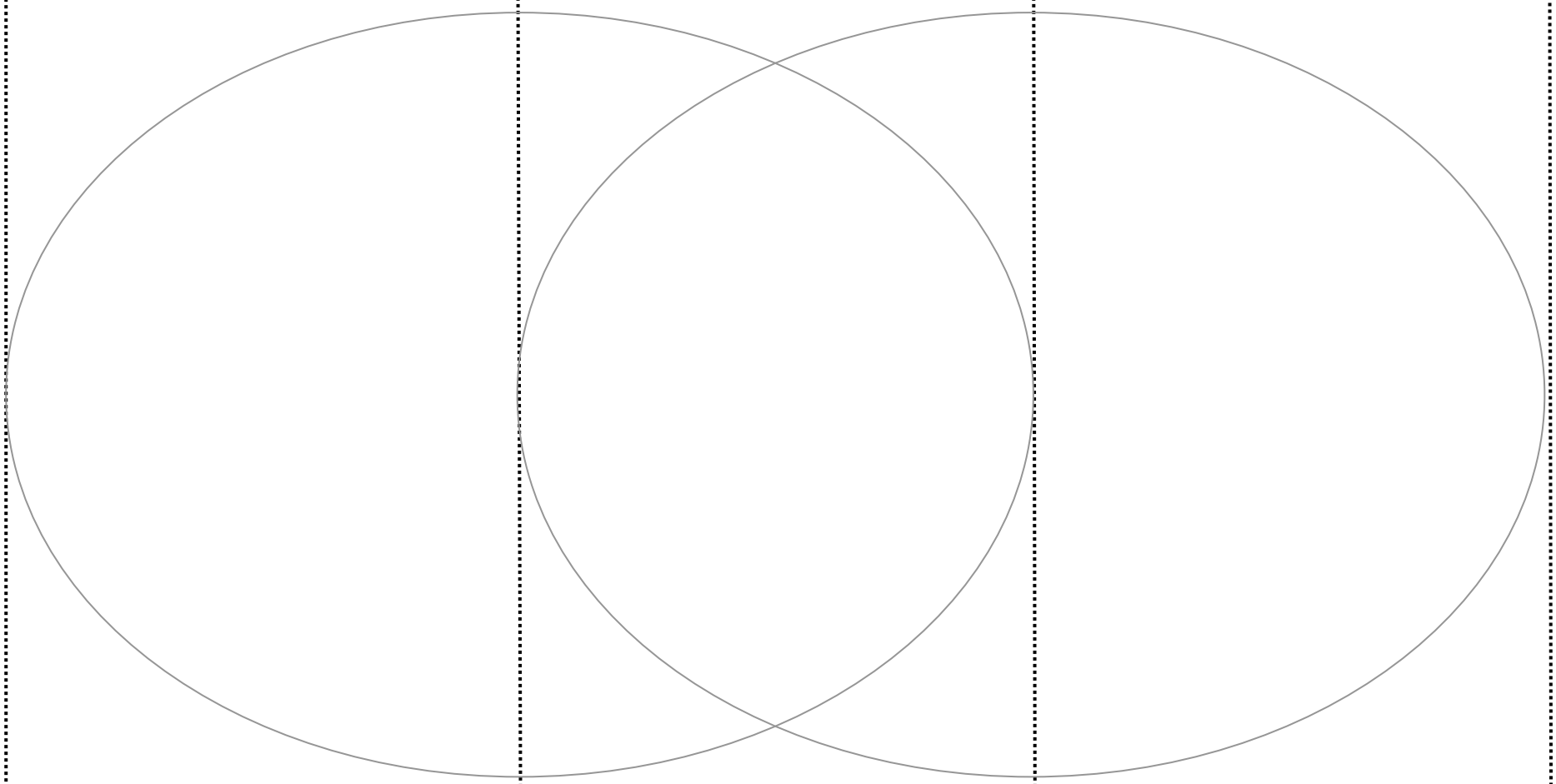
_____

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



Classroom Literacy Strategies: Extended Discussions

Why This Instructional Goal is Important

Extended, guided group discussion is a powerful means to help students to learn vocabulary and advanced concepts. Discussion can also model for students various 'thinking processes' and cognitive strategies(Kamil et al. 2008, p. 22). To be effective, guided discussion should go beyond students answering a series of factual questions posed by the teacher: Quality discussions are typically open-ended and exploratory in nature, allowing for multiple points of view (Kamil et al., 2008).

When group discussion is used regularly and well in instruction, students show increased growth in literacy skills. However, discussion is often underused as an instructional method. In one large research study of middle and high school language arts classes, for example, teachers were found on average to devote less than 2 minutes per class period to discussion activities (Kamil et al., 2008). Guided discussion holds an additional benefit: Content-area teachers can use it to demonstrate the 'habits of mind' and patterns of thinking of experts in various their discipline: e.g., historians, mathematicians, chemists, engineers, literacy critics, etc.

Strategies to Promote This Instructional Goal

Use a 'Standard Protocol' to Structure Guided Discussions (Kamil et al., 2008). Good guided classwide discussions elicit a wide range of student opinions, subject individual viewpoints to critical scrutiny in a supportive manner, put forth alternative views, and bring closure by summarizing the main points of the discussion. Teachers can use a simple structure to effectively and reliably organize their discussions:

A. Pose questions to the class that require students to explain their positions and the reasoning to support those positions.
B. When needed, 'think aloud' as the discussion leader to model good reasoning practices such as taking a clear stand on a topic or providing an explanation of why one supports a particular position.
C. Supportively challenge student views by offering possible counter arguments that students must attempt to answer.
D. Single out and mention examples of effective student reasoning.
E. Avoid being overly directive; the purpose of extended discussions is to more fully investigate and think about complex topics, not to push students toward a pre-determined viewpoint or finding.
F. At the conclusion of the discussion, sum up the general ground covered in the discussion and highlight the main ideas covered.

Teachers can train students to lead discussions (with teacher coaching as needed) and have those students moderate extended discussions in whole-group or cooperative learning format. Teachers can use the standard discussion protocol provided here as a starting point for training students as discussion leaders.

Troubleshooting Tips

Students Are Reluctant to Participate in Discussions (Kamil et al., 2008). As the discussion leader, be sure to make the discussion activity a 'safe' one in which all students feel that their

thoughts are valued. The teacher should provide sufficient structure to the activity so that students know clearly what is expected of them. If necessary when first training students to participate in extended discussions, the instructor can use texts that will elicit student interest—even if those texts are only marginally related to course content. As students are drawn into discussion by those high-interest texts and class participation increases, the teacher can start to use texts for future discussions that overlap more with the curriculum.

Teachers Lack the Time for Frequent Use of Extended Discussion. Guided discussion is an effective method for enhancing and verifying student understanding of course content (Kamil et al., 2008). If class time is limited, the instructor should reserve discussion time at least for those course topics and concepts that are potentially most complex, challenging, ambiguous, or open to misinterpretation.

Teachers Require Behavior Management Training to Manage Discussions. Extended discussions can require flexible behavior management strategies to both promote student involvement and maintain classroom order. Some teachers may be reluctant to engage in sustained discussions in their classrooms because of behavior management concerns. One solution is for the school to offer staff development to teachers on how to effectively manage a classroom during large-group or small-group discussion activities (Kamil et al., 2008).

Building Capacity

Provide 'Discussion Coaches'. The school can identify teachers in the school who have the formal training and/or experience to run effective discussion groups. These teachers might then be available to coach other instructors in how to integrate discussion into classroom instruction. The school may consider having these 'discussion coaches' visit classrooms to actually demonstrate discussion techniques with students, as well as to observe and provide feedback to other teachers on those educators' use of discussion strategies.

Allow Teachers Opportunities to Share Their Successes in Using Extended Discussion. Adopting new classroom practices is not easy. Schools can assist teachers to make the transition to using discussion more creatively and widely by allowing them opportunities to communicate regularly with their colleagues (perhaps by content area) to share ideas for discussion topics, formats, etc.

References

Kamil, M. L., Borman, G. D., Dole, J., Kral, C. C., Salinger, T., & Torgesen, J. (2008). *Improving adolescent literacy: Effective classroom and intervention practices: A practice guide* (NCEE #2008-4027). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc

Classroom Literacy Strategies: Reading Comprehension

Why This Instructional Goal is Important

Teachers have a wide degree of latitude in selecting reading comprehension strategies to use in their classrooms. At present, there is no clear evidence that any one instructional technique to promote reading comprehension is clearly superior to others. In fact, it appears that students benefit from being taught any self-directed practice that prompts them to engage more actively in understanding the meaning of text (Kamil et al., 2008). Reading comprehension interventions vary: Some (e.g., Oral Retell) are whole-group or cooperative learning strategies that promote a better understanding of specific reading assignments, while others (e.g., Question Generation) are designed to teach specific reading comprehension skills such as the ability to formulate a main idea sentence to capture essential ideas from an informational passage.

Strategies to Promote This Instructional Goal

Assist Students to Set 'Content Goals' for Reading (Boardman et al., 2008). Students are more likely to be motivated to read--and to read more closely—if they have specific content-related reading goals in mind. At the start of a reading assignment, for example, the instructor has students state what questions they might seek to answer or what topics they would like to learn more about in their reading. The student or teacher writes down these questions. After students have completed the assignee reading, they review their original questions and share what they have learned (e.g., through discussion in large group or cooperative learning group, or even as a written assignment).

Have Students Monitor Their Own Comprehension and Apply 'Fix-Up' Skills (Boardman et al., 2008). Teachers can teach students specific strategies to monitor their understanding of text and independently use 'fix-up' skills as needed. Examples of student monitoring and repair skills for reading comprehension include encouraging them to:

- Stop after every paragraph to summarize its main idea
- Reread the sentence or paragraph again if necessary
- Generate and write down questions that arise during reading
- Restate challenging or confusing ideas or concepts from the text in the student's own words

Teach Question-Answer Relationships (QARs) (Raphael, 1982; Raphael, 1986). Students are taught to identify 'question-answer relationships', matching the appropriate strategy to comprehension questions based on whether a question is based on fact, requires inferential thinking, or draws upon the reader's own experience. Students learn that answers to 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. Students are informed that they will also find answers to THINK AND SEARCH questions in the text--but must piece those answers together by scanning the text and making connections between different pieces of factual information. AUTHOR AND YOU questions require that students take information or opinions that appear in the text and combine them with the reader's own experiences or opinions to formulate an answer. ON MY OWN questions are based on the students' own experiences and do not require knowledge of the text to answer. Students are taught to identify question-answer relationships in class discussion and demonstration. They are then given specific questions and directed to identify the question type and to use the appropriate strategy to answer.

Use a Pre-Reading Questionnaire to Tap Prior Knowledge (Duffelmeyer, 1994; Merkley, 1996).

To activate their prior knowledge of a topic, students complete a brief questionnaire on which they must express agreement or disagreement with 'opinion' questions tied to the selection to be read; students then engage in a class discussion of their responses. The instructor first constructs the questionnaire. Each item on the questionnaire is linked to the content of the article or story that the students will read. All questionnaire items use a 'forced-choice' format in which the student must simply agree or disagree with the item. After students have completed the questionnaire, the teacher reviews responses with the class, allowing students an opportunity to explain their rationale for their answers. Then students read the article or story.

Troubleshooting Tips

Content-area Teachers Are Intimidated by the Request to Teach 'Reading Comprehension'. A busy teacher may feel overwhelmed at the thought of having to teach so global a skill as 'reading comprehension' to struggling students. Instead, the school can acknowledge that classroom teachers are 'content experts' and encourage them to generate ideas for helping students to better those comprehend specialized course texts and readings in which the teacher is highly knowledgeable.

Building Capacity

Allow Instructional Departments to Develop Their Own Set of Comprehension Ideas. Each academic subject presents unique reading comprehension challenges. For example, social studies often requires that students be able to read and understand historical documents from different time periods, while advanced math courses expect that students can comprehend and solve word problems with advanced math graphics. Build in regular opportunities for teachers within the various instructional departments to communicate with each other about reading comprehension strategies that work best within their discipline.

References

Boardman, A. G., Roberts, G., Vaughn, S., Wexler, J., Murray, C. S., & Kosanovich, M. (2008). *Effective instruction for adolescent struggling readers: A practice brief*. Portsmouth,NH: RMC Research Corporation, Center on Instruction.

Duffelmeyer, F.A. (1994). Effective anticipation guide statements for learning from expository prose. *Journal of Reading, 37*, 452 - 457.

Kamil, M. L., Borman, G. D., Dole, J., Kral, C. C., Salinger, T., & Torgesen, J. (2008). *Improving adolescent literacy: Effective classroom and intervention practices: A practice guide* (NCEE #2008-4027). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc.

Merkley, D.J. (1996). Modified anticipation guide. *Reading Teacher, 50,* 365-368.

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.

Paired Reading

Description: The student reads aloud in tandem with an accomplished reader. At a student signal, the helping reader stops reading, while the student continues on. When the student commits a reading error, the helping reader resumes reading in tandem.

Materials:

- Reading book

Preparation:

- The teacher, parent, adult tutor, or peer tutor working with the student should be trained in advance to use the paired-reading approach.

Intervention Script:

1. Sit with the student in a quiet location without too many distractions. Position the book selected for the reading session so that both you and the student can easily follow the text.

2. Say to the student, *"Now we are going to read aloud together for a little while. Whenever you want to read alone, just tap the back of my hand like this* [demonstrate] *and I will stop reading. If you come to a word you don't know, I will tell you the word and begin reading with you again."*

3. Begin reading aloud with the student. If the student misreads a word, point to the word and pronounce it. Then have the student repeat the word. When the student reads the word correctly, resume reading through the passage.

4. When the child delivers the appropriate signal (a hand tap), stop reading aloud and instead follow along silently as the student continues with oral reading. Be sure occasionally to praise the student in specific terms for good reading (e.g., "That was a hard word. You did a nice job sounding it out!").

5. If, while reading alone, the child either commits a reading error or hesitates for longer than 5 seconds, point to the error-word and pronounce it. Then tell the student to say the word. When the student pronounces the error-word correctly, begin reading aloud again in unison with the student.

6. Continue reading aloud with the student until he or she again signals to read alone.

Tips:

Consider Using Paired Reading for Peer Tutoring or as a Parent Strategy. Paired reading is a highly structured but simple strategy that can easily be taught to others—including to school-age children and youth. If you have a pool of responsible older students available you may want to create a cross-age peer tutoring program that uses

paired reading as its central intervention. Or train parents to use this simple reading strategy when they read with their children at home.

References:

Topping, K. (1987). Paired reading: A powerful technique for parent use. *Reading Teacher, 40,* 608-614.

Reading Comprehension: Main-Idea Maps

Description: This simple strategy teaches students to generate a graphic organizer containing the main ideas of an expository passage.

Reserve at least a full instructional session to introduce this comprehension strategy. (For effective-teaching tips, consult the guidelines presented in "*Introducing Academic Strategies to Students: A Direct-Instruction Approach*").

Materials:

- Overhead transparencies of practice expository passages, transparency markers
- Student copies of practice expository passages (optional) or reading/text books, *Main Idea Graphic Organizer*

Preparation:

- Prepare overheads of sample passages.

Intervention Script:

1. Introduce the strategy by telling students that we can draw pictures, or Main Idea Maps, that help us to understand how the ideas of a multi-paragraph passage fit together. Present these three steps for mapping out the main ideas of an expository:

   Locating the Main Ideas of Paragraphs. Read through a short (2-6 paragraph) practice expository passage with students.

   On a blank overhead transparency or chart paper, begin building a graphic organizer by writing the title of the passage in the center. Draw a box around the title. (If the passage has no title, query the class and make up a suitable title based on their suggestions.) NOTE: Instead of drawing your own map, you can use the pre-formatted *Main Idea Graphic Organizer* that is included with this strategy.

   Tell students that some paragraphs have summary sentences that state the main idea or "gist" of the paragraph or passage. Other paragraphs have *implied* main ideas, which the reader must figure out, based on key facts or ideas that they contain.

   Go through each paragraph in the practice passage and identify the paragraph's main idea. Demonstrate how to summarize that main idea as a single, succinct phrase.

   Building the Main Idea Graphic Organizer. As you summarize each paragraph's main idea, write the number of the paragraph and main-idea summary phrase on the graphic organizer. (Start writing at the upper left corner of the organizer sheet and continue clockwise around the page. Space the summary phrases to allow space to write under each. See the sample "Main Idea Graphic Organizer.").

Adding Key Facts. When you have written the main idea for all of the paragraphs onto the graphic organizer, return to the passage. For each paragraph, pull out 2-3 important facts, ideas, or supporting details. On the graphic organizer, write these key pieces of additional information under the main-idea phrase for that paragraph. Then draw a box around the main-idea and supporting details and move on to the next paragraph.

2. Practice Using the Graphic Organizer as a Study Tool. Demonstrate how the completed Main Idea Graphic Organizer can be a useful method to summarize and review the content of expository passages. Give students new practice passages and have them create their own graphic organizers. Provide feedback and encouragement as needed.

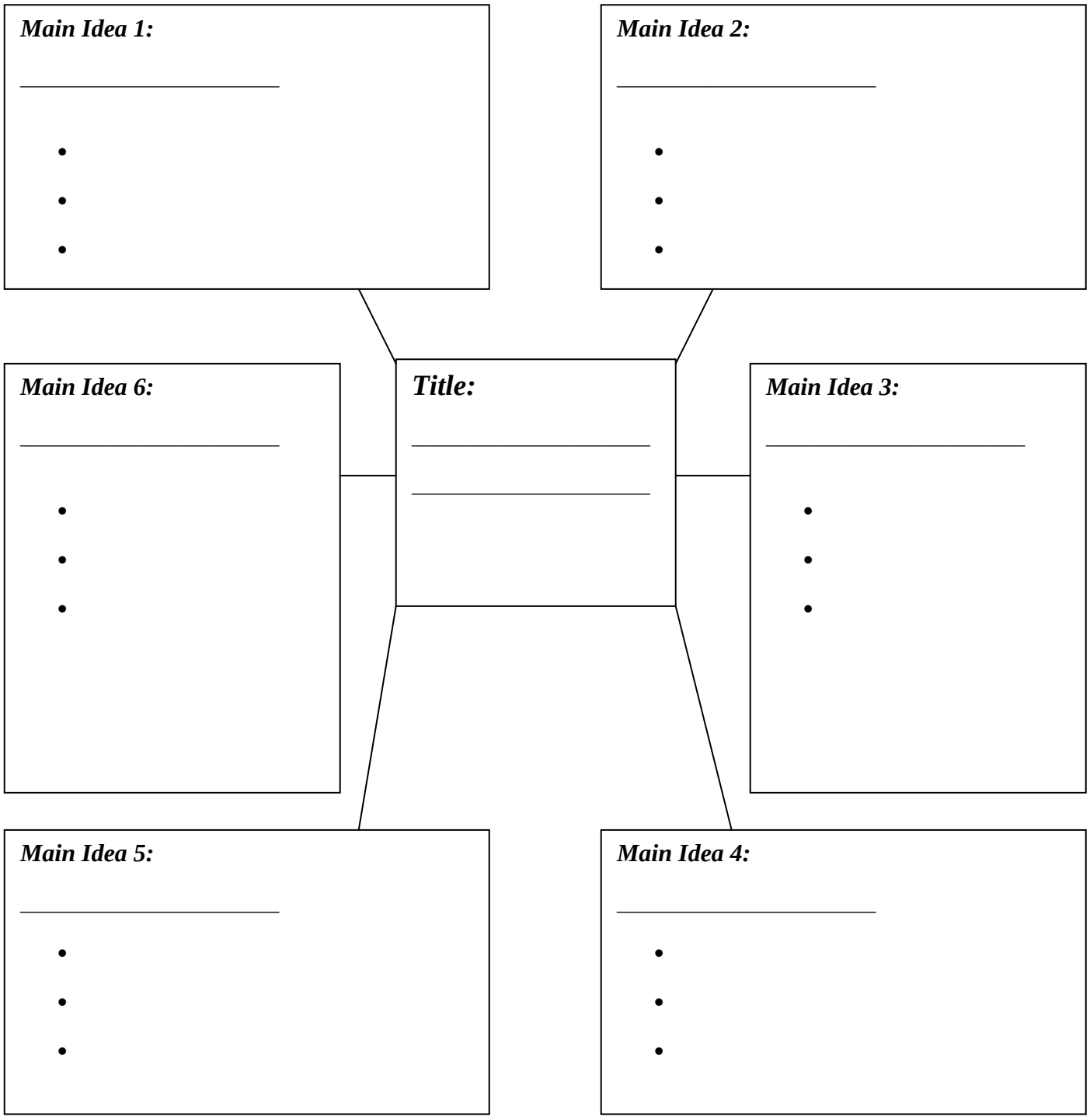
Tips:

Use a Giant 'Main Idea Map' to Teach The Strategy. You can make the teaching of this strategy fun and highly interactive by drawing a giant version of the Main Idea Graphic Organizer onto newsprint and laying it on the floor. Assign each individual in the class to read through a practice passage and write out a summary main-idea phrase and key ideas or facts for each paragraph. Review the passage with the group. For each paragraph, invite a volunteer to stand on the space on the giant organizer that corresponds to the paragraph and read aloud his or her summary for class feedback. Continue through the passage until all paragraphs have been reviewed and student volunteers have occupied each point on the graphic organizer.

References:

Berkowitz, S.J. (1986). Effects of instruction in text organization on sixth-grade students' memory for expository reading. *Reading Research Quarterly, 21*, 161-178.

Main Idea Graphic Organizer (adapted from Berkowitz, 1986)



Reading Comprehension: Mental Imagery: Improving Text Recall

Description: By constructing "mental pictures" of what they are reading and closely studying text illustrations, students increase their reading comprehension.

Reserve at least a full instructional session to introduce this comprehension strategy. (For effective-teaching tips, consult the guidelines presented in "*Introducing Academic Strategies to Students: A Direct-Instruction Approach*").

Materials:

- Overhead transparencies of sample passages taken from expository or narrative texts, transparency markers
- Student copies of practice expository or narrative passages (optional) or reading/text books

Preparation:

- Prepare overheads of sample expository or narrative passages.

Intervention Script:

1. Tell students that they can remember more of what they read by:

    - making pictures in their mind of what they are reading
    - carefully studying pictures or illustrations that appear in their reading or text books

2. Using a "think-aloud" approach, read through a short sample narrative or expository passage. Pause at several points to tell the class what "mental pictures" come to your mind as you read; ask students to describe their own mental imagery as they react to the same passage. As you come across pictures or illustrations in the passage, study them and reflect aloud on what clues they give you about the passage's meaning.

3. Read aloud from additional passages. Stop at key points in the passage and call on students to relate their mental imagery evoked by the passage or to give their interpretation of the significance of illustrations or pictures.

4. When students are able to use mental imagery independently, use a prompt at the start of reading assignments to cue them to use the strategy. You might say, for example, "Now we are going to read about what life is like in a country village in Zimbabwe. Remember to make pictures in your head about what you are reading and study the pictures carefully."

Tips:

Have Your Students Become More Active Reading Participants. As your students become more adept at using mental imagery and text illustrations to comprehend their reading, enlist them in critical discussions about the strengths or drawbacks of a particular book, chapter, or article. How clearly does the author write? Is it easy or difficult to form mental pictures of the passage's content, and why? How would they grade the author on the quality and clarity of his or her illustrations?

References:

Gambrell, L.B. & Bales, R.B. (1986). Mental imagery and the comprehension-monitoring performance of fourth- and fifth-grade poor readers. *Reading Research Quarterly*, *21*, 454-464.

Gambrell, L.B. & Jawitz, P.B. (1993). Mental imagery, text illustrations, and children's story comprehension and recall. *Reading Research Quarterly*, *23*, 265-273.

Reading Comprehension: Prior Knowledge: Activating the 'Known'

Description: Through a series of guided questions, the instructor helps students activate their prior knowledge of a specific topic to help them comprehend the content of a story or article on the same topic. Linking new facts to prior knowledge increases a student's *inferential* comprehension (ability to place novel information in a meaningful context by comparing it to already-learned information).

Reserve at least a full instructional session to introduce this comprehension strategy. (For effective-teaching tips, consult the guidelines presented in "*Introducing Academic Strategies to Students: A Direct-Instruction Approach*").

Materials:

- Overhead transparencies of practice reading passages and sample Text Prediction questions, transparency markers
- Student copies of practice reading passages (optional) or reading/text books, blank paper and pencil or pen

Preparation:

- Prepare overheads of sample passages.
- Locate 3 main ideas per passage and—for each idea—develop a prior knowledge question and a prediction question (see below).

Intervention Script:

1. Introduce this strategy to the class:

    1. Explain the Benefit of Using Prior Knowledge to Understand a Reading Passage: Tell students that recalling their prior experiences ("their own life") can help them to understand the content of their reading. New facts make sense only when we connect them to what we already know.

    2. Demonstrate the Text Prediction Strategy. Select a sample passage and use a "think-aloud" approach to show students how to use the text-prediction strategy. (Note: To illustrate how the strategy is used, this intervention script uses the attached example, *Attending Public School in Japan*.)

        Step 1: Think About What and Why: Describe what strategy you are about to apply and the reason for doing so. You might say, for example, "*I am about to read a short article on public schools in Japan. Before I read the article, though, I should think about my life experiences and what they might tell me about the topic that I am about to read about. By thinking about my own life, I will better understand the article.*"

Step 2: Preview Main Ideas from the Reading and Pose Prior Knowledge and Prediction Questions. One at a time, pose three main ideas that appear in the article or story. For each key idea, present one question requiring that readers tap their own *prior knowledge* of the topic and another that prompts them to predict how *the article or story* might deal with the topic.

Here is a typical question cycle, composed of a main idea statement, prior knowledge question, prediction question, and student opportunity to write a response.

"The article that we are going to read describes how different the writing system used in Japanese schools is from our own writing system" [A main idea from the passage].

"*What are your own attitudes and experiences about writing?*" [prior knowledge question] Answer this question aloud, and then encourage students to respond.

"*What do you think that the article will say about the Japanese writing system?*" [prediction question] Answer this question aloud, and then seek student responses.

"*Now, write down your own ideas about what you think the article will say about the Japanese writing system."* [student written response] As students write their own responses, model for them by writing out your answer to the question on the overhead transparency.

Step 3: Students Read the Story or Article Independently. Once you have presented three main ideas and students have responded to all questions, have them read the selection independently.

2. When students have learned the Text Prediction strategy, use it regularly to introduce new reading assignments.

Tips:

Use Text Prediction to Prepare Students for Homework Reading. You can apply the Text Prediction strategy to boost student comprehension of homework reading assignments. When assigning the homework passages, take students through the steps in the strategy. Then require that students take their own written predictions home to compare to their actual reading.

Transition from Group to Individual Application of the Strategy. As your students become proficient in applying the strategy, you can gradually train them to use the strategy independently. As the instructor, you might hand out the three main ideas for a story and then direct students to take each idea and write out (1) a short account of their

own experiences with the topic, and (2) a prediction of what the article or story will say about the main idea. You can collect these written assignments to monitor student understanding and follow-through in using the technique.

References:

Hansen, J. & Pearson, P.D. (1983). An instructional study: Improving the inferential comprehension of good and poor fourth-grade readers. *Journal of Educational Psychology, 75*, 821-829.

Attending Public School in Japan

Japan is a country of 125 million inhabitants, with a rich and ancient cultural tradition. The geography is varied, with many mountains and valleys.

The Japanese language is quite different from English. In fact, linguists (researchers who study to form and structure of languages) disagree on how Japanese evolved as a language and how closely it is related to other world languages. Because Japan is an archipelago (a series of islands), sections of the country were once quite isolated from one another. Even now, throughout Japan there are a number of different *dialects* (variant spoken versions of the language) that can make it difficult at times for a speaker of one dialect to understand a speaker of another dialect.

The food in Japanese public schools is generally very healthy but quite different than students are used to eating in America. Dishes may contain combinations of raw or cooked seafood, vegetables, noodles, rice, or seaweed. While meat is commonly served, the portions are smaller than are typical in American meals. Fast food has become popular in Japan, but diners must also be able to handle chopsticks.

In Japan, all children attend primary (elementary) school and middle school. Although high school is not mandatory in Japan, virtually all high-school-age students attend them. Unlike most American school systems, high schools in Japan are selective. Students must take competitive exams to be admitted to these schools, which are largely designed to prepare students for college. Many students choose to attend vocational schools, rather than academic high schools.

In public school, students must learn four separate writing systems: Kanji, hiragana, katakana, and romaji. The most challenging of these systems, kanji, is based on Chinese ideograms (words written as a pictorial series of brush- or pen-strokes) and takes years to learn to read and write properly.

Most high school students in Japan will tell you that they have no assigned homework. However, Japanese students regularly spend *several hours* per night reviewing their lessons and reading ahead on the material that will be covered in school the following day. Japanese students, like their American counterparts, love television shows, movies, computer games, and other forms of popular entertainment.

Reading Comprehension: Question-Generation

Description: Students are taught to boost their comprehension of expository passages by (1) locating the main idea or key ideas in the passage and (2) generating questions based on that information.

Reserve at least a full instructional session to introduce this comprehension strategy. (For effective-teaching tips, consult the guidelines presented in "*Introducing Academic Strategies to Students: A Direct-Instruction Approach*").

Materials:

- Overhead transparencies of practice reading passages, transparency markers
- Student copies of practice reading passages (optional) or reading/text books

Preparation:

- Prepare overheads of sample passages.

Intervention Script:

1. Introduce this strategy to the class:

   A. Locating Explicit Main Idea: Tell students that some passages have summary sentences that state the main idea or "gist" of the paragraph or passage. Using examples of passages with explicit main ideas, train students to identify and underline main-idea sentences.

   B. Finding Key Facts. In some passages, the main idea is implied rather than explicitly stated. Readers must first identify the key facts or ideas of the passage before they can summarize the passage's main idea.

      Using examples of passages with implied main ideas, locate and circle key facts or ideas. Describe to students how you distinguished this central information from less important details. Have students practice this skill on additional practice passages.

   C. Writing a "Gist" Sentence. Show students a passage with an implied main idea. Circle all key ideas or facts. Demonstrate how to write a "gist" sentence (one that is built from the identified key ideas and summarizes the paragraph's main idea). Emphasize that the reader may have link information from different sections of the passage to build a gist sentence. Have students practice this skill on additional practice passages.

   D. Generating Questions. Tell students that careful readers often construct questions about what they are reading to help them learn. Put up a list of 'signal words' that can be used as question-starters: e.g., who, what, where, when, why, how. Using sample passages, show students how to convert

explicit main-idea sentences or reader-created "gist" sentences into questions. Point out that these questions can be a good study tool because they are linked to answers that the student has already located in the passage.

2. Give students selected practice passages and instruct them to apply the full question-generation strategy. Provide feedback and encouragement as needed.

Tips:

Use "Gist" Sentences to Organize Student Research Notes. When students are writing research papers, they often find it challenging to synthesize their scattered research notes into an orderly outline with sequentially presented main ideas. Students who have mastered the skill of assembling key ideas into "gist" sentences can identify their most important research notes, copy these notes individually onto index cards, and group cards with related notes. The student can then write a single "gist" sentence for each pile of note cards and use these sentences as the starting point for a paper outline.

Collect Exemplary Examples of Student-Generated Questions as Study Aids. If your class is using an assigned textbook, you may want to collect well-written student-generated questions and share them with other students. Or assign students different sections of an article or book chapter and require that they 'teach' the content by presenting their text-generated questions and sharing the correct answers.

Select Student Questions As Quiz or Test Items. You can build classroom interest (and competition!) in using this question-generation strategy by occasionally using one or more student text-questions as quiz or test items.

References:

Davey, B., & McBride, S. (1986). Effects of question-generation training on reading comprehension. *Journal of Educational Psychology, 78*, 256-262.

Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research, 66*, 181-221.

Reading Comprehension: Text Lookback

Description: Text lookback is a simple strategy that students can use to boost their recall of expository prose by looking back in the text for important information.

Reserve at least a full instructional session to introduce this comprehension strategy. (For effective-teaching tips, consult the guidelines presented in "*Introducing Academic Strategies to Students: A Direct-Instruction Approach*").

Materials:

- Overhead transparencies of short (100-200 word) passages from expository text and teacher-prepared text and lookback/think questions, transparency markers
- Student copies of expository text passages and text-lookback /think questions

Preparation:

- Create at least 3 lookback questions and one think question for each expository text passage selected

Intervention Script:

1. Introduce the text-lookback strategy by telling students that people cannot always remember everything that they read. If we read an article or book chapter, though, and are asked a 'fact' question about it that we cannot answer, we can always look back in the article to find the information that we need.

2. Describe for the class the difference between lookback and think questions. An example of an explanation that you might use is:

   "*When we are asked questions about an article, sometimes the answer can be found directly in the article and sometimes it cannot be found directly."*

   "*Lookback questions are those that tell us that the answer can be found right in the article. For example, if a question uses phrases such* as in the article *or* in the author's words, *these phrases would be clues that the question is a lookup question and that we can find the answer in the article. "*

   "*Think questions are those that ask you to give your own opinion, beliefs, or ideas. Our answers to these questions are based on our own ideas or thoughts about the topic. For example, if a question uses phrases such* as in your opinion *or* what do you think, *these phrases would be clues that the question is a think question and that the answer cannot be found in the article. "*

3. Read aloud through the sample expository passage. Then read the series of 4 text-lookback/think questions to the class. As you read each question, highlight for

students the word clues that indicate whether the question is a think or text-lookback question.

4. Tell students that they must reread carefully to find the answer to a text-lookback question. However, they can save time by first *skimming* the article to get to the general section where the answer to the question is probably located. To skim, the student should:

   - read the text-lookback question carefully and underline the section that tells the reader what to look for (e.g., "What does the article say <u>are the five most endangered species of whales</u> today?").

   - look for titles, headings, or illustrations in the article that might tell the reader where the information that he or she is looking for is probably located

   - look at the beginning and end sentences in individual paragraphs to see if that paragraph might contain the desired information.

5. "Thinking aloud", demonstrate for students how to skim the example article to locate efficiently the answer to each text-lookback question.

6. Present additional example articles with text-lookback questions and monitor student mastery of the technique. Assign students to use the strategy independently when, under your supervision, they can distinguish reliably between think and text-lookback questions and are able to find the answers to text-lookback questions in the text.

Tips:

Have Students Write Text-Lookback Questions for Assigned Reading. For homework, encourage students to compose several challenging text-lookback questions based on their assigned reading. Use these questions later for class review.

References:

Garner, R., Hare, V.C., Alexander, P., Haynes, J., & Vinograd, P. (1984). Inducing use of a text lookback strategy among unsuccessful readers. *American Educational Research Journal, 21*, 789-798.

Reading Comprehension 'Fix-Up' Skills: A Toolkit

Good readers continuously monitor their understanding of informational text. When necessary, they also take steps to improve their understanding of text through use of reading comprehension 'fix-up' skills. Presented here are a series of fix-up skill strategies that can help struggling students to better understand difficult reading assignments.

- [Core Instruction] Providing Main Idea Practice through 'Partner Retell' (Carnine & Carnine, 2004). Students in a group or class are assigned a text selection to read silently. Students are then paired off, with one student assigned the role of 'reteller' and the other appointed as 'listener'. The reteller recounts the main idea to the listener, who can comment or ask questions. The teacher then states the main idea to the class. Next, the reteller locates two key details from the reading that support the main idea and shares these with the listener. At the end of the activity, the teacher does a spot check by randomly calling on one or more students in the listener role and asking them to recap what information was shared by the reteller.

- [Accommodation] Developing a Bank of Multiple Passages to Present Challenging Concepts (Hedin & Conderman, 2010; Kamil et al., 2008; Texas Reading Initiative, 2002). The teacher notes which course concepts, cognitive strategies, or other information will likely present the greatest challenge to students. For these 'challenge' topics, the teacher selects alternative readings that present the same general information and review the same key vocabulary as the course text but that are more accessible to struggling readers (e.g., with selections written at an easier reading level or that use graphics to visually illustrate concepts). These alternative selections are organized into a bank. Students are encouraged to engage in wide reading by choosing selections from the bank as a means to better understand difficult material.

- [Student Strategy] Promoting Understanding & Building Endurance through Reading-Reflection Pauses (Hedin & Conderman, 2010). The student decides on a reading interval (e.g., every four sentences; every 3 minutes; at the end of each paragraph). At the end of each interval, the student pauses briefly to recall the main points of the reading. If the student has questions or is uncertain about the content, the student rereads part or all of the section just read. This strategy is useful both for students who need to monitor their understanding as well as those who benefit from brief breaks when engaging in intensive reading as a means to build up endurance as attentive readers.

- [Student Strategy] Identifying or Constructing Main Idea Sentences (Davey & McBride, 1986; Rosenshine, Meister & Chapman, 1996). For each paragraph in an assigned reading, the student either (a) highlights the main idea sentence or (b) highlights key details and uses them to write a 'gist' sentence. The student then writes the main idea of that paragraph on an index card. On the other side of the card, the student writes a question whose answer is that paragraph's main idea sentence. This stack of 'main idea' cards becomes a useful tool to review assigned readings.

- [Student Strategy] Restructuring Paragraphs with Main Idea First to Strengthen 'Rereads' (Hedin & Conderman, 2010). The student highlights or creates a main idea sentence for each paragraph in the assigned reading. When rereading each paragraph of the selection, the student (1) reads the main idea sentence or student-generated 'gist' sentence first (irrespective of where that sentence actually falls in the paragraph); (2) reads the remainder of the paragraph, and (3) reflects on how the main idea relates to the paragraph content.

- [Student Strategy] Summarizing Readings (Boardman et al., 2008). The student is taught to summarize readings into main ideas and essential details--stripped of superfluous content. The act of summarizing longer readings can promote understanding and retention of content while the summarized text itself can be a useful study tool.

- [Student Strategy] Linking Pronouns to Referents (Hedin & Conderman, 2010). Some readers lose the connection between pronouns and the nouns that they refer to (known as 'referents')—especially when reading challenging text. The student is encouraged to circle pronouns in the reading, to explicitly identify each pronoun's referent, and (optionally) to write next to the pronoun the name of its referent. For example, the student may add the referent to a pronoun in this sentence from a biology text: *"The Cambrian Period is the first geological age that has large numbers of multi-celled organisms associated with* ***it*** *Cambrian Period."*

- [Student Strategy] Apply Vocabulary 'Fix-Up' Skills for Unknown Words (Klingner & Vaughn, 1999). When confronting an unknown word in a reading selection, the student applies the following vocabulary 'fix-up' skills:

  1. Read the sentence again.
  2. Read the sentences before and after the problem sentence for clues to the word's meaning.
  3. See if there are prefixes or suffixes in the word that can give clues to meaning.
  4. Break the word up by syllables and look for 'smaller words' within.

- [Student Strategy] Compiling a Vocabulary Journal from Course Readings (Hedin & Conderman, 2010). The student highlights new or unfamiliar vocabulary from course readings. The student writes each term into a vocabulary journal, using a standard 'sentence-stem' format: e.g., "*Mitosis* means…" or "A *chloroplast* is…". If the student is unable to generate a definition for a vocabulary term based on the course reading, he or she writes the term into the vocabulary journal without definition and then applies other strategies to define the term: e.g., look up the term in a dictionary; use Google to locate two examples of the term being used correctly in context; ask the instructor, etc.).

- [Student Strategy] Encouraging Student Use of Text Enhancements (Hedin & Conderman, 2010). Text enhancements can be used to tag important vocabulary terms, key ideas, or other reading content. If working with photocopied material, the student can use a highlighter--but should limit highlighting to important text elements such as main idea and key vocabulary terms. Another enhancement strategy is the 'lasso and rope' technique—using a pen or pencil to circle a vocabulary term and then drawing a line that connects that term to its underlined definition. If working from a textbook, the student can cut sticky notes into strips. These strips can be inserted in the book as pointers to text of interest. They can also be used as temporary labels—e.g., for writing a vocabulary term and its definition.

- [Student Strategy] Reading Actively Through Text Annotation (Harris, 1990; Sarkisian et al., 2003). Students are likely to increase their retention of information when they interact actively with their reading by jotting comments in the margin of the text. Using photocopies, the student is taught to engage in an ongoing 'conversation' with the writer by recording a running series of brief comments in the margins of the text. The student may write annotations to record opinions about points raised by the writer, questions triggered by the reading, or unknown vocabulary words.

References

Boardman, A. G., Roberts, G., Vaughn, S., Wexler, J., Murray, C. S., & Kosanovich, M. (2008). *Effective instruction for adolescent struggling readers: A practice brief.* Portsmouth, NH: RMC Research Corporation, Center on Instruction.

Carnine, L., & Carnine, D. (2004). The interaction of reading skills and science content knowledge when teaching struggling secondary students. *Reading & Writing Quarterly, 20*, 203-218.

Davey, B., & McBride, S. (1986). Effects of question-generation training on reading comprehension. *Journal of Educational Psychology, 78*, 256-262.

Harris, J. (1990). Text *annotation and underlining as metacognitive strategies to improve comprehension and retention of expository text*. Paper presented at the Annual Meeting of the National Reading Conference (Miami).

Hedin, L. R., & Conderman, G. (2010). Teaching students to comprehend informational text through rereading. *The Reading Teacher, 63*(7), 556–565.

Kamil, M. L., Borman, G. D., Dole, J., Kral, C. C., Salinger, T., & Torgesen, J. (2008). *Improving adolescent literacy: Effective classroom and intervention practices: A practice guide* (NCEE #2008-4027). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc.

Klingner, J. K., & Vaughn, S. (1999). Promoting reading comprehension, content learning, and English acquisition through collaborative strategic reading (CSR). *The Reading Teacher, 52*(7), 738-747.

Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research, 66*, 181-221.

Sarkisian V., Toscano, M., Tomkins-Tinch, K., & Casey, K. (2003). Reading *strategies and critical thinking*. Retrieved October 15, 2006, from http://www.academic.marist.edu/alcuin/ssk/stratthink.html

Texas Reading Initiative. (2002). *Promoting vocabulary development: Components of effective vocabulary instruction*. Austin, TX: Author. Retrieved November 15, 2010, from http://www.tea.state.tx.us/reading/practices/redbk5.pdf

School-Wide Strategies for Managing... MATHEMATICS

A service of www.interventioncentral.org

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.

References

Armendariz, F., & Umbreit, J. (1999). Using active responding to reduce disruptive behavior in a general education classroom. Journal of Positive Behavior Interventions, 1(3), 152-158.

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

Bryan, T., & Sullivan-Burstein, K. (1998). Teacher-selected strategies for improving homework completion. Remedial & Special Education, 19, 263-275.

Carnine, D. (1997). Instructional design in mathematics for students with learning disabilities. Journal of Learning Disabilities, 30, 130-141.

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

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

Cooke, L B. & Adams, V. M. (1998). Encouraging "math talk" in the classroom. Middle School Journal, 29(5), 35-40.

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

Hong, E., Sas, M., & Sas, J. C. (2006). Test-taking strategies of high and low mathematics achievers. Journal of Educational Research, 99(3), 144-155.

Lambert, M. C., Cartledge, G., Heward, W. L., & Lo, Y. (2006). Effects of response cards on disruptive behavior and academic responding during math lessons by fourth-grade urban students. Journal of Positive Behavior Interventions, 8(2), 88-99.

Montague, M. (1997). Cognitive strategy instruction in mathematics for students with learning disabilities. Journal of Learning Disabilities, 30, 164-177.

Montague, M., Warger, C., & Morgan, T. H. (2000). Solve it! Strategy instruction to improve mathematical problem solving.. Learning Disabilities Research & Practice, 15, 110-116.

Pólya, G. (1957). How to solve it (2nd ed.). Princeton University Press: Princeton, N.J.

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

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

Van Essen, G., & Hamaker, C. (1990). Using self-generated drawings to solve arithmetic word problems. Journal of Educational Research, 83, 301-312.

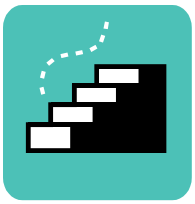
Van Garderen, D. (2006). Spatial visualization, visual imagery, and mathematical problem solving of students with varying abilities. Journal of Learning Disabilities, 39, 496-506.

Williams, K. M. (2003). Writing about the problem solving process to improve problem-solving performance. Mathematics Teacher, 96(3), 185-187.

Woodward, J. (2006). Developing automaticity in multiplication facts integrating strategy instruction with timed practice drills. Learning Disability Quarterly, 29, 269-289.

Zrebiec Uberti, H., Mastropieri, M. A., & Scruggs, T. E. (2004). Check it off: Individualizing a math algorithm for students with disabilities via self-monitoring checklists. Intervention in School and Clinic, 39, 269-275.

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.

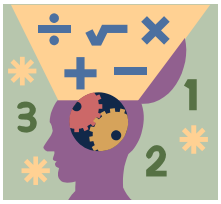
5. The student is then presented with a new math fact to answer, taken from the 'unknown facts' deck. With each new 'unknown' math fact, the review sequence is again repeated as described above until the 'unknown' math fact is grouped incrementally with nine math facts from the 'known facts' deck—and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

References

Burns, M. K., VanDerHeyden, A. M., & Boice, C. H. (2008). Best practices in intensive academic interventions. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology V* (pp.1151-1162). Bethesda, MD: National Association of School Psychologists.

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

Montague, M., & Dietz, S. (2009). Evaluating the evidence base for cognitive strategy instruction and mathematical problem solving. *Exceptional Children, 75*, 285-302.