
*RTI Toolkit: A Practical Guide for Schools*

# Interventions for Math-Challenged Students in Middle and High School: A Toolkit

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8 January 2019
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Harrison, NY

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Workshop Downloads at: http://www.interventioncentral.org/math_toolkit

# How To: Implement Strong Core Instruction

When teachers must present challenging academic material to struggling learners, they can make that material more accessible and promote faster learning by building assistance directly into instruction. Researchers use several terms to refer to this increased level of student instructional support: explicit instruction, direct instruction, supported instruction (Rosenshine, 2008).

The checklist below summarizes the essential elements of a supported-instruction approach. When preparing lesson plans, instructors can use this resource as a 'pre-flight' checklist to make sure that their lessons reach the widest range of diverse learners.

| 1. Increase Access to Instruction | |
|---|---|
| Instructional Element | Notes |
| ☐ Instructional Match. Lesson content is appropriately matched to students' abilities (Burns, VanDerHeyden, & Boice, 2008). | |
| ☐ Content Review at Lesson Start. The lesson opens with a brief review of concepts or material that have previously been presented. (Burns, VanDerHeyden, & Boice, 2008, Rosenshine, 2008). | |
| ☐ Preview of Lesson Goal(s). At the start of instruction, the goals of the current day's lesson are shared (Rosenshine, 2008). | |
| ☐ Chunking of New Material. The teacher breaks new material into small, manageable increments, 'chunks', or steps (Rosenshine, 2008). | |

| 2. Provided 'Scaffolding' Support | |
|---|---|
| Instructional Element | Notes |
| ☐ Detailed Explanations & Instructions. Throughout the lesson, the teacher provides adequate explanations and detailed instructions for all concepts and materials being taught (Burns, VanDerHeyden, & Boice, 2008). | |
| ☐ Think-Alouds/Talk-Alouds. When presenting cognitive strategies that cannot be observed directly, the teacher describes those strategies for students. Verbal explanations 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) (Burns, VanDerHeyden, & Boice, 2008, Rosenshine, 2008). | |
| ☐ Work Models. The teacher makes exemplars of academic work (e.g., essays, completed math word problems) available to students for use as models (Rosenshine, 2008). | |
| ☐ Active Engagement. The teacher ensures that the lesson engages the student in 'active accurate responding' (Skinner, Pappas & Davis, 2005) often enough to capture student attention and to optimize learning. | |
| ☐ Collaborative Assignments. Students have frequent opportunities to work collaboratively--in pairs or groups. (Baker, Gersten, & Lee, 2002; Gettinger & Seibert, 2002). | |
| ☐ Checks for Understanding. The instructor regularly checks for student understanding by posing frequent questions to the group (Rosenshine, 2008). | |

| | |
|---|---|
| ☐ Group Responding. The teacher ensures full class participation and boosts levels of student attention by having all students respond in various ways (e.g., choral responding, response cards, white boards) to instructor questions (Rosenshine, 2008). | |
| ☐ High Rate of Student Success. The teacher verifies that students are experiencing at least 80% success in the lesson content to shape their learning in the desired direction and to maintain student motivation and engagement (Gettinger & Seibert, 2002). | |
| ☐ Brisk Rate of Instruction. The lesson moves at a brisk rate--sufficient to hold student attention (Carnine,1976; Gettinger & Seibert, 2002). | |
| ☐ Fix-Up Strategies. Students are taught fix-up strategies (Rosenshine, 2008) for use during independent work (e.g., for defining unknown words in reading assignments, for solving challenging math word problems). | |

| 3. Give Timely Performance Feedback | |
|---|---|
| Instructional Element | Notes |
| ☐ Regular Feedback. The teacher provides timely and regular performance feedback and corrections throughout the lesson as needed to guide student learning (Burns, VanDerHeyden, & Boice). | |
| ☐ Step-by-Step Checklists. For multi-step cognitive strategies, the teacher creates checklists for students to use to self-monitor performance (Rosenshine, 2008). | |

| 4. Provide Opportunities for Review & Practice | |
|---|---|
| Instructional Element | Notes |
| ☐ Spacing of Practice Throughout Lesson. The lesson includes practice activities spaced throughout the lesson. (e.g., through teacher demonstration; then group practice with teacher supervision and feedback; then independent, individual student practice) (Burns, VanDerHeyden, & Boice). | |
| ☐ Guided Practice. When teaching challenging material, the teacher provides immediate corrective feedback to each student response. When the instructor anticipates the possibility of an incorrect response, that teacher forestalls student error through use of cues, prompts, or hints. The teacher also tracks student responding and ensures sufficient success during supervised lessons before having students practice the new skills or knowledge independently (Burns, VanDerHeyden, & Boice, 2008). | |
| ☐ Support for Independent Practice. The teacher ensures that students have adequate support (e.g., clear and explicit instructions; teacher monitoring) to be successful during independent seatwork practice activities (Rosenshine, 2008). | |
| ☐ Distributed Practice. The teacher reviews previously taught content one or more times over a period of several weeks or months (Pashler et al., 2007; Rosenshine & Stevens, 1995). | |

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# Motivating Students Through Collaboration: Numbered Heads Together

Description. Teacher questioning during whole-group instruction is a key method that instructors use to monitor student understanding of content. Ideally, instructors should use a mix of closed-response queries (i.e., limited number of correct responses) and open-response questions (i.e., wide range of acceptable answers, opinions, or judgments). Students should also be given sufficient wait-time to formulate an adequate answer, and the teacher should provide targeted performance feedback (Maheady et al., 2006). Numbered Heads Together is an instructional technique build upon peer collaboration that provides the supports and structure necessary to promote effective teacher questioning and student responding (Maheady et al., 2006). This technique can be useful for students with emotional/behavioral disorders (EBD) (Hunter & Haydon, 2013).

Procedure: During whole-group instruction, Numbered Heads Together is implemented using the following steps:

1. Create teams. The teacher divides the class into 4-person teams. Ideally, each team includes a mix of high, average, and low-achieving students. Students in each team assign themselves the numbers 1 through 4. (Note: If a team has only 3 members, one student takes two numbers: 3 and 4.)

2. State a question. The teacher poses separate queries to the class. After each question, the instructor tells students to *"put your heads together, think of the best answer you can, and make sure that everybody in your group knows that answer."*

3. Allow think-time. The teacher gives students 30 seconds to discuss an answer in their groups.

4. Elicit student responses. The teacher randomly selects a number from 1-4 and says, *"All number [1, 2, 3, or 4] students who know the answer, raise your hand."* The teacher then calls on one student with hand raised and asks him or her to give the answer. The teacher next says, *"How many [1, 2, 3, or 4] students think that that answer is correct? Raise your hand."* [Optional: The teacher can call on additional students with hand raised to elaborate on a previous student's answer.]

5. Give teacher feedback. Finally, the instructor gives feedback about the answer, e.g., verifying that it is correct, elaborating on the answer, providing corrective feedback for an incorrect response.

Tips for Use. Teachers may wish to create standing groups for Numbered Heads Together to allow for more rapid transition into student teams. Also, the instructor might post a checklist that reminds students of appropriate NHT behaviors and briefly review that checklist as a pre-correction strategy prior to moving into the NHT activity.

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# Helping Students to Retain Skills and Content: Classroom Ideas

Students who struggle with academic work often have difficulty with retention—the capacity to maintain a previously mastered skill or content over the long term with little or no additional practice. Retention of skills and content does not happen automatically but requires sustained work on the part of both teacher and student.

Below are teaching strategies that can lay the foundation for student retention in your classroom. NOTE: While these strategies can work effectively with individuals, they are even more effective when woven into whole-group instruction:

1. Use multiple direction formats. When directing students to complete a task, provide those directions through more than one format (Thorne, 2006). For example, the teacher may state directions aloud, provide a visual demonstration, and also give students a written summary of the steps to follow. When directions to perform a task or skill are delivered through several formats, they can be made more memorable and thus easier for a student to retain and recall as needed.

2. Encourage read-alouds. Research shows that when we read text aloud to ourselves, we retain more information than when we read the same text silently (Cox, n.d.). The act of reading combined with the act of *listening* to one's own reading increases attention and retention. Teachers can suggest to students that, when completing assigned readings, they read particularly challenging passages aloud to promote comprehension and retention. Or the student can read multi-step directions aloud before undertaking a difficult academic task.

3. Simplify learning with guides and organizers. Teachers can use various types of organizers to streamline tasks and allow learners to concentrate on the most important content to be memorized (Thorne, 2006). Handouts distributed prior to a lecture can highlight key concepts to be covered. Guided notes (copies of teacher notes with strategically located blanks into which students copy important terms) can reduce the cognitive load on learners and allow them to attend more closely to the lecture. More specialized organizers such as comparison/contrast charts prompt students to narrow their inquiry to a manageable scope and maintain attention. Or, in mathematics, a student may be given a 'sequence chart' that walks the learner through the steps to follow when solving a linear equation with one variable (Florida Department of Education, 2010).

4. Break tasks into checklists. Students tasked with memorizing a multi-step cognitive task can benefit from having the steps of that task converted into a printed checklist. Initially, the student may need to reference the checklist sequentially while completing steps of the task. That student can then gradually reduce dependence on the checklist in stages. For example, a student familiar with a 7-step checklist for solving math word problems (Montague & Dietz, 2009) may switch to reviewing the checklist once as a prompt at the start of a homework assignment and then relying on memory to implement the steps—with the eventual goal of memorizing the checklist completely.

5. Have students work collaboratively. The likelihood that skills will be retained increases when the learner reviews or practices those skills with full attention. Collaborative learning activities are naturally motivating and can help to boost student engagement (Cox, n.d.). For example, students who are taught a math problem-solving strategy can be partnered with a peer and use a structured format like Think-Pair-Share (Rasinkski & Padak, 1996). to apply the strategy to a particular problem. (In Think-Pair-Share, students are first directed by the teacher to 'think' about a problem or task or question, then to 'pair' off with another student and 'share' their thinking. The instructor then directs a whole-group discussion to explore students' shared thinking.).

6. Activate prior knowledge. Learners' capacity to retain newly taught skills or content increases when they are able to *link* that new material to what they already know (Cox, n.d.). So, as teachers prepare lessons, they can promote retention of the novel instruction by explicitly activating students' prior knowledge of the topic.

   The 3-column KWL chart is one classroom method that illustrates how to activate prior knowledge to support retention. Before completing a reading or other learning activity, the student fills out column 1: *What I KNOW about this topic.* The student next fills out column 2: *What I WANT to know more about this topic*. After completing the reading or other learning activity, the student fills out column 3: *What I have LEARNED about this topic*.

7. Use memory tricks. An effective approach to improve retention relies is to teach students explicit strategies for memorization and recall (mnemonics) (Brigham & Brigham, 2001).

   One memory trick is to use an acrostic, an easy-to-remember word whose letters each signify an element or step to be memorized. For example, students in algebra can acquire a useful sequence for multiplying 2 binomials—e.g., (a+b)*(c+d)—by memorizing the word 'FOIL' (Wyzant, n.d.), whose letters are linked to specific prompts. FOIL directs the student to complete multiplication in this sequence: multiply the (1) First terms—*ac*; (2) Outer terms—*ad*; (3) Inner terms—*bc*; (4) Last terms—*bd*.

   A related memory trick is to create a sentence whose words each evoke a fact, concept, or activity sequence. For example, the sentence *Please Excuse My Dear Aunt Sally* (Florida Department of Education, 2010) prompts the student to follow this order of operations when solving math equations: Parentheses, Exponents, Multiplication, Division, Addition, Subtraction.

8. Employ summarization activities. Students sometimes have difficulty retaining information from informational passages because they cannot identify the most important facts for recall. In short, they can be overwhelmed by information. Any activity requiring the student to summarize and reflect on their reading can help the learner to winnow the content and increase the odds that they will retain the essentials of the passage. Examples of effective summarization activities include having a student write or dictate a brief 'retell' just after reading (Schisler et al., 2010) and directing the reader to write a summary (main idea and 2 supporting details) for each paragraph in a passage (Hagaman, Casey, & Reid, 2010).

9. 'Overlearn' the skill. A powerful method for skill retention is to have the student 'overlearn' it through frequent practice (Martens & Witt, 2004). With overlearning, the teacher sets a skill-proficiency goal for the student (e.g., math-fact fluency) that is actually higher than required for classroom success. When the student reaches this ambitious goal, he or she is more likely to retain the skill over the long term.

10. Practice memory retrieval. Retention includes the ability to retrieve memorized content or skills on demand. Like any other ability, retrieval of information from memory improves with practice (Thorne, 2006). Even better, each time that students successfully recall information, they can access it more easily in the future (Weinstein & Wu, 2009). One strategy to promote retrieval is for teachers to give frequent quizzes –rather than infrequent longer exams—to allow students more opportunities to try out their retrieval strategies (Weinstein & Wu, 2009). Another option is for students to begin the class each day with a bell-ringer activity in which they complete several short-answer questions that tap recently learned information (Weinstein & Wu, 2009).

11. Maintain skills through occasional ('distributed') practice. After the student has committed skills or content to long-term memory, the teacher's work is still not done. All of us experience 'memory decay', the gradual

forgetting of memorized content that we do not review or use over extended periods of time (Pashler et al., 2007). Teachers can guard against this predictable threat to retention of information through use of 'distributed practice'. This term simply means that the teacher periodically (e.g., at intervals of 4-12 weeks) has students engage in practice activities that require the recall and application of the information or skills that the instructor wishes to maintain.

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# How To: Define Academic Problems: The First Step in Effective Intervention Planning

Students who struggle with academic deficits do not do so in isolation. Their difficulties are played out in the larger context of the school environment and curriculum—and represent a 'mismatch' between the characteristics of the student and the instructional demands of the classroom (Foorman & Torgesen, 2001).

It may surprise educators to learn that the problem-identification step is the most critical for matching the student to an effective intervention (Bergan, 1995). Problem identification statements should be defined in clear and specific terms sufficient to pass 'the stranger test' (Howell, Hosp, & Kurns, 2008). That is, the student problem can be judged as adequately defined if a person with no background knowledge of the case and equipped only with the problem-identification statement can observe the student in the academic setting and know with confidence when the problem behavior is displayed and when it is not.

Here are recommendations for increasing teacher capacity to describe student academic problems in specific terms, and generate a hypothesis about why the problem is occurring.

1. Describe the academic problem in specific, skill-based terms with a meaningful instructional context (Batsche et al., 2008; Upah, 2008). Write a clear, brief description of the academic skill or performance deficit that focuses on a specific skill or performance area. Include information about the conditions under which the academic problem is observed and typical or expected level of performance.

   - *Conditions*. Describe the environmental conditions or task demands in place when the academic problem is observed.
   - *Problem Description*. Describe the actual observable academic behavior with which the student has difficulty. If available, include specifics about student performance, such as rate of work, accuracy, or other relevant quantitative information.
   - *Typical or Expected Level of Performance*. Provide a typical or expected performance criterion for this skill or behavior. Typical or expected academic performance can be calculated using a variety of sources, such as benchmark norms, local (classroom) norms, or expert opinion.

| Math-Related Problems: Sample Definitions | | |
|---|---|---|
| Environmental Conditions or Task Demands | Problem Description | Typical or Expected Level of Performance |
| When shown flashcards with multiplication math facts 0 to 12 for 3 seconds | Annika can answer 57 of 169 correctly | while most peers in her class can name all facts correctly. |
| When completing a beginning-level algebra word problem | Dennis is unable to translate that word problem into an equation with 1 variable | although this is a prerequisite skill for the course. |
| Given a 2-term addition or subtraction problem with proper fractions | Franklin (grade 7) cannot correctly solve | although this skill is a Grade 5 Common Core Learning Standard. |
| On math homework | Neda attempts approximately 60 % of assigned items | while peers typically attempt 90% or more of items. |

2. Select a hypothesis to explain the academic skill or performance problem. The hypothesis states the assumed reason(s) or cause(s) for the student's academic problems. Once selected, the hypothesis acts as a compass needle, pointing toward interventions that most logically address the student academic problems.

Listed below are common reasons for academic problems. Note that occasionally more than one hypothesis may apply to a particular student (e.g., a student may demonstrate a skill deficit as well as a pattern of escape/avoidance).

| Academic Problems: Possible Hypotheses & Recommendations | |
|---|---|
| Hypothesis | Recommendation |
| • *Skill Deficit.* The student has not yet acquired the skill(s). | Provide direct, explicit instruction to acquire the skill. Reinforce the student for effort and accuracy. |
| • *Fluency Deficit.* The student has acquired the skill(s) but is not yet proficient. | Provide opportunities for the student to practice the skill and give timely performance feedback. Reinforce the student for fluency as well as accuracy. |
| • *Generalization Deficit.* The student possesses the skill(s) but fails to use across appropriate situations or settings. | • Enlist adults to prompt and remind the student to use the target skills when needed.<br>• Train the student to identify relevant characteristics of situations or settings when the skill should be used—and to self-monitor skill use.<br>• Provide incentives (e.g., praise, rewards) for the student to use the skill in the appropriate settings. |
| • *Learned Helplessness.* The student lacks confidence to undertake the academic task. He or she also may seek to escape or avoid that task. | • Adjust the work to the student's ability level.<br>• Use scaffolding and accommodation strategies to make the academic work more manageable, e.g., breaking larger tasks into smaller increments ("chunking"), allowing the student to take brief breaks during work sessions, etc.<br>• Communicate using techniques to instill a sense of optimism and to engage the student (e.g., growth-mindset and wise-feedback statements). |

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# How To: Create a Written Record of Classroom Interventions

When general-education students begin to struggle with academic or behavioral issues, the classroom teacher will typically select and implement one or more evidence-based intervention strategies to assist those students. But a strong intervention plan needs more than just well-chosen interventions. It also requires 4 additional components (Witt, VanDerHeyden, & Gilbertson, 2004): (1) student concerns should be clearly and specifically defined; (2) one or more methods of formative assessment should be used to track the effectiveness of the intervention; (3) baseline student data should be collected prior to the intervention; and (4) a goal for student improvement should be calculated before the start of the intervention to judge whether that intervention is ultimately successful. If a single one of these essential 4 components is missing, the intervention is to be judged as fatally flawed (Witt, VanDerHeyden, & Gilbertson, 2004) and as not meeting minimum Response to Intervention standards.

Teachers need a standard format to use in documenting their classroom intervention plans. The *Classroom Intervention Planning Sheet* that appears later in this article is designed to include all of the essential documentation elements of an effective intervention plan. The form includes space to document:

- *Case information*. In this first section of the form, the teacher notes general information, such as the name of the target student, the adult(s) responsible for carrying out the intervention, the date the intervention plan is being created, the expected start and end dates for the intervention plan, and the total number of instructional weeks that the intervention will be in place. Most importantly, this section includes a description of the student problem; research shows that the most significant step in selecting an effective classroom intervention is to correctly identify the target student concern(s) in clear, specific, measureable terms (Bergan, 1995).
- *Intervention.* The teacher describes the evidence-based intervention(s) that will be used to address the identified student concern(s). As a shortcut, the instructor can simply write the intervention name in this section and attach a more detailed intervention script/description to the intervention plan.
- *Materials.* The teacher lists any materials (e.g., flashcards, wordlists, worksheets) or other resources (e.g., Internet-connected computer) necessary for the intervention.
- *Training.* If adults and/or the target student require any training prior to the intervention, the teacher records those training needs in this section of the form.
- *Progress-Monitoring.* The teacher selects a method to monitor student progress during the intervention. For the method selected, the instructor records what type of data is to be used, collects and enters student baseline (starting-point) information, calculates an intervention outcome goal, and notes how frequently he or she plans to monitor the intervention.

A completed example of the *Classroom Intervention Planning Sheet* that includes a math computation intervention can be found later in this article.

While a simple intervention documentation form is a helpful planning tool, schools should remember that teachers will need other resources and types of assistance as well to be successful in selecting and using classroom interventions. For example, teachers should have access to an 'intervention menu' that contains evidence-based strategies to address the most common academic and behavioral concerns and should be able to get coaching support as they learn how to implement new classroom intervention ideas.

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# Classroom Intervention Planning Sheet

This worksheet is designed to help teachers to quickly create classroom plans for academic and behavioral interventions.

## Case Information

What to Write: Record the important case information, including student, person delivering the intervention, date of plan, start and end dates for the intervention plan, and the total number of instructional weeks that the intervention will run.

| | | | | | |
|---|---|---|---|---|---|
| Student: | | Interventionist(s): | | Date Intervention Plan Was Written: | |
| Date Intervention is to Start: | | Date Intervention is to End: | | Total Number of Intervention Weeks: | |
| Description of the Student Problem: | | | | | |

## Intervention

What to Write: Write a brief description of the intervention(s) to be used with this student. TIP: If you have a script for this intervention, you can just write its name here and attach the script to this sheet.

## Materials

What to Write: Jot down materials (e.g., flashcards) or resources (e.g., Internet-connected computer) needed to carry out this intervention.

## Training

What to Write: Note what training--if any--is needed to prepare adult(s) and/or the student to carry out the intervention.

## Progress-Monitoring

What to Write: Select a method to monitor student progress on this intervention. For the method selected, record what type of data is to be used, enter student baseline (starting-point) information, calculate an intervention outcome goal, and note how frequently you plan to monitor the intervention. Tip: Several ideas for classroom data collection appear on the right side of this table.

| Type of Data Used to Monitor: | |
|---|---|
| Baseline | Outcome Goal |
| | |
| How often will data be collected? (e.g., daily, every other day, weekly): | |

Ideas for Intervention Progress-Monitoring

- Existing data: grades, homework logs, etc.
- Cumulative mastery log
- Rubric
- Curriculum-based measurement
- Behavior report card
- Behavior checklist

# Classroom Intervention Planning Sheet: Math Computation Example

This worksheet is designed to help teachers to quickly create classroom plans for academic and behavioral interventions.

## Case Information

What to Write: Record the important case information, including student, person delivering the intervention, date of plan, start and end dates for the intervention plan, and the total number of instructional weeks that the intervention will run.

| | | | | | |
|---|---|---|---|---|---|
| Student: | *John Samuelson-Gr 4* | Interventionist(s): | *Mrs. Kennedy, classroom teacher* | Date Intervention Plan Was Written: | *10 October 2012* |
| Date Intervention is to Start: | *M 8 Oct 2012* | Date Intervention is to End: | *F 16 Nov 2012* | Total Number of Intervention Weeks: | *6 weeks* |
| Description of the Student Problem: | *Slow math computation speed (computes multiplication facts at 12 correct digits in 2 minutes, when typical gr 4 peers compute at least 24 correct digits).* | | | | |

## Intervention

What to Write: Write a brief description of the intervention(s) to be used with this student. TIP: If you have a script for this intervention, you can just write its name here and attach the script to this sheet.

*Math Computation Time Drill.(Rhymer et al., 2002)*

*Explicit time-drills are a method to boost students' rate of responding on arithmetic-fact worksheets: (1) The teacher hands out the worksheet. Students are instructed that they will have 3 minutes to work on problems on the sheet. (2) The teacher starts the stop watch and tells the students to start work. (3) 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. (4) This process is repeated at the end of minutes 2 and 3. (5) At the conclusion of the 3 minutes, the teacher collects the student worksheets.*

## Materials

What to Write: Jot down materials (e.g., flashcards) or resources (e.g., Internet-connected computer) needed to carry out this intervention.

*Use math worksheet generator on www.interventioncentral.org to create all time-drill and assessment materials.*

## Training

What to Write: Note what training--if any--is needed to prepare adult(s) and/or the student to carry out the intervention.

*Meet with the student at least once before the intervention to familiarize with the time-drill technique and timed math computation assessments.*

## Progress-Monitoring

What to Write: Select a method to monitor student progress on this intervention. For the method selected, record what type of data is to be used, enter student baseline (starting-point) information, calculate an intervention outcome goal, and note how frequently you plan to monitor the intervention. Tip: Several ideas for classroom data collection appear on the right side of this table.

Type of Data Used to Monitor: *Curriculum-based measurement: math computation assessments: 2 minute single-skill probes*

| Baseline | Outcome Goal |
|---|---|
| *12 correct digits per 2 minute probe* | *24 correct digits per 2 minute probe* |

How often will data be collected? (e.g., daily, every other day, weekly):
*WEEKLY*

<u>Ideas for Intervention Progress-Monitoring</u>

- Existing data: grades, homework logs, etc.
- Cumulative mastery log
- Rubric
- Curriculum-based measurement
- Behavior report card
- Behavior checklist

# 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<br>• Not yet able to perform learning task reliably or with high level of accuracy | • Teacher actively demonstrates target skill<br>• Teacher uses 'think-aloud' strategy-- especially for thinking skills that are otherwise covert<br>• Student has models of correct performance to consult as needed (e.g., correctly completed math problems on board)<br>• Student gets feedback about correct performance<br>• 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<br>• Performs learning task slowly, haltingly | • Teacher structures learning activities to give student opportunity for active (observable) responding<br>• Student has frequent opportunities to *drill* (direct repetition of target skill) and *practice* (blending target skill with other skills to solve problems)<br>• Student gets feedback on *fluency* and *accuracy* of performance<br>• 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<br>• May fail to apply skill to new situations, settings<br>• 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.<br>• Student receives encouragement, praise, reinforcers for using skill in new settings, situations<br>• 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<br>• Teacher works with parents to identify tasks that the student can do outside of school to practice target skill<br>• 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<br>• Applies skill in novel situations, settings without prompting<br>• 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*)<br>• 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.<br>• Encourage student to set own goals for adapting skill to new and challenging situations. |

# *Math Interventions: Sampler*

| | Academic Intervention Strategies | Research Citations |
|---|---|---|
| ❑ | MATH: INSTRUCTION: PEER-GUIDED PAUSE. During large-group math lectures, teachers can help students to retain more instructional content by incorporating brief Peer Guided Pause sessions into lectures: (1) 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. (2) 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) currently being reviewed in the lecture. The sheet also contains several additional, similar problems that pairs of students must work cooperatively to complete, along with an answer key. (3) 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. (4) The teacher can direct student pairs to write their names on the practice sheets and collect the work as a convenient way to monitor student participation and understanding. | 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. |
| ❑ | MATH: ARITHMETIC FACTS: ACQUISITION: COVER-COPY-COMPARE. To memorize arithmetic facts, the student can be trained to independently use Cover-Copy-Compare: The student is given a worksheet with computation problems and answers appearing on the left side of the sheet, and the right side of the page left blank. The student is also given an index card. For each arithmetic-fact item, the student is directed (1) to study the correct arithmetic problem and answer on the left, (2) to cover the correct model with the index card, (3) from memory, to copy the arithmetic fact and answer onto the work space on the right side of the sheet, and (4) to compare the student version of the arithmetic fact and answer to the original model to ensure that it was copied correctly and completely. | Skinner, C. H., McLaughlin, T. F., & Logan, P. (1997). Cover, copy, and compare: A self-managed academic intervention effective across skills, students, and settings. Journal of Behavioral Education, 7, 295-306. |
| ❑ | MATH: ARITHMETIC FACTS: ACQUISITION: INCREMENTAL REHEARSAL. Incremental rehearsal is a useful strategy to help the student to acquire arithmetic facts. Sessions last 10-15 minutes. In preparation for this intervention, the teacher prepares a set of arithmetic-fact flashcards displaying equations but no answers. The teacher reviews all of the flashcards with the student. Flashcards that the student correctly answers within 2 seconds are sorted into a 'KNOWN' pile, while flashcards for which the student gives an incorrect answer or hesitates for longer than 2 seconds are sorted into the 'UNKNOWN' pile. During the intervention: (1) the teacher selects a card from the UNKNOWN pile (Card UK1), presents it to the student, reads off the arithmetic problem, and provides the answer (e.g., '4 x 8=32'). The student is then prompted to read the problem and give the correct answer (2) Next, the teacher selects a card from the KNOWN pile (Card K1) and adds it to the previously practiced card (UK1). In succession, the teacher shows the student the unknown (UK1) and the known (K1) card. The student has 2 seconds to provide an answer for each card. Whenever the student responds incorrectly or hesitates for longer than 2 | 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. |

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| | seconds, the teacher corrects student responses as needed and has the student state the correct response. (3) The teacher then selects a second card from the KNOWN pile (card K2) and adds it to the student stack--reviewing cards UK1, K1, and K2. (4) This incremental review process repeats until the student's flashcard stack comprises 10 cards: 1 unknown and 9 known. (5) At this point, the original unknown card (UK1) is now considered to be a 'known' card and is retained in the student's review-card stack. To make room for it, the last known card (K9) is removed, leaving 9 known cards in that student's stack. (6) The teacher then draws a new card from the UNKNOWN pile (card UK2) and repeats the incremental review process described above, each time adding known cards from the 9-card student stack in incremental fashion. | |
| ❑ | MATH COMPUTATION STRATEGY: ACQUISITION: STUDENT HIGHLIGHTING. Students who are inattentive or impulsive can improve their accuracy and fluency on math computation problems through student-performed highlighting. The student is given highlighters of several colors and a math computation sheet. Before completing the worksheet, the student is directed to color-code the problems on the sheet in a manner of his or her choosing (e.g., by level of difficulty, by math operation). The student then completes the highlighted worksheet. | Kercood, S., & Grskovic, J. A. (2009). The effects of highlighting on the math computation performance and off-task behavior of students with attention problems. Education and Treatment of Children, 32, 231-241. |
| ❑ | MATH: ARITHMETIC FACTS: FLUENCY: PERFORMANCE FEEDBACK & GOAL-SETTING. The student gets regular feedback about computation fluency and sets performance goals. In preparation for this intervention, the teacher decides on a fixed time limit for worksheet drills (e.g., 5 or 10 minutes) --with an equivalent worksheet to be prepared for each session. In each session, before the student begins the worksheet, (1) the teacher provides the student with feedback about the number of correct problems and errors on the most recent previous worksheet, and (2) the teacher and student agree on an improvement-goal for the current worksheet (e.g., to increase the number of correct problems by at least 2 and to reduce the errors by at least 1). Student performance on worksheets is charted at each session. | Codding, R. S., Baglici, S., Gottesman, D., Johnson, M., Kert, A. S., & LeBeouf, P. (2009).Selecting intervention strategies: Using brief experimental analysis for mathematics problems. Journal of Applied School Psychology, 25, 146-168. |
| ❑ | MATH: ARITHMETIC FACTS: FLUENCY: PROVIDE INCENTIVES. A student may benefit from incentives to increase fluency with math facts. BRIEF ANALYSIS: The teacher first conducts a brief experimental analysis to determine whether incentives will increase a particular student's performance: (1) The student is given a worksheet with arithmetic facts and allotted two minutes to complete as many items as possible. The student receives a point for each correct digit written on the worksheet. (2) The teacher next prepares an equivalent worksheet with different problems--but composed of the same type and number of problems. (3) Before administering the second worksheet, the teacher presents the student with a 'prize bag' with tangible items (e.g., markers, small toys) and perhaps edible items (e.g., packaged raisins, crackers, etc.). The student is told that if he/she can increase performance on the second worksheet by at least 30%, the student will earn a prize. The student is asked to select a preferred prize from the prize bag. (4) The student is given the second worksheet and works on it for 2 minutes. Again, the worksheet is scored for correct digits. (5) If the student meets the fluency goal, he/she receives the selected prize. If the student fails to meet the goal, he/she is given a sticker as a consolation prize. USE OF | Codding, R. S., Baglici, S., Gottesman, D., Johnson, M., Kert, A. S., & LeBeouf, P. (2009).Selecting intervention strategies: Using brief experimental analysis for mathematics problems. Journal of Applied School Psychology, 25, 146-168. |

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| | INCENTIVES: The teacher uses incentives only if the preceding brief analysis indicates that incentives are an effective motivator. For this intervention, the teacher decides on a fixed time limit for worksheet drills (e.g., 5 or 10 minutes) --with an equivalent worksheet to be prepared for each session. In each session, before the student begins the worksheet, (1) the student is asked to select a potential prize from the prize bag, (2) the student reviews his/her most recent previous worksheet score, and (3) the student and teacher set an improvement goal for the current worksheet (e.g., to exceed the previous score by at least 2 correct digits). If the student meets the goal, he/she is given the prize; if the student falls short, the teacher provides verbal encouragement and perhaps a sticker as a consolation prize. Student performance on worksheets is charted at each session. | |
| ❑ | MATH: ARITHMETIC FACTS: FLUENCY: TIME DRILLS. Explicit time-drills are a method to boost students' rate of responding on arithmetic-fact worksheets: (1) The teacher hands out the worksheet. Students are instructed that they will have 3 minutes to work on problems on the sheet. (2) The teacher starts the stop watch and tells the students to start work. (3) 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. (4) This process is repeated at the end of minutes 2 and 3. (5) At the conclusion of the 3 minutes, the teacher collects the student worksheets. | 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.<br><br>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. |
| ❑ | MATH: WORD PROBLEMS: ACQUISITION: USE WORKED EXAMPLES. Students acquiring math skills in the form of word-problems benefit from being given completed problems ('worked examples') to study. Teachers should observe these recommendations when formatting, teacher, and using worked examples as a student support: (1) FORMAT PROBLEM-SOLVING STEPS: the solution presented in the worked example should be broken down into discrete, labeled sub-steps/sub-goals corresponding to the appropriate process for solving the problem. (2) COMBINE TEXT AND GRAPHICS. If both text and visual elements appear in the worked example, they should be integrated into a single unitary display, if possible, rather than split into separate components--so as not to overwhelm the novice learner. (3) PAIR WORKED WITH UNWORKED EXAMPLES. Whenever the student is given a worked example to study, he or she should then immediately be presented with 1-2 similar examples to solve. | Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. Review of Educational Research, 70(2), 181-214. |
| ❑ | MATH: WORD PROBLEMS: METACOGNITION: PAIRING WORKED EXAMPLES WITH SELF-EXPLANATION. Students who can coach themselves through math problem-solving steps ('self-explanation') demonstrate increased conceptual understanding of the task. The | Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional |

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|---|---|---|
| | student should be explicitly coached to 'self-explain' each of the steps to be used in solving a particular type of problem--starting with completed problems ('worked examples') before advancing to unworked problems: (1) INTRODUCTION TO SELF-EXPLANATION. The teacher first explains the importance of self-explanation as a student math self-help skill. (2) TEACHER MODELING. Next, the teacher models self-explanation, applying the appropriate problem-solving steps to a worked example. (3) STUDENT MODELING WITH TEACHER FEEDBACK. The teacher then coaches the student's own self-explanation efforts, as the student moves through the steps of a second worked example. (4) INDEPENDENT STUDENT APPLICATION. When the student has successfully mastered the process, he or she is directed to use self-explanation during the problem-solving steps with any unworked problems. | principles from the worked examples research. Review of Educational Research, 70(2), 181-214.<br><br>Tajika, H., Nakatsu, N., Nozaki, H., Neumann, E., & Maruno, S. (2007). Self-explanation for solving mathematical word problems: Effects of self-explanation as a metacognitive strategy for solving mathematical word problems. Japanese Psychological Research, 49(3), 222-233. |
| ❑ | MATH: WORD PROBLEMS: STRATEGY: DRAW THE PROBLEM. The student can clarify understanding of a word problem by making a drawing of it before solving. To teach this strategy: (1) The teacher gives the student a worksheet containing at least six word problems. (2) The teacher explains to the student that making a picture of a word problem can make that problem clearer and easier to solve. (3) The teacher and student independently create drawings of each of the problems on the worksheet. (4) Next, the student shows his or her drawings for each problem while explaining each drawing and how it relates to the word problem. (5) The teacher also participates, explaining his or her drawings to the student. (6) The student is then directed to 'draw the problem' whenever solving challenging word problems. | Van Garderen, D. (2006). Spatial visualization, visual imagery, and mathematical problem solving of students with varying abilities. Journal of Learning Disabilities, 39, 496-506. |
| ❑ | MATH: WORD PROBLEMS: STRATEGY: 4-STEP PLANNING PROCESS. The student can consistently perform better on applied math problems when following this efficient 4-step plan: (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. | Pólya, G. (1957). How to solve it (2nd ed.). Princeton University Press: Princeton, N.J.<br><br>Williams, K. M. (2003). Writing about the problem solving process to improve problem-solving performance. Mathematics Teacher, 96(3), 185-187. |

# How To: Use Accommodations With General-Education Students: Teacher Guidelines

Classrooms in most schools look pretty much alike, with students sitting at rows of desks attending (more or less) to teacher instruction. But a teacher facing any class knows that behind that group of attentive student faces lies a kaleidoscope of differences in academic, social, self-management, and language skills. For example, recent national test results indicate that well over half of elementary and middle-school students have not yet attained proficiency in mathematics (NAEP, 20011a) or reading (NAEP 2011b). Furthermore, 1 in 10 students now attending American schools is an English Language Learner (Institute of Education Sciences, 2012) who must grapple with the complexities of language acquisition in addition to the demands of academic coursework.

Teachers can increase the chances for academic success by weaving into their instructional routine an appropriate array of classwide curricular accommodations made available to any general-education student who needs them (Kern, Bambara, & Fogt, 2002). However, teachers also know that they must strike an appropriate balance: while accommodations have the potential to help struggling learners to more fully engage in demanding academics, they should not compromise learning by holding a general-education student who accesses them to a lesser performance standard than the rest of the class. After all, students with academic deficits must actually *accelerate* learning to close the skill-gap with peers, so allowing them to do less is simply not a realistic option.

Read on for guidelines on how to select classroom accommodations to promote school success, verify whether a student actually *needs* a particular accommodation, and judge when accommodations should be used in instruction even if not allowed on state tests.

Identifying Appropriate Accommodations: Access vs. Target Skills. As an aid in determining whether a particular accommodation both supports individual student differences and sustains a demanding academic environment, teachers should distinguish between *target* and *access* skills (Tindal, Daesik, & Ketterlin, 2008). *Target skills* are those academic skills that the teacher is actively trying to assess or to teach. Target skills are therefore 'non-negotiable'; the teacher must ensure that these skills are not compromised in the instruction or assessment of any general-education student. For example, a 4th-grade teacher sets as a target skill for his class the development of computational fluency in basic multiplication facts. To work toward this goal, the teacher has his class complete a worksheet of 20 computation problems under timed conditions. This teacher would not allow a typical student who struggles with computation to do fewer than the assigned 20 problems, as this change would undermine the target skill of computational fluency that is the purpose of the assignment.

In contrast*, access skills* are those needed for the student to take part in a class assessment or instructional activity but are not themselves the target of current assessment or instruction. Access skills, therefore, *can* be the focus of accommodations, as altering them may remove a barrier to student participation but will not compromise the academic rigor of classroom activities. For example, a 7th-grade teacher assigns a 5-paragraph essay as an in-class writing assignment. She notes that one student finds the access skill of handwriting to be difficult and aversive, so she instead allows that student the accommodation of writing his essay on a classroom desktop computer. While the access skill (method of text production) is altered, the teacher preserves the integrity of those elements of the assignment that directly address the target skill (i.e., the student must still produce a full 5-paragraph essay).

Matching Accommodations to Students: Look for the 'Differential Boost'. The first principle in using accommodations in general-education classrooms, then, is that they should address access rather than target

academic skills. However, teachers may also wish to identify whether an individual actually benefits from a particular accommodation strategy. A useful tool to investigate this question is the 'differential boost' test (Tindal & Fuchs, 1999). The teacher examines a student's performance both with and without the accommodation and asks these 2 questions: (1) Does the student perform significantly better *with* the accommodation than without?, and (2) Does the accommodation boost that particular student's performance substantially *beyond* what could be expected if it were given to all students in the class? If the answer to both questions is YES, there is clear evidence that this student receives a 'differential boost' from the accommodation and that this benefit can be explained as a unique rather than universal response. With such evidence in hand, the teacher should feel confident that the accommodation is an appropriate match for the student. (Of course, if a teacher observes that most or all of a class seems to benefit from a particular accommodation idea, the best course is probably to revise the assignment or assessment activity to incorporate the accommodation!)

For example, a teacher may routinely allocate 20 minutes for her class to complete an in-class writing assignment and finds that all but one of her students are able to complete the assignment adequately within that time. She therefore allows this one student 10 minutes of additional time for the assignment and discovers that his work is markedly better with this accommodation. The evidence shows that, in contrast to peers, the student gains a clear 'differential boost' from the accommodation of extended time because (1) his writing product is substantially improved when using it, while (2) few if any other students appear to need it.

Classroom Accommodations and State Tests: To Allow or Not to Allow? Teachers may sometimes be reluctant to allow a student to access classroom accommodations if the student cannot use those same accommodations on high-stakes state assessments (TIndal & Fuchs, 1999). This view is understandable; teachers do not want students to become dependent on accommodations only to have those accommodations yanked away at precisely the moment when the student needs them most. While the teacher must be the ultimate judge, however, there are 3 good reasons to consider allowing a general-education student to access accommodations in the classroom that will be off-limits during state testing.

1. *Accommodations can uncover 'academic blockers'.* The teacher who is able to identify which student access skills may require instructional accommodations is also in a good position to provide interventions proactively to strengthen those deficient access skills. For example, an instructor might note that a student does poorly on math word problems because that student has limited reading decoding skills. While the teacher may match the student to a peer who reads the word problems aloud (texts read) as a classroom accommodation, the teacher and school can also focus on improving that student's decoding skills so that she can complete similar math problems independently when taking the next state examinations.

2. *Accommodations can promote content knowledge.* Students who receive in-class accommodations are likely to increase their skills and knowledge in the course or subject content substantially beyond the level to be expected without such supports. It stands to reason that individuals whose academic skills have been strengthened through the right mix of classroom accommodations will come to the state tests with greater mastery of the content on which they are to be tested.

3. *Accommodations can build self-confidence.* When students receive classroom accommodations, they are empowered to better understand their unique pattern of learning strengths and weaknesses and the strategies that work best for them. Self-knowledge can build self-confidence. And not only are such students primed to advocate for their own educational needs; they are also well-placed to develop compensatory strategies to manage difficult, high-stakes academic situations where support is minimal--such as on state tests.

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# Mindsets: The Power to Help or Hinder Student Motivation

Motivation is central to student academic achievement. And research shows that there is one crucial factor that greatly impacts academic engagement and performance: whether a student has a 'fixed' or 'open' mindset (Dweck, 2006). Students with a *fixed mindset* view intelligence, or general ability, as having a fixed upward limit. Viewed from this perspective, accomplishments are explained largely by one's intellectual potential, with effort playing only a minor role. In contrast, students with a *growth mindset* see intelligence as 'malleable': they have faith that increased effort will result in more effective learning and accomplishment. When growth-mindset learners are challenged by academic tasks, they interpret these struggles as "an opportunity for growth, not a sign that a student is incapable of learning" (Paunesku et al., 2015; p. 785).

Why should teachers be concerned about students having a fixed mindset? When such students encounter difficulty or setbacks, they are likely to respond by becoming discouraged, withdrawing effort, or even giving up entirely. Of even more concern, a fixed mindset can result in learners 'disidentifying' with (i.e., disengaging from) those academic subjects or tasks that they find difficult. Research indicates that rates of cheating may also be higher among students with a fixed mindset (Blackwell, Trzesniewski & Dweck, 2007).

Yet students with a growth mindset have a much more positive reaction to setbacks. When they experience difficulty with schoolwork, they respond by viewing the setback as an opportunity to learn, putting more effort into mastering the task, and analyzing where their work or study processes fall short and correcting them. It's no surprise, then, that--because growth-mindset learners remain optimistic and engaged in the challenging task-- they are likely to be successful (Blackwell, Trzesniewski & Dweck, 2007).

Teachers have an important role to play in promoting a growth mindset among their students. First and foremost, instructors should take care not to use statements in their classrooms that reinforce a fixed-mindset. For example, a teacher who says "Excellent essay, Rebecca. You are a natural-born writer!" is implying that writing is an innate talent, immune to skill-building. Similarly, when an instructor responds to the student with a poor math-test grade, "That's OK. Not everyone is good at math", the educator has suggested that "math ability" is a fixed quantity that cannot expand much despite the learner's efforts.

On the other hand, when instructors structure their statements of praise, process feedback, and encouragement to reflect a growth-mindset attitude, even learners with a habitual negative fixed-mindset attitude can receive a boost of optimism and motivation. 'Growth mindset' statements can be as varied as the educators, students, and situations they address. However, they typically:

- lay out a specific process for moving forward.
- recognize difficulties or struggles to be faced and frame them as opportunities to learn.
- convey optimism that the student can and will move toward success if the learner puts in sufficient effort, follows the recommended process, and makes appropriate use of any 'help' resources.

In their day-to-day communication with students, instructors have many opportunities to craft statements according to growth-mindset principles. Below is a sampling of statements--praise, work-prompts, encouragement, introducing of assignments-- that teachers can use to foster motivation in their classrooms:

## Praise

Effective teacher praise has two elements: (1) a description of noteworthy student academic performance or general behavior, and (2) a signal of teacher (Hawkins & Hellin, 2011). Because this 'process praise' ties performance directly to effort, it reinforces a growth mindset in students who receive it. Here is an example of process praise:

*"Your writing is improving a lot. The extra time you put in and your use of an outline has really paid off."*

### Work-Prompt

When students stop working during an independent assignment, the teacher can structure the "get-back-to-work" prompt to follow a growth-mindset format. An example of such a work prompt is:

*"Sarah, please keep reading....you still have 10 minutes to work on the assignment. It's a challenging passage, so if you get stuck, be sure to use your reading fix-up skills. Remember, it's also OK to ask a neighbor or to come to me for help. Use your strategies and you WILL be successful!"*

Note in this example how the teacher directs the student to resume the assignment, acknowledges the challenging nature of the work, reminds her to use her fix-up strategies and that she has the option to seek peer and teacher assistance, and ends by linking effort to a positive outcome.

### Encouragement

Students can become discouraged if they are unsuccessful on an academic task or receive a low test or quiz grade. The teacher can respond with empathy, while also framing the situation as a learning opportunity, describing proactive steps to improve the situation, and expressing confidence in the learner. An example of growth-mindset encouragement is:

*"I can see that you didn't do as well on this math test as you had hoped, Luis. Let's review ideas to help you to prepare for the next exam. If you are willing to put in the work, I know that you can raise your score."*

### Introducing Assignments

The teacher can make assignment directions motivating by giving them a growth-mindset spin--describing the challenge(s), offering a realistic appraisal of the effort that will be required, reminding learners of the strategies or steps to apply, and closing with a confident statement tying methodical effort to success. Here is an example:

*"You should plan spend at least an hour on tonight's math homework. When you start the assignment, some problems might look like they are too difficult to solve. But if you give it your best and follow your problem-solving checklist, you should be able to answer them."*

**Closing Thoughts: Use Growth-Mindset Statements Frequently.** Instructors who want to attain the full motivational benefit of growth-mindset statements should ensure that they use those statements often to promote an optimistic 'can-do' climate. In busy classrooms, teachers may feel so pressed to cover the demanding curriculum that they overlook the need to use growth-mindset statements as a daily motivational tool. They wrongly assume that all students are already adequately motivated to do the expected work. In fact, though, many learners have fallen into a pattern of 'learned helplessness' and choose to withdraw in the face of challenging academics (Sutherland & Singh, 2004).

But the right teacher communication, if sustained, can motivate even students with negative, fixed mindsets to apply their best effort on an assignment or test . Yet research shows that process-praise is often dramatically *underused* in both general- and special-education classrooms--even though it is a prime means of shifting students toward an optimistic view of themselves as learner (Brophy, 1981; Hawkins & Heflin, 2011; Kern, 2007). So, as their own optimistic goal, teachers should adopt the regular use of a variety of growth-mindset statements to promote student achievement.

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# How to Help Students Accept Constructive Criticism: 'Wise' Feedback

Teachers of middle and high school students know that these learners sometimes require pointed critical feedback on academic assignments to shape their learning. The *reason* that most instructors put substantial effort into providing often-detailed performance feedback is clear: to benefit the student. But many students—particularly those at risk of academic underperformance or failure—may instead misinterpret critical instructional feedback as a sign that the teacher lacks confidence in and is negatively biased toward the learner.

A factor that can contribute to students' negatively skewed view of instructional feedback is that it is often ambiguous, presented without an explicit context for understanding the intention behind it. This ambiguity leaves learners free to impose their own interpretations—for example, regarding a teacher's written or verbal feedback about an assignment as a sign either of caring and commitment or a curt dismissal of the student's abilities (Yeager et al., 2013). And, in fact, there is evidence that a tendency to construe teacher feedback in a negative light is more common among those students already sensitive to being stereotyped because of social characteristics such as race, gender, or economic class (Cohen, Steele, & Ross, 1999; Yeager et al., 2013). An African-American student, for example, might interpret a White teacher's written feedback on how to improve her research-paper draft as picky, unfair, and driven by racial bias rather than as representing a genuine desire to help the learner advance her writing skills. As a result, the student fails to heed and apply that adult feedback.

Wise Feedback: Supplying a Proactive, Empowering Explanation. Teachers can reduce the tendency of at-risk students to discount evaluative statements as biased by formatting those statements as 'wise' feedback (Cohen, Steele, & Ross, 1999; Yeager et al., 2013). The teacher structures written or verbal feedback to include these 3 elements:

- *Feedback description.* The teacher describes the nature of the feedback being offered.
- *High standards.* The teacher emphasizes and explains the high standards used to evaluate the student work and generate the instructional feedback.
- *Assurance of student ability.* The teacher states explicitly that the student has the skills necessary to successfully meet those standards.

The wise-feedback strategy appears deceptively simple but is powerful in application. Wise feedback prevents the student from misconstruing teacher comments as negatively biased by proactively offering an alternative, positive explanation: the teacher is giving detailed, ambitious feedback because the standards of the course are high and the teacher is confident that the student has the skills and motivation to meet them.

Wise Feedback: Examples. Here are 3 examples of teacher critical feedback formatted as 'wise' feedback:

| Wise Feedback: Example 1: Research Paper with Written Feedback | |
|---|---|
| Feedback description | *Your paper met the basic expectations of the assignment but needs work. Please look over my comments.* |
| High standards | *You will see that I give detailed, critical feedback. This course sets the expectation that you will take your writing to a level suitable for college work.* |
| Assurance of student ability | *Your past assignments have shown me that you have the skills and motivation to use my feedback to revise and improve your paper.* |

| Wise Feedback: Example 2: PowerPoint Presentation with Oral Feedback | |
|---|---|
| Feedback description | *Review the attached rubric and my notes evaluating your recent science PowerPoint presentation.* |
| High standards | *This PowerPoint is an adequate starting point, but can be made better. Remember* |

| | |
|---|---|
| | *the goal for this assignment is to create a presentation that showcases your communication skills to a potential employer.* |
| Assurance of student ability | *I know from examples in your work portfolio and contributions to class discussion that you will be able to implement my suggestions and increase the quality and persuasiveness of your PowerPoint.* |

| Wise Feedback: Example 3: Math Diagnostic Test with Oral Feedback: Whole Class | |
|---|---|
| High standards | *By grade 7, students are expected to have fully mastered all math concepts and operations taught in the earlier grades.* |
| Feedback description | *Look over this diagnostic math test that you took last week. You will see that I have written a number of comments highlighting where you made errors or failed to show or explain your work.* |
| Assurance of student ability | *I have looked at the recent math work of everyone in this class—and know that you all have the skills to be strong math students. My comments will point you to those skills that you should review and practice to ensure success in this course.* |

Wise Feedback: Additional Considerations. Like all teacher communication tools, wise feedback has constraints attached to its use:

- *Do not pair grades with wise feedback.* When possible, teachers should avoid attaching grades to any student work that contains wise feedback. Students tend to view a summative number or letter grade as the 'real' evaluation of an assignment and are therefore likely to ignore comments that accompany them (Yeager et al., 2013). So grades can 'short-circuit' the positive impact of wise feedback. The reality, however, is that the assignment of grades is usually unavoidable in course work. One strategy to keep wise-feedback and grading separate on an assignment is to return the first draft of the assignment ungraded with wise feedback. The student is then directed to use the feedback to revise the assignment and submit for a grade.

- *Make student feedback 'ambitious'*. In an attempt to bond with unmotivated students, the teacher may commit the errors of over-praising them for mediocre work or providing only easy suggestions for improving the assignment. Either strategy sets a low bar for performance and can backfire. When students sense that instructors have limited expectations of them, they can feel patronized and stereotyped, lose motivation, and further withdraw effort from academic tasks (Yeager et al., 2013). Instead, the teacher should praise work that truly deserves it and offer thoughtful critical feedback that, relative to students' current abilities, taxes them to stretch and expand their skills in a meaningful way.

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# Classroom Data Tools: What Are They and What Can They Measure?

Teachers have a variety of tools that they can access to collect behavioral or academic information and monitor classroom interventions. This 'look-up' chart provides a review of the most common data sources and what they can measure:

| Data Tool | What It Is | What It Can Measure |
|---|---|---|
| Archival Data | Existing data routinely collected by schools that provides useful ongoing information about the student's academic or behavioral performance. | • Attendance<br>• Office disciplinary referrals<br>• Other aspects of behavior or academic performance captured in the school database |
| Behavior Report Cards | A teacher-created rating scale that measures student classroom behaviors. A behavior report card contains 3-4 rating items describing goal behaviors. Each item includes an appropriate rating scale (e.g., Poor-Fair-Good). At the end of an observation period, the rater fills out the report card as a summary snapshot of the student's behavior. | • General behaviors (e.g., complies with teacher requests; waits to be called on before responding)<br>• Academic 'enabling' behaviors (e.g., has all necessary work materials; writes down homework assignment correctly and completely, etc.) |
| Checklists | The dividing of a larger behavioral task or sequence into constituent steps, sub-skills, or components. Each checklist element is defined in a manner that allows the observer to make a clear judgment (e.g., YES/NO, COMPLETED/NOT COMPLETED) about whether the student is displaying it. | • Step-by-step cognitive strategies<br>• Behavioral routines<br>• Generalization: Target behavior carried out across settings |
| Cumulative Mastery Records | A cumulative record of the student's acquisition/mastery of a defined collection of academic items such as multiplication math facts. This record is updated after every intervention session. | • Any discrete collection of academic items to be mastered: e.g., vocabulary, math facts, spelling words, letter or number names |
| Curriculum-Based Measures/ Assessment | A series of brief measures of basic academic skills given under timed conditions and scored using standardized procedures. CBM/CBA measures often include research-derived benchmark norms to assist in evaluating the student's performance. | • Speed and accuracy in basic academic skills: e.g., letter naming, number naming, number sense, vocabulary, oral reading fluency, reading comprehension (maze), production of writing, math fact computation |
| Grades | Represent in letter or number form the teacher's formal, summary evaluation of the student's academic performance on an assignment, quiz, test, or longer span of evaluation. | • Homework grades<br>• Test grades<br>• Quarterly report card grades |
| Interviews | Guided by prompts or questions, the student periodically provides verbal feedback about | • Student routines outside of class (e.g., use of study hall time, homework regimen) |

| | | |
|---|---|---|
| | academic performance, conduct, or other relevant intervention targets.<br><br>Interviews are most effective when brief and consistent in format, with structured questions designed to elicit objective student responses. The interviewer can also reference specific instruments to focus questions: e.g., checklist, rubric, rating scale. | • Collecting covert information accessible only to the student (e.g., a learner's demonstration of ability to implement essential steps of a cognitive strategy) |
| Logs | Written adult or student entries that track the frequency (and perhaps additional details) of relevant academic performance and/or behaviors. | • Homework completion<br>• Incidents of non-compliance<br>• Student record of dates when he or she uses a self-guided academic intervention.<br>• Listing of student-teacher meetings. |
| Observation | Data on behavior or academic performance collected during direct observation of the student. The objectivity and consistency of data is often improved if the observer uses instruments to structure the observation: e.g., checklist, rubric, rating scale. | • Academic engagement<br>• Out of seat<br>• Any other observable behavior of interest |
| Rubrics | An instrument designed to measure a student on complex tasks.<br><br>In a rubric, the teacher defines the categories that make up the important dimensions of a task, develops written exemplars representing mastery for each dimension, and creates a rating scale to be used in evaluating a particular student's work for each dimension. | • Any complex, multi-dimensional task: e.g., participation in a discussion; writing a research paper; preparing and presenting a PowerPoint; completing and documenting a science lab project, etc. |
| Self-Monitoring | The student collects information about his or her own performance.<br><br>The objectivity and consistency of data collection increases if the self-monitoring student uses a structured instrument (e.g., behavior report card, rubric, checklist, etc.). | • Collecting data from settings outside of the classroom (e.g., self-monitoring homework routines)<br>• Monitoring covert information (e.g., student use of multi-step cognitive strategy to solve math problems) |
| Work Products | Student work that reflects performance on a series of similar in-class or homework assignments (e.g., successive writing assignments or ongoing math homework). A work product is selected because it can reflect growth in the intervention target skill(s). The element(s) of the work product being tracked can be objectively measures and converted to numeric data (e.g., percentage of problems completed). | • Work completion<br>• Work accuracy<br>• Written evidence of problem-solving steps<br>• Quality of student work (e.g., on writing assignments) |

# How To: Assess Mastery of Math Facts With CBM: Computation Fluency

Computation Fluency measures a student's accuracy and speed in completing 'math facts' using the basic number operations of addition, subtraction, multiplication, and division. Computation fluency in the elementary grades is a strong predictor of later success in higher-level math coursework (Gersten, Jordan, & Flojo, 2005).

For students to attain 'computational fluency', however, they must be both accurate and speedy in solving basic math facts--ideally through automatic recall (VanDerHeyden & Burns, 2008). In an influential report, the National Mathematics Advisory Panel (2008) stressed the need for students to become proficient in math facts, calling on schools to make it a priority to "develop automatic recall of addition and related subtraction facts, and of multiplication and related division facts." (p. xix).

The Common Core Standards also recognize the importance of computation fluency. For example, a 4th-grade math standard in Number and Operations in Base Ten (CCSM.4.NBT.4) states that the student will "fluently add and subtract multi-digit whole numbers using the standard algorithm" (National Governors Association Center for Best Practices et al., 2010; p. 29). However, the challenge for teachers is to define specifically what level of performance is required to identify a student as fluent in compuation.

CBM-Computation Fluency is a brief, timed assessment that can indicate to teachers whether a student is developing computation fluency and is thus on track to master grade-appropriate math facts (basic computation problems). This assessment can be administered to an individual student or to larger groups. The student is given a worksheet containing math facts and is given 2 minutes to answer as many problems as possible. The worksheet is then collected and scored, with the student receiving credit for each correct digit in his or her answers. Teachers can then compare any student's performance to research norms to determine whether that student is at risk because of delayed computational skills (Burns, VanDerHeyden, & Jiban, 2006).

Computation Fluency Measures: How to Access Resources. Teachers who would like to screen their students in grades 1 through 6 for possible delays in computation skills can obtain these free Computation Fluency assessment resources: (1) materials for assessment, (2) guidelines for administration and scoring, and (3) research-based norms.

- *Materials for assessment*. Schools can customize their own CBM Computation Fluency assessment materials at no cost, using the Math Worksheet Generator, a free online application: *http://www.interventioncentral.org/teacher-resources/math-work-sheet-generator*

  This program generates printable student and examiner assessment sheets for CBM Computation Fluency.

- *Guidelines for administration and scoring.* Instructions for preparing, administering, and scoring CBM-Computation Fluency assessments appear later in this document:

- *Research-based norms.* A table, *Curriculum-Based Measurement: Computation Fluency Norms* is included in this document. The table contains fluency benchmarks for grades 1-6, drawn from several research studies (e.g., Burns, VanDerHeyden, & Jiban, 2006).

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# Curriculum-Based Measurement-Computation Fluency: Guidelines for Use

## CBM-Computation Fluency: Description

CBM-Computation Fluency measures a student's accuracy and speed in completing 'math facts' using the basic number operations of addition, subtraction, multiplication, and division. CBM-Computation Fluency probes are 2-minute assessments of basic math facts that are scored for number of 'correct digits'.

There are 2 types of CBM math probes, single-skill worksheets (those containing like problems) and multiple-skill worksheets (those containing a mix of problems requiring different math operations). Single-skill probes give instructors good information about students' mastery of particular problem-types, while multiple-skill probes allow the teacher to test children's math competencies on a range of computational objectives during a single CBM session.

Both types of math probes can be administered either individually or to groups of students. The examiner hands the worksheet(s) out to those students selected for assessment. Next, the examiner reads aloud the directions for the worksheet. Then the signal is given to start, and students proceed to complete as many items as possible within 2 minutes. The examiner collects the worksheets at the end of the assessment for scoring.

Figure 1: A Sampling of Math Computational Goals for Addition, Subtraction, Multiplication, and Division (from Wright, 2002).

Addition
Two 1-digit numbers: sums to 10
Two 3-digit numbers: no regrouping
1- to 2-digit number plus 1- to 2-digit number: regrouping

Subtraction
Two 1-digit numbers: 0 to 9
2-digit number from a 2-digit number: no regrouping
2-digit number from a 2-digit number: regrouping

Multiplication
Multiplication facts: 0 to 9
2-digit number times 1-digit number: no regrouping
3-digit number times 1-digit number: regrouping

Division
Division facts: 0 to 9
2-digit number divided by 1-digit number: no remainder
2-digit number divided by 1-digit number: remainder

Wright, J. (2002) *Curriculum-Based Assessment Math Computation Probe Generator: Multiple-Skill Worksheets in Mixed Skills*. Retrieved from *http://www.interventioncentral.org/teacher-resources/math-work-sheet-generator*

## CBM-Computation Fluency: Materials

The following materials are needed to administer CBM-Computation Fluency:

- Student and examiner copies of CBM Computation Fluency Probes
- Stopwatch
- Pencils for students

## CBM-Computation Fluency: Preparation

After computational objectives have been selected, the instructor is ready to prepare math probes. The teacher may want to create single-skills probes, multiple-skill probes, or both types of CBM math worksheets. The teacher will probably want to consult the Common Core State Standards for Mathematics or district math curriculum when selecting the kinds of problems to include in the single- or multiple-skill probe.

*Creating the single-skill math probe.* As the first step in putting together a single-skill math probe, the teacher will select one computational objective as a guide. The worksheet, then, will consist of problems randomly constructed that conform to the computational objective chosen.

For example, the instructor may select any of the computational objectives in Figure 1 as the basis for a math probe. The teacher would then construct a series of problems that match the computational goal, as in Figure 2. In general, single-skill math probes should contain between 80 and 200 problems, and worksheets should have items on both the front and back of the page. Adequate space should also be left for the student to show his or her work, especially with more complex problems such as long division.

Figure 2: Example of a single-skill math probe: Three to five 3- and 4-digit numbers: no regrouping

| | | | |
|---|---|---|---|
| 105<br>+ 600<br>+ 293 | 2031<br>+ 531<br>+ 2322 | 111<br>+ 717<br>+ 260 | 634<br>+ 8240<br>+ 203 |

*Creating the Multiple-skill Math Probe.* To assemble a multiple-skill math probe, the instructor will first select the range of math operations and of problem-types that will make up the probe. Once the computational objectives have been

Figure 3: Example of a multiple-skill math probe:

- *Division: 3-digit number divided by 1-digit number: no remainder*
- *Subtraction: 2-digit number from a 2-digit number: regrouping*
- *Multiplication" 3-digit number times 1-digit number: no regrouping*
- *Division: Two 3-digit numbers: no regrouping*

| | | | |
|---|---|---|---|
| 9/431 | 20<br>-18 | 113<br>x 2 | 106<br>+ 172<br>+ 200<br>+ 600 |

chosen, the teacher can make up a worksheet of mixed math facts conforming to those objectives. Using our earlier example, the teacher who wishes to estimate the proficiency of his 4th-grade math group may decide to create a multiple-skills CBM probe. He could choose to sample only those problem-types that his students have either mastered or are presently being taught. Figure 3 shows four computation skills with matching sample problems that might appear on a worksheet of mixed math facts.

NOTE: Schools can customize their own CBM Computation Fluency assessment materials at no cost, using the Math Worksheet Generator, a free online application:
*http://www.interventioncentral.org/teacher-resources/math-work-sheet-generator*

CBM-Computation Fluency: Directions for Administration

1. The examiner distributes copies of math probes to all the students in the group, face down. (Note: These probes may also be administered individually). The examiner says to the students: "The sheets on your desk are math facts."
2. If the students are to complete a single-skill probe, the examiner says: "All the problems are [addition or subtraction or multiplication or division] facts."

If the students are to complete a multiple-skill probe, the examiner then says: "There are several types of problems on the sheet. Some are addition, some are subtraction, some are multiplication, and some are division [as appropriate]. Look at each problem carefully before you answer it."

3. The examiner then says: "When I say 'begin', turn the worksheet over and begin answering the problems. Start on the first problem on the left on the top row [point]. Work across and then go to the next row. If you can't answer a problem, make an 'X' on it and go to the next one. If you finish one side, go to the back. Are there any questions? ".
4. The examiner says 'Start' and starts the stopwatch. While the students are completing worksheets, the examiner and any other adults assisting in the assessment circulate around the room to ensure that students are working on the correct sheet and that they are completing problems in the correct order (rather than picking out only the easy items)..
5. After 2 minutes have passed, the examiner says, "Stop" and collects the CBM computation probes for scoring.
6. *Initial Assessment:* If the examiner is assessing the student for the first time, the examiner administers a total of 3 computation probes during the session using the above procedures and takes the median (middle) score as the best estimate of the student's computation fluency.
   *Progress-Monitoring:* If the examiner is monitoring student growth in computation (and has previously collected CBM-Computation Fluency data), only one computation probe is given in the session.

## CBM-Computation Fluency: Directions for Practice

If the student is not yet familiar with CBM-Computation Fluency probes, the teacher can administer one or more practice computation probes (using the administration guidelines above) and provide coaching and feedback as needed until assured that the student fully understands the assessment.

## CBM-Computation Fluency: Scoring Guidelines

Traditional approaches to computational assessment usually give credit for the total number of correct answers appearing on a worksheet. If the answer to a problem is found to contain one or more incorrect digits, that problem is marked wrong and receives no credit. In contrast to this all-or-nothing marking system, CBM assigns credit to each individual correct digit appearing in the solution to a math fact.

On the face of it, a math scoring system that awards points according to the number of correct digits may appear unusual, but this alternative approach is grounded in good academic-assessment research and practice. By separately scoring each digit in the answer of a computation problem, the instructor is better able to recognize and to give credit for a student's partial math competencies. Scoring computation problems by the digit rather than as a single answer also allows for a more minute analysis of a child's number skills.

Imagine, for instance, that a student was given a CBM math probe consisting of addition problems, sums less than or equal to 19 (incorrect digits appear in boldface and italics):

Figure 4: Example of completed problems from a single-skill math probe

| | | | |
|---|---|---|---|
| 105 | 2031 | 111 | 634 |
| + 600 | + 531 | + 717 | + 8240 |
| + 293 | + 2322 | + 260 | + 203 |
| 9***8***8 | 4884 | 108***7*** | 9***0***77 |

If the answers in Figure 4 were scored as either correct or wrong, the child would receive a score of 1 correct answer out of 4 possible answers (25 percent). However, when each individual digit is scored, it becomes clear that the student actually correctly computed 12 of 15 possible digits (80 percent). Thus, the CBM procedure of assigning credit to each correct digit demonstrates itself to be quite sensitive to a student's emerging, partial competencies in math computation.

The following scoring rules will aid the instructor in marking single- and multiple-skill math probes:

- Individual correct digits are counted as correct.
  Reversed or rotated digits are not counted as errors unless their change in position makes them appear to be another digit (e.g., 9 and 6).

- Incorrect digits are counted as errors.
  Digits that appear in the wrong place value, even if otherwise correct, are scored as errors.

Example

```
  97
  x9
8730
```

"873" is the correct answer to this problem, but no credit can be given since the addition of the 0 pushes the other digits out of their proper place-value positions.

- The student is given credit for "place-holder" numerals that are included simply to correctly align the problem. As long as the student includes the correct space, credit is given whether or not a "0" has actually been inserted.

Example

```
  55
x 82
 110
4400
4510
```

Since the student correctly placed 0 in the "place-holder" position, it is given credit as a correct digit. Credit would also have been given if the space were reserved but no 0 had been inserted.

- In more complex problems such as advanced multiplication, the student is given credit for all correct numbers that appear below the line.

Example

```
  33
x 28
 264
 660
 924
```

Credit is given for all work below the line. In this example, the student earns credit for 9 correct digits.

- Credit is not given for any numbers appearing above the line (e.g., numbers marked at the top of number columns to signify regrouping).

Example

```
 1
  46
+ 39
  85
```

Credit is given for the 2 digits below the line. However, the carried "1" above the line does not receive credit.

# Curriculum-Based Measurement: Computation Fluency Norms

(Burns, VanDerHeyden, & Jiban, 2006; Deno & Mirkin, 1977; Fuchs & Fuchs, 1993; Fuchs & Fuchs, n.d.)*

CBM-Computation Fluency measures a student's accuracy and speed in completing 'math facts' using the basic number operations of addition, subtraction, multiplication, and division. Computation fluency in the elementary grades is a strong predictor of later success in higher-level math coursework (Gersten, Jordan, & Flojo, 2005). CBM-Computation Fluency probes are 2-minute assessments of basic math facts that are scored for number of 'correct digits'.

| Grade | End of Year Benchmark: Correct Digits per 2 Mins (Fuchs & Fuchs, n.d.) | Weekly Growth: 'Realistic' (Fuchs & Fuchs, 1993) | Weekly Growth: 'Ambitious' (Fuchs & Fuchs, 1993) |
|---|---|---|---|
| 1 | 20 | 0.3 | 0.5 |

| Grade | Performance Level | Correct Digits per 2 Mins (Burns, VanDerHeyden, & Jiban, 2006) | Weekly Growth: 'Realistic' (Fuchs & Fuchs, 1993) | Weekly Growth: 'Ambitious' (Fuchs & Fuchs, 1993) |
|---|---|---|---|---|
| 2 | Mastery | More than 31 | 0.3 | 0.5 |
| | Instructional | 14-31 | | |
| | Frustration | Less than 14 | | |
| 3 | Mastery | More than 31 | 0.3 | 0.5 |
| | Instructional | 14-31 | | |
| | Frustration | Less than 14 | | |
| 4 | Mastery | More than 49 | 0.75 | 1.2 |
| | Instructional | 24-49 | | |
| | Frustration | Less than 24 | | |
| 5 | Mastery | More than 49 | 0.75 | 1.2 |
| | Instructional | 24-49 | | |
| | Frustration | Less than 24 | | |

| Grade | Performance Level | Correct Digits per 2 Mins (Deno & Mirkin, 1977) | Weekly Growth: 'Realistic' (Fuchs & Fuchs, 1993) | Weekly Growth: 'Ambitious' (Fuchs & Fuchs, 1993) |
|---|---|---|---|---|
| 6 | Mastery | More than 79 | 0.45 | 1.0 |
| | Instructional | 40-79 | | |
| | Frustration | Less than 40 | | |

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*Reported Characteristics of Student Sample(s) Used to Compile These Norms:
- Burns, VanDerHeyden, & Jiban, 2006: *Number of Students Assessed:* 434 students across grades 2-5/*Geographical Location:* Southwest: Sample drawn from 1 elementary school/ *Socioeconomic Status:* 15% rate of Free & Reduced Lunch/ *Ethnicity of Sample:* 74% Caucasian-non-Hispanic; 17% Hispanic or Latino; 6% African-American; 3% Asian-American; 1% Native American/*Limited English Proficiency in Sample:* 2% of students.
- Deno & Mirkin, 1977: *Number of Students Assessed:* Not reported/*Geographical Location:* Sample drawn from 1 elementary school; location not reported/ *Socioeconomic Status:* Not reported/ *Ethnicity of Sample:* Not reported/*Limited English Proficiency in Sample:* Not reported.
- Fuchs & Fuchs, n.d.: *Number of Students Assessed:* Not reported/*Geographical Location:* Not reported/ *Socioeconomic Status:* Not reported/ *Ethnicity of Sample:* Not reported/*Limited English Proficiency in Sample:* Not reported.
- Fuchs & Fuchs, 1993: *Number of Students Assessed:* Year 1: 177 students in grades 1-6; Year 2:1208 students across grades 1-6/*Geographical Location:* Upper Midwest: Sample drawn from 5 elementary schools/ *Socioeconomic Status:* 33%-55% rate of Free & Reduced Lunch across participating schools/ *Ethnicity of Sample:* Not reported/*Limited English Proficiency in Sample:* Not reported.

Where to Find Materials: Schools can create their own CBM Computation Fluency assessment materials at no cost, using the Math Worksheet Generator, a free online application:
*http://www.interventioncentral.org/teacher-resources/math-work-sheet-generator*

This program generates printable student and examiner assessment sheets for CBM Computation Fluency.

Limitations of These Research Norms: Norms generated from small-scale research studies--like those used here--provide estimates of student academic performance based on a sampling from only one or two points in time, rather than a more comprehensive sampling across separate fall, winter, and spring screenings. These norms also have been compiled from a relatively small student sample that is not fully representative of a diverse 'national' population. Nonetheless, norms such as these are often the best information that is publically available for basic academic skills and therefore do have a definite place in classroom instruction decision-making.

These norms can be useful in general education for setting student performance outcome goals for core instruction and/or any level of academic intervention. Similarly, these norms can be used to set performance goals for students with special needs. In both cases, however, single-sample norms would be used only if more comprehensive fall/winter/spring academic performance norms are not available.

# Teacher Communication Tools to Motivate

Teachers communication is a powerful means to boost academic performance. Instructor comments have the ability to boost confidence, focus attention, and engage reluctant learners. Four prime tools in the teacher communication toolbox are change talk, praise, growth-mindset statements, and wise feedback.

Change Talk. Change talk (Miller & Rollnick, 2004) is any statement (or partial statement) that expresses hope, interest in making positive changes, a willingness to try new strategies, or other positive attitudes. When people focus on their own 'change talk', they are more likely to develop and successfully carry out plans to make positive changes in their lives.

Elements of student change talk are often intermixed with expressions of uncertainty, frustration, and doubt. Teachers who are effective listeners listen for 'change talk' (Miller & Rollnick, 2004). In a low-key manner, the educator can then draw attention to that positive change talk, reinforce it, have the student elaborate on it, and thus increase that learner's optimism and confidence (Miller & Rollnick, 2004).

For example, in a teacher conference, the student may say, "I want to do better in this course but the work is so hard!" The student's statement includes both positive change talk (the goal of performing better in the course) and a limiting factor (the work is difficult). In conversation, the instructor can strategically draw attention to the student's change talk ("I want to do better in this course") through restatement: e.g., "I am hearing that doing better in the course is important to you" or "So if you could find a way, you would like to do better in the course, right?" This encourages the student to focus on a plan for change rather than on roadblocks preventing change.

Praise. Praise is a type of positive coaching comment. It pinpoints for the student the specific academic or general behavior that is noteworthy and also conveys teacher approval of that behavior (Burnett, 2001). Praise can be thought of as a kind of verbal highlighter, prompting (and reinforcing) the student to engage in *more* of the praised behavior. Praise statements are most effective when they target effort and accomplishment, not general ability. Effective praise consists of two elements:

- DESCRIPTION. The teacher describes in specific terms the noteworthy student academic performance or general behavior to be praised.
- APPROVAL. The teacher signals approval of the student's performance.

Here is a sample praise statement:

- DESCRIPTION. "*Russell, today in class, you wrote non-stop through the entire writing period.*"
- APPROVAL. "*I really appreciate your hard work!*"

Growth Mindset Statements. Research shows that there is one crucial factor that greatly impacts motivation and academic engagement: whether a student possesses a 'fixed' or 'open' mindset (Dweck, 2006). Students with a *fixed mindset* view intelligence, or general ability, as having a fixed upward limit. Viewed from this perspective, effort plays only a minor role in intellectual accomplishment. In contrast, students with a *growth mindset* see intelligence as 'malleable': they have faith that increased effort will result in more effective learning and accomplishment. When fixed-mindset students are challenged by academic tasks, they can easily give up, while, growth-mindset learners interpret academic struggles as "an opportunity for growth, not a sign that a student is incapable of learning" (Paunesku et al., 2015; p. 785).

In their day-to-day communication with students, instructors have many opportunities to craft encouraging statements about schoolwork that can help fixed-mindset learners adopt a more positive, growth-mindset view. These statements contain 3 elements:

- CHALLENGE. The teacher acknowledges that the learning task is difficult—but frames that challenge as an opportunity to learn.
- PROCESS. The teacher identifies the specific process that the student should follow to accomplish the academic task.
- CONFIDENCE. The teacher provides assurance that the student can be successful if the learner puts in sufficient effort and follows the recommended process.

Here is an example of a growth-mindset statement that an instructor uses to encourage a student to continue on an independent reading assignment:

*"Sarah, please keep reading. You still have 10 minutes to work on the assignment."*

- CHALLENGE. *"Your reading assignment has a lot of advanced vocabulary."*
- PROCESS. *"If you get stuck, be sure to use your reading fix-up skills. Remember, it's also OK to ask a neighbor or to come to me for help. "*
- CONFIDENCE. *"Use your strategies, and you should get through the reading just fine."*

Wise Feedback. Some students—particularly those with a history of academic underperformance or failure—may misinterpret critical instructional feedback as a sign that the teacher lacks confidence in and is negatively biased toward the learner.

An effective way for teachers to reduce the tendency of at-risk students to discount evaluative statements as biased is to format those statements as 'wise' feedback (Yeager et al., 2013). The teacher structures written or verbal feedback to include these 3 elements:

- FEEDBACK DESCRIPTION. The teacher describes the nature of the feedback being offered.
- HIGH STANDARDS. The teacher emphasizes and explains the high standards used to evaluate the student work.
- ASSURANCE OF ABILITY. The teacher states explicitly his or her confidence that the student has the skills necessary to successfully meet those standards.

Here is an example of wise feedback that a teacher wrote on a student writing assignment:

- FEEDBACK DESCRIPTION. "*Your paper met the basic requirements of the assignment but needs work. Please look over my comments. You will see that I give detailed feedback.*"
- HIGH STANDARDS. "*The expectation in this class is that you will take your writing to a level suitable for college or business communication."*
- ASSURANCE OF ABILITY. "*Your past writing assignments have shown me that you have the skills and motivation to use my feedback to revise and improve this paper.* "

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