RTI Toolkit: A Practical Guide for Schools

RTI: Best Practices in Elementary Math Interventions: SUPPLEMENTAL PACKET

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Intervention & Related RTI Terms: Definitions

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

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

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

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

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

References

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The Instructional Hierarchy: Linking Stages of Learning to Effective Instructional Techniques

When mastering new academic skills or strategies, the student learner typically advances through a predictable series of 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 below). 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. Here the goal is for the student to be able to identify elements of previously learned skills that he or she can adapt to the new demands or situation.

When the teacher accurately identifies a student's learning stage, the instructor can select instructional ideas that are more likely to be successful *because* these strategies match the student's learning needs.

Reference

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.

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

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

Academic Interventions 'Critical Components' Checklist

This checklist summarizes the essential components of academic interventions. When preparing a student's Tier 1, 2, or 3 academic intervention plan, use this document as a 'pre-flight checklist' to ensure that the academic intervention is of high quality, is sufficiently strong to address the identified student problem, is fully understood and supported by the teacher, and can be implemented with integrity. NOTE: While the checklist refers to the 'teacher' as the interventionist, it can also be used as a guide to ensure the quality of interventions implemented by non-instructional personnel, adult volunteers, parents, and peer (student) tutors.

Directions: When creating an academic intervention plan, review that plan by comparing it to each of the items below.

- If a particular intervention element is missing or needs to be reviewed, check the 'Critical Item?' column for that element.
- Write any important notes or questions in the 'Notes' column.

Allocating Sufficient Contact Time & Assuring Appropriate Student-Teacher Ratio

The cumulative time set aside for an intervention and the amount of direct teacher contact are two factors that help to determine that intervention's 'strength' (Yeaton & Sechrest, 1981).

Critical Item?	Intervention Element	Notes
☐	**Time Allocated.** The time set aside for the intervention is appropriate for the type and level of student problem (Burns & Gibbons, 2008; Kratochwill, Clements & Kalymon, 2007). When evaluating whether the amount of time allocated is adequate, consider: • Length of each intervention session. • Frequency of sessions (e.g.., daily, 3 times per week) • Duration of intervention period (e.g., 6 instructional weeks)	
☐	**Student-Teacher Ratio.** The student receives sufficient contact from the teacher or other person delivering the intervention to make that intervention effective. NOTE: Generally, supplemental intervention groups should be limited to 6-7 students (Burns & Gibbons, 2008).	

Matching the Intervention to the Student Problem

Academic interventions are not selected at random. First, the student academic problem(s) is defined clearly and in detail. Then, the likely explanations for the academic problem(s) are identified to understand which intervention(s) are likely to help—and which should be avoided.

Critical Item?	Intervention Element	Notes
☐	**Problem Definition.** The student academic problem(s) to be addressed in the intervention are defined in clear, specific, measureable terms (Bergan, 1995; Witt, VanDerHeyden & Gilbertson, 2004). The full problem definition describes: • *Conditions*. Describe the environmental conditions or task demands in place when the academic problem is observed. • *Problem Description*. Describe the actual observable academic behavior in which the student is engaged. Include rate, accuracy, or other quantitative information of student performance. • *Typical or Expected Level of Performance*. Provide a typical or expected performance criterion for this skill or behavior. Typical or expected academic performance can be calculated using a variety of sources,	
☐	**Appropriate Target.** Selected intervention(s) are appropriate for the identified student problem(s) (Burns, VanDerHeyden & Boice, 2008). TIP: Use the Instructional Hierarchy (Haring et al., 1978) to select	

	academic interventions according to the four stages of learning: • *Acquisition*. The student has begun to learn how to complete the target skill correctly but is not yet accurate in the skill. Interventions should improve accuracy. • *Fluency*. The student is able to complete the target skill accurately but works slowly. Interventions should increase the student's speed of responding (fluency) as well as to maintain accuracy. • *Generalization*. The student may have acquired the target skill but does not typically use it in the full range of appropriate situations or settings. Or the student may confuse the target skill with 'similar' skills. Interventions should 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. • *Adaptation*. The student is not yet able to modify or adapt an existing skill to fit novel task-demands or situations. Interventions should help the student to identify key concepts or elements from previously learned skills that can be adapted to the new demands or situations.	
☐	'Can't Do/Won't Do' Check. The teacher has determined whether the student problem is primarily a skill or knowledge deficit ('can't do') or whether student motivation plays a main or supporting role in academic underperformance ('wont do'). If motivation appears to be a significant factor contributing to the problem, the intervention plan includes strategies to engage the student (e.g., high interest learning activities; rewards/incentives; increased student choice in academic assignments, etc.) (Skinner, Pappas & Davis, 2005; Witt, VanDerHeyden & Gilbertson, 2004).	

Incorporating Effective Instructional Elements

These effective 'building blocks' of instruction are well-known and well-supported by the research. They should be considered when selecting or creating any academic intervention.

Critical Item?	Intervention Element	Notes
☐	Explicit Instruction. Student skills have been broken down "into manageable and deliberately sequenced steps" and the teacher provided" overt strategies for students to learn and practice new skills" (Burns, VanDerHeyden & Boice, 2008, p.1153).	
☐	Appropriate Level of Challenge. The student experienced sufficient success in the academic task(s) to shape learning in the desired direction as well as to maintain student motivation (Burns, VanDerHeyden & Boice, 2008).	
☐	Active Engagement. The intervention ensures that the student is engaged in 'active accurate responding' (Skinner, Pappas & Davis, 2005).at a rate frequent enough to capture student attention and to optimize effective learning.	
☐	Performance Feedback. The student receives prompt performance feedback about the work completed (Burns, VanDerHeyden & Boice, 2008).	
☐	Maintenance of Academic Standards. If the intervention includes any accommodations to better support the struggling learner (e.g., preferential seating, breaking a longer assignment into smaller chunks), those accommodations do not substantially lower the academic standards against which the student is to be evaluated and are not likely to reduce the student's rate of learning (Skinner, Pappas & Davis, 2005).	

Verifying Teacher Understanding & Providing Teacher Support		
The teacher is an active agent in the intervention, with primary responsibility for putting it into practice in a busy classroom. It is important, then, that the teacher fully understands how to do the intervention, believes that he or she can do it, and knows whom to seek out if there are problems with the intervention.		
Critical Item?	Intervention Element	Notes
☐	Teacher Responsibility. The teacher understands his or her responsibility to implement the academic intervention(s) with integrity.	
☐	Teacher Acceptability. The teacher states that he or she finds the academic intervention feasible and acceptable for the identified student problem.	
☐	Step-by-Step Intervention Script. The essential steps of the intervention are written as an 'intervention script'--a series of clearly described steps—to ensure teacher understanding and make implementation easier (Hawkins, Morrison, Musti-Rao & Hawkins, 2008).	
☐	Intervention Training. If the teacher requires training to carry out the intervention, that training has been arranged.	
☐	Intervention Elements: Negotiable vs. Non-Negotiable. The teacher knows all of the steps of the intervention. Additionally, the teacher knows which of the intervention steps are 'non-negotiable' (they must be completed exactly as designed) and which are 'negotiable' (the teacher has some latitude in how to carry out those steps) (Hawkins, Morrison, Musti-Rao & Hawkins, 2008).	
☐	Assistance With the Intervention. If the intervention cannot be implemented as designed for any reason (e.g., student absence, lack of materials, etc.), the teacher knows how to get assistance quickly to either fix the problem(s) to the current intervention or to change the intervention.	

Documenting the Intervention & Collecting Data		
Interventions only have meaning if they are done within a larger data-based context. For example, interventions that lack baseline data, goal(s) for improvement, and a progress-monitoring plan are 'fatally flawed' (Witt, VanDerHeyden & Gilbertson, 2004).		
Critical Item?	Intervention Element	Notes
☐	Intervention Documentation. The teacher understands and can manage all documentation required for this intervention (e.g., maintaining a log of intervention sessions, etc.).	
☐	Checkup Date. Before the intervention begins, a future checkup date is selected to review the intervention to determine if it is successful. Time elapsing between the start of the intervention and the checkup date should be short enough to allow a timely review of the intervention but long enough to give the school sufficient time to judge with confidence whether the intervention worked.	
☐	Baseline. Before the intervention begins, the teacher has collected information about the student's baseline level of performance in the identified area(s) of academic concern (Witt, VanDerHeyden &	

	Gilbertson, 2004).	
☐	Goal. Before the intervention begins, the teacher has set a specific goal for predicted student improvement to use as a minimum standard for success (Witt, VanDerHeyden & Gilbertson, 2004). The goal is the expected student outcome by the checkup date if the intervention is successful.	
☐	Progress-Monitoring. During the intervention, the teacher collects progress-monitoring data of sufficient quality and at a sufficient frequency to determine at the checkup date whether that intervention is successful (Witt, VanDerHeyden & Gilbertson, 2004).	

References

Bergan, J. R. (1995). Evolution of a problem-solving model of consultation. *Journal of Educational and Psychological Consultation, 6(2),* 111-123.

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Building Number Sense Through a Counting Board Game

DESCRIPTION: The student plays a number-based board game to build skills related to 'number sense', including number identification, counting, estimation skills, and ability to visualize and access specific number values using an internal number-line (Siegler, 2009).

MATERIALS:

- *Great Number Line Race!* Form (attached)
- Spinner divided into two equal regions marked "1" and "2" respectively. (NOTE: If a spinner is not available, the interventionist can purchase a small blank wooden block from a crafts store and mark three of the sides of the block with the number "1" and three sides with the number "2".)

INTERVENTION STEPS: A counting-board game session lasts 12 to 15 minutes, with each game within the session lasting 2-4 minutes. Here are the steps:

1. *Introduce the Rules of the Game.* If the student is unfamiliar with the counting board game, interventionist trains the student to play it.

   The student is told that he or she will attempt to beat another player (either another student or the interventionist). The student is then given a penny or other small object to serve as a game piece. The student is told that players takes turns spinning the spinner (or, alternatively, tossing the block) to learn how many spaces they can move on *the Great Number Line Race!* board. Each player then advances the game piece, moving it forward through the numbered boxes of the game-board to match the number "1" or "2" selected in the spin or block toss.

   When advancing the game piece, the player must call out the number of each numbered box as he or she passes over it. For example, if the player has a game piece on box 7 and spins a "2", that player advances the game piece two spaces, while calling out "8" and "9" (the names of the numbered boxes that the game piece moves across during that turn).

   The player who reaches the "10" box first is the winner.

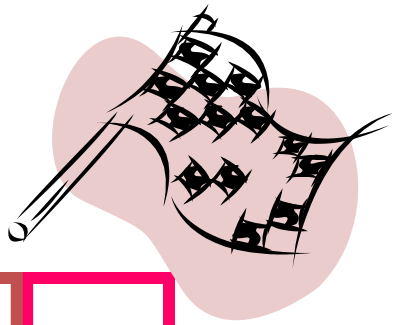
2. *Record Game Outcomes.* At the conclusion of each game, the interventionist records the winner using the form found on the *Great Number Line Race!* form. The session continues with additional games being played for a total of 12-15 minutes.

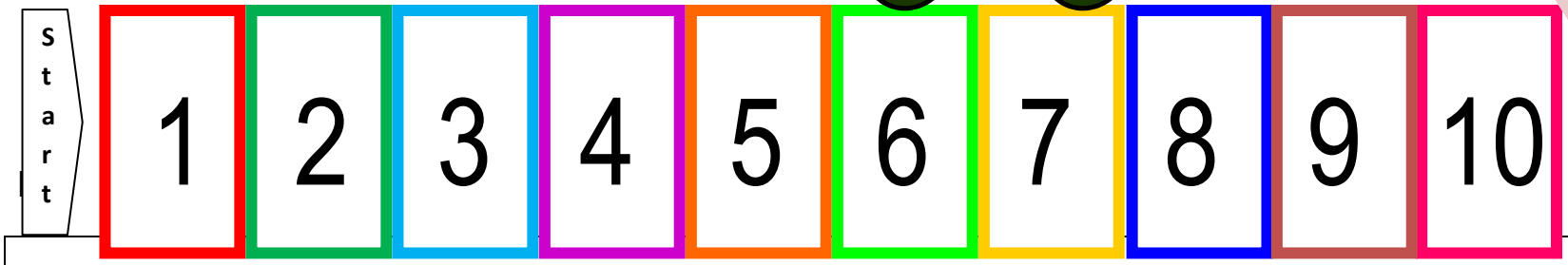
3. *Continue the Intervention Up to an Hour of Cumulative Play.* The counting-board game continues until the student has accrued a total of at least one hour of play across multiple days. (The amount of cumulative play can be calculated by adding up the daily time spent in the game as recorded on the *Great Number Line Race!* form.)

Reference

Siegler, R. S. (2009). Improving the numerical understanding of children from low-income families. *Child Development Perspectives, 3*(2), 118-124.

The Great Number-Line Race!





Date: _____ Start Time: _____ : _____ End Time: _____ : _____

Directions: Mark the winner for each game with an 'X' in the table below.

Players	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6	Game 7
1: _____							
2: _____							

Source: Siegler, R. S. (2009). Improving the numerical understanding of children from low-income families. *Child Development Perspectives, 3*(2), 1

Reducing the Student's Memorization Load: Math 'Shortcuts'

Students who struggle with math computation may benefit from being taught math 'shortcuts' that lighten the cognitive load (Gersten, Jordan & Flojo, 2005). Here are suggested shortcuts for the basic math operations:

Addition (Miller, Strawser & Mercer, 1996)

- ❑ The order of the numbers in an addition problem does not affect the answer.
- ❑ When zero is added to the original number, the answer is the original number.
- ❑ When 1 is added to the original number, the answer is the next larger number.

- ❑ ADDITION: Strategic Count-Up Strategy (Fuchs et al., 2009):

    1. The student is given a copy of the number-line.
    2. When presented with a two-addend addition problem, the student is taught to start with the larger of the two addends and to 'count up' by the amount of the smaller addend to arrive at the answer to the problem.

Subtraction (Miller, Strawser & Mercer, 1996)

- ❑ When zero is subtracted from the original number, the answer is the original number.
- ❑ When 1 is subtracted from the original number, the answer is the next smaller number.
- ❑ When the original number has the same number subtracted from it, the answer is zero.

- ❑ SUBTRACTION: Strategic Count-Up Strategy (Fuchs et al., 2009):

    1. The student is given a copy of the number-line.
    2. The student is taught to refer to the first number appearing in the subtraction problem (the minuend) as 'the number you start with' and to refer to the number appearing after the minus (subtrahend) as 'the minus number'.
    3. The student is directed to start at the minus number on the number-line and to count up to the starting number while keeping a running tally of numbers counted up on his or her fingers.
    4. The final tally of digits separating the minus number and starting number is the answer to the subtraction problem.

Multiplication (Miller, Strawser & Mercer, 1996)

- ❑ When a number is multiplied by zero, the answer is zero.
- ❑ When a number is multiplied by 1, the answer is the original number.
- ❑ When a number is multiplied by 2, the answer is equal to the number being added to itself.
- ❑ The order of the numbers in a multiplication problem does not affect the answer.

MULTIPLICATION: Strategic Count-By Strategy (Cullinan, Lloyd & Epstein, 1981)

1. The student looks at the two terms of the multiplication problem. The student picks one of the terms as a number that he or she can count by (the 'count by' number).
2. The student takes the remaining term from the multiplication problem (the 'count times' number) and makes a corresponding number of tally marks to match it.
3. The student starts counting using the 'count by' number. While counting, the student touches each of the tally marks matching the 'count times' number.
4. The student stops counting when he or she has reached the final tally-mark. The student writes down the last number said as the answer to the multiplication problem.

Division (Miller, Strawser & Mercer, 1996)

- ❑ When zero is divided by any number, the answer is zero.
- ❑ When a number is divided by 1, the answer is the original number.
- ❑ When a number is divided by itself, the answer is 1.

References

Cullinan, D., Lloyd, J., & Epstein, M.H. (1981). Strategy training: A structured approach to arithmetic instruction. *Exceptional Education Quarterly, 2*, 41-49.

Fuchs, L. S., Powell, S. R., Seethaler, P. M., Cirino, P. T., Fletcher, J. M., Fuchs, D., & Hamlett, C. L. (2009). The effects of strategic counting instruction, with and without deliberate practice, on number combination skill among students with mathematics difficulties. *Learning and Individual Differences 20*(2), 89-100.

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

Miller, S.P., Strawser, S., & Mercer, C.D. (1996). Promoting strategic math performance among students with learning disabilities. *LD Forum, 21*(2), 34-40.

Strategic Number Counting Instruction

DESCRIPTION: The student is taught explicit number counting strategies for basic addition and subtraction. Those skills are then practiced with a tutor (adapted from Fuchs et al., 2009).

MATERIALS:

- Number-line (attached)
- Number combination (math fact) flash cards for basic addition and subtraction
- *Strategic Number Counting Instruction Score Sheet* (attached)

PREPARATION: The tutor trains the student to use these two counting strategies for addition and subtraction:

ADDITION: The student is given a copy of the appropriate number-line (1-10 or 1-20—see attached). When presented with a two-addend addition problem, the student is taught to start with the larger of the two addends and to 'count up' by the amount of the smaller addend to arrive at the answer to the problem.

SUBTRACTION: The student is given a copy of the appropriate number-line (1-10 or 1-20—see attached).. The student is taught to refer to the first number appearing in the subtraction problem (the minuend) as 'the number you start with' and to refer to the number appearing after the minus (subtrahend) as 'the minus number'. The student is directed to start at the minus number on the number-line and to count up to the starting number while keeping a running tally of numbers counted up on his or her fingers. The final tally of digits separating the minus number and starting number is the answer to the subtraction problem.

INTERVENTION STEPS: For each tutoring session, the tutor follows these steps:

1. *Create Flashcards.* The tutor creates addition and/or subtraction flashcards of problems that the student is to practice. Each flashcard displays the numerals and operation sign that make up the problem but leaves the answer blank.

2. *Review Count-Up Strategies*. At the opening of the session, the tutor asks the student to name the two methods for answering a math fact. The correct student response is 'Know it or count up.' The tutor next has the student describe how to count up an addition problem and how to count up a subtraction problem. Then the tutor gives the student two sample addition problems and two subtraction problems and directs the student to solve each, using the appropriate count-up strategy.

3. *Complete Flashcard Warm-Up*. The tutor reviews addition/subtraction flashcards with the student for three minutes. Before beginning, the tutor reminds the student that, when shown a flashcard, the student should try to 'pull the answer from your head'—but that if the student does not know the answer, he or she should use the appropriate count-up strategy. The tutor then reviews the flashcards with the student. Whenever the student makes an error, the tutor directs the student to use the correct count-up strategy to solve. NOTE: If the student cycles through all cards in the stack before the three-minute period has elapsed, the tutor shuffles the cards and begins again.

   At the end of the three minutes, the tutor counts up the number of cards reviewed and records the number of

cards that the student (a) identified from memory, (b) solved using the count-up strategy, and (c) was not able to correctly answer. These totals are recorded on the Strategic *Number Counting Instruction Score Sheet*

4. *Repeat Flashcard Review*. The tutor shuffles the math-fact flashcards, encourages the student to try to beat his or her previous score, and again reviews the flashcards with the student for three minutes. As before, whenever the student makes an error, the tutor directs the student to use the appropriate count-up strategy. Also, if the student completes all cards in the stack with time remaining, the tutor shuffles the stack and continues presenting cards until the time is elapsed.

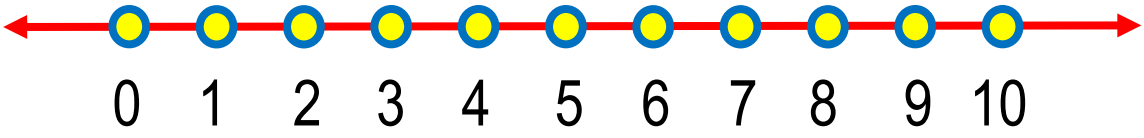
   At the end of the three minutes, the tutor again counts up the number of cards reviewed and records the number of cards that the student (a) identified from memory, (b) solved using the count-up strategy, and (c) was not able to correctly answer. These totals are again recorded on the Strategic *Number Counting Instruction Score Sheet.*

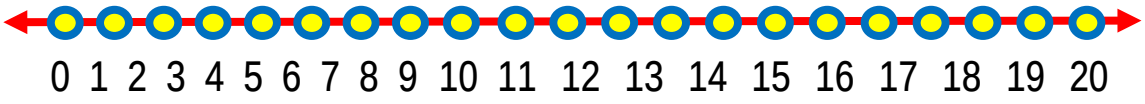
5. *Provide Performance Feedback*. The tutor gives the student feedback about whether (and by how much) the student's performance on the second flashcard trial exceeded the first. The tutor also provides praise if the student beat the previous score or encouragement if the student failed to beat the previous score.

Reference

Fuchs, L. S., Powell, S. R., Seethaler, P. M., Cirino, P. T., Fletcher, J. M., Fuchs, D., & Hamlett, C. L. (2009). The effects of strategic counting instruction, with and without deliberate practice, on number combination skill among students with mathematics difficulties. *Learning and Individual Differences 20*(2), 89-100.

Strategic Number Counting Instruction: Number-Lines





Strategic Number Counting Instruction Score Sheet

Student: _____ Interventionist(s): _____

Directions: During the strategic number counting instruction intervention, use this sheet to tally student responses: Number of Flash-Cards Known From Memory; Number of Flash-Cards Answered Correctly With Count-Up Strategy (with or without assistance); Number of Flash-Cards Unknown or Answered Incorrectly (even with assistance).

Date:_____	[Optional] Type/Range of Addition/Subtraction Math-Fact Flash-Cards Reviewed This Session:	
Trial 1: Math Flash-Card Warm-Up: 3 Minutes		
Number of Flash-Cards Known From Memory	Number of Flash-Cards Answered Correctly With Count-Up Strategy	Number of Flash-Cards Unknown or Answered Incorrectly
Trial 2: Math Flash-Card Review: 3 Minutes		
Number of Flash-Cards Known From Memory	Number of Flash-Cards Known From Memory	Number of Flash-Cards Known From Memory

Date:_____	[Optional] Type/Range of Addition/Subtraction Math-Fact Flash-Cards Reviewed This Session:	
Trial 1: Math Flash-Card Warm-Up: 3 Minutes		
Number of Flash-Cards Known From Memory	Number of Flash-Cards Answered Correctly With Count-Up Strategy	Number of Flash-Cards Unknown or Answered Incorrectly
Trial 2: Math Flash-Card Review: 3 Minutes		
Number of Flash-Cards Known From Memory	Number of Flash-Cards Known From Memory	Number of Flash-Cards Known From Memory

Student Self-Monitoring of Productivity to Increase Fluency on Math Computation Worksheets

DESCRIPTION: The student monitors and records her or his work production on math computation worksheets on a daily basis—with a goal of improving overall fluency (Maag, Reid, R., & DiGangi, 1993). This intervention can be used with a single student, a small group, or an entire class.

MATERIALS:

- Student self-monitoring audio prompt: Tape / audio file with random tones or dial-style kitchen timer
- Math computation worksheets containing problems targeted for increased fluency
- *Student Speed Check!* recording form (attached)

Preparation: To prepare for the intervention the teacher:

1. *Decides on the Length and Frequency of Each Self-Monitoring Period.* The instructor decides on the length of session and frequency of the student's self-monitoring intervention. NOTE: One good rule of thumb is to set aside at least 10 minutes per day for this or other interventions to promote fluent student retrieval of math facts (Gersten et al., 2009). For example, Mrs. Rilke, a 3rd-grade teacher, decides that her student, Roy, will monitor his productivity on math computation worksheets on a daily basis for 10 minutes per session.

2. *Selects a Math Computation Skill Target*. The instructor chooses one or more problem types that are to appear in intervention worksheets. For example, Mrs. Rilke decides to target two math computation problem-types for Roy: Addition—double-digit plus double-digit with regrouping and Subtraction—double-digit plus double-digit with no regrouping.

3. *Creates Math Computation Worksheets*. When the teacher has chosen the problem types, he or she makes up sufficient equivalent worksheets (with the same number of problems and the same mix of problem-types) to be used across the intervention days. Each worksheet should have enough problems to keep the student busy for the length of time set aside for a self-monitoring intervention session.

   For example, when designing a worksheet, Mrs. Rilke decides to include 15 problems per sheet for her 3rd grade student, to keep Roy busy for the 10 minute daily intervention period. The teacher then goes to the free math worksheet generator at www.interventioncentral.org to create and print off 25 equivalent math worksheets for use across all intervention days (5 days per week for five instructional weeks).

4. *Determines How Many Audio Prompts the Student Will Receive.* This intervention relies on student self-monitoring triggered by audio prompts. Therefore, the teacher must decide on a fixed number of audio prompts the student is to receive per session. NOTE: On the attached *Student Speed Check!* form, space is provided for the student to record productivity for up to five audio prompts per session.

5. *Selects a Method to Generate Random Audio Prompts*. Next, the teacher must decide on how to generate the audio prompts (tones) that drive this intervention. There are two possible choices:

(A) The teacher can develop a tape or audio file that has several random tones spread across the time-span of the intervention session, with the number of tones equaling the fixed number of audio prompts selected for the intervention (see previous step). For example, the instructor may develop a 10-minute tape with five tones randomly sounding at 2 minutes, 3 minutes, 5 minutes, 7 minutes, and 10 minutes.

(B) The instructor may purchase a dial-type kitchen timer. During the intervention period, the instructor turns the dial to a randomly selected number of minutes. When the timer expires and chimes as a student audio prompt, the teacher resets the timer to another random number of minutes and repeats this process until the intervention period is over. Of course, the teacher must ensure that the student receives the same fixed number of audio prompts (e.g., 5) across each intervention session and that all audio prompts are delivered by the conclusion of the timed intervention session. Before each intervention session, the teacher may want to preselect several random time intervals. For example, on a given day, the instructor who wants to include five timer prompts in a 10 minute intervention session may decide to ring the timer at 2 minutes, 3 minutes, 5 minutes, 7 minutes, and 10 minutes. This sequence would then be changed for the next session.

6. *Trains the Student in the Procedures to Self-Monitor Productivity.* The teacher meets with the student to train him or her in the steps of the intervention (described in the next session).

INTERVENTION STEPS: Sessions of the productivity self-monitoring intervention for math computation include these steps:

1. *[Student] Set a Session Computation Goal.* The student looks up the total number of problems completed on his or her most recent timed worksheet and writes that figure into the 'Score to Beat' section of the current day's *Student Speed Check!* form.

2. *[Teacher] Set the Timer or Start the Tape.* The teacher directs the student to begin working on the worksheet and either starts the tape with tones spaced at random intervals or sets a kitchen timer. If using a timer, the teacher randomly sets the timer randomly to a specific number of minutes. When the timer expires and chimes as a student audio prompt, the teacher resets the timer to another random number of minutes and repeats this process until the intervention period is over.

3. *[Student] At Each Tone, Record Problems Completed.* Whenever the student hears an audio prompt or at the conclusion of the timed intervention period, the student pauses to:

    a. circle the problem that he or she is currently working on

    b. count up the number of problems completed since the previous tone (or in the case of the first tone, the number of problems completed since starting the worksheet)

    c. record the number of completed problems next to the appropriate tone interval on the attached *Student Speed Check!* form.

4. [Teacher] *Announce the End of the Intervention Period*. The teacher announces that the intervention period is over and that the student should stop working on the worksheet. NOTE: If a tape or audio file is being used to deliver audio tones, it can contain an announcement stating that the intervention period has ended.

5. *[Student] Tally Day's Performance.* The student adds up the problems completed at the tone-intervals to give a productivity total for the day. The student then compares the current day's figure to that of the previous day to see if he or she was able to beat the previous score. If YES, the student receives praise from the teacher; if NO, the student receives encouragement from the teacher.

References

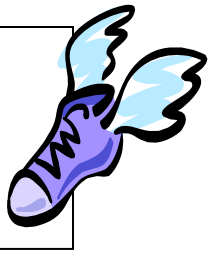
Maag, J. W., Reid, R., & DiGangi, S. A. (1993). Differential effects of self-monitoring attention, accuracy, and productivity. *Journal of Applied Behavior Analysis, 26*, 329-344.

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

Student Speed Check!

Student Name: _____ Classroom: _____

Directions: Use this form to track your speed in completing math worksheets.



Score to Beat: How many problems did I complete at my last session?	_____ Problems
Today's Session:	Date: _____
How many problems did I complete at TONE #1?	_____ Problems
How many more problems did I complete at TONE #2?	_____ Problems
How many more problems did I complete at TONE #3?	_____ Problems
How many more problems did I complete at TONE #4?	_____ Problems
How many more problems did I complete at TONE #5?	_____ Problems
How many more problems did I complete between the final tone and the end of the session?	_____ Problems
TOTAL number of problems completed in this session:	_____ Problems
Did I beat my previous score?	___ Yes ___ No

Score to Beat: How many problems did I complete at my last session?	_____ Problems
Today's Session:	Date: _____
How many problems did I complete at TONE #1?	_____ Problems
How many more problems did I complete at TONE #2?	_____ Problems
How many more problems did I complete at TONE #3?	_____ Problems
How many more problems did I complete at TONE #4?	_____ Problems
How many more problems did I complete at TONE #5?	_____ Problems
How many more problems did I complete between the final tone and the end of the session?	_____ Problems
TOTAL number of problems completed in this session:	_____ Problems
Did I beat my previous score?	___ Yes ___ No

Increase Student Math Success with Customized Math Self-Correction Checklists

DESCRIPTION: The teacher analyzes a particular student's pattern of errors commonly made when solving a math algorithm (on either computation or word problems) and develops a brief error self-correction checklist unique to that student. The student then uses this checklist to self-monitor—and when necessary correct—his or her performance on math worksheets before turning them in.

MATERIALS:

- Customized student math error self-correction checklist (described below)
- Worksheets or assignments containing math problems matched to the error self-correction checklist

INTERVENTION STEPS: The intervention with customized math error self-correction checklists includes these steps (adapted from Dunlap & Dunlap, 1989; Uberti et al., 2004):

1. *Develop the Checklist*. The teacher draws on multiple sources of data available in the classroom to create a list of errors that the student commonly makes on a specific type of math computation or word problem. Good sources of information for analyzing a student's unique pattern of math-related errors include review of completed worksheets and other work products, interviewing the student, asking the student to solve a math problem using a 'think aloud' approach to walk through the steps of an algorithm, and observing the student completing math problems in a cooperative learning activity with other children.

   Based on this error analysis, the teacher creates a short (4-to-5 item) student self-correction checklist that includes the most common errors made by that student. Items on the checklist are written in the first person and when possible are stated as 'replacement' or goal behaviors. This checklist might include steps in an algorithm that challenge the student (e.g., "I underlined all numbers at the top of the subtraction problem that were smaller than their matching numbers at the bottom of the problem") as well as goals tied to any other errors that impede math performance (e.g., "I wrote all numbers carefully so that I could read them easily and not mistake them for other numbers").

   NOTE: To reduce copying costs, the teacher can laminate the self-correction checklist and provide the student with an erasable marker to allow for multiple re-use of the form.

2. *Introduce the Checklist.* The teacher shows the student the self-correction checklist customized for that student. The teacher states that the student is to use the checklist to check his or her work before turning it in so that the student can identify and correct the most common errors.

3. *Prompt the Student to Use the Checklist to Evaluate Each Problem.* The student is directed to briefly review all items on the checklist before starting any worksheet or assignment containing the math problems that it targets.

   When working on the math worksheet or assignment, the student uses the checklist after *every* problem to check his or her work—marking each checklist item with a plus sign ('+') if correctly followed or a minus sign ('-') if not correctly followed. If any checklist item receives a minus rating, the student is directed to leave the original

solution to the problem untouched, to solve the problem again, and again to use the checklist to check the work. Upon finishing the assignment, the student turns it in, along with the completed self-correction checklists.

4. *Provide Performance Feedback, Praise, and Encouragement*. Soon after the student submits any math worksheets associated with the intervention, the teacher should provide him or her with timely feedback about errors, praise for correct responses, and encouragement to continue to apply best effort.

5. *[OPTIONAL] Provide Reinforcement for Checklist Use*. If the student appears to need additional incentives to increase motivation for the intervention, the teacher can assign the student points for intervention compliance: (1) the student earns one point on any assignment for each correct answer, and (2) the student earns an additional point for each problem on which the student committed none of the errors listed on the self-correction checklist. The student is allowed to collect points and to redeem them for privileges or other rewards in a manner to be determined by the teacher.

6. *Fade the Intervention*. The error self-correction checklist can be discontinued when the student is found reliably to perform on the targeted math skill(s) at a level that the teacher defines as successful (e.g., 90 percent success or greater).

Reference

Dunlap, L. K., & Dunlap, G. (1989). A self-monitoring package for teaching subtraction with regrouping to students with learning disabilities. *Journal of Applied Behavior Analysis, 229*, 309-314.

Uberti, H. Z., Mastropieri, M. A., & Scruggs, T. E. (2004). Check it off: Individualizing a math algorithm for students with disabilities via self-monitoring checklists. *Intervention in School and Clinic, 39*(5), 269-275.

SAMPLE: Math Self-Correction Checklist

Student Name: _____ Date: _____

Rater: Student Classroom: _____

Directions: To the Student: BEFORE YOU START: Look at each of these goals for careful math work before beginning your assignment. AFTER EACH PROBLEM: Stop and rate YES or NO whether you performed each goal correctly.

	Problem#1	Problem#2	Problem#3	Problem#4	Problem#5
I underlined all numbers at the top of the subtraction problem that were smaller than their matching numbers at the bottom of the problem. Did the student succeed in this behavior goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N
I wrote all numbers carefully so that I could read them easily and not mistake them for other numbers. Did the student succeed in this behavior goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N
I lined up all numbers in the right place-value columns. Did the student succeed in this behavior goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N
I rechecked all of my answers. Did the student succeed in this behavior goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N

Math Self-Correction Checklist

Student Name: _____ Date: _____

Rater: Student Classroom: _____

Directions: To the Student: BEFORE YOU START: Look at each of these goals for careful math work before beginning your assignment. AFTER EACH PROBLEM: Stop and rate YES or NO whether you performed each goal correctly.

	Problem#1	Problem#2	Problem#3	Problem#4	Problem#5
_____ Did the student succeed in this math goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N
_____ Did the student succeed in this math goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N
_____ Did the student succeed in this math goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N
_____ Did the student succeed in this math goal? ❑ YES ❑ NO	__Y __N	__Y __N	__Y __N	__Y __N	__Y __N