

Mathematics Interventions

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Effective teaching components

- Evidence-based teaching practices are the key to high quality interventions
 - Objective for the lesson (concrete and measurable), including a rationale
 - Motivational activities to get students interested in and excited about the lesson
 - Modeling
 - Guided practice
 - Independent practice
 - Assessment

Making decisions about intervention implementation

- Assessment
 - Task analysis
 - Error analysis
 - Checklists of skills
 - Interviews
 - Can use the CBM mathematics probes diagnostically, but remember that they do not include all essential skills. They are indicators.

Review by Gersten, Baker, Chard (2006)— centeroninstruction.org

- Practices with moderate to large effect sizes for students at-risk or students with special needs:
 - Visual and graphic depictions
 - Systematic and explicit instruction
 - Student think-alouds
 - Structured peer-assisted learning activities
 - Formative assessment data provided to teachers and/or students

Recommendations from the experts

- Doing what works: <http://dww.ed.gov/index.cfm>
- Helping your child learn mathematics: <http://www.ed.gov/parents/academic/help/math/math.pdf>
- Mathematics curriculum focal points (NCTM): <http://nctm.org/standards/focalpoints.aspx?id=298>
- Lesson plans from NCTM (sample, pgs. 23-25)
 - illuminations.nctm.org
- Institute on Educational Sciences (IES) report on assisting students struggling with math: http://ies.ed.gov/ncee/wwc/pdf/practiceguides/r/ti_math_pg_042109.pdf

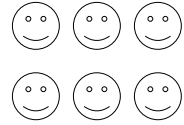
IES Report

- Practices with strong evidence:
 - Explicit and systematic instruction
 - Solving word problems using common underlying structures
- Practices with moderate evidence:
 - Screening
 - Working with visual representations
 - 10 minutes per session on basic facts
- Practices with low evidence:
 - Intense focus on whole numbers K-5 and rational numbers 4-8
 - Progress monitoring
 - Motivational strategies

Visual and graphic depictions

Sequencing of Skills

- Concrete-to-Semiconcrete-to-Abstract (CSA)
 - Concrete: manipulatives
 - Semiconcrete: pictures
 - Abstract: number symbols
- Use *parallel modeling*
 - Relate manipulation of concrete objects or pictures immediately to number symbols
- Remember:
 - Conceptual understanding and automaticity are different skills



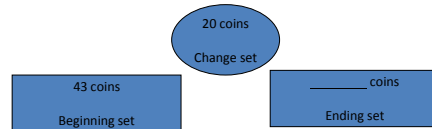
1. "How many rows?"
2. "How many faces in each row?"
3. "How many in all?"

Schema-based strategy instruction

- Researched with grades 2-8 (see Xin & Jitendra, 2006, for example)
 - Goal for students is to identify the schema, or type of problem, and use that information to solve the problem
 - Four interrelated steps
 - Identify the problem schema (i.e., a "compare" problem)
 - Generate a representation for the schema identified
 - Plan how to solve the problem, including setting a final goal, subgoals, selecting the appropriate operation, and writing the math sentence or equation
 - Carry out the plan

Change problem

Stacy had 43 coins in her coin collection. She lost 20 of them when she moved from one house to another. Now Stacy has ____ coins.



Group problem

Jim has _ baseball cards in his collection. 20 are from the St. Louis Cardinals and the remaining 15 are Kansas City Royals players.



Your turn...

Erica baked 3 dozen chocolate chip cookies and Gary ate 6 of them. Now Erica has ____ cookies to take to the office.

1. What type of schema (change, group, compare?)
2. Generate a representation
3. Plan how to solve the problem
4. Carry out the plan

Systematic and explicit instruction

Basic Instructional Plan

- Key features
 - Evidence-based techniques combined into one, 20-minute lesson
 - Can be used with a variety of levels of students
 - Individually or small group
 - Can use any type of material
 - Can use with any skill
 - Highly engaging and motivation is built in

BIP—example

- Model and sample in your handout packet (model, pgs. 26-27; sample, pgs. 28-29)

BIP—create your own

- Work with a partner to fill in the blanks on the BIP
 - Decide what you'll be using for progress monitoring
 - Decide on your skill
 - Make some notes about examples and non-examples
 - What vocabulary will you choose? See examples on pg. 30-31
 - How will you provide modeling, guided, and independent practice?
 - Examples of real-world problems?
 - How will you wrap up your lesson?

Student think-alouds

Sample Problem-Solving Strategies

Montague (1992)

1. Read for understanding
2. Paraphrase in your own words
3. Visualize a picture or diagram
4. Hypothesize a plan to solve the problem
5. Estimate or predict the answer
6. Compute the answer
7. Check to be sure everything is correct

Miller, Strawser, & Mercer (1996)

1. Read the problem
2. What is the question the problem asks?
3. To answer the question, do I have to:
 ___ Add ___ Subtract
 ___ Multiply ___ Divide
4. What information is not needed?
5. Write out the problem using numbers
6. Solve the problem
7. Check the answer

Sample Problem-Solving Strategies

Fleischner, Nuzum, & Marzola (1987)

1. Read
What is the question?
2. Reread
What is the necessary information?
3. Think
Putting together means addition
Taking apart means subtraction
4. Solve
Write the equation
5. Check
Recalculate, label, & compare

Generic

1. Read problem
- circle unknown words (ask)
- underline cue words
2. Choose operation
3. Write down necessary numbers
4. Cross out unnecessary information
5. Write equation
6. Solve problem
7. Check answer. Ask yourself, does this make sense?

Structured peer-assisted learning activities



Peer-Assisted Learning Strategies (PALS): A Multiple Strategy Intervention

<http://kc.vanderbilt.edu/pals/>

PALS Research

- Based on Juniper Gardens ClassWide Peer Tutoring model
- Has over 10 years of experimental research
- Used in Title 1 and Non-Title 1 Schools
- Implemented in urban and suburban schools
- Includes high, average, and low achievers as well as students with disabilities

Critical Features of PALS

- Supplemental reading practice several times per week (30-45 min. each session, depending on grade level and activities)
- Structured activities
- Reciprocal roles (Coaches and Readers)
- Individualized support--corrective feedback
- More time on task with active engagement
- Inclusion of all students with built-in opportunities for success
- Facilitation of positive peer interactions
- Opportunities to monitor student progress
- Practical AND effective strategies

General Procedures for PALS

- PALS is conducted three times each week (about 30-45 min. per session) but four times is recommended in Title I schools or very low-achieving schools.
- Students are rank ordered, split in half, and stronger readers in top half are paired with weaker readers in bottom half.
- Each pair is assigned to one of two teams.
- Teams and pairs remain together for 3-4 weeks, and partners work to earn points for their team each week.
- Within pairs, the stronger reader reads first to provide a model, but coach and reader roles are switched during each activity.
- Partners read text at the level of the weaker reader.
- Teachers monitor students, provide help, and award bonus points for good tutoring behaviors.

Points

- ❖ Students earn points for the team total by:
 - Completing the standard reading activities,
 - Cooperating with their partners,
 - Praising their partners,
 - Giving specific compliments,
 - Remaining on-task.
- ❖ Points are totaled at the end of each week. Winning team might bow while the 2nd place team claps, after which the 2nd place team bows and the winning team claps (in recognition of the 2nd place team's good effort.)

PALS Activities for Kindergarten and First-Grade Students

Includes Teacher-Led Practice and Partner Activities Conducted in Pairs:

- Kindergarten
 - The focus of PALS Math is on number recognition, number concepts, and the development of a mental number line representation. Tasks include: associating numerals with their numerical value, playing games involving “more” and “less,” and working with number lines to compare the placement and value of numbers. Early concepts of addition and subtraction are also introduced with an emphasis on number stories
- First Grade
 - PALS-Math becomes more challenging. In addition to a strong focus on number recognition and the development of a mental number line representation, emphasis is on place value within numeration, number concepts, and addition and subtraction concepts. The first-grade PALS curriculum also addresses missing addends and mathematical operations, and the number values extend to the hundreds.

Lesson 6 Day 1A

How many?			
How many?			
Which is less?			

- This is a sample gameboard from a Kindergarten lesson focusing on More and Less. The Coach asks the Player the amount for each picture and the Player determines which is less. (pg. 32)

Lesson 14 Day 1B

How many do you start with?	8 + 1 = 9
How many do you add or take away?	3 + 5 = 8
	5 + 2 = 7
Now how many?	1 + 4 = 5
	7 + 2 = 9
	4 + 3 = 7

- This is a sample gameboard from a Kindergarten lesson focusing on Addition and Subtraction. The Coach walks the Player through each problem as the Player uses beans to add the numbers together. (pg. 33)

Lesson 17 Day 3A

Do you add or take away?	79 - 41	22 + 23	45 - 43
Where do you start?	Tens Ones	Tens Ones	Tens Ones
Write it.	80 + 6	40 + 35	67 - 37
Where do you move?			
Write it.	58 - 54	95 - 50	25 + 34
Read it and break it down.	86 + 2	74 - 70	85 + 14

This is a sample gameboard from a 1st grade lesson focusing on Addition and Subtraction. The Coach asks the questions on the left side as the Player adds or subtracts each problem. (pg. 34)

Lesson 4 Day 2A

What number?	14	19	3	11	9
Find it on the number line.	12	7	19	1	15
What number is 1 more than ...?	3	17	13	5	18
What number is 1 less than ...?	19	1	12	8	16

- This is sample gameboard from a 1st-grade lesson on More and Less. The Coach asks the question on the left hand side as the Player uses a number line to determine more and less. (pg. 35)

Peer-assisted learning strategies (PALS) in Math (2-6), pg. 36

<http://kc.vanderbilt.edu/kennedy/pals/>

- 2 basic procedures
 - Coaching
 - Practicing
- Coaching
 - During coaching, students work on a sheet of problems in the skill area (e.g., adding, subtracting with regrouping, number concepts, charts, and graphs) to which they have been assigned
 - The coach uses a sheet that contains a series of questions, differing by problem type, designed to guide the player (pg.)
 - Coaches also use a correction procedure. Coaching usually lasts 15-20 minutes. Materials are available for kindergarten through grade 6.
- Practicing
 - During practice, every student receives a mixed-problem worksheet containing the problem type just worked on, as well as easier types of problems. Students work independently until about two-thirds of class are finished. Students then exchange papers and score each others' practice sheets. Practice lasts 5-10 minutes.
- Students earn points for cooperating and constructing good explanations during coaching and for doing problems correctly during practice.

Pg. 37 2Fr

**Fractions
Coach's Question Sheet**

1. Look at the picture.
2. How many parts are there in all?
3. Write the number on the bottom.
4. How many shaded parts are there?
5. Write the number on the top.
6. What is the fraction?

Pg. 38 2Fr Day 1

**Fractions
Coaching Sheet**

Player's Name _____ Date _____
Coach's Name _____

Write the fraction for the shaded part.

Pg. 39 2Fr Day 1

**Fractions
Practice Sheet**

Name _____ Date _____
Scored by _____

Write the fraction for the shaded part. (BOTH blanks must be correct to get 1 point.)

A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.

- ### PALS math materials
- Applications
 - Counting
 - Number concepts
 - Names of numbers
 - Measurement
 - Charts/Graphs
 - Money
 - Fractions
 - Applied Computation
 - Word Problems
 - Computation
 - Adding basic facts
 - Adding w/o regrouping
 - Adding w/ regrouping
 - Subtracting basic facts
 - Subtracting w/o regrouping
 - Subtracting w/ regrouping

Formative assessment data provided to
teachers and/or students

- ### Error Analysis
- Discovering patterns of errors by analyzing student's work samples
 - Goal is identification of error patterns
 - Work sample is scored
 - All errors are noted
 - An attempt is made to sort the errors into meaningful categories
 - Random responding
 - Basic fact error
 - Wrong operation
 - Defective algorithm
 - Place value problems

344	24	14
<u>-192</u>	<u>x2</u>	<u>x6</u>
536	77	246
39	84 / 4 = 20	
<u>+42</u>		
711		

Assessment & Error Analysis

- Construct probes with representative problem types
- Have student complete probe and either
 - Talk while doing problems
 - Tell you after each problem how he or she solved the problems

- Sample problems:

Find the error

1.45 2. 15 3. 743

+64 x 5 + 581

19 525 235

1. Added all numbers together (defective algorithms, no regard for place value)
2. Student does not regroup (carry)
3. Student adds numbers from left to right (and carries to column on right)

Task analysis

- Analyzing a task by breaking it down into the smallest steps or skills
- Used with a task where the student experiences difficulty
 - If the task is part of the standard curriculum, the teacher may have to access the scope and sequence charts that describe the task's subcomponents
 - The teacher can determine the important task components

Questions for discussion

- What are the critical areas of need for our students in math?
- How can we address these needs or how are we addressing these needs?
- Additional resources on pages 40-44.