

Designing, Implementing, and Monitoring Effective Mathematics Intervention for Students At-Risk

Dr. Erica Lembke
University of Missouri
lembkee@missouri.edu

Overview

- Mathematics assessment to inform instruction
- Evidence-based mathematics interventions

Mathematics measures

Early numeracy
Elementary
Middle and High School

Math CBM and early intervention

- Important to identify students that are at-risk in math early
- Relationship between number sense and deficit areas in LD (Geary, 1993; McCloskey and Macaruso, 1995)
- What measures can we use to screen and progress monitor students in early elementary grades?

In math, what measures for early numeracy?

- First, define early numeracy components
- Second, need to address key components of CBM measures (reliability, validity, sensitivity, for example)
- Number identification, quantity discrimination, missing number, mixed numeracy

Brief directions for Early numeracy tasks

- For all early numeracy tasks:
 - For kindergarten or first grade students.
 - After completing some sample items, the student works for 1 minute.
 - Teacher writes the student's responses on the score sheet.
- Number identification
 - Student is asked to orally identify the written number between 0 and 100.
- Quantity Discrimination
 - Student is asked to orally identify the larger number from a set of two numbers
- Missing number
 - Student is asked to orally identify the missing number in a sequence of four numbers

Number Identification

Student Copy
of a Number
Identification
test

- Actual student copy is 3 pages long

Number Identification, page 1—Student copy

12	17	5	5
34	13	3	10
37	45	20	13
45	64	31	12
23	10	17	47
17	49	58	1
14	23	6	23

Quantity Discrimination

Student Copy of a
Quantity
Discrimination test

- Actual student copy is 3 pages long.

Quantity discrimination, page 1—student copy

3	7	8	5	13	16
16	2	13	12	9	0
4	11	8	1	1	11
5	0	2	10	10	9
7	1	8	7	16	2
0	7	1	0	9	1
6	0	9	19	5	1

Missing Number

Student Copy of a Missing Number Test

- Actual student copy is 3 pages long.

Missing Number, page 1—Student copy

3 4 ___ 6	___ 4 5 6	___ 8 9 10
5 6 ___ 8	60 70 80 ___	14 16 18 ___
2 3 4 ___	70 80 90 ___	6 7 ___ 9
40 50 60 ___	0 1 2 ___	4 ___ 6 7
0 1 ___ 3	30 35 40 ___	1 2 ___ 4
___ 1 2 3	2 ___ 4 5	1 ___ 3 4
3 4 ___ 6	2 3 4 ___	___ 2 3 4

Probe availability

K-1 Probes (Oral Counting, Quantity Discrimination, Missing Number, Number Identification)

- www.progressmonitoring.org
- www.aimsweb.com

- Measures now available for data collection electronically: wirelessgeneration.com, mclass math

Elementary Measures

Computation

- For students in grades 1–6.
- Student is presented with 25 computation problems representing the year-long, grade-level math curriculum.
- Student works for set amount of time (time limit varies for each grade).
- Teacher grades test after student finishes.

Computation

Student Copy of a First Grade Computation Test

Sheet #1		Computation 1				
Password: ACT						
Name: _____			Date: _____			
A $\begin{array}{r} 0 \\ +3 \\ \hline 8 \end{array}$	B $\begin{array}{r} 7 \\ +2 \\ \hline 9 \end{array}$	C $\begin{array}{r} 0 \\ +7 \\ \hline 7 \end{array}$	D $\begin{array}{r} 54 \\ +23 \\ \hline 77 \end{array}$	E $\begin{array}{r} 7 \\ +2 \\ \hline 9 \end{array}$		
F $\begin{array}{r} 10 \\ -0 \\ \hline 10 \end{array}$	G $\begin{array}{r} 9 \\ +0 \\ \hline 9 \end{array}$	H $\begin{array}{r} 0 \\ +9 \\ \hline 9 \end{array}$	I $\begin{array}{r} 6 \\ -0 \\ \hline 6 \end{array}$	J $\begin{array}{r} 8 \\ -5 \\ \hline 3 \end{array}$		
K $\begin{array}{r} 10 \\ -1 \\ \hline 9 \end{array}$	L $\begin{array}{r} 8 \\ -1 \\ \hline 7 \end{array}$	M $\begin{array}{r} 10 \\ -7 \\ \hline 3 \end{array}$	N $\begin{array}{r} 1 \\ 7 \\ +1 \\ \hline 8 \end{array}$	O $\begin{array}{r} 6 \\ -2 \\ \hline 4 \end{array}$		
P $\begin{array}{r} 65 \\ +23 \\ \hline 88 \end{array}$	Q $\begin{array}{r} 45 \\ -4 \\ \hline 41 \end{array}$	R $\begin{array}{r} 5 \\ +1 \\ \hline 6 \end{array}$	S $\begin{array}{r} 8 \\ 1 \\ +0 \\ \hline 9 \end{array}$	T $\begin{array}{r} 7 \\ -5 \\ \hline 2 \end{array}$		
U $\begin{array}{r} 8 \\ +1 \\ \hline 9 \end{array}$	V $\begin{array}{r} 99 \\ -8 \\ \hline 91 \end{array}$	W $\begin{array}{r} 10 \\ -3 \\ \hline 7 \end{array}$	X $\begin{array}{r} 9 \\ -7 \\ \hline 2 \end{array}$	Y $\begin{array}{r} 9 \\ +1 \\ \hline 10 \end{array}$		

Computation

Sixth Grade Computation Test

Sheet #1		Computation 6				
Password: ARM						
Name: _____			Date: _____			
A $\frac{3}{9} - \frac{1}{3} =$	B $\begin{array}{r} 2.66 \\ \times 5.4 \\ \hline \end{array}$	C $5\frac{3}{5} - 3\frac{2}{5} =$	D $\begin{array}{r} 15961 \\ + 92307 \\ \hline \end{array}$	E $\begin{array}{r} 23281 \\ - 16754 \\ \hline \end{array}$		
F $\begin{array}{r} 2.591 \\ + 7.6588 \\ \hline \end{array}$	G $\begin{array}{r} 65983 \\ + 56937 \\ \hline \end{array}$	H $.13\overline{)884}$	I $122\overline{)8614}$	J $3 \times \frac{1}{2} =$		
K $\begin{array}{r} 5952 \\ \times 248 \\ \hline \end{array}$	L $7\frac{2}{7} + 1\frac{2}{5} =$	M $45\overline{)65}$	N $3\frac{3}{3} + 8\frac{2}{5} =$	O $\begin{array}{r} 3.4423 \\ - 1.23 \\ \hline \end{array}$		
P $\frac{2}{9} \times \frac{2}{5} =$	Q $81\overline{)9501}$	R $\begin{array}{r} 1.292 \\ \times 1.7 \\ \hline \end{array}$	S $1.3\overline{)598}$	T $\frac{7}{9} + \frac{2}{5} =$		
U $\begin{array}{r} 3996 \\ \times 168 \\ \hline \end{array}$	V $7 + \frac{1}{5} =$	W $\frac{3}{4} \div \frac{2}{6} =$	X $9\frac{3}{10} - 3\frac{3}{5} =$	Y $\begin{array}{r} 55867 \\ - 32719 \\ \hline \end{array}$		

Computation

- Length of test varies by grade.

Grade	Time limit
First	2 min.
Second	2 min.
Third	3 min.
Fourth	3 min.
Fifth	5 min.
Sixth	6 min.

Computation

- Students receive 1 point for each problem answered correctly or each digit answered correctly.
- The number of correct answers or digits within the time limit is the student's score.

Concepts and Applications

- For students in grades 2–6.
- Student is presented with 18–25 Concepts and Applications problems representing the year-long grade-level math curriculum.
- Student works for set amount of time (time limit varies by grade).
- Teacher grades test after student finishes.

Concepts and Applications

Student Copy of a Concepts and Applications test

- This sample is from a second grade test.
- The actual Concepts and Applications test is 3 pages long.

Name _____ Date _____ Test 3 Page 1

Column A Applications 2 Column B

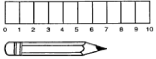
(1) Write the number in each blank.

_____ two
 _____ eleven
 _____ thirteen

(2) Write + or - in the blank.

9 _____ 2 = 11

(3) How long is the pencil?



_____ units


(4) Counting by 3's, fill in the blanks.

64, 67, 90, _____

(5) Write the number in the blank.

1 + 7 = _____ + 1

(6) Favorite Toys



Write the number in each blank.



How many votes did video games get? _____

How many fewer votes did remote control cars get than board games? _____

How many more votes did dolls get than board games? _____

Concepts and Applications

Fifth Grade Concepts and Applications Test

Column A	Applications 5	Column B
<p>Name _____ Date _____ Test 4 Page 1</p> <p>(1) Area of rectangle = length x width</p>  <p>Area = _____ sq. ft.</p>	<p>(5) Find the average of these numbers. 5, 13, 3, 8, 6 Arithmetic mean = _____</p>	
<p>(2) Round to the nearest thousand: 65,721 _____</p>	<p>(6) Write the letter P next to prime numbers and the letter N next to numbers that are not prime. _____ 7 _____ 10</p>	
<p>(3) Write a letter in each blank</p>  <p>_____ center _____ diameter</p> <p>(A) point Q (B) segment QS (C) segment RS (D) segment ST</p>	<p>(7) Gum is priced 4 packs for \$1.00. Bill bought 1 pack. He gave the clerk a \$5.00 bill and received change in the least number of bills and coins. How many of each were there? (If none, write the number zero.) _____ \$5 bills _____ \$1 bills _____ quarters</p>	
<p>(4) Reid drove 17.8 miles on Saturday and 10.5 miles on Sunday. How many miles did he drive altogether? _____</p>	<p>(8) Look at this number. 1,238.647 Which digit is in the millions place? _____ Which digit is in the ten thousands place? _____</p>	

Concepts and Applications

- Length of test varies by grade.

Grade	Time limit
Second	8 min.
Third	6 min.
Fourth	6 min.
Fifth	7 min.
Sixth	7 min.

Concepts and Applications

- Students receive 1 point for each blank answered correctly.
- The number of correct answers within the time limit is the student's score.

Probe availability—Math

- Monitoring Basic Skills Progress (MBSP), Fuchs, L.S., Hamlett, & Fuchs, www.proedinc.com
- www.aimsweb.com
 - Early numeracy measures
 - Computation and concepts and applications probes
- www.edcheckup.com
 - Math facts probes
- www.interventioncentral.org
 - Math facts probes
- Easycbm.com
- Middle and high school measures—check Anne Foegen's (Iowa State) work:
http://www.ci.hs.iastate.edu/aaims/training_opportunities.php

Mathematics Interventions

Where do students struggle in mathematics?

- Computation
 - Do not know basic addition, subtraction, multiplication, & division facts
 - Cannot use to solve complex problems
- Automaticity
 - Cannot automatically and efficiently execute arithmetic operations
- Word Problems
 - Difficulty solving even simple word problems
 - Special difficulties if problems contain irrelevant information
 - Do not have strategies for solving word problems
- Motivation
 - Low motivation

Effective teaching components

- Evidence-based teaching practices are the key to most 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
 - Interviews
 - Can use the CBM numeracy probes diagnostically, but remember that they do not include all essential skills. They are indicators.

Recommendations for resources

- 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
- IES practice guide: http://ies.ed.gov/ncee/wwc/pdf/practiceguides/rti_math_pg_042109.pdf
- Center on instruction mathematics resources: <http://www.centeroninstruction.org/topic.cfm?s=1&k=ST&c=2>

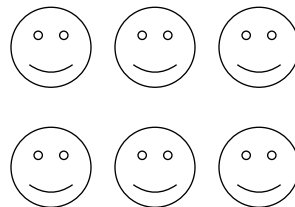
Review by Gersten, Baker, Chard (2006)—centeroninstruction.org

- 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

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



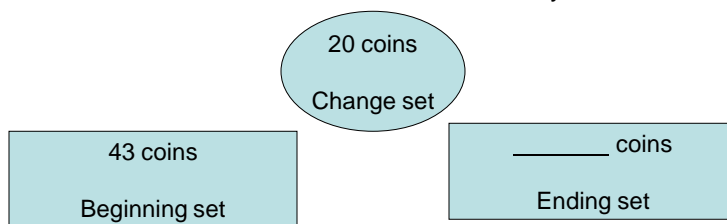
1. "How many rows?"
2. "How many faces in each row?"
3. "How many in all?"

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., change, group, compare problems)
 - 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.



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

Basic Instructional Plan in Math for 1st grade
Topic: Addition

1

Instructional Activities	Tch/Stu Ratio	Time	Materials	Motivational Plan
<u>Administer Progress Monitoring Probe</u> T: Administer early numeracy probe(s) to student, using standardized procedures. Score and graph following the lesson	1:1-5	3 min	Probes, pencil	Increasing score on probe. Timed task.
<u>Review</u> T: The last time we met we talked about skip counting. T: Skip counting means that we count by 5's, or 10's. So if I count by 5's like 5-10-15-20, I'm skip counting. What does skip counting mean? T: Have each student skip count by 2's to 50 and by 10's and 5's to 100.	1:1-5	3 min	Dry erase board or paper to practice problems, pencil	Success on a previously introduced topic
<u>Lesson objective and rationale</u> T: Today we are going to move on to a new topic and we're going to talk about adding. Adding means putting two numbers or groups of objects together. It's important to be able to add so that we know how many things there are altogether. This will help us at home and school. What is another way that adding can help us?	1:1-5	1 min	None	Establish relevance
<u>Math Vocabulary</u> T: The words that we're going to talk about today are add and altogether (write word on the board). When you add, it means that you put two numbers or groups of objects together to get the total. When you put groups together, you find out how many there are altogether. T: If I put five counters and 4 counters together and count them all, (model) am I adding? If I put 3 counters out and count them, am I adding? (model) (give at least one example and one non-example to each student. Use groups of counters that total less than 20) S: Respond T: who can think of another example of adding? What is not an example of adding? (have students say the answer out loud. Have each student give an example and a non-example) S: Respond T: What does it mean to add?	1:1-5	5 min	none	Positive praise
<u>Skill/Concept Development</u> T: We just practiced adding a little bit. First we count one group of objects and then we keep counting the other group of objects to get the total. If I have this group of counters (5 counters) and this group (5 counters), I would start by counting how many are in one group (1-2-3-4-5) and then keeping counting to add the second group (5-6-7-8-9-10). So 5 added to 5 is 10. (Demonstrate with 2 other groups of counters). T: Now count with me as I point to a group and count the squares and then add the other group of counters. (model using 7 counters and 5 counters). Lets do another one (model using 8 counters and adding on 3 counters. Each time make sure to say "so 3 added to 5 equals 8" or whatever the problem and answer was.) T: Can you show me two groups of counters (have each student give you an example)? How would you add these two groups? (have them show you one at a time). Now make two groups and have a friend add the two groups. Make sure to say the numbers (like 3 added to 5 equals 8) after each one. T: Now I want you to work on adding some groups. Here is a math page with addition problems (use page with	1:1-5	13 min	Writing material and writing utensil (i.e., paper, pencil, dry erase, marker); counters	Teacher support

2

monkey on it). Write the answer on the line and under the problem. Use the counters if you need to. Then say the problem and answer to yourself. Lets practice the first one together. (Use counters to model, if necessary. Keep going through them one at a time, if you need to.) If you get done early, write an addition fact on the back of your page for a friend to solve.				
<u>Problem solving and wrap up</u> T: So today we practice adding some groups of pictures together. If you are at lunch and you have 6 cookies and your friend has 3 cookies, how many cookies do you have altogether? If you have 9 carrots and your mom has 4 carrots, how many do you have altogether? If you have 5 pieces of gum and your friend has 1 piece, how many pieces do you have altogether? Can you give us a story problem to solve? T: What was one word that we learned about today? What does that mean? Give me an example.	1:1-5	5 min	Writing material and writing utensil (i.e., paper, pencil, dry erase, marker)	Opportunity for generalization

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)

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

- Evidence-based classwide peer tutoring program in reading and math (Fuchs, Fuchs, and Karns, 2001)
- Validated instructional practices that strengthen general education's capacity to meet academic needs of increasingly diverse population in classrooms
- Materials for grades K, 1, and 2-6 in Math
 - Has demonstrated moderate effect sizes on computation performance with HS students with math disabilities (Calhoun & Fuchs, 2003)

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 or replacement math practice
- Structured activities
- Reciprocal roles (Coaches and Players)
- 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

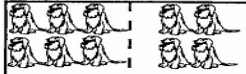

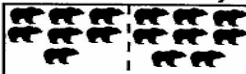
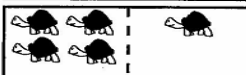


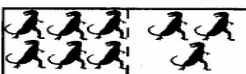
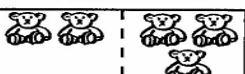
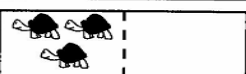

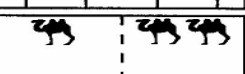

- PALS is conducted 2-3 times each week (about 20-40min. per session)
- Students are rank ordered, split in half, and stronger students in top half are paired with weaker students in bottom half
- For K-1, teachers direct the lesson on day 1, students work together on gameboards on days 2 and 3
- Points are given for working quietly, giving positive praise, working only on PALS activities.

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 8 Day 1A

How many?			
How many?			
Which is less?			
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.

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.

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.









$58 - 54$ $95 - 50$ $25 + 34$

Tens Ones Tens Ones Tens Ones

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.

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.

Peer-assisted learning strategies (PALS) in Math (2-6)

<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.

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?

Fractions
Coaching Sheet

Player's Name _____ Date _____

Coach's Name _____

Write the fraction for the shaded part.

				
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
				
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
				
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<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Fractions
Practice Sheet

2Fr Day 1

Name _____ Date _____

Scored by _____

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

A.



$$\frac{\square}{\square}$$

B.



$$\frac{\square}{\square}$$

C.



$$\frac{\square}{\square}$$

D.



$$\frac{\square}{\square}$$

E.



$$\frac{\square}{\square}$$

F.



$$\frac{\square}{\square}$$

Solve. (1 point each)

G. $\frac{15}{-8}$

H. $\frac{7}{+2}$

I. $\frac{13}{+3}$

J. $\frac{16}{+4}$

K. $\frac{4}{+9}$

L. $\frac{5}{+8}$

M. $\frac{7}{+4}$

N. $\frac{13}{-9}$

O. $\frac{13}{+4}$

P. $\frac{14}{+5}$

Q. $\frac{8}{-4}$

R. $\frac{16}{-2}$

S. $\frac{7}{+8}$

T. $\frac{14}{+3}$

U. $\frac{17}{-9}$

V. $\frac{14}{-5}$

W. $\frac{11}{+4}$

X. $\frac{12}{-3}$

Y. $\frac{13}{+7}$

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

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

$$\begin{array}{r} \underline{+64} \\ 19 \end{array} \quad \begin{array}{r} \underline{\times 5} \\ 525 \end{array} \quad \begin{array}{r} \underline{+ 581} \\ 235 \end{array}$$

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)

Wrap up, questions,
evaluation

Conclusion, questions

- How will you determine what interventions to implement?
- How can you use parts of what we've discussed today? Or all of what we've discussed today?
- Further questions?
- Check CBM resources/references in the back of your packet
- Please complete the evaluation. Thank you!