Screening in Mathematics: Building Effective Systems

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Successful Learning Conference
Sydney, Australia
June 28 , 2016

Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools

Copies are available on the IES website:
http://ies.ed.gov/ncee
http://ies.ed.gov/ncee/wwc/publications/practiceguides/

Search for Coherence

Panel works to develop 5 to 10 assertions that are:

- Forceful and useful
- And COHERENT
- Do not encompass all things for all people
- Do not read like a book chapter or article

Challenges for the panel:

- State of math research
- Distinguishing between tiers of support

Jump start the process by using individuals with topical expertise and complementary views

Structure of the Practice Guide

- Recommendations
- Levels of evidence
- How to carry out the recommendations
- Potential roadblocks & suggestions

Recommendation 1

Screen all students to identify those at risk for potential mathematics difficulties and provide interventions to students identified as at risk

– Level of Evidence: **Moderate**

Screening Assessment

- Purpose: To determine children who are likely to require additional instructional support (predictive validity)
- When: Early in the academic year or when new students enter school. May be repeated in the Winter and Spring
- Who: All students
- Relation to instruction: Most valuable when used to identify children who may need further assessment or additional instructional *support*

Technical Evidence

- Correlational design studies
  - Greater evidence in the earlier grades
  - Reliability typically included inter-tester, internal consistency, test-retest, and alternate form
    - Most fall between r=.8 to .9
  - Validity primarily focused on criterion related with an emphasis on predictive validity
    - Most fall between r=.5 to .7
  - Measures are beginning to report on sensitivity and specificity

Content (1)

- Content of Measures
  - Single aspect of number sense (e.g., strategic counting) – most common in earlier grades
  - Or broad measures incorporating multiple aspects of number
    - Some measures are combination scores from multiple single aspect measures
  - Measures reflecting the computation and concepts, and applications objectives for a specific grade level – most common in later grades
    - Often referred to as CBM or General Outcome

Content (2)

- Promising measures include
  - Word problems
  - Pre-algebra and algebra skills
  - Based on state standards or NCTM/NMAP benchmarks

Features

- Short duration measures (1 minute fluency measures)
  - Note many measures that are short duration also used in progress monitoring
- Longer duration measures (untimed up to 20 minutes) often examine multiple aspects of number sense
  - Issue of purpose is critical to examine
- Most research examines predictive validity from Fall to Spring.

Examples: Single aspect number sense

– Example: Magnitude comparison

12 3	4 1	5 11	9 4

– Example: Strategic counting

__ 13 14	6 __ 8	3 4 __

Example – Single aspect of number sense

- Base 10 understanding – addition and subtraction problems that require cross 10
  - 7 + 5
  - 15 - 9

Example: Multiple aspects number sense

- Number Knowledge Test
  - Level 1
    - If you had 4 chocolates and someone gave you 3 more, how many chocolates would you have?
    - Which is bigger: 5 or 4?
  - Level 3
    - What number comes 9 after 999?
    - Which difference is smaller: the difference between 48 and 36 or the difference between 84 and 73?

Examples: 2nd grade and above

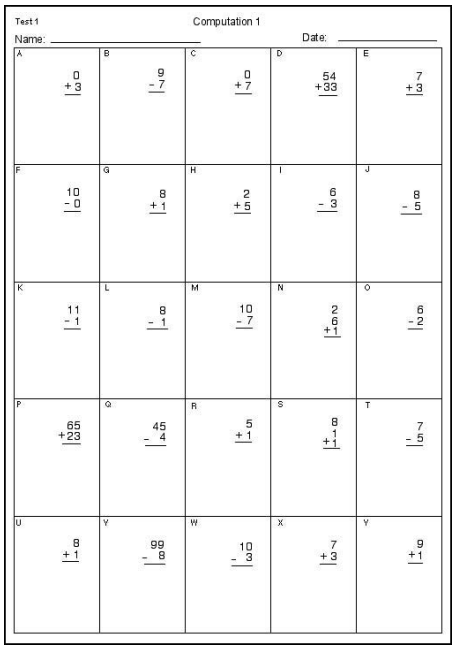
- Number combinations
- Word problems
- Grade-level computation objectives
- Grade-level concepts and applications
- Measures tied to CCSS; NMAP; Focal Points

General Outcome: Computation and Concepts, and Application Objectives

- For students in grades 1–6
- Student is presented with 25 computation or concepts and applications 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

15

Fuchs MBSP

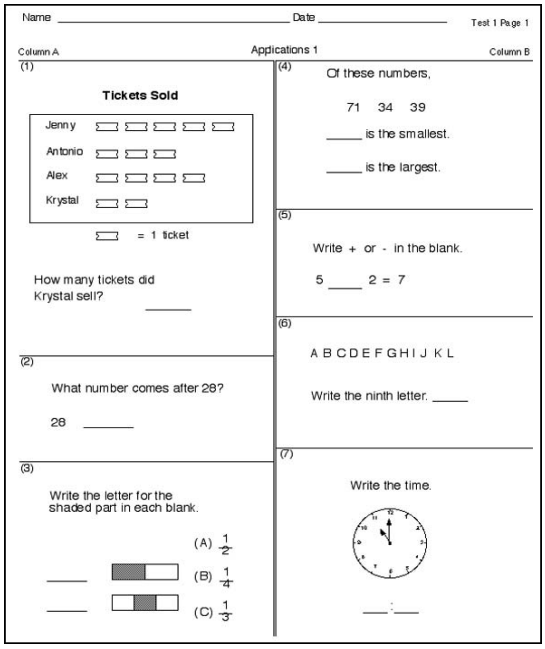


Test 1 Computation 1

Name: _____ Date: _____

A	B	C	D	E
0 + 3	9 - 7	0 + 7	54 +33	7 + 3
F	G	H	I	J
10 - 0	8 + 1	2 + 5	6 - 3	8 - 5
K	L	M	N	O
11 - 1	8 - 1	10 - 7	2 6 +1	6 - 2
P	Q	R	S	T
65 +23	45 - 4	5 + 1	8 1 +1	7 - 5
U	Y	W	X	Y
8 + 1	99 - 8	10 - 3	7 + 3	9 + 1

Fuchs MBSP



Name _____ Date _____ Test 1 Page 1

Column A — Applications 1 — Column B

(1)

Tickets Sold

Jenny
Antonio
Alex
Krystal

= 1 ticket

How many tickets did Krystal sell? _____

(2)

What number comes after 28?

28 _____

(3)

Write the letter for the shaded part in each blank.

_____ (A) $\frac{1}{2}$

_____ (B) $\frac{1}{4}$

_____ (C) $\frac{1}{3}$

(4)

Of these numbers,

71 34 39

_____ is the smallest.

_____ is the largest.

(5)

Write + or - in the blank.

5 ____ 2 = 7

(6)

A B C D E F G H I J K L

Write the ninth letter. _____

(7)

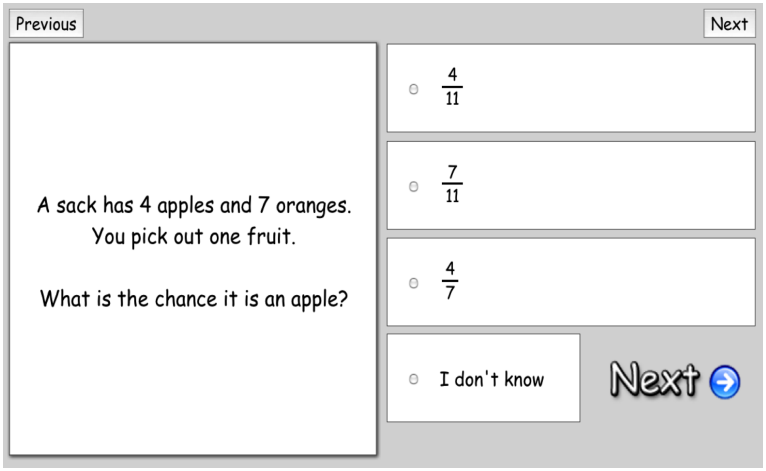
Write the time.

___:___

Example: Reflecting critical math content

- easy-CBM
- Items created according to NCTM Focal Points for grade level
- 48 items for screening (16 per focal point)
- Ongoing research (not reviewed in practice guide)

easy-CBM: Number and Operations



Middle School

- Algebra measures
  - Designed by Foegen and colleagues assess pre-algebra and basic algebra skills. Administered and scored similar to Math-CBM
- Math CBM Computation and Concepts and Applications
  - Concepts and Applications showed greater validity in 6th, 7th, and 8th grade

Basic Skills (in Algebra)

- 60 items; 5 minutes
- Problems include:
  - Solving basic fact equations;
  - Applying the distributive property;
  - Working with integers;
  - Combining like terms;
  - Simplifying expressions;
  - Applying proportional reasoning
- Scoring: # of problems correct

Basic Pre-algebra Skills

Solve: $9 + a = 15$ $a =$	Solve: $10 \text{ œ} 6 = g$ $g =$
Evaluate: $12 + (\text{œ}8) + 3$	Simplify: $9 \text{ œ} 4d + 2 + 7d$
Simplify: $2x + 4 + 3x + 5$	Simplify: $5(b \text{ œ} 3) \text{ œ} b$
Solve: $12 \text{ œ} e = 4$ $e =$	Solve: $q \bullet 5 = 30$ $q =$
Simplify: $4(3 + s) \text{ œ} 7$	Evaluate: $8 \text{ œ}(\text{œ}6) \text{ œ} 4$
Simplify: $b + b + 2b$	Simplify: $2 + w(w \text{ œ} 5)$
Solve: $\frac{b}{6} = \frac{12}{18}$ $b =$	Solve: 1 foot =12 inches 5 feet = ____ inches
Simplify: $7 \text{ œ} 3(f \text{ œ} 2)$	Simplify: $4 \text{ œ} 7b + 5(b \text{ œ} 1)$
Evaluate: $\text{œ}5 + (\text{œ}4) \text{ œ} 1$	Simplify: $s + 2s \text{ œ} 4s$
Solve: $63 \div c = 9$ $c =$	Solve: $x + 4 = 7$ $x =$
Simplify: $2(s \text{ œ} 1) + 4 + 5s$	Simplify: $\text{œ}5(q + 3) + 9$
Simplify: $8m \text{ œ} 9(m + 2)$	Evaluate: $9 + (\text{œ}3) \text{ œ} 8$

Suggestions (1)

- Have a building-level team select measures based on critical criteria such as reliability, validity, and efficiency
  - Team should have measurement expertise (e.g., school psychologist) and mathematics (e.g., math specialist)
  - Set up a screening to occur twice a year (Fall and Winter)
  - Be aware of students who fall near the cut scores

Suggestions (2)

- Select screening measures based on the content they cover, with an emphasis on critical instructional objectives for each grade level
  - Lower elementary: Whole Number
  - Upper elementary: Rational Number
  - Across grades: Computational Fluency (hallmark of mathematics learning disabilities)

Suggestions (3)

- In grades 4-8, use screening measures in combination with state testing data
  - Use state testing data from the previous year as the first cut in a screening system
  - Can then use a screening measure with a reduced pool of students or a more diagnostic measure linked to the intervention program for a second cut

Suggestions (4)

- Use the same screening tool across a district to enable analyzing results across schools
  - Districts may use results to determine the effectiveness of district initiatives
  - May also be used to determine systematic areas of weakness and provide support in that area (e.g., fractions)

Roadblocks (1)

- Resistance may be encountered in allocating time and resources to the collection of screening data
- Suggested Approach: Use data collection teams to streamline the data collection and analysis process

Roadblocks (2)

- Questions may arise about testing students who are "doing fine"
- Suggested Approach: Screening all students allows the school or district to evaluate the impact of instructional approaches
  - Screening all students creates a distribution of performance allowing the identification of at-risk students

Roadblocks (3)

- Screening may identify students as at-risk who do not need services and miss students who do
- Suggested Approach: Schools should frequently examine the sensitivity and specificity of screening measures to ensure a proper balance and accurate decisions about student risk status.

Sensitivity and Specificity

		Students at-risk	
		YES	NO
Students identified as at-risk	YES	True positive (A)	False positive (B)
	NO	False negative (C)	True negative (D)

Sensitivity: Number of students correctly identified as at-risk or A/(A+C)

Specificity: Number of students correctly identified as not at risk or D/(D+B)

Sensitivity and Specificity

- Cut score is set too high:
  - You have good sensitivity (all kids that need help are identified), but poor specificity (lots of kids who don't need help are identified)
- Cut score is set too low:
  - You have good specificity (most kids who don't need help will not be identified as at-risk), but poor sensitivity (you may miss many kids who do need help)

An example - easyCBM

- Sensitivity at least .90 - Johnson, Jenkins, Petscher, & Catts (2009)
  - Favors higher cut scores
- Sensitivity and Specificity at least .70 - Silberglitt & Hintze (2005)
  - Favors lower cut scores

Example cont.

- Winter 25th%ile criteria
- Johnson procedure = cut of 34
  - 70 students identified as at-risk
  - 22 truly at-risk
  - 48 false positives (provided non needed services)
  - 1 false negative (not provided needed services)

Example cont.

- Winter 25th%ile criteria
- Silberglitt procedure = cut score 30
  - 41 students identified at-risk
  - 18 truly at-risk
  - 23 false positives
  - 5 false negatives

Example cont.

- To identify 4 additional at-risk students; you over identify an additional 29 students
  - If small group instruction provided (3-5 students per group) an additional 6-10 groups are needed.
  - Impact on limited school resources
- Schools rarely discuss what "at-risk" means

Roadblocks (4)

- Screening may identify large numbers of students who need support beyond the current resources of the school or district
- Suggested Approach: Schools and districts should
  - Allocate resources to the students with the most risk and at critical grade levels; and
  - Implement school-wide interventions to all students in areas of school-wide low performance (e.g., fractions)

Activity

- Discuss with your team the screening process in your school including:
  - Measures utilized
  - Efficiency of measures
  - And Roadblocks encountered – solutions enacted or possible

How to start and next steps

- Focus on one grade or grade band
- Because there is accumulating evidence that math trajectories are established early and difficult to alter, K/1 may be a smart and strategic option
  - Greater comfort with whole number content and instruction
  - Greater array of researched and research-based instructional programs