Early Mathematics Assessment

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A lesson from reading: Perhaps?

- The trajectory of reading development led to a focus on prevention efforts
- Preventing the establishment of reading problems is now accepted practice dependent on…
  - Early identification assessments
  - Effective early literacy interventions
- Does the same pattern hold true for mathematics?

What about math?

- Does math develop in the same way as reading? That is, does it make “sense” to prevent math problems?
  - Less knowledge about long term trajectories
  - Emerging databases may help to answer this question (ECCLES, Jordan, Fuchs)
  - Emerging evidence suggests difficulty in math is relatively stable over time

What about math?

- We do know that math knowledge develops across multiple domains (e.g. number, geometry)
  - Students may be on-track in one area and at-risk in another
  - How these domains develop and interact continues to be researched
  - The importance of a logical scope and sequence is paramount

Characteristics of students with mathematics difficulties

- Different profile types exist for students with mathematics difficulties
- Students with mathematics difficulties often have
  - difficulty with quick and accurate retrieval of basic facts (Hasselbring, 88)
  - Working memory deficits (Geary, 94)
  - Difficulty in abstracting mathematical meaning from symbols

Types of Assessment

- Screening
- Diagnostic
- Progress Monitoring
- Each type of assessment requires measures with certain characteristics

Early Screening

- Brief screening measures
  - Used with all students to screen for risk status
  - Use with all students drives the design and construction of screening measures
  - Measures are of short duration and may be timed

Early Screening Cont.

- Goal is to maximize the amount of information collected in the minimum amount of time
- Predictive validity is critical (e.g. a low score in the Fall predicts difficulty at the end of the year)
- Predictive validity is to a broad measure of mathematics. That is we are predicting general outcomes.
- Screening instruments have been developed by a number of researchers and focus primarily on critical aspects of numerical proficiency and number sense

Number Sense

- Critical early mathematical skills may be centered around the concept of number sense.

- Number sense has been defined as:

  “a child’s fluidity and flexibility with numbers, the sense of what numbers mean, and an ability to perform mental mathematics and to look at the world and make comparisons”

  (Gersten & Chard, 1999)

Number Sense (Case, 98)

- ✓ Fluent, accurate estimation and judgment of magnitude comparisons.
- ✓ Flexibility when mentally computing.
- ✓ Ability to recognize unreasonable results.
- ✓ Ability to move among different representations and to use the most appropriate representation.

Numerical proficiency skills for early screening

- Strategic counting
- Magnitude comparison
- Number combinations
- Word problems
- Number identification (gateway skill)
- Sequence Counting (gateway skill)

Examples of Screening Measures

- Research line by Clarke and colleagues
- Four measures for K and 1st grade
  - EN-CBM Oral Counting measure
    - Students orally count for one minute. No student materials.
  - EN-CBM Number Identification measure

13	1	12	4	8	17	11	6

Early Numeracy CBM

- EN-CBM Quantity Discrimination measure (Magnitude Comparison)

12 3	4 1	5 11	9 4

- EN-CBM Missing Number measure (strategic counting)

__ 13 14	6 __ 8	3 4 __

Examples Cont. - CBM

- Fuchs and Colleagues
- CBM - Computation
- CBM - Concepts/Applications
- Also experimented with Number Combinations and Number Counting/Identification

Test 1

Computation 1

Name: _____ Date: _____

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

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

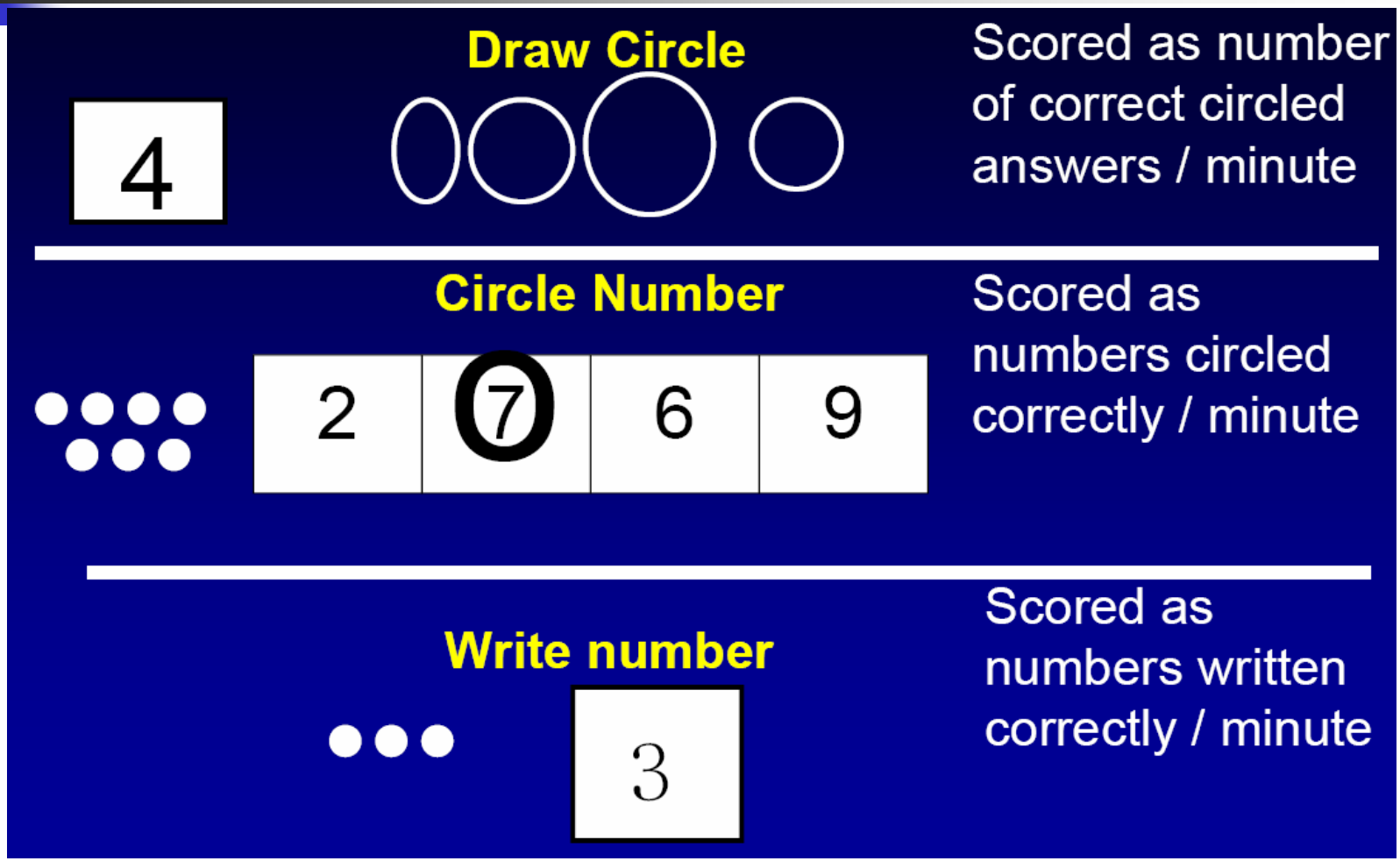
Write the ninth letter. _____

(7)

Write the time.

___ : ___

VanDerheyden: K-CBM



Examples with Key Variables

- Simple word problems (Jordan, 05)
  - Jill has two pennies. Jim gives her one more penny. How many pennies does Jill have now?
  - Mark has three cookies. Colleen takes away one of his cookies. How many cookies does Mark have now?
- Magnitude comparison/Number Identification (Mazzocco, 05)
  - Four items that predicted 3rd grade performance (also included number constancy and mental addition)

Diagnostic Measures

- In-depth measures
  - May not be used with all students
  - Provides greater information about student performance within a domain (e.g. number, geometry, measurement) or across multiple domains
  - Purpose is to provide diagnostic information about a student's strength and weakness and guide the development of appropriate instructional plans

Example: Number Knowledge Test

- Developed by Case, Okamato, and Griffin
- Contains four levels
- Students advance to the next level if they score above a criterion at the previous level
- Each level introduces new problems but also repeats problems with larger numbers

Number Knowledge Test: Cont.

- Level 0
  - Here are some circles and triangles. Count just the triangles and tell me how many there are.
- 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?

Number Knowledge Test: Cont.

- Level 2
  - Which is bigger: 19 or 21?
  - What number comes 4 numbers before 17?
- Level 3
  - What number comes 9 numbers after 999?
  - Which difference is smaller: the difference between 48 and 36 or the difference between 84 and 73?

Progress Monitoring Measures

- Progress monitoring measures
  - Some early screening measures have features that also enable them to be used in progress monitoring (e.g. Fuchs - CBM computation)
  - Other screening measures do not have features to enable progress monitoring (e.g. Mazzocco)

Considerations

- Timed measures vs. Untimed measures
- Skill specific measures vs. Multiple skill measures
- Domain specific or across domains
- Long term-predictive validity

Future Research

- Examine and develop longitudinal databases
- Construct analysis of early mathematics measures (what are we really measuring)
- Investigate sensitivity of measures to model growth