

## Exploring Student Responses to Support Struggling Learners

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## Session Overview

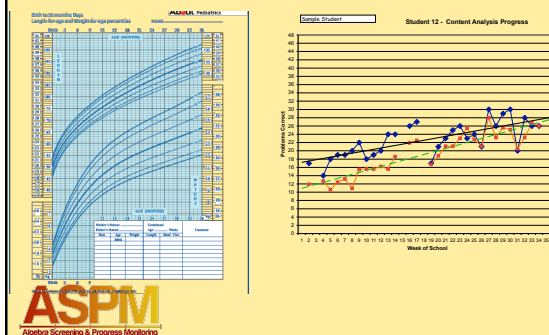
- Understanding progress monitoring
- The ASPM project
- Procedural measures
- Conceptual measures
- Student performance data



## Defining Progress Monitoring



## Indicators of Development



## Historical Foundations of Progress Monitoring

- Special Education
- Dr. Stanley Deno, University of Minnesota, late 1970s
- Curriculum-based measurement (CBM)
- Extensive empirical literature base (30 years, over 300 articles) across content areas and grade levels

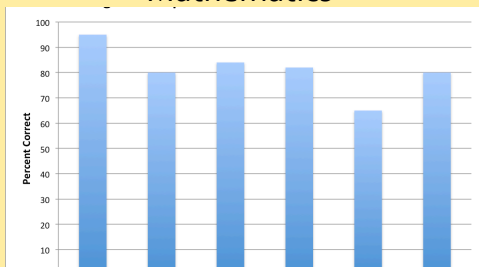


## Key Characteristics of Progress Monitoring Measures

- Brief
- Efficient
- Multiple forms of constant difficulty
- INDICATORS
- Standardized administration and scoring
- Initial development in elementary grades for basic skills (reading, spelling, written language)
- Technical adequacy
- More commonly used in reading (DIBELS, ORF)

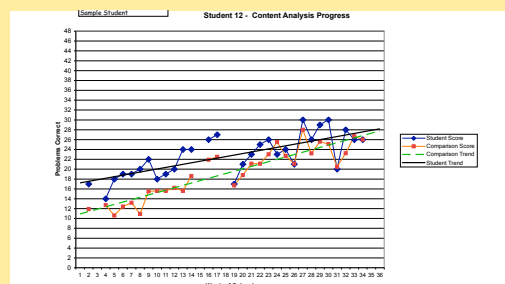


## Common Assessment Practices in Mathematics



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## Sample Progress Monitoring Graph



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## Algebra Screening and Progress Monitoring

- Collaboration between Iowa State University and University of Missouri; 4 years of funding from US Department of Education, IES
- School partners in 3 states
  - 25-28 teachers/year
  - 1800-2200 students/year
- Refine existing procedural progress monitoring measures
- Develop and refine conceptual progress monitoring measures

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## Procedural Measures for Algebra Progress Monitoring

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## Procedural Measures

- Algebra Basic Skills
- Algebra Foundations
- Algebra Content Analysis

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## Algebra Basic Skills

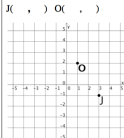
Algebra Basic Skills 1		Page 1	
Solve: $9 + a = 15$	$a =$	Solve: $10 - 6 = g$	$g =$
Evaluate: $12 + (-8) + 3$		Simplify: $9 - 4d + 2 + 7d$	
Simplify: $2x + 4 + 3x + 5$		Simplify: $5(3 - n) - n$	
Solve: $4 = 12 - k$	$k =$	Solve: $(q)(5) = 30$	$q =$
Simplify: $4(3 + u) - 7$		Simplify: $2 + u(w - 5)$	

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## Algebra Foundations

Algebra Foundations 1 Page 1

List the ordered pair for each point:  
J( , ) O( , )



If  $y > 9$ , two possible values for  $y$  are \_\_\_\_\_ and \_\_\_\_\_.

Evaluate  $4b + 2$  when  
 $b = 1$  \_\_\_\_\_  
 $b = 3$  \_\_\_\_\_

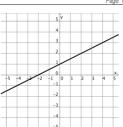
Write an expression for this phrase:  
*The difference of a number and 6*

Evaluate:  
 $9 \cdot 4 - 6$  \_\_\_\_\_

Simplify:  
 $7a + (2a + a)$  \_\_\_\_\_

Evaluate:  
 $(-2) \cdot (-4)$  \_\_\_\_\_

Graph the inequality  $m > -4$

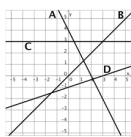


Calculate the slope \_\_\_\_\_  
What is the y-intercept? \_\_\_\_\_

Solve:  
 $19 = 3x + 4$   
 $x =$  \_\_\_\_\_

Evaluate  $a^2 - c + 2$  when  
 $a = 4$  and  $c = 6$

Which line on the graph represents the equation  $y + 2x = 4$ ?

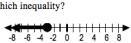


A) Line A  
B) Line B  
C) Line C  
D) Line D

Evaluate the expression:  
 $6^{-2}$  \_\_\_\_\_

Solve the system of linear equations:  
 $x - y = 4$   
 $x + 2y = 19$

This graph shows the solution for which inequality?



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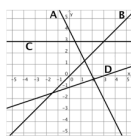
## Algebra Content Analysis

Algebra Content Analysis 1 Page 1

Solve:  
 $19 = 3x + 4$   
 $x =$  \_\_\_\_\_

Evaluate  $a^2 - c + 2$  when  
 $a = 4$  and  $c = 6$

Which line on the graph represents the equation  $y + 2x = 4$ ?

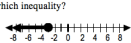


A) Line A  
B) Line B  
C) Line C  
D) Line D

Evaluate the expression:  
 $6^{-2}$  \_\_\_\_\_

Solve the system of linear equations:  
 $x - y = 4$   
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This graph shows the solution for which inequality?



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## Time to Talk

- Reactions to the procedural measures
  - Is the content important?
  - How do you anticipate students will perform on these tasks?
  - What instructionally useful information can be derived from student work?
- Predicting student performance
  - Average scores




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## Conceptual Measures for Algebra Progress Monitoring

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## Conceptual Measures

- Targets big ideas
- Focuses on deeper understanding
- Applies skills
- Three measures
  - Concept of Variable
  - Proportional Reasoning
  - Translations, Functions, and Graphing



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## Concept of Variable

Concept of Variable A Page 1

Jon said, " $m - 1$  is always greater than  $1 - m$ ." Do you agree with Jon?

A. Yes, Jon is correct because  $m$  is a positive number.  
B. Yes, Jon is correct because you cannot substitute a negative number for  $m$ .  
C. No, Jon is not correct because  $1 - m$  is greater than  $m - 1$  when  $m$  is negative integer.  
D. No, Jon is not correct because these expressions are equivalent.

Answer \_\_\_\_\_

If  $x = d + 2$  and  $d + 2 + x = y$ , then which of the following statements is true?

A.  $y = 2d + 4 + x$   
B.  $4d + 2 = y$   
C.  $y = 2x$   
D.  $6d = y$

Answer \_\_\_\_\_

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## Proportional Reasoning

Proportional Reasoning A

Page 1

For every foot of fence built ( $t$ ), a carpenter needs a consistent number of nails ( $n$ ). What does the equation tell you?

$$n = 12t + 24$$

- A. You need 36 nails and boards.
- B. The number of nails increases by 12 for every foot of fence.
- C. The number of nails increases 12 times for every foot of fence.
- D. The number of nails increases by 24 for every foot of fence.

Answer \_\_\_\_\_

Do these ratios represent the same relationship?  $3:4$  and  $\frac{18}{24}$

- A. No, because one is written like a fraction.
- B. No, because they are different numbers.
- C. Yes, because they are both in the ratio of 3 to 4.
- D. Yes, because they are written like a ratio.

Answer \_\_\_\_\_

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## Translations, Functions, and Graphing

Match each equation to a corresponding graph or data table.

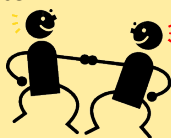
A	B	C	D																																																
$y = x$	$2x = y + 1$	$y = 1.5$	$y = -x + 1$																																																
1.	2.	3.	4.																																																
5. <table border="1"><tr><th>x</th><th>y</th></tr><tr><td>2</td><td>1.5</td></tr><tr><td>1</td><td>1.5</td></tr><tr><td>0</td><td>1.5</td></tr><tr><td>-1</td><td>1.5</td></tr><tr><td>-2</td><td>1.5</td></tr></table>	x	y	2	1.5	1	1.5	0	1.5	-1	1.5	-2	1.5	6. <table border="1"><tr><th>x</th><th>y</th></tr><tr><td>2</td><td>-1</td></tr><tr><td>1</td><td>0</td></tr><tr><td>0</td><td>1</td></tr><tr><td>-1</td><td>2</td></tr><tr><td>-2</td><td>3</td></tr></table>	x	y	2	-1	1	0	0	1	-1	2	-2	3	7. <table border="1"><tr><th>x</th><th>y</th></tr><tr><td>2</td><td>3</td></tr><tr><td>1</td><td>1</td></tr><tr><td>0</td><td>-1</td></tr><tr><td>-1</td><td>-3</td></tr><tr><td>-2</td><td>-5</td></tr></table>	x	y	2	3	1	1	0	-1	-1	-3	-2	-5	8. <table border="1"><tr><th>x</th><th>y</th></tr><tr><td>4</td><td>4</td></tr><tr><td>2</td><td>2</td></tr><tr><td>0</td><td>0</td></tr><tr><td>-2</td><td>-2</td></tr><tr><td>-4</td><td>-4</td></tr></table>	x	y	4	4	2	2	0	0	-2	-2	-4	-4
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9. <table border="1"><tr><th>x</th><th>y</th></tr><tr><td>4</td><td>-3</td></tr><tr><td>2</td><td>-1</td></tr><tr><td>0</td><td>1</td></tr><tr><td>-2</td><td>3</td></tr><tr><td>-4</td><td>5</td></tr></table>	x	y	4	-3	2	-1	0	1	-2	3	-4	5	10. Which graph represents the sum of a variable and one is equal to two multiplied by a second variable?																																						
x	y																																																		
4	-3																																																		
2	-1																																																		
0	1																																																		
-2	3																																																		
-4	5																																																		
12. Jake graphed equation B. Jamie graphed the equation $y = 4x - 3$ . How does Jamie's graph compare to Jake's graph?																																																			

- A). Jamie's graph is translated down 3 units from Jake's graph.
- B). Jamie's graph is translated up 3 units from Jake's graph.
- C). Jamie's graph is steeper than Jake's graph.
- D). Jamie's graph is less steep than Jake's graph.

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## Time to Talk

- Reactions to the conceptual measures
  - Is the content important?
  - How do you anticipate students will perform on these tasks?
  - What instructionally useful information can be derived from student work?
- Predicting student performance
  - Average scores



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## Exploring Student Responses

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## Levels of Student Performance

- What total scores did you predict for Algebra Basic Skills, Algebra Foundations, and Algebra Content Analysis?

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## The Overall Performance Perspective: Procedural Measures

Mean scores for beginning of course data collection in 2012-13; ranges represent differences across students

	State A	State B	State C
Algebra Basic Skills	10.7 (0 - 31) N = 184	12.72 (1 - 34) N = 114	9.6 (0 - 28) N = 248
Algebra Foundations	11.7 (0 - 25) N = 182	13.7 (1 - 33) N = 125	11.1 (0 - 33) N = 296
Algebra Content Analysis	10.2 (0 - 31) N = 190	16.2 (0 - 43) N = 100	7.6 (0 - 35) N = 252

## Looking at the Item Level: Proportion

Solve:  
1 ft. = 12 in.  
5¼ ft. = \_\_\_\_ in.

Solve:  
3 ft. = 1 yd.  
\_\_\_\_ ft. = 100 yds.

How do you think your students would do on these problems?

Scoring = Correct or Incorrect



## Looking at the Item Level: Proportion

Solve:  
1 ft. = 12 in.  
5¼ ft. = \_\_\_\_ in.

Solve:  
3 ft. = 1 yd.  
\_\_\_\_ ft. = 100 yds.

Page 1, 2<sup>nd</sup> row, 1<sup>st</sup> problem

Page 1, 8<sup>th</sup> row, 1<sup>st</sup> problem

1,169 students

1,169 students

12% **answered correctly**

31% **answered correctly**

23% answered incorrectly

12% answered incorrectly

65% skipped the item

57% skipped the item



### Student Responses: Proportion Items on ABS

Solve:  
1 ft. = 12 in.  
5¼ ft. = \_\_\_\_ in.

Solve:  
3 ft. = 1 yd.  
\_\_\_\_ ft. = 100 yds.

60.75

5

60

10

50

23

66

27

55.9

30

45

33

60.5

33.3



## Levels of Student Performance

- What total scores did you predict for Concept of Variable and Proportional Reasoning?
- How will overall performance compare relative to the procedural measures?



### The Overall Performance Perspective: Conceptual Measures

Mean scores for beginning of course data collection in 2012-13;  
ranges represent differences across students

	State A	State B	State C
Concept of Variable	<b>5.4</b> (0 - 26) N = 515	<b>6.6</b> (0 - 22) N = 318	<b>5.3</b> (0 - 18) N = 742
Proportional Reasoning	<b>5.5</b> (0 - 16) N = 502	<b>5.8</b> (0 - 15) N = 321	<b>5.3</b> (0 - 18) N = 750



## Looking at the Item Level: Proportion

3:5 and 6:8

Are these ratios equivalent? Yes No Explain your answer.

#### Scoring of Yes/No

249\* / 353 / 907 students

47 / 59 / 39% said "No"

7 / 5 / 14% said "Yes"

46 / 36 / 47% circled nothing

#### Scoring of Explanation

6 / 7 / 2% received **full credit**

12 / 16 / 9% rec'd partial credit

35 / 29 / 41% received no credit

47 / 47 / 48% wrote nothing



### Student Responses: Proportion Item on PR-A

- No, because the 3 double and the 5 didn't
- No, because they do not have the same numbers as each other
- No, because they are not in the same ratio
- No, because  $3 \cdot 2 = 6$ , but  $5 \cdot 2$  is not 8, and they need to be the same
- [shows  $3/5$  with a common multiplier of 2]



### Looking at the Item Level: Expressions

Evaluate  $8r + 4$  when

$r = 2$  \_\_\_\_\_

$r = 5$  \_\_\_\_\_

Page 1, 2<sup>nd</sup> row, 1<sup>st</sup> problem

1,157 students

61% answered **correctly**

4% answered incorrectly

35% skipped the item



Evaluate  $5x + 2y$  when  
 $x = -4$  and  $y = 2$

Page 1, 5<sup>th</sup> row, 4<sup>th</sup> problem

1,157 students

29% answered **correctly**

18% answered incorrectly

53% skipped the item

### Student Responses: Expressions Items on AF

Evaluate  $8r + 4$  when

$r = 2$  \_\_\_\_\_

$r = 5$  \_\_\_\_\_

Evaluate  $5x + 2y$  when  
 $x = -4$  and  $y = 2$

4, 1

4, 5

1, 10

4, 8

$20 \div 1$

5

-16

$-20x \div 4y$



### Looking at the Item Level: Expressions

What can you say about  $d$  if  $d = t + w$  and  $t + w = 40$ ? Explain.

Scoring of  $d =$  \_\_\_\_\_

625 / 355 / 520\* students

30 / 44 / 30% said " **$d = 40$** "

11 / 9 / 12% said something else

59 / 47 / 58% did not respond



Scoring of Explanation

5 / 16 / 4% received **full credit**

3 / 8 / 8% rec'd partial credit

20 / 11 / 30% received no credit

72 / 65 / 58% wrote nothing

### Student Responses:

#### Expression Item on CoV-A

- " $D$ " is the sum of  $t$  &  $w$ , & two even #s added equals " $d$ "
- $d = 40$ , because  $t$  and  $w$  are the same variables
- $D$  is 40 because it is the inverse
- $D = 40$  because  $t + w = 40$ , and  $d = t + w$ , therefore,  $d$  is 40.
- $D$  is 40
- $w$  and  $t$  might be 20



### Time to Talk

1. Reactions to student performance data
  - a. Total scores
  - b. Student work
  - c. Comparisons between performance on procedural and conceptual measures



Discussion  
Questions? Comments?

Friday, 12:30-2, L4-L5:  
Instructional Implications

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