Data-Based Instruction in Special Education

Douglas Fuchs and Lynn S. Fuchs

Vanderbilt University

Responsiveness-To-Intervention (RTI)

- RTI integrates assessment and intervention within a multi-level prevention system to identify and reduce risk for academic failure.

Typical RTI Procedure

- *Primary Prevention*

- All children receive the universal, core instructional program.
- All children are tested once in the fall to identify students as potentially at-risk for academic failure.
- The progress of potentially at-risk students is monitored for 6-8 weeks to (dis)confirm risk and identify students for secondary prevention.

Typical RTI Procedure

- *Secondary Prevention*

– For at-risk students, a second level of prevention is implemented using standard research-validated tutoring protocols.
– Student progress is monitored throughout intervention, and students are re-tested following intervention.
– Growth/performance is dichotomized as responsive or unresponsive.
– Students who respond well return to this primary prevention, with ongoing progress monitoring.

Typical RTI Procedure

- *Tertiary Prevention*

– Those who do not respond receive a multidisciplinary team evaluation and are identified for individualized programming in special education.
– Tertiary prevention represents a reformed special education where
  - Individual student goals are set ambitiously.
  - Ongoing progress monitoring is used in a formative and recursive way to formulate individualized programs that are effective.
  - Ongoing progress monitoring is also used to identify when students have met benchmarks that permit flexible return to secondary or primary prevention (with progress monitoring so re-entry to tertiary prevention occurs as needed), making special education a flexible service.

The Origins of RTI

- The notion of a multi-level prevention system is borrowed from the health-care system.

Health Care Analogy

- High blood pressure (HBP) can lead to heart attacks or strokes *(like academic failure can produce serious long-term negative consequences).*
- At the annual check-up (primary prevention), HBP screening *(like annual fall screening for low reading or math scores).*
- If screening suggests HBP, then monitoring over 6-8 weeks occurs to verify HBP *(like PM to ([dis]confirm risk).*
- If HBP is verified, secondary prevention occurs with relatively inexpensive diuretics, which are effective for vast majority, and monitoring continues *(like small-group secondary preventive tutoring, using a standard treatment protocol, with PM to index response).*
- For patients who fail to respond to secondary prevention (diuretics), then tertiary prevention occurs—experimentation with more expensive medications (e.g., ACE inhibitors, beta blockers), with ongoing monitoring to determine which drug or combination of drugs is effective *(like individualized instructional programs inductively formulated with progress monitoring).*

Progress Monitoring: An Essential Form of Assessment within RTI

To screen students as at risk for academic failure.

To determine whether students respond to standard forms of instruction.

For students who fail to respond, to build individualized instructional programs.

Progress Monitoring

- Teachers assess students' academic performance, using brief measures, on a frequent basis

Curriculum-Based Measurement

the scientifically validated form of progress monitoring

Research Shows

- CBM produces accurate, meaningful information about students' academic levels and their rates of improvement.
- CBM is sensitive to student improvement.
- CBM corresponds well with high-stakes tests.
- When teachers use CBM to inform their instructional decisions, students achieve better.

Most Progress Monitoring: Mastery Measurement

CBM is **NOT**

Mastery Measurement

MASTERY MEASUREMENT
Tracks Mastery of Short-term Instructional Objectives

To implement Mastery Measurement, the teacher

- Determines the sequence of skills in an instructional hierarchy
- For each skill, develops a criterion-referenced test

Hypothetical Fourth-Grade Math Computation Curriculum

1. ***Multidigit addition with regrouping***
2. Multidigit subtraction with regrouping
3. Multiplication facts, factors to 9
4. Multiply 2-digit numbers by a 1-digit number
5. Multiply 2-digit numbers by a 2-digit number
6. Division facts, divisors to 9
7. Divide 2-digit numbers by a 1-digit number
8. Divide 3-digit numbers by a 1-digit number
9. Add/subtract simple fractions, like denominators
10. Add/subtract whole number and mixed number

Multidigit Addition Mastery Test

Name: _____ Date_____

Adding

36521 + 63758	53429 + 63421	84525 + 75632	67842 + 53937	57321 + 46391
56382 + 94742	36422 + 57529	34824 + 69426	32415 + 85439	45321 + 86274

Hypothetical Fourth-Grade Math Computation Curriculum

1. Multidigit addition with regrouping
2. ***Multidigit subtraction with regrouping***
3. Multiplication facts, factors to 9
4. Multiply 2-digit numbers by a 1-digit number
5. Multiply 2-digit numbers by a 2-digit number
6. Division facts, divisors to 9
7. Divide 2-digit numbers by a 1-digit number
8. Divide 3-digit numbers by a 1-digit number
9. Add/subtract simple fractions, like denominators
10. Add/subtract whole number and mixed number

Multidigit Subtraction Mastery Test

Name:_____ Date_____

Subtracting

6521 - 375	5429 - 634	8455 - 756	6782 - 937	7321 - 391
5682 - 942	6422 - 529	3484 - 426	2415 - 854	4321 - 874

Problems with Mastery Measurement

- Hierarchy of skills is logical, not empirical.
- Performance on single-skill assessments can be misleading.
- Assessment does not reflect maintenance or generalization.
- Assessment is designed by teachers or sold with textbooks, with unknown reliability and validity.
- SO THAT, the number of objectives mastered does not relate well to performance on high-stakes tests.

CBM was designed to address these problems.

An Example of CBM:

Math Computation

Hypothetical Fourth-Grade Math Computation Curriculum

Multidigit addition with regrouping

Multidigit subtraction with regrouping

Multiplication facts, factors to 9

Multiply 2-digit numbers by a 1-digit number

Multiply 2-digit numbers by a 2-digit number

Division facts, divisors to 9

Divide 2-digit numbers by a 1-digit number

Divide 3-digit numbers by a 1-digit number

Add/subtract simple fractions, like denominators

Add/subtract whole number and mixed number

- Each weekly test incorporates the same problems types, but problems are not the same and are in a different order.

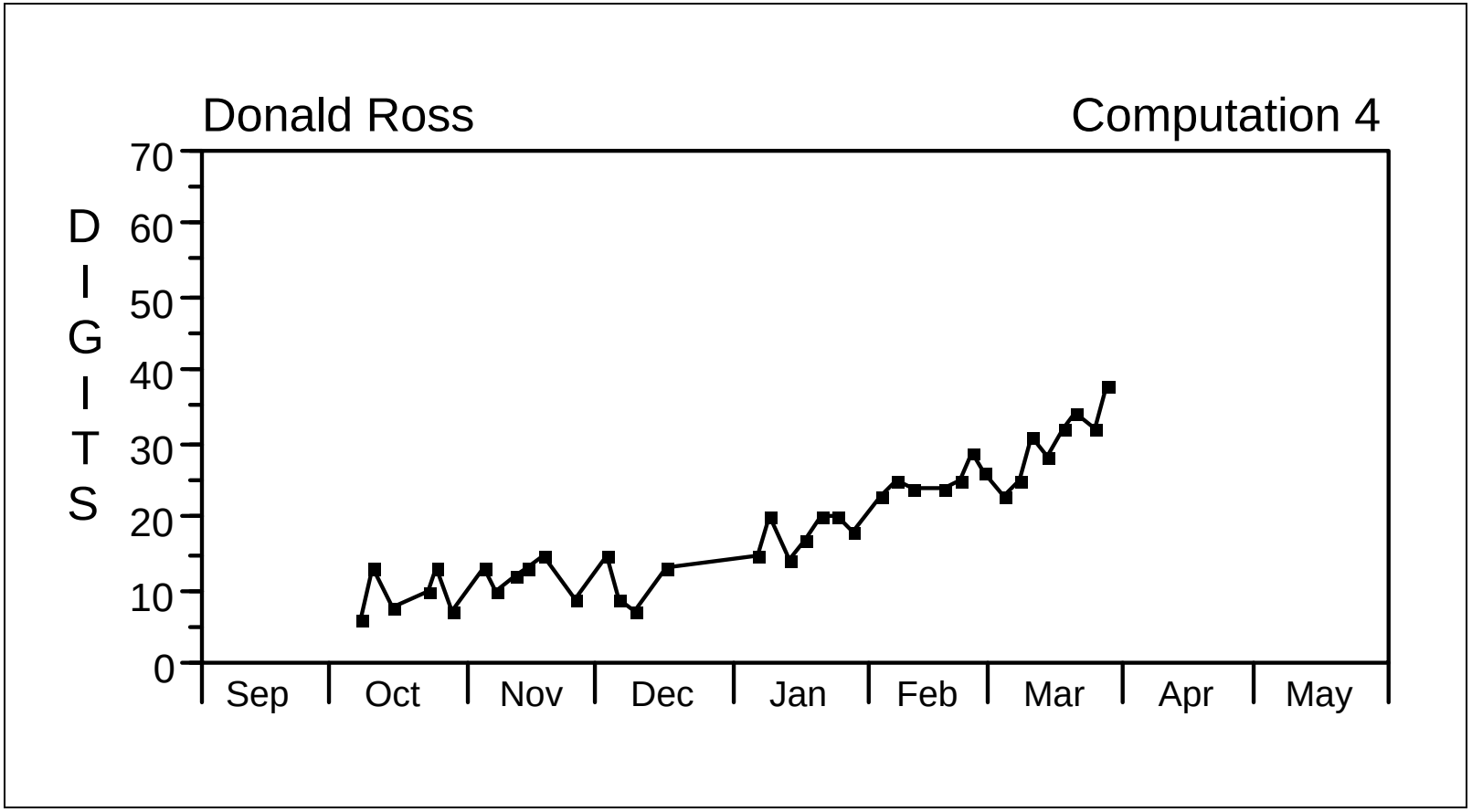
Sheet #1 Computation 4

Password: ARM

Name: _____ Date _____

A $\frac{3}{7} - \frac{2}{7} =$	B $1\frac{6}{7} + 3 =$	C $4\overline{)6}$	D $6\overline{)78}$	E 875×7
F 6×7	G 9×0	H 244×7	I $6\overline{)48}$	J $5\overline{)20}$
K $2\overline{)50}$	L $6144 - 4420$	M 33×10	N 6×0	O $7\overline{)30}$
P $95225 + 75268$	Q $8\overline{)32}$	R $1156 + 2824 + 83$	S $7\frac{4}{7} - 2 =$	T 38×33
U $\frac{3}{5} + \frac{1}{5} =$	V $982 - 97$	W 9×5	X 4×1	Y $7\overline{)56}$

Donald's Progress in Digits Correct Across the School Year



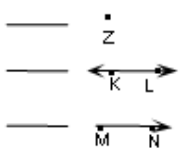
One page of a 3-page CBM in math concepts and applications (24 total problems)

Name _____ Date _____ Test 4 Page 1

Column A — Applications 4 — Column B

(1)

Write the letter in each blank.



(A) line segment
(B) line
(C) point
(D) ray

(2)

Look at this numbers.:

356.17

Which number is in the hundredths place? ____

(3)

Solve the problem by estimating the sum or difference to the nearest ten.

Jeff wheels his wheelchair for 33 hours a week at school and for 28 hours a week in his neighborhood. About how many hours does Jeff spend each week wheeling his wheelchair?

_____

(4)

Write the number in each blank.

3 ten thousands, 6 hundreds, 8 ones

_____

2 thousands, 8 hundreds, 4 tens, 6 ones

_____

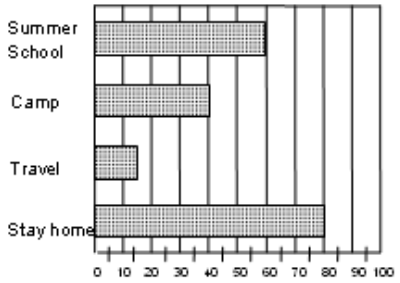
(5)

Write a number in the blank.

1 week = _____ days

(6)

Vacation Plans for Summit School Students



Use the bar graph to answer the questions.

The P.T.A. will buy a Summit School T-Shirt for each student who goes to summer school. Each shirt costs $4.00. How much money will the P.T.A. spend on these T shirts? $ .00

How many students are planning to travel during the summer? _____

How many fewer students are planning to go to summer school than planning to stay home? _____

(7)

To measure the distance of the bus ride from school to your house you would use

(A) meters
(B) centimeters
(C) kilometers

_____

Sampling performance on year-long curriculum for each CBM

- Avoids need to specify a skills hierarchy
- Avoids single-skill tests
- Automatically assesses maintenance/generalization
- Permits standardized procedures for sampling the curriculum, with known reliability and validity
- SO THAT: CBM scores relate well to performance on high-stakes tests

Two CBM Methods for Representing Year-Long Performance

Method #1:

Systematically sample items from the annual curriculum (illustrated in Math CBM, just presented)

Method #2:

Identify a global behavior that simultaneously requires the many skills taught in the annual curriculum (illustrated in Reading CBM, presented next)

Hypothetical Grade 2 Reading Curriculum

- Phonics
  - cvc patterns
  - cvce patterns
  - cvvc patterns . . .
- Sight Vocabulary
- Comprehension
  - Identification of who/what/when/where
  - Identification of main idea
  - Sequence of events
- Fluency

Grade 2 Reading CBM

- Each week, every student reads aloud from a different second-grade passage for 1 minute.
- Each week's passage is the same difficulty.
- As student reads, teacher marks errors.
- Teacher counts number of words read correctly and graphs scores.

Mom was going to have a baby. Another one! That is all we need thought Samantha who was ten years old. Samantha had two little brothers. They were brats. Now Mom was going to have another one. Samantha wanted to cry.

"I will need your help," said Mom. "I hope you will keep an eye on the boys while I am gone. You are my big girl!"

Samantha told Mom she would help. She did not want to, thought. The boys were too messy. They left toys everywhere. They were too loud, too. Samantha did not want another baby brother. Two were enough.

Dad took Samantha and her brothers to the hospital. They went to Mom's room. Mom did not feel good. She had not had the baby. The doctors said it would be later that night. "I want to wait here with you," said Samantha. "Thank you Samantha. But you need to go home. You will get too sleepy. Go home with Grandma. I will see you in the morning," said Mom.

That night Samantha was sad. She knew that when the new baby came home that Mom would not have time for her. Mom would spend all of her time with the new baby.

The next day Grandma woke her up. "Your mom had the baby last night," Grandma said. "We need to go to the hospital. Get ready. Help the boys get ready, too."

Samantha slowly got ready. She barely had the heart to get dressed. After she finished, she helped the boys. They sure were a pain! And now another one was coming. Oh brother!

Soon they were at the hospital. They walked into Mom's room. Mom was lying in the bed. Her tummy was much Smaller. Samantha . . .

CBM

- Not interested in making students read faster.
- Interested in students becoming better readers.
- The CBM score is an overall indicator of reading competence.
- Students who score high on CBM
  - Are better decoders
  - Are better at sight vocabulary
  - Are better comprehenders.
- Score correlates highly with performance on high-stakes tests.

Kindergarten
Letter-Sound Fluency

Teacher: ***Say the sound that goes with each letter.***

Time: 1 minute

p	**U**	**z**	**u**	**y**
i	**t**	**R**	**e**	**w**
O	**a**	**s**	**d**	**f**
v	**g**	**j**	**S**	**h**
k	**m**	**n**	**b**	**V**
Y	**E**	**i**	**c**	**x**

…

Grade 1
Word-Identification Fluency

Teacher: ***Read these words.***

Time: 1 minute.

two

for

come

because

last

from

...

Grades 2-3
Passage Reading Fluency

- Number of words read aloud correctly in 1 minute on end-of-year passages

Grades 4-6
Maze Fluency

- Number of words replaced correctly in 2.5 minutes on end-of-year passages from which every 7th word has been deleted and replaced with 3 choices

Computer Maze

A SCARY NOISE

Ray lived in Georgia. He was born there and had _____ friends. One day Dad had come home _____ work to say that they would have ____ move far away. Dad worked in ___ factory. The factory had closed and Dad _____ a new job. Dad had found a _____ job and now they had to move.

Ray _____ sad because he did not want _____ leave his school. He did not _____ to leave his friends.

"I am _____, son," said Dad.

"It is OK," _____ Ray with a smile. He did _____ want Dad to feel bad.

They _____ up the car and moved to a _____ state. Their new

Go forward

Using CBM within RTI

- Primary Prevention
  - All students are screened for possible risk.
  - For students with possible risk, CBM occurs for 5-8 weeks.
  - If slope is inadequate, student moves to secondary prevention
- Secondary Prevention
  - CBM is used to assess response to a standard, research-validated tutoring protocol.
  - If slope is inadequate, student moves to tertiary prevention
- Tertiary Prevention
  - CBM is used to
    - set IEP goals
    - inductively formulate individualized instruction
    - formulate decisions about exiting special education.

Tertiary Prevention as Special Education

- Most RTI attention has been on primary and secondary prevention where the purpose is to reform general education.
- Reforming special education is just as important.
- Connect special and general education in a synergistic way
- Infuse special education with RTI's focus on progress monitoring and student outcomes

RTI as Special Education Reform

- Set ambitious goals
- Distinguish the intensity of secondary vs. tertiary prevention
  - Tertiary prevention is reserved for students who fail to respond to standard forms of instruction (i.e., validated, standard tutoring protocols) and who therefore need a nonstandard (individualized) form of instruction.
  - Begin tertiary prevention with a validated protocol, but implement more frequently, and/or with longer sessions, with smaller group size. Collect CBM weekly to systematically experiment with instructional components that individually tailor the protocol to match the student's needs and ensure its effectiveness for that student.
- Use flexible exit/re-entry decisions, based on student progress, to rely on tertiary prevention as needed and to maximize time in primary/secondary prevention as possible.

Ongoing Progress Monitoring

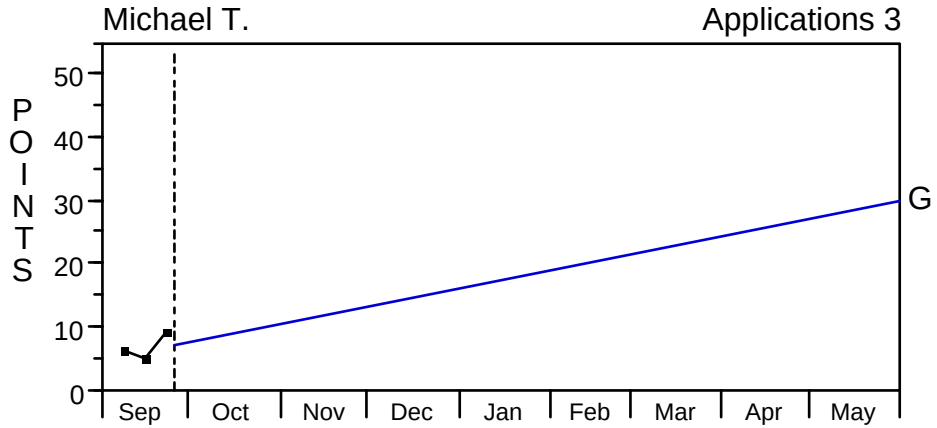
- *Example*

- For a third-grade student with a learning disability and an IEP math goal, curriculum-based measurement (CBM) is collected each week.

Ongoing Progress Monitoring

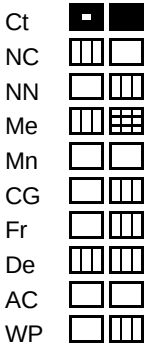
- *Example*

- For a third-grade student with a learning disability and an IEP math goal, CBM is collected each week.
- Take baseline and set year-end goal. Draw goal line to represent performance level expected each week of the school year.



Wait. Not enough scores for decision.

You need at least 8 scores to make a decision.



Ongoing Progress Monitoring

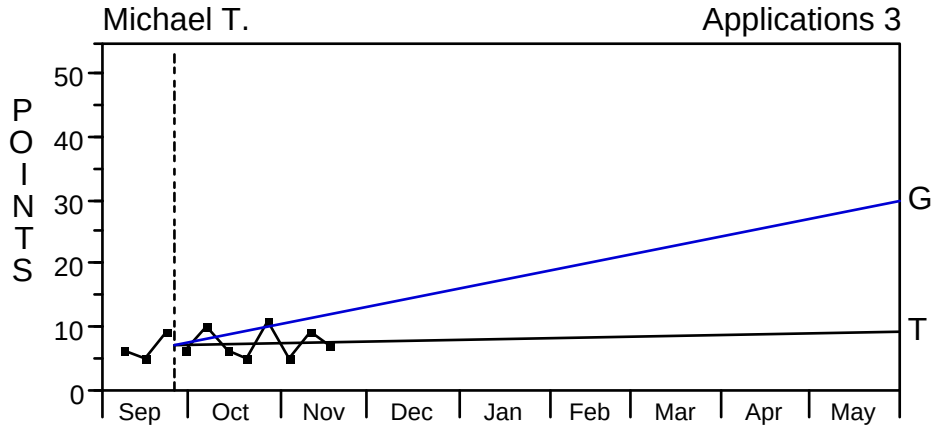
- *Example*

- For a third-grade student with a learning disability and an IEP math goal, CBM is collected each week.
- Take baseline and set year-end goal. Draw goal line to represent performance level expected each week of the school year.
- Special education involves five 30-minute math tutoring sessions per week in dyads. Initial program is a validated tutoring protocol. Weekly progress monitoring continues.

Ongoing Progress Monitoring

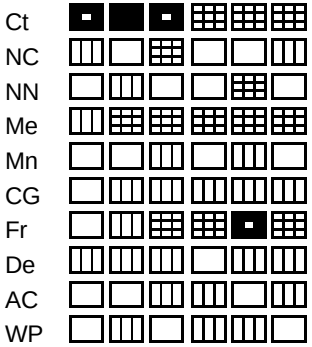
- *Example*

- For a third-grade student with a learning disability and an IEP math goal, CBM is collected each week.
- Take baseline and set year-end goal. Draw goal line to represent performance level expected each week of the school year.
- Special education involves five 30-minute math tutoring sessions per week. Initial program is a validated tutoring protocol. Weekly progress monitoring continues.
- After 8 weeks, the student's progress is evaluated against the goal line. The special educator determines whether a revision to the program is needed to boost the student's rate of improvement. If so, an instructional feature, based on a well researched instructional principle, is added to the validated protocol.



Uh-oh! Make a teaching change.

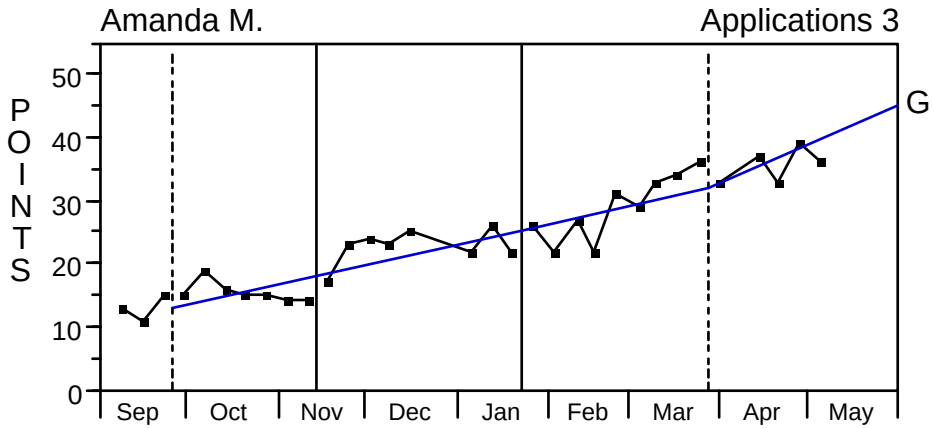
Student's rate of progress is less than the goal line.



Ongoing Progress Monitoring

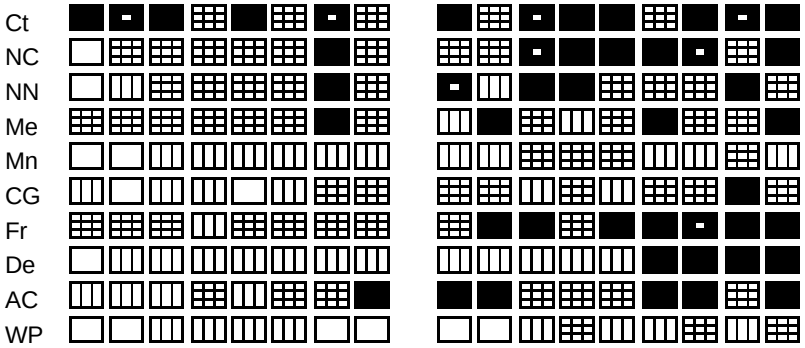
- *Example*

- For a third-grade student with a learning disability and an IEP math goal, CBM is collected each week.
- Take baseline and set year-end goal. Draw goal line to represent performance level expected each week of the school year.
- Special education involves five 30-minute tutoring sessions in dyads on calculation and word problem skills, deficit areas for the student. Initial program is a validated tutoring protocol. Weekly progress monitoring continues.
- After 8 weeks, the student's progress is evaluated against the goal line. The special educator determines that a revision to the program is required to boost the student's rate of improvement. If so, an instructional feature, based on a well researched instructional principle, is added to the validated protocol.
- This iterative process recurs over time so that the teacher uses the data to formatively design an individualized, appropriate instruction (i.e., scientifically-based and intensive special education and related services) that addresses the general education curriculum.

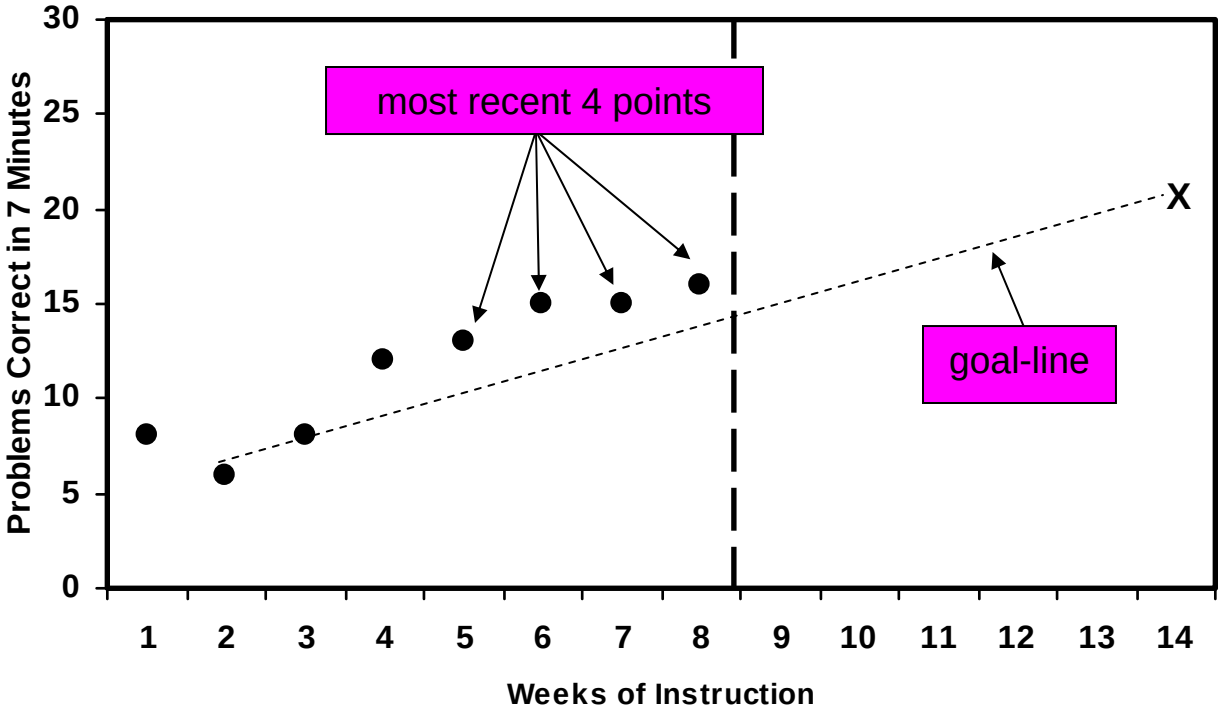


Wait. Not enough scores for decision.

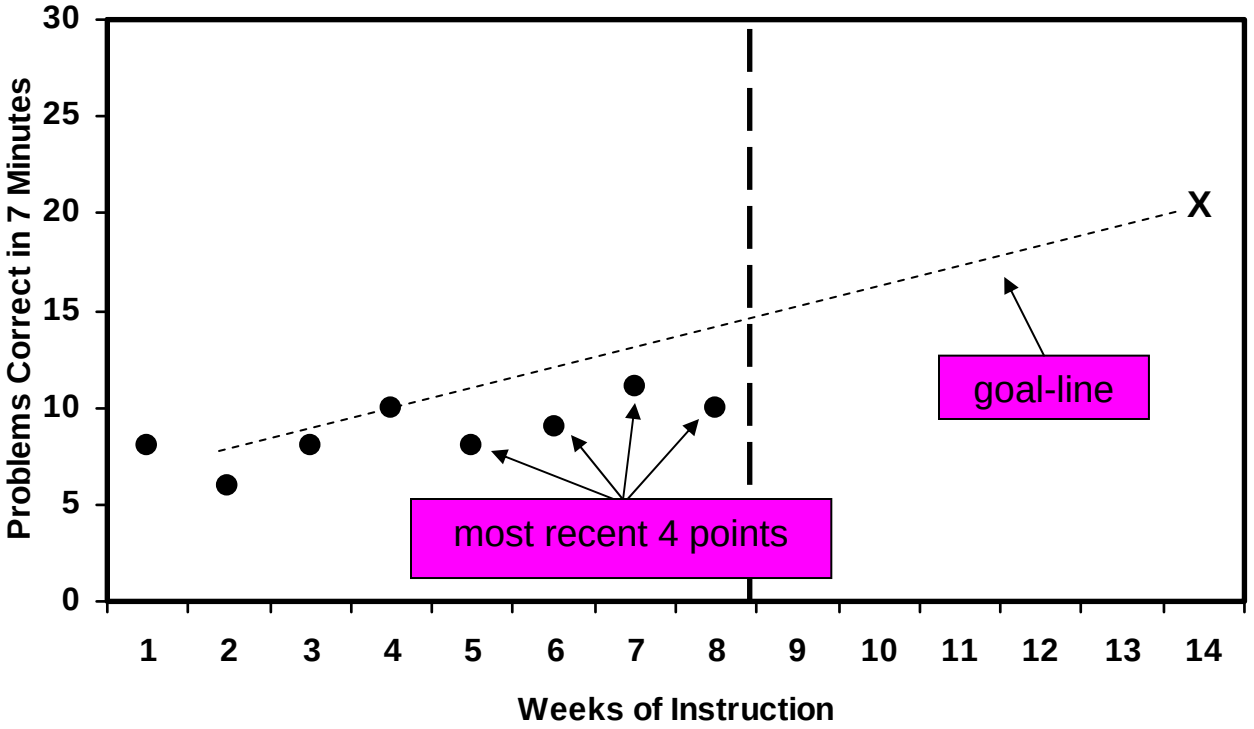
You need at least 8 scores to make a decision.



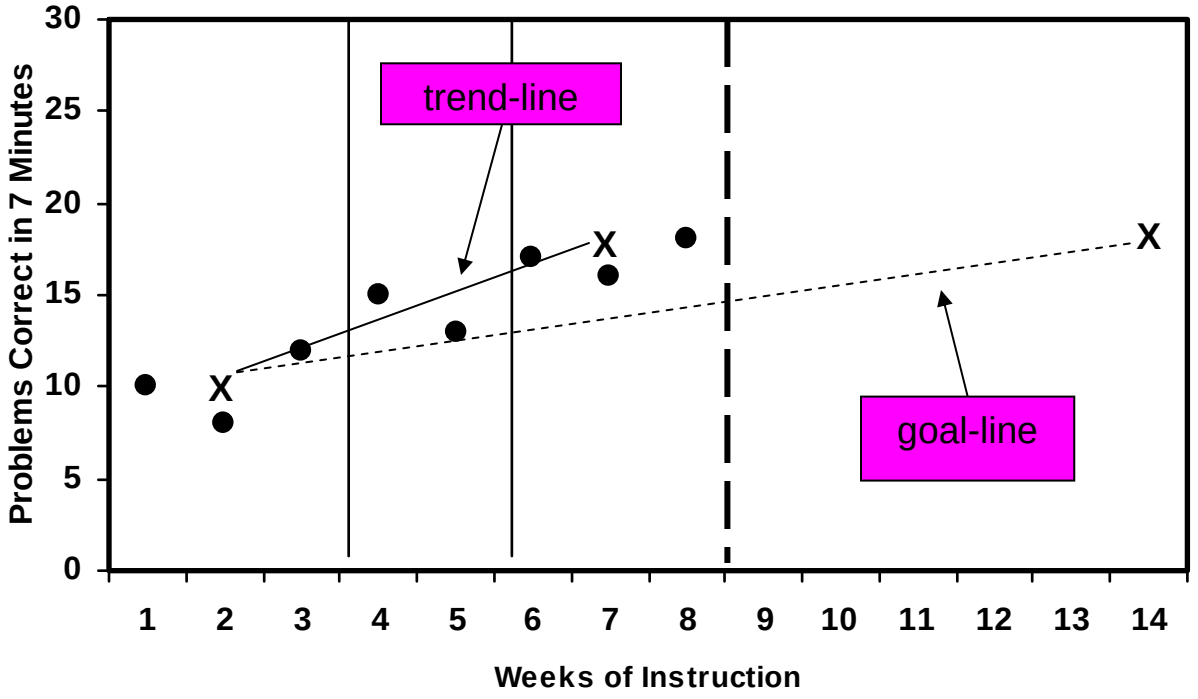
PM in Tertiary Prevention: 4-Point Method



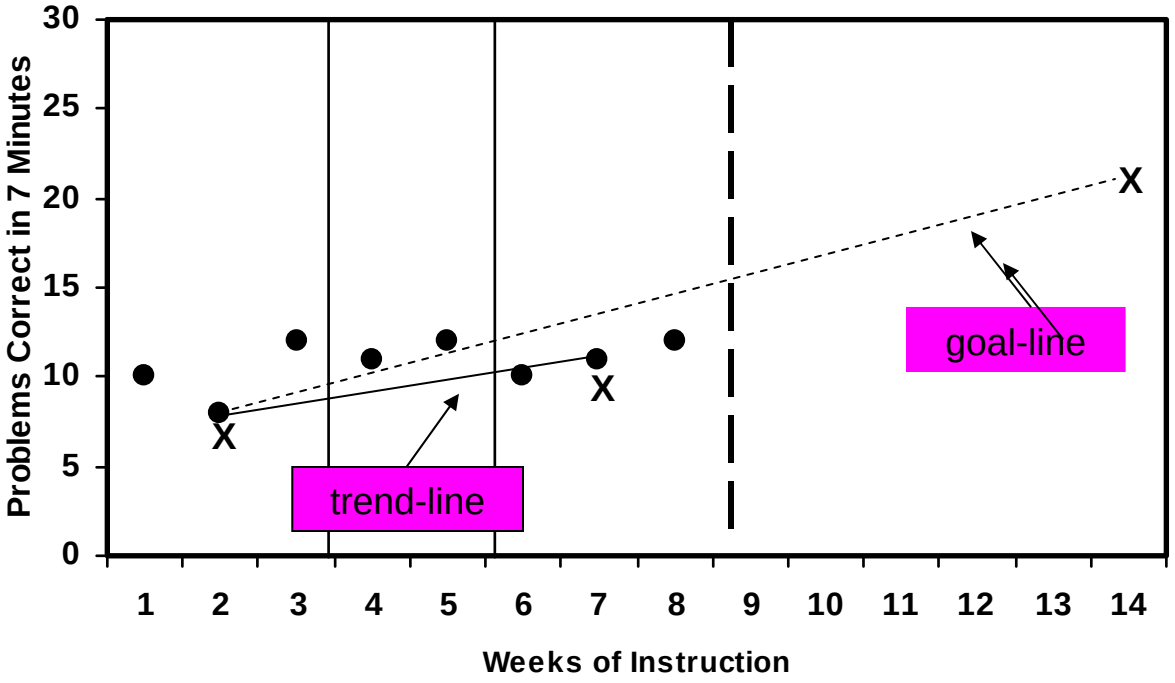
PM in Tertiary Prevention: Four-Point Method

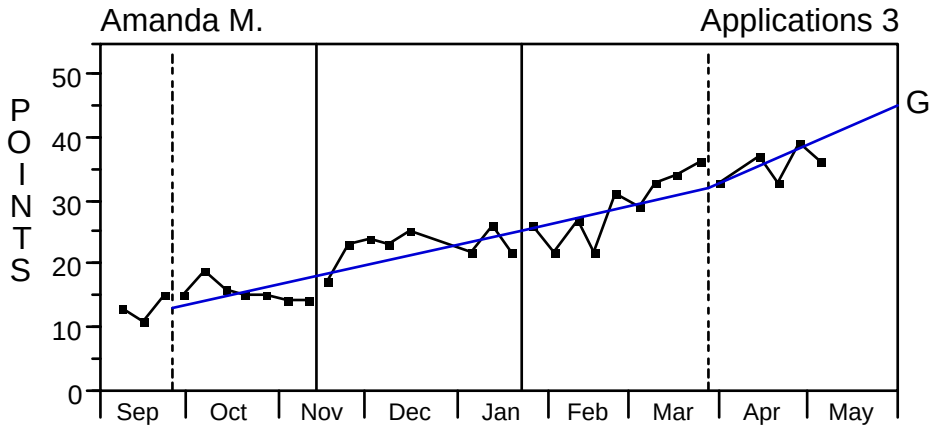


PM in Tertiary Prevention: Based on Trend



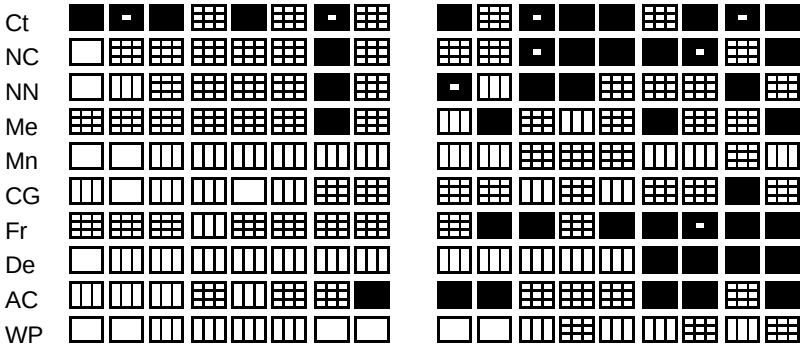
PM in Tertiary Prevention: Based on Trend





Wait. Not enough scores for decision.

You need at least 8 scores to make a decision.



Roberto's Case Study

- Roberto developed sizeable math deficits in 1st and 2nd grades despite strong primary and secondary prevention. In November of 3rd grade, he entered tertiary prevention.
- His special education teacher, Mrs. Hayes, set his IEP goal as competent 2nd-grade performance at the end of 3rd grade.
  - Rationale: The 2nd-grade curriculum is transparently connected to the 3rd-grade mathematics curriculum, but includes easier problem types that create the platform for learning the harder, third-grade problems.

Roberto's Case Study: CBM

- Mrs. Hayes used CBM to monitor Roberto's response to tertiary intervention.
- Each weekly CBM test systematically samples the 2nd-grade math curriculum in the same way and is of equivalent difficulty.
- The score on each week's CBM test is an indicator of mathematics competence at 2nd grade.

Computation 2 - Test 1

Name: _____ Date: _____

A 30 + 7	B 8 + 7	C 12 - 3	D 15 - 5	E 5 4 + 2
F 10 - 7	G 35 - 6	H 11 - 6	I 55 - 33	J 32 41 + 23
K 14 + 9	L 64 + 16	M 16 - 8	N 9 + 7	O 7 + 7
P 50 - 5	Q 83 - 67	R 254 - 20	S 5 + 3	T 15 - 7
U 30 + 32	V 6 - 5	W 4 + 6	X 12 - 6	Y 8 + 9

Name _____ Date _____ Test 1 Page 1

Column A

Applications 2

Column B

(1)

Counting by 2's, fill in the blanks.

32, 34, 36, _____, _____

(2)

Write a number in each blank.

Of these numbers,

346 332 798

_____ is the smallest.
_____ is the largest.

(3)

Look at this group of numbers.

1 2 3 4 5 6 7

8 9 10 11 12 13 14

15 16 17 18 19 20

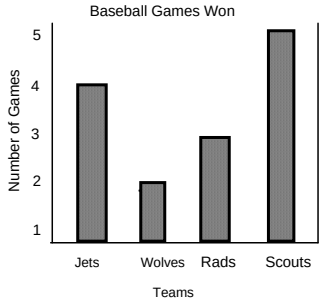
Write the sixteenth number. _____
Write the eleventh number. _____
Write the eighteenth number. _____

(4)

How much money?

_____

(5)



Write a number in each blank.

How many games did the Jets win? ____

How many more games did the Jets win than the Rads? ____

How many fewer games did the Wolves win than the Scouts? ____

(6)

Write the number in the blank.

5 + 11 = _____ + 5

A

Name _____ Date _____ Test 1 Page 2

Column C — Applications 2 — Column D

(7)

Counting by 3's, fill in the blanks.

60, 63, 66, _____, _____

(8)

Number of Hours Bill Watches T.V. on School Days.

Monday	D D D
Tuesday	D
Wednesday	D
Thursday	D D

Each D means 2 hours

Write the number in each blank.

How many hours does Bill watch T.V. on Tuesday? _____

How many more hours does Bill watch T.V. on Thursday than on Tuesday? _____

How many hours does Bill watch T.V. on Tuesday and Wednesday together? _____

(9)

Write **+** or **-** in the blank.

4 ____ 5 = 9

(10)

Write the number in the blank.

____ + 3 = 3 + 7

(11)

Write the letter of the matching fraction in each blank.

____ 

____ 

____ 

(A) 1/3

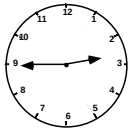
(B) 1/10

(C) 1/5

(D) 1/4

(12)

Write the time.



___ : ___

Name _____ Date _____ Test 1 Page 3

Column E — Applications 2 — Column F

(13)

Write the answer in the blank.

Norris biked to the candy store and spent 67¢ on candy. Lynn walked to the store and spent 98¢. How much more did Lynn spend on candy than Norris?

_____

(14)

December

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	(9)	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Christmas Play

Write the letter in the blank.

The Christmas play falls on which day of the week?

(A) Monday
(B) Friday
(C) Wednesday

_____

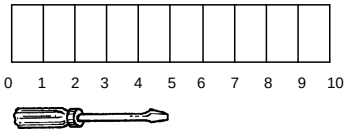
(15)

Write + or - in the blank.

8 ____ 4 = 4

(16)

How long is the screwdriver?



_____ units

(17)

Write the answer in the blank.

Jim found 6 empty coke cans in the park. Sally found 11 empty coke cans. How many empty coke cans did Jim and Sally find?

_____

(18)

Fill in the blanks.

618 =

_____hundreds _____tens _____ ones

Roberto's Case Study: The Initial Program

- When Mrs. Hayes assumed responsibility for Roberto's math tertiary intervention, she decided to the validated protocol "Pirate Math" to remediate his computation and word problem deficits.

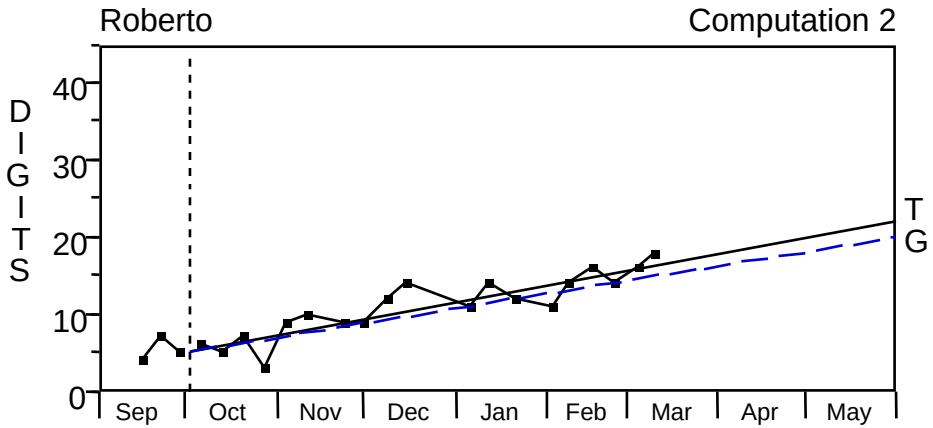
- 30 minutes per session, 3 times per week, 1:1

Roberto's Case Study: IEP Goal Setting

- After 3 weeks, Mrs. Hayes calculated baseline:
  - Median of first 3 computation test scores (5)
  - Median of first 3 concepts/application test scores (3)
- She decided that her year-end goal for Roberto would require a weekly increase of .5 digits for computation and .6 points for concepts/applications (CBM norms).
- Year-end goals (25 weeks later):
  - 18 digits correct on CBM computation
  - 18 points correct on concepts/applications.
- She drew these goals onto Roberto's graphs.
- She connected Roberto's baseline scores with the year-end goals to show the goal lines (desired weekly rates of improvement).

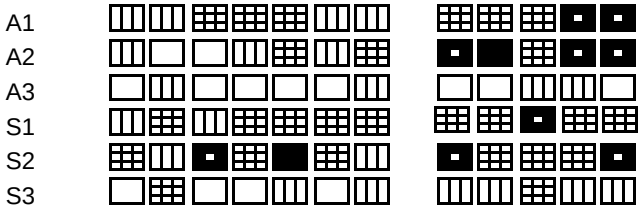
Roberto's Case Study: How Did Roberto Do?

- Eight weeks later, Mrs. Hayes drew lines of best fit through Roberto's actual CBM scores and compared these trend lines to the goal lines.
- The CBM data showed that Pirate Math, with its focus on counting-up strategies for math facts and with its instruction and ongoing review on double-digit addition and subtraction, was producing strong growth for Roberto.
- Roberto's actual rate of improvement (solid diagonal line) was steeper than the goal line (broken diagonal line). She increased the CBM computation goal and continued weekly progress monitoring.



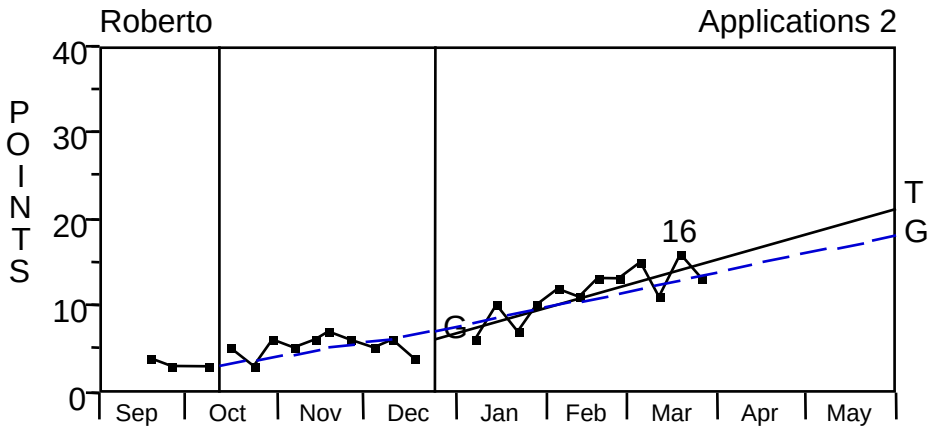
OK!! Raise the goal.

The 4 most recent scores are above the goal line.



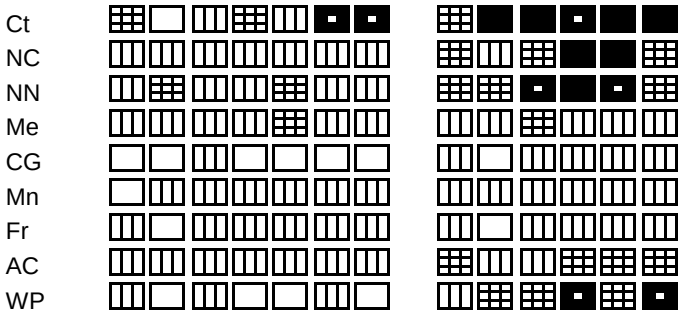
Roberto's Case Study: How Did Roberto Do?

- By contrast, Roberto was proving unresponsive to Pirate Math's word-problem instruction.
- His actual rate of improvement was dramatically less steep than the goal line, indicating that Roberto was growing slower than hoped and was unlikely to achieve his year-end goal.
- Mrs. Hayes considered Roberto's performance during tutoring and reviewed his performance on the CBM story problems.
- She determined Roberto was having difficulty when irrelevant information was included in problems. So she revised Pirate Math by adding instructional time on irrelevant information.
- This revision in the protocol is signified on Roberto's CBM concepts/applications graph with the solid vertical line.



OK!! Raise the goal.

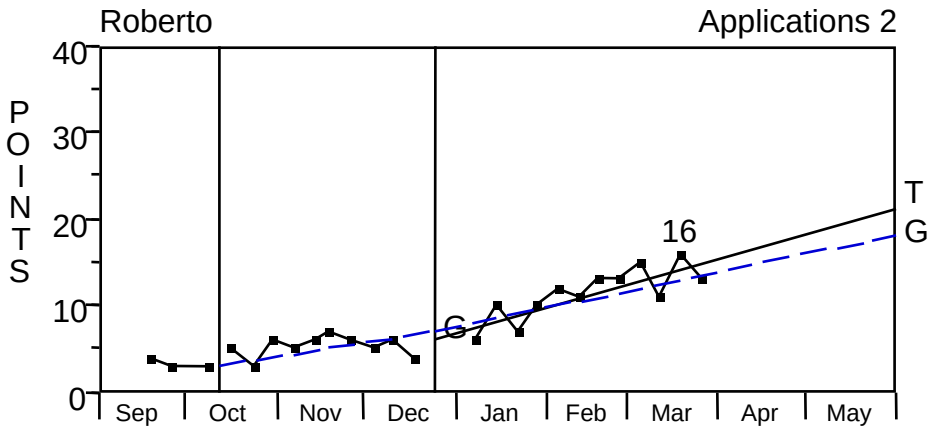
Student's rate of progress exceeds the goal line



Roberto's Case Study: Individualizing the Program

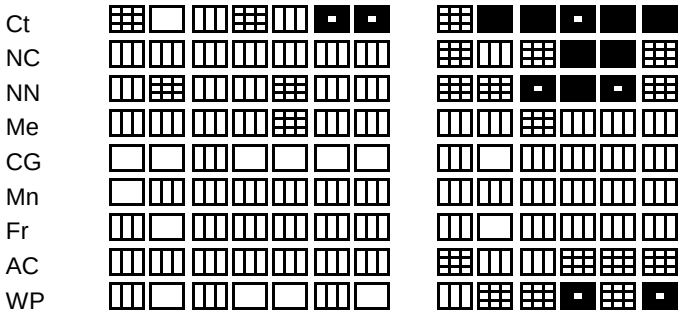
- As she implemented this revision, Mrs. Hayes continued to monitor Roberto's responsiveness using weekly the CBM concepts/applications tests.
- Roberto's learning, as shown in the new trend line improved and was now steeper than the goal line Mrs. Hayes had set for Roberto. Mrs. Hayes then increased Roberto's goal.

Teachers use CBM in this formative, inductive, and recursive way to design individualized instructional programs that are effective for individual students and improve student outcomes.



OK!! Raise the goal.

Student's rate of progress exceeds the goal line



Exiting Tertiary Prevention (with ongoing PM to return to tertiary prevention as needed)

- CBM is also used to quantify response.
- On the basis of level and slope, decisions are formulated about when to exit tertiary prevention.
- The goal is to return students to primary or secondary prevention as soon as possible, but weekly CBM continues so that students return to tertiary prevention as frequently and for as long as needed to ensure strong outcomes.

Tertiary Prevention: Determining Response in Reading

Grade	CBM Probe	> Slope	>End Level
Kindergarten	Letter Sound Fluency	> 1	> 40
Grade 1	Word Identification Fluency	> 1.8	> 50
Grade 2	Passage Reading Fluency	> 1	> 60
Grade 3	Passage Reading Fluency	> 0.75	> 70
Grade 4	Maze Fluency	> 0.25	> 25
Grade 5	Maze Fluency	> 0.25	> 25
Grade 6	Maze Fluency	> 0.25	> 25

Note: These figures may change pending additional RTI research.

Tertiary Prevention: Determining Response in Math

Grade	Computation		Concepts and Applications	
	> Slope	> End level	> Slope	> End level
Grade 1	> 0.50	> 20 digits	> 0.40	> 20 points
Grade 2	> 0.40	> 20 digits	> 0.40	> 20 points
Grade 3	> 0.40	> 20 digits	> 0.70	> 20 points
Grade 4	> 0.70	> 20 digits	> 0.70	> 20 points
Grade 5	> 0.70	> 20 digits	> 0.70	> 20 points
Grade 6	> 0.70	> 20 digits	> 0.70	> 20 points

Note: These figures may change pending additional RTI research.

Online Resources

- For more information on Data-Based Instruction in Special Education visit:
  - National Center on Student Progress Monitoring
    - www.studentprogress.org
  - National Center on Response to Intervention
    - www.rti4success.org

In Sum …,

- CBM is a research-validated form of progress monitoring.
- CBM is a signature feature of effective tertiary prevention for individualizing instruction for students who do not respond to validated, standard tutoring protocols at secondary prevention.
- CBM is essential for documenting response (i.e., improvement) at all three levels of the prevention system.
- RTI provides an important opportunity to reform special education.