My Student is Just NOT Learning Math: What Do I Do???

Matthew Burns

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Special Education

- President's Commission on Excellence in Special Education
- Reduce paperwork and increase flexibility
- Identify and intervene early
  - Service first and assessment later
- "Those that get counted, count."
- Use special education staff more effectively

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Individualized instruction , at no cost to the parents or guardians, to meet the unique needs of a child with a disability.

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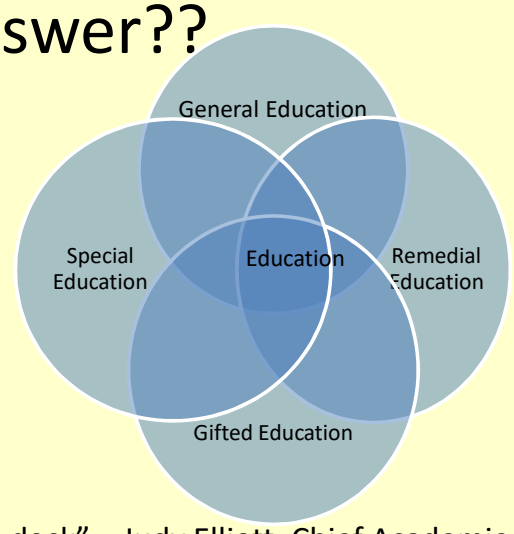
The answer??



"All hands on deck" – Judy Elliott, Chief Academic Officer of Los Angeles Unified Schools

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And DATA!

Unique learning needs =
Education that is SPECIAL

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MTSS (or RtI?)

The (a) systematic use of assessment data to
(b) most efficiently allocate resources in order to
(c) enhance learning for all students.

Burns, Jimerson, VanDerHeyden, & Deno, 2015

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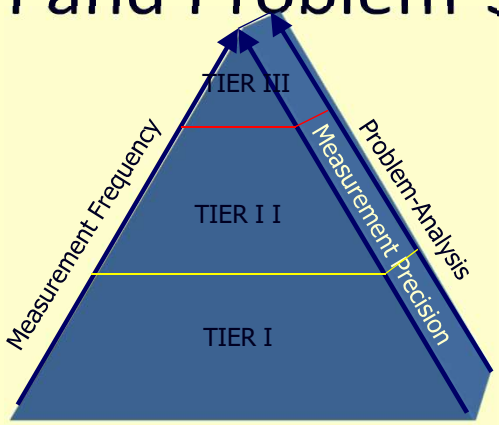
RTI and Problem-Solving



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Problem Solving

- Tier I – Identify discrepancy between expectation and performance for class or individual (Is there a classwide need?)
- Tier II – Identify discrepancy for individual. Identify category of problem. (What is the category of the problem?)
- Tier III – Identify discrepancy for individual. Identify causal variable. (What is the causal variable?)

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Four Purposes of Assessment

Program evaluation: How is the education system working for students overall?

- PSSA

Screening: Which of my students are not meeting grade level expectations given Universal Instruction?

- E.g., STAR/MAP

Diagnostic: What are the specific needs of students who struggle with math?

E.g., measures of specific skills

Monitoring Progress: What does the student's growth look like?

E.g., CBM

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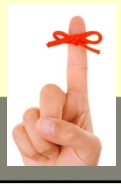

Screener	MAP < 25th %ile	MAP ≥ 25th %ile	Total
Oral Reading Fluency (ORF)			
ORF < Benchmark Goal	276	145	421
	a	b	
ORF ≥ Benchmark Goal	46	501	547
	c	d	
Total	322	646	968
Informal Reading Inventory (RI)			
RI < Benchmark Goal	90	189	279
	a	b	
RI ≥ Benchmark Goal	200	367	567
	c	d	
Total	290	556	846

Sensitivity = a / (a + c)
.86 for ORF
.31 for F&P

Specificity = d / (b + d)
.78 for ORF
.66 for F&P,

Correct Classification = (a + d) / N
.80 for ORF
.54 for F&P

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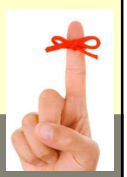

Table 3
Diagnostic Accuracy Between Measures at Fall and Winter Assessments Using 16th %tile as the Cut Score

Pairs of Measures	Total N	N At-risk PSSA	N At-risk MCBM	N At-risk MCAP	Sensitivity	Specificity	PPP	NPP
			Fall					
STAR-Math with PSSA	181	28			.72	.93	.62	.95
MCBM with PSSA	184	28			.28	.91	.33	.89
MCAP with PSSA	184	28			.28	.94	.41	.89
STAR-Math with MCBM	374		53		.43	.86	.21	.95
STAR-Math with MCAP	280			29	.50	.89	.25	.96

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	Screening/ Benchmark	Diagnostic	Monitor Progress Skill	Monitor Progress General
Kindergarten				
First through Fifth Grades				
Middle School				

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Type of Math Assessment

- General outcome measures (GOMs)
  - Assess proficiency of global outcomes associated with an entire curriculum
- Subskill mastery measures (SMMs)
  - Assess learning of specific objective or skill

Academic Progress Monitoring General Outcome Measures Chart

Tool	Area	Psychometric Standards: Reliability of the Performance Level Score	Psychometric Standards: Reliability of the Slope	Psychometric Standards: Validity of the Performance Level Score	Psychometric Standards: Predictive Validity of the Slope of Improvement	Psychometric Standards: Disaggregated Reliability and Validity Data	Progress Monitoring Standards: Alternate Forms	Progress Monitoring Standards: Sensitive to Student Improvement	Progress Monitoring Standards: End-of-Year Benchmarks	Progress Monitoring Standards: Rates of Improvement Specified	DBI Standards: Decision Rules for Changing Instruction	DBI Standards: Decision Rules for Increasing Goals	DBI Standards: Improved Student Achievement	DBI Standards: Improved Teacher Planning
AIMSweb	M-CBM	○	○	○	○	●	◒	○	●	●	—	—	—	—
AIMSweb	Math Computation	●	●	○	—	—	◒	●	●	●	●	●	—	—
AIMSweb	Math Concepts and Applications	●	●	●	○	—	◒	●	●	●	●	●	—	—

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	Screening/ Benchmark	Diagnostic	Monitor Progress Skill	Monitor Progress General
Kindergarten	Measures of Early Numeracy			
First through Fifth Grades	MAP or multi-skill CBM (STAR)	CBM of specific objectives CFA's	Every week CBM of specific skill/objective	Every other week multi-skilled CBM
Middle School	STAR	CBM of specific objectives CFAs	Every week CBM of specific skill/objective	Every other week multi-skilled CBM, word problems

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Interventions for Children with Math Difficulties

Guided practice	.86
Direct instruction	.65
Teaching problem-solving	.52
Modality instruction	.15
Executive functioning	.09
Working memory training	.07
Perceptual training	.08

POWERTHEKNOWLEDGE (Hattie,2009; Jacob & Parkinson, 2015; Kavale & Forness, 2000; Melby-Lervag & Hulme, 2013)

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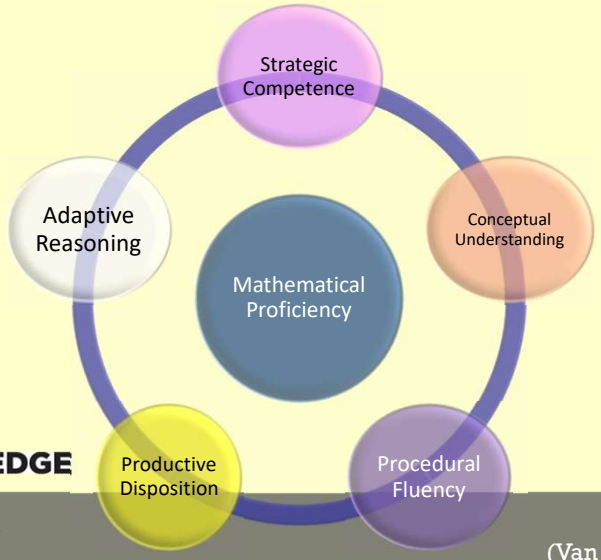
Adding it Up (NRC, 2001)



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(Van de Walle, 2010)

Types of Math Knowledge

- Conceptual - the understanding that math involves an interrelated hierarchical network that underlies all math-related tasks
- Procedural - the organization of conceptual knowledge into action to actually perform a mathematical task (Hiebert & Lefevre, 1986).
- Which comes first?
  - Sequence may be specific to the domain or the individual (Rittle-Johnson & Siegler, 1998; Rittle-Johnson, Siegler, & Wagner, 2001)
  - But the two are clearly interrelated.

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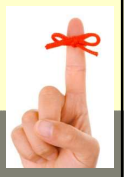
Strands of Proficiency	Instructional Implication
Conceptual Understanding	Fosters the developmental knowledge of relationships and ideas that underlie the problem.
Procedural Knowledge	Fosters the developmental understanding of the steps needed to solve a problem.
Strategic Competence	Fosters the development of learning to flexibly solve problems using multiple strategies.
Adaptive Reasoning	Fosters the development of learning to justify the correct answer and demonstrate reasoning.
Productive Disposition	Fosters the development of viewing math as useful and worthwhile, while increasing students' confidence.



	Mathematical Proficiency Strands				
Intervention	Conceptual Understanding	Procedural Knowledge	Strategic Competence	Adaptive Reasoning	Productive Disposition
Cognitive Strategy Instruction	X	X	X	X	
Concrete-Representational-Abstract	X	X	X	X	
Contingent Reinforcement					X
Cover, Copy, Compare		X			
Explicit Instruction	X	X	X		
Feedback				X	
Flashcard Interventions		X			
Goal Setting					X
Great Leaps	X				X
Math to Mastery		X			X
Peer-Assisted Learning Strategies	X	X		X	X
Schema-Based Instruction	X	X	X	X	
Self-Monitoring				X	X
Taped Problems		X			
Think Alouds	X			X	

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Pulles, 2015

- Model or demonstration — I do it.
  - Demonstrate the skill
  - Describe what is being done
- Prompted or guided practice — We do it.
  - Physical prompts
  - Verbal prompts
  - Visual prompts
- Unprompted practice — You do it.
  - One problem at a time, with feedback.

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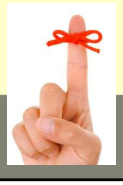

Tier 2 Problem Solving

- Check student's attendance – Does the student attend school regularly
- Observe the student – Are behavioral difficulties interfering with the interventions?
- Incentivize the intervention – Is the student sufficiently motivated?
- Examine intervention fidelity – Is the intervention occurring as it should?
- Examine the accuracy within skill and GOM data – Are the students receiving a proficiency intervention when they should be focusing on acquisition?
- Compare skill and GOM data – Are students not generalizing (skill data are going up but GOM are not)

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Tier II Problem Solving Questionnaire

Student Name _____ Grade _____ Teacher _____ School _____
Intervention Group _____ Intervention Instructor _____
Current Intervention _____ Past Interventions _____
Data Meeting Date _____

Question	Answer	Notes
1. Is the most recent GOM score below the upcoming seasonal target but the GOM slope is at or above the criterion?	YES Continue supplemental support/intervention. NO Examine skill measure data.	
2. Are the skills being acquired using current strategy?	YES Continue with current strategy. Add generalization strategy. NO Adjust intervention within level of support to match skill need.	
3. Is the student individually practicing the skill many times within the session?	YES NO Increase individual responses.	
4. Is the mean instructional fidelity during intervention with the student below 90%?	YES Improve instructional fidelity NO	
5. Is student showing motivation difficulties?	YES Provide incentives NO	
6. Is the student attendance below 95% during last instructional period (1 month)	YES Address attendance with building administration NO	
7. Are behavioral difficulties leading to student missing intervention more than 3 times during the last instructional period? (1 month)	YES Address behavior difficulties with building administration. NO	
8. Has the student received intervention with good fidelity for less than 9 weeks?	YES Implement intervention for up to 9 weeks. NO	
9. Has the student received intervention four times per week for the past instructional period ***for less than*** 15 minutes for kindergarten or ***less than*** 20 minutes for grades 1-3?	YES Increase time and sessions. NO	
10. ***If NO to Questions 4-8*** above and YES to Question 3, consider moving to Brief Experimental Analysis (BEA)/Tier III		

Next steps: Action Plan: Intervention modifications _____
Date to start: _____
Date to review (4 weeks) _____
Date:_____ Was there satisfactory improvement **YES:** Continue **NO:** Go to Tier III (conduct BEA)

Age Group	Reading	Writing	Math
Elementary			
Practices with Large Effects	• Repeated reading • Using easier reading material • Immediate performance feedback • Direct instruction • Phonemic awareness instruction • Explicit phonics instruction	• Strategy instruction for planning, editing, and paragraph structure • Peer assisted writing • Set clear and specific goals	• Drill techniques • Practice with modeling • Explicit instruction • Student verbalizations of their mathematical reasoning • Include a broad range of examples • Cross-age tutoring • Concrete-representational-abstract • Speed-based intervention
Practices with Small or Negative Effects	• Whole language approaches • Sentence combining	• Grammar instruction	• Problem structure representation
Adolescent			
Practices with Large Effects	• Comprehension strategies • Reciprocal teaching • Teaching vocabulary • Concept maps	• Self-regulation strategy development • Summarization • Setting product goals	• Using visual representations of problems • Self-monitor problem solving • Self-reflect on problem solving
Practices with Small or Negative Effects	• Fluency Interventions	• Studying models of writing • Teaching grammar	• Technological enhanced instruction

(Burns, VanDerHeyden & Zaslofsky, 2014)

TABLE 1
Individual Children's Baseline and Intervention Total Raw Scores, Percent of Change, and Effect Size

Participants	Plan	Sim	Att	Suc	Baseline mean	Baseline *SD*	Intervention mean	Intervention *SD*	% Change	Effect size
1	**65**	76	77	97	1.0	1.2	2.0	2.6	100	**0.9**
2	**79**	94	97	94	2.3	2.2	3.7	1.9	63	**0.6**
3	**65**	97	85	84	1.1	1.5	5.0	3.8	338	**2.6**
1-3	69.7	89	86.3	91.7	1.5	1.6	3.6	2.8	167	**1.4**
10	74	100	85	78	4.1	3.2	3.9	2.8	−7	**−0.1**
11	**71**	79	77	78	4.4	3.7	5.1	2.8	15	**0.2**
12	103	103	91	89	2.7	3.0	3.2	2.8	18	**0.2**
13	71	70	**88**	75	3.4	3.6	2.8	2.8	−19	**−0.2**
14	**94**	**88**	**112**	89	4.7	3.5	5.2	2.8	11	**0.1**
15	85	85	103	86	6.3	2.6	5.6	2.6	−10	**−0.2**
16	79	76	77	86	3.4	2.1	6.9	2.9	100	**1.6**
17	88	73	77	81	2.0	2.0	2.4	2.4	18	**0.2**
18	74	67	88	66	4.0	3.9	3.2	3.2	−20	**−0.2**
19	94	109	94	103	1.9	1.5	2.9	2.3	54	**0.7**
NCW	83.3	85.0	89.2	83.1	3.7	2.9	4.1	2.7	16	**0.2**

Note. *N* = 19. Plan = Planning, Sim = Simultaneous, Att = Attention, Suc = Successive. Percentage change was calculated using the formula: (mean number correct intervention − mean number correct baseline) / mean number correct baseline. Effect size was calculated using the formula: (intervention mean − baseline mean) / baseline SD. PCW = Planning Cognitive Weakness; SIMCW = Simultaneous Cognitive Weakness; ATTCW = Attention Cognitive Weakness; SUCCW = Successive Cognitive Weakness; NCW = No Cognitive Weakness. PASS scores that are Cognitive Weaknesses appear in boldface.

g = -0.05.

Change score
g = 0.32

Working Memory

Melby-Lervag & Hulme, 2013

- Verbal Ability .13
  - Comprehension and problem solving
  - Children (-.05) and young children (.03)
- Word Decoding .13
- Arithmetic .07

"There was no convincing evidence of the generalization of working memory training to other skills."

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Relationship between EF and Achievement

- Best, Miller, & Naglieri, 2011
- 96 correlations 4 measures of achievement and 3 measures of EF (12) for 8 age groups 5 - 17
- 43 were *r* = .39 or less, 42 were .40 to .49, highest was .59
- 104/120 (87%) were .49 or less for math (5 measures)

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Correlation

- *r* = .67 - # of people annually who drowned in swimming pools and # of Nicolas Cage movies
- *r* = .98 - Per capita consumption of mozzarella cheese and # of awarded civil engineering doctorates
- *r* = .89 – Per capita consumption of chicken and US crude oil imports
- *r* = .6 to .7
- Correlation is not causation.

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Executive Function Meta-Analysis

- Jacob and Parkinson (2016) reviewed 67 studies
  - Most of the research occurred in 2010 or later
  - There was a correlation between executive functioning and academic skills
  - The correlation with executive functioning was approximately equal for reading and mathematics
- Changing skills in executive functioning through various interventions did not lead to increase skills in reading and mathematics.
- There was little to no evidence that executive functioning and academic skills were causally linked.

Table 2
Median Effect Sizes for Each Variable

Variable	*k*	Median *g*	95% CI	Fail-safe *N* for a small effect	Fail-safe *N* for a large effect
Use of data					
Screening	30	.41	.31–.51	32	15
Designing interventions	4	.42	−.05–.89	4	2
Tier of intervention					
Small group	15	.30	.18–.42	8	9
Individual	16	.44	.28–.60	19	7
Type of assessment					
Cognitive function	8	.17	−.07–.41	NA	6
Phonological/phonemic awareness	13	.50	.34–.66	20	5
Reading fluency	11	.43	.29–.57	13	5
Mixed	2	.26	.12–.40	1	1

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Table 1. summary of Meta-Analyses Regarding Cognitive Processes and Academic interventions

Study	Description	k	d
Burns et al. (in press)	Academic interventions from cognitive processing measures	37	0.17
Kearns & Fuchs (2013)*	Academic outcomes of cognitively focused intervention	34	0.44
	matched to cognitive deficits	5	0.48
	Compared to no intervention	11	0.58
	Compared to academic interventions	34	0.26
Melby-Lervag & Hhulme, (2013)	Working memory training and academic outcomes	8	0.11
	mathematics	7	0.07
	Decoding	7	0.13
	Verbal ability (comprehension)	8	0.13
Scholin & Burns (2012)	Predicting response to intervention for reading with IQ	18	0.27
Stuebing et al. (2009)	Relationship between IQ and academic outcomes	22	0.32
Stuebing et al. (2015)	Cognitive characteristics and response to intervention	54	0.46
	baseline characteristics and growth curves	36	0.65
	baseline characteristics and gain scores	30	0.43
	baseline characteristics and posttest	54	0.30
Schwaighofer et al. (2015)	Near and far transfers for working memory training	47	0.15
	mathematics	15	0.09
	Decoding	14	0.15
	Verbal ability (comprehension)	29	0.21
Total		**203**	**0.27**

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Assessments

- Product Assessment
  - Focus on answers
  - Identifies content areas that need further assessment
  - Norm-referenced tests
  - Criterion-referenced tests
- Process Assessment
  - Focus on how student arrived at the answer
  - Identifies areas for intervention
  - Active
  - Passive

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Common Errors

- Slips
  - Errors in procedural tasks (e.g., regrouping)
- Bugs
  - Overgeneralization of "known" rule to a new situation
- Number facts
  - Not mastered basic addition, subtraction, multiplication, or division facts.

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Instructional Hierarchy:
Stages of Learning

	Acquisition	Proficiency	Generalization	Adaption
Learning Hierarchy	■Slow and inaccurate	■Accurate but slow	■Can apply to novel setting	■Can use information to solve problems
Instructional Hierarchy	■Modeling ■Explicit instruction ■Immediate corrective feedback	■Novel practice opportunities ■Independent practice ■Timings ■Immediate feedback	■Discrimination training ■Differentiation training	■Problem solving ■Simulations

Haring, N. G., & Eaton, M. D. (1978). Systematic instructional procedures: An instructional hierarchy. In N. G. Haring, T. C. Lovitt, M. D. Eaton, & C. L. Hansen (Eds.) *The fourth R: Research in the classroom* (pp. 23-40). Columbus, OH: Charles E. Merrill.

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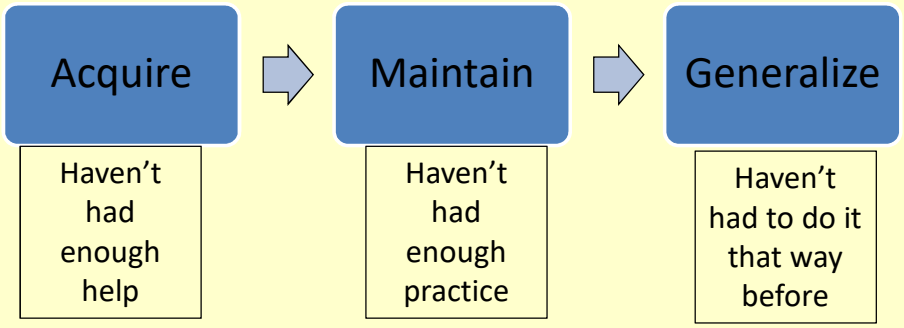
Learning Process



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- Acquire
  - Acquisition rate (less targets per sessions with more intervention sessions)
  - Make stimuli more salient and errorless
- Retain
  - Increased repetition within lesson (IR)
  - Increased repetition across lessons (same number of targets with more intervention sessions)
  - Frequent review (same number of intervention sessions, but daily review)
- Generalize
  - Integrate a variety of forms of the letters/words, including those similar to how they are presented during assessment into intervention sessions

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Acquire

- Acquisition rate (less targets per sessions with more intervention sessions)
- Make stimuli more salient and errorless

Types of Math Knowledge

- Conceptual - the understanding that math involves an interrelated hierarchical network that underlies all math-related tasks
- Procedural - the organization of conceptual knowledge into action to actually perform a mathematical task (Hiebert & Lefevre, 1986).

Correlations for Above 25th Percentile

	MAP	DCPM	Conceptual	WPS
1. MAP Math RIT	1.00	.46*	.10	.52*
2. Procedural MF DCPM		1.00	.11*	.43*
3. Conceptual Probe			1.00	.24*
4. Application WPS				1.00

*p< .05

493 students in 3rd grade

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Correlations for Below 25th Percentile

	Map	DCPM	Conceptual	WPS
1. MAP Math RIT	1.00	.78*	.61*	.50*
2. Procedural MF DCPM		1.00	.15	.57*
3. Conceptual Probe			1.00	.83*
4. Application WPS				1.00

*p < .05

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Instructional Hierarchy for Conceptual Knowledge				
Phase of Learning	Acquisition	Proficiency	Generalization	Adaption
Examples of appropriate instructional activities	Explicit Instruction in basic principles and concepts Modeling with math manipulatives Immediate corrective feedback	Independent practice with manipulatives Immediate feedback on the speed of responding, but delayed feedback on the accuracy. Contingent reinforcement for speed of response.	Instructional games with different stimuli Provide word problems for the concepts	Use concepts to solve applied problems

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Instructional Hierarchy for Procedural Knowledge				
Phase of Learning	Acquisition	Proficiency	Generalization	Adaption
Examples of appropriate instructional activities	Explicit instruction in task steps Modeling with written problems Immediate feedback on the accuracy of the work.	Independent practice with written skill Immediate feedback on the speed of the response, but delayed feedback on the accuracy. Contingent reinforcement	Apply number operations to applied problems Complete real and contrived number problems in the classroom	Use numbers to solve problems in the classroom

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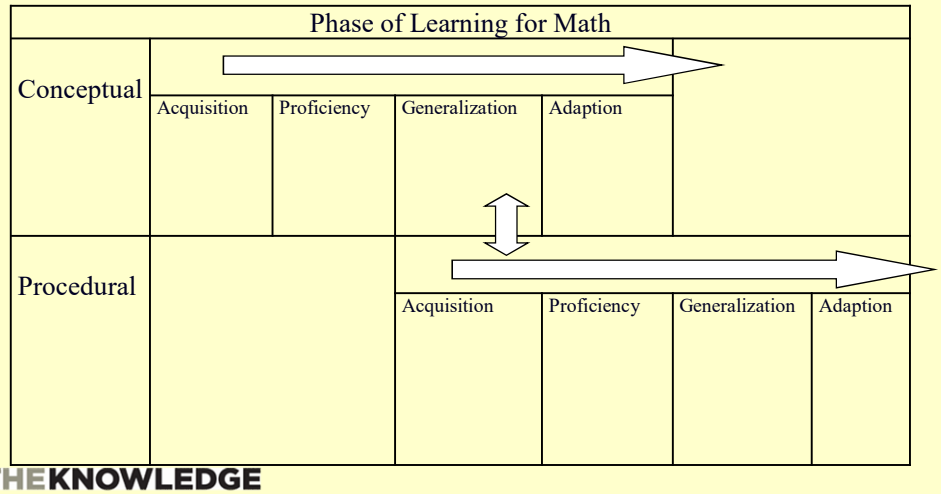

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Skill by Treatment Interaction

- Instructional Level (Burns, VanDerHeyden, & Jiban, 2006)
- 2nd and 3rd grade -14 to 31 Digits Correct/Min
- 4th and 5th grade - 24 to 49 Digits Correct/Min

Type of Intervention	Baseline Skill Level	*k*	Median PAND	Mean Phi
Acquisition	Frustration	21	97%	.84
	Instructional	15	66%	.49
Fluency	Frustration	12	62%	.47
	Instructional	NA		

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Assessing Conceptual Knowledge
Concept Oriented CBM

- *Monitoring Basic Skills Progress-Math Concepts and Applications* (Fuchs, Hamlett, & Fuchs, 1999).
- 18 or more problems that assess mastery of concepts and applications
- 6 to 8 minutes to complete

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Conceptual Assessment

- Ask students to judge if items are correct
  - 10% of 5-year-old children who correctly counted did not identify counting errors in others (Briars & Siegler, 1984).
- Provide three examples of the same equation and asking them to circle the correct one
- Provide a list of randomly ordered correct and incorrect equations and ask them to write or circle "true" or "false" (Beatty & Moss, 2007).

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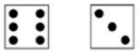
Look at the picture of dots below the two problems and circle the problem that best goes with the picture.

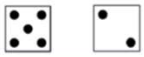
1. $2 + 4 = 6$ $3 + 4 = 7$

2. $4 + 2 = 6$ $4 + 1 = 5$

3. $6 + 5 = 11$ $6 + 3 = 9$



4. $5 + 2 = 7$ $5 + 3 = 8$



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Conceptual Intervention

- Jessica – 8th grade African-American female
- History of math difficulties (6th percentile)
- Could not learn fractions

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Assessment

- 0 correct on adding fractions probe
- Presented sheet of fractions with two in each problem and asked which was larger (47% and 45% correct)
- 0% reducing

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Step 1 – size of fractions

- 1. I do
- 2. We do
- 3. You do
- Comparing fractions with pie charts

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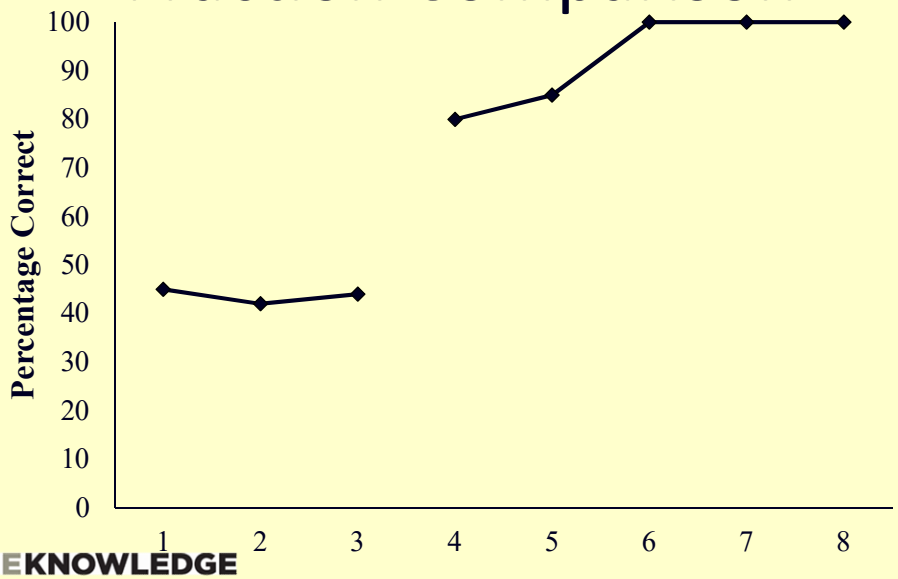
Fraction Comparison



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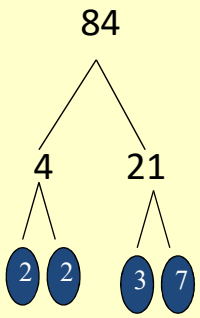
Step 2 – Reducing Fractions

- Factor trees (I do, we do, you do)



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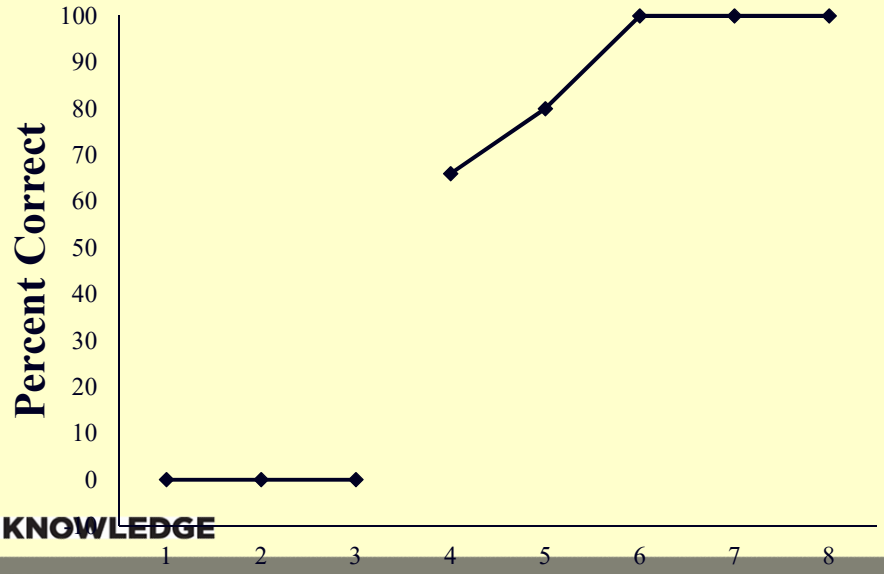
Reducing Fractions



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Conceptual Assessment

Problem 1
Please use a picture to solve the problem

3 x 4 = ____

Problem 2
Please use a picture to solve the problem

5 x 6 =____

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Problem 1
Please use a picture to solve the problem

2 x 4 = ___

Problem 2
Please use a picture to solve the problem

3 x 5 = ___

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1. How did you figure this problem out?

COUNTED THE 3'S AND THEN THE 5'S

If the student response is vague or insufficient and does not describe the solution process, then prompt as follows:

a. Please tell me more about what you did so I can understand you better.

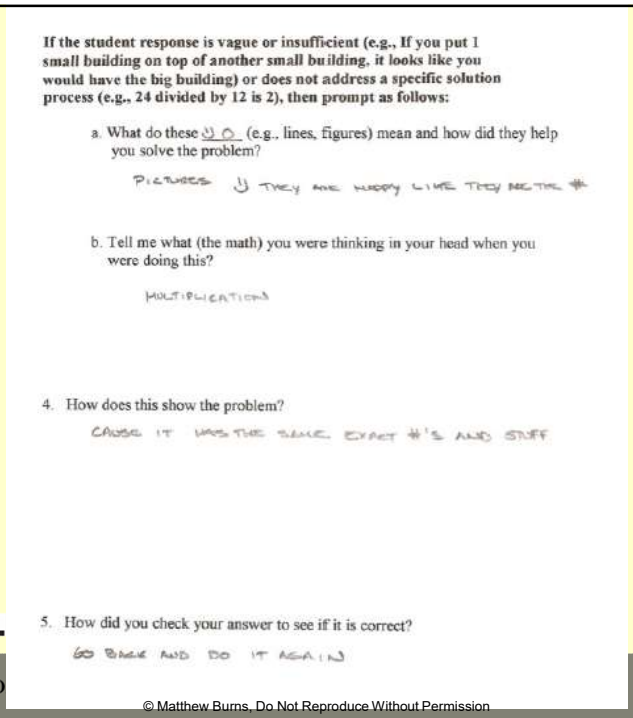
NO RESPONSE

b. I never thought about it that way. Can you tell me more?

USE THE PICTURES TO SOLVE IT

2. How did you find the answer?

ADD THEM UP



If the student response is vague or insufficient (e.g., If you put 1 small building on top of another small building, it looks like you would have the big building) or does not address a specific solution process (e.g., 24 divided by 12 is 2), then prompt as follows:

a. What do these ☺ ☹ (e.g., lines, figures) mean and how did they help you solve the problem?

PICTURES ☺ THEY ARE HAPPY LIKE THEY ME THE #

b. Tell me what (the math) you were thinking in your head when you were doing this?

MULTIPLICATION

4. How does this show the problem?

CAUSE IT WAS THE SAME EXACT #'S AND STUFF

5. How did you check your answer to see if it is correct?

GO BACK AND DO IT AGAIN

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Tech Options

- Mathfactcafe.com
- Thatquiz.org
- Xtramath.org

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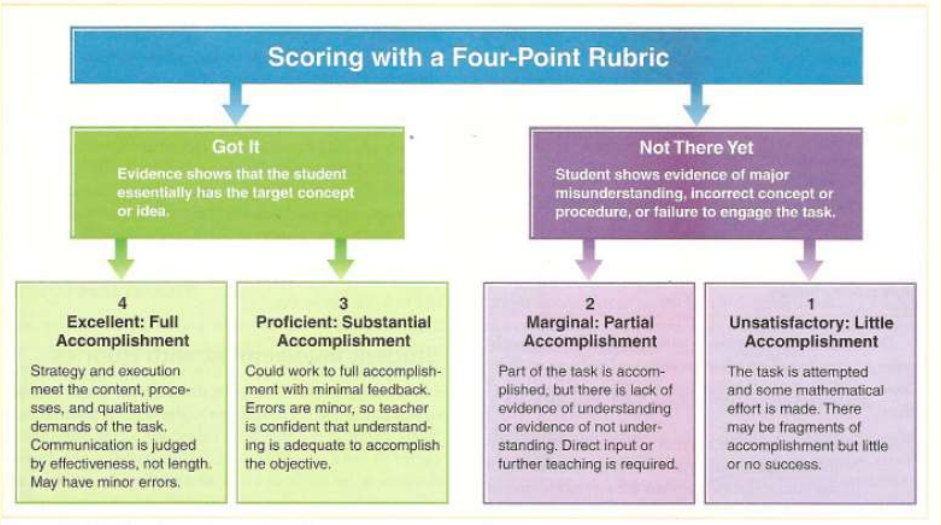

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Vandewalle, 2008

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Ratings for Problem 2

- Counts with understanding
- Understands number sign
- Understands the facts of adding/ subtraction or multiplication/division of whole numbers
- Uses visual model (Correct relationship between diagram and problem)
- Uses an identifiable strategy
- Answers the problem correctly

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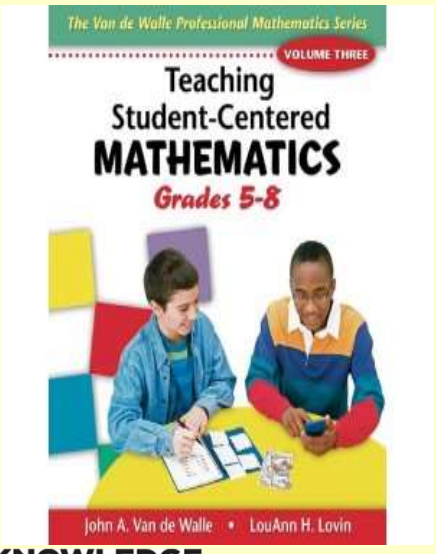

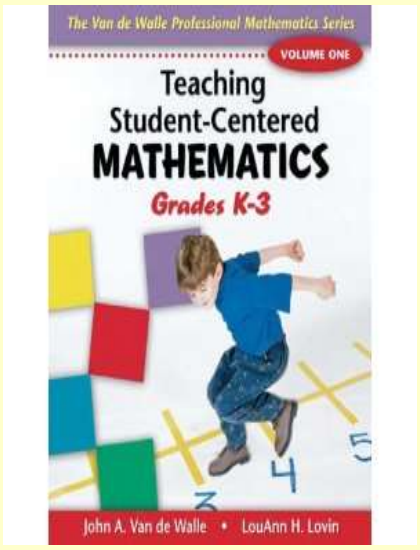

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From Objects to Numbers

- Make Sets
- Count the number write the number
- Part-Part-Whole
- Fill the Chutes
- Broken Calculator Key
- Algebra – Pattern Match
- Algebra – Tilt or Balance

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ACTIVITY 9.3

Fill the Chutes

Create a simple game board with four "chutes." Each consists of a column of about twelve 1-inch squares with a star at the top. Children take turns rolling a die and collecting the indicated number of counters. They then place these counters in one of the chutes. The object is to fill all of the chutes with counters. As an option, require that the chutes be filled exactly. A roll of 5 cannot be used to fill a chute with four spaces.

ACTIVITY 9.18

Build It in Parts

Provide children with one type of material, such as connecting cubes or squares of colored paper. The task is to see how many different combinations for a particular number they can make using two parts. (If you wish, you can allow for more than two parts.) Each different combination can be displayed on a small mat, such as a quarter-sheet of construction paper. Here are just a few ideas, each of which is illustrated in Figure 9.8.

- Use two-color counters such as lima beans spray painted on one side (also available in plastic).
- Make bars of connecting cubes. Make each bar with two colors. Keep the colors together.
- Color rows of squares on 1-inch grid paper.
- Make combinations using two dot strips—strips of poster board about 1 inch wide with stick-on dots. (Make lots of strips with from one to four dots and fewer strips with from five to ten dots.)
- Make combinations of "two-column strips." These are cut from tagboard ruled in 1-inch squares. All pieces except the single squares are cut from two columns of the tagboard.

Connect Four!

Addition

8	2	7	11	3	9	6
4	10	5	12	9	2	11
7	3	8	10	5	8	4
9	11	4	2	6	12	9
6	10	7	5	3	8	9
10	7	2	11	6	3	12

How To Play:

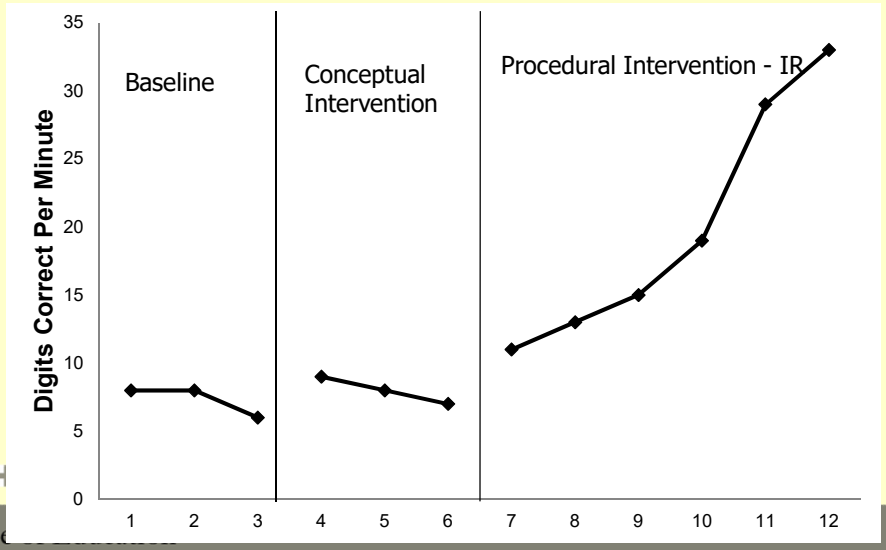
1. Roll two dice
2. Add the numbers
3. Cover the sum with your marker.
4. First player to get 4 in a row wins!

Broken Multiplication Key

Directions: Partners pretend that one of the number keys on the calculator is broken. One partner says a number, and the other tries to display it on the calculator without using the "broken" key.

Keeping Score: an extended challenge (optional): A player's score is the number of keys entered to obtain the goal. Scores for five rounds are totaled, and the player with the lowest total wins.

Example: If the 8 key is "broken," a player can display the number 18 by pressing 9 [+] 7 [+] 2 (score 5 points); 9 [x] 2 (score 3 points); or 72 [÷] 4 (score 4 points).



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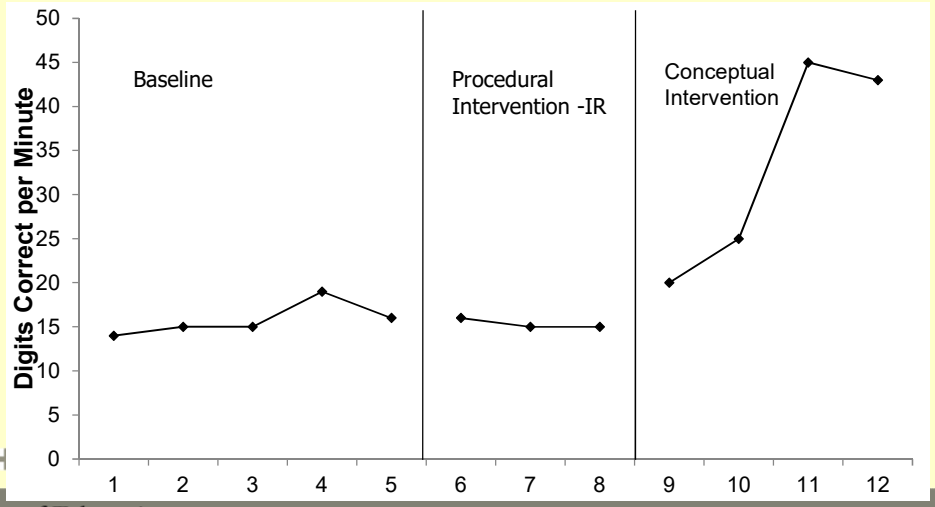

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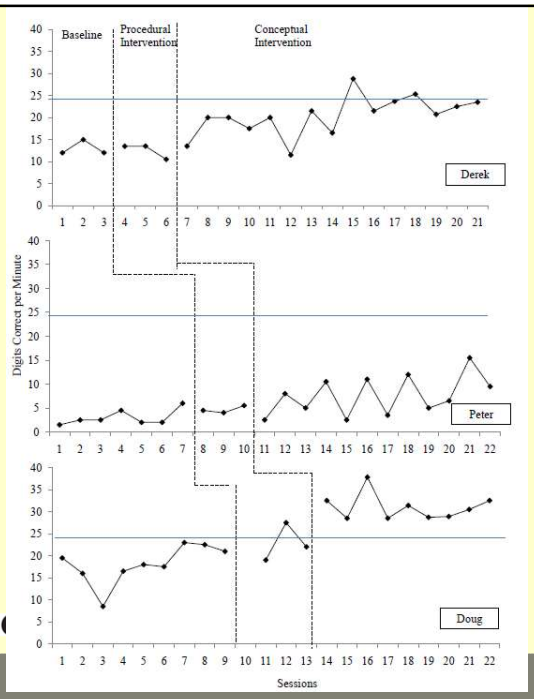

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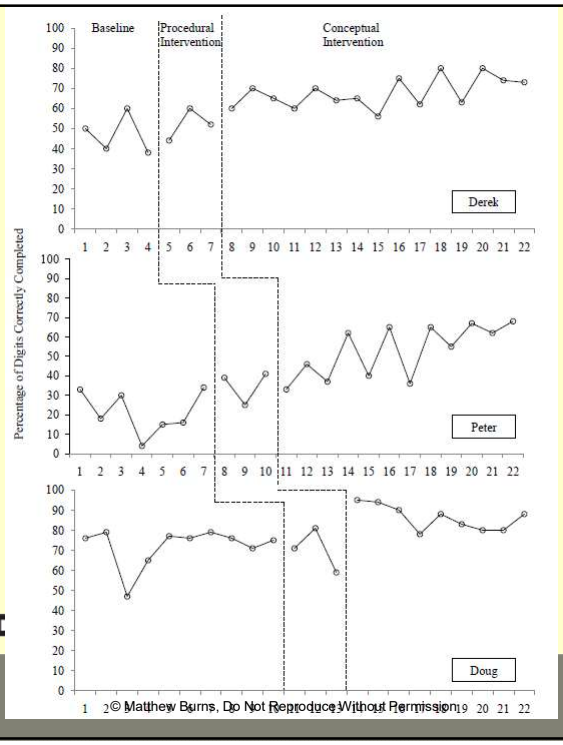

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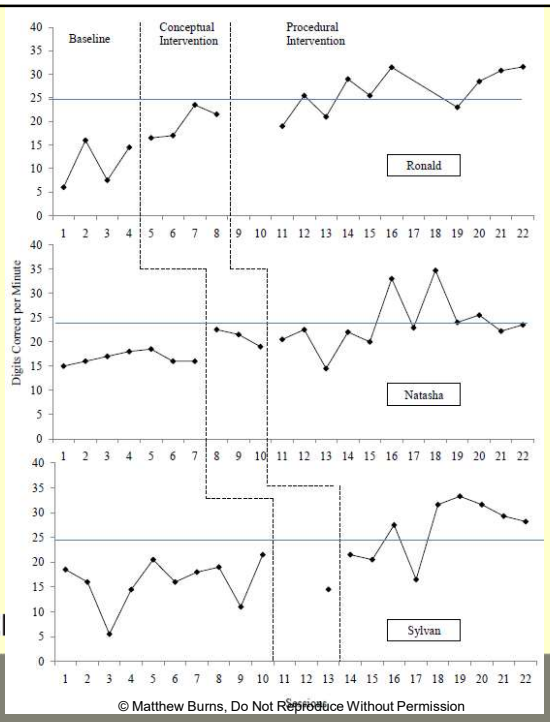
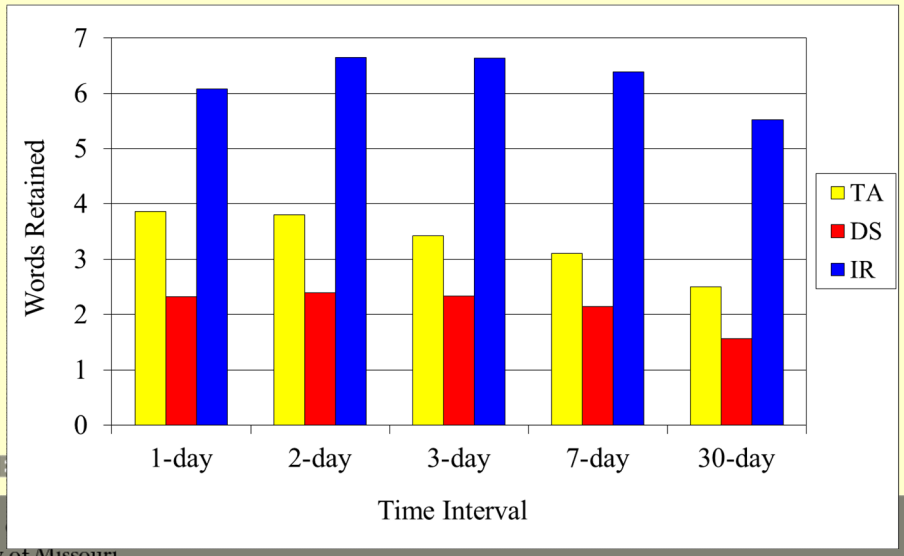


Remember What They Learned

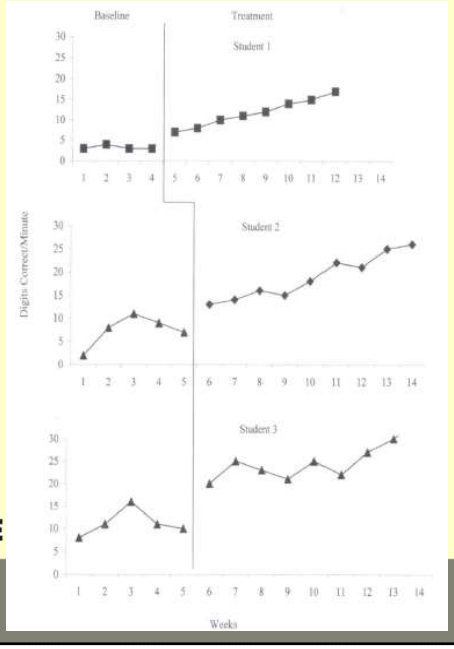
Incremental Rehearsal

- Developed by Dr. James Tucker (1989)
- Folding in technique
- Rehearses one new item at a time
- Uses instructional level and high repetition

Mean Number of Words Retained



IR and Math LD



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Incremental Rehearsal Effectiveness

Bunn, R., Burns, M. K., Hoffman, H. H., & Newman, C. L. (2005). Using incremental rehearsal to teach letter identification with a preschool-aged child. *Journal of Evidence Based Practice for Schools, 6,* 124-134.

Burns, M. K. (2007). Reading at the instructional level with children identified as learning disabled: Potential implications for response–to-intervention. *School Psychology Quarterly,* 22, 297-313.

Burns, M. K. (2005). Using incremental rehearsal to practice multiplication facts with children identified as learning disabled in mathematics computation. *Education and Treatment of Children, 28,* 237-249.

Burns, M. K., Dean, V. J., & Foley, S. (2004). Preteaching unknown key words with incremental rehearsal to improve reading fluency and comprehension with children identified as reading disabled. *Journal of School Psychology, 42,* 303-314.

Burns, M. K., Zaslofsky, A. F., Kanive, R., & Parker, D. C. (2012). Meta-analysis of incremental rehearsal: Using phi coefficients to compare single-case and group designs. *Journal of Behavioral Education, 21,* 185-202.

Codding, R. S., Archer, J., & Connell, J. (2010). A systematic replication and extension of using incremental rehearsal to improve multiplication skills: An investigation of generalization. *Journal of Behavioral Education, 19,* 93-105.

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Nist, L. & Joseph L. M. (2008). Effectiveness and efficiency of flashcard drill instructional methods on urban first-graders' word recognition, acquisition, maintenance, and generalization. *School Psychology Review, 37,* 294-208.

Peterson, M., Brandes, D., Kunkel, A., Wilson, J., Rahn, N., Egan, A., & McComas, J. J. (2014). Teaching letter sounds to kindergarten English language learners using Incremental Rehearsal. *Journal of School Psychology, 52,* 97-107.

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Say-Ask-Check (Montague, 1992)

Steps	Prompt Sample
1. Read	I will read the problem and reread what I don't understand. Do I fully understand it?
2. Paraphrase	I will highlight key words and restate it in my own words. Did I highlight the most important words?
3. Draw	I will draw a picture of the problem. Does the drawing contain the important parts?
4. Plan	I will make a plan to solve the problem. What is the first step? What is the second step?
5. Predict	I will predict what I think the answer is. What numbers should be used to estimate?
6. Compute	I will compute the answer. Does my answer sound right?
7. Check	I will check the steps of my answer. Did I go through each step and check my work?

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Schema-based Instruction

- Instructional approach for teaching problem-solving
- Problem types for addition/subtraction
  - Change
  - Group
  - Compare
- Students are explicitly taught how to identify, organize, plan, and solve various word problem types
- Diagrams are systematically faded

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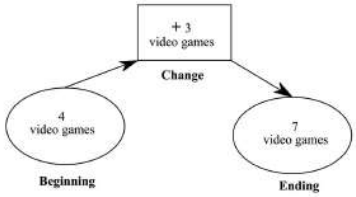
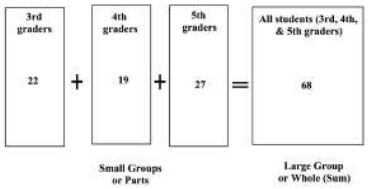
Change: Jane had 4 video games. Then her mother gave her 3 more video games for her birthday. Jane now has 7 video games.



Group: 68 students at Hillcrest Elementary took part in the school play. There were 22 third graders, 19 fourth graders, and 27 fifth graders in the school play.



Compare: Joe is 8 years older than Jill. Jill is 7 years old and Joe is 15 years old.

Figure 1. Schematic diagrams for change, group, and compare problem situations. Change diagram from *Schemas in Problem Solving* (p. 133), by S. P. Marshall, 1995, New York: Cambridge University Press. Copyright 1995. Adapted with permission.

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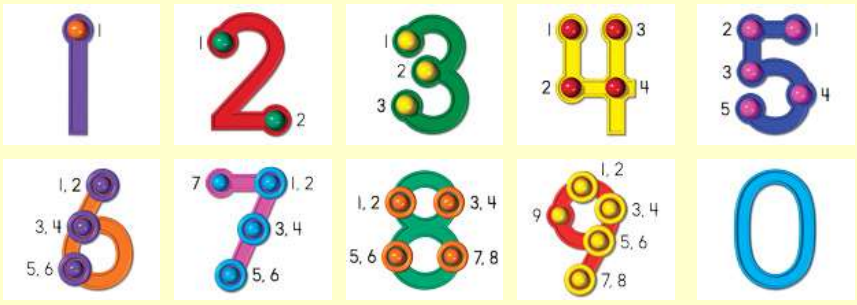
Touch Math



- Do you see any issues with this method?
- How would it affect generalization? Fluency?

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