





Professional Development

"The Developing Mathematical Thinking Institute (DMTI) is dedicated to enhancing students' learning of mathematics by supporting educators in the implementation of researchbased instructional strategies through high-quality professional development, curricular resources and assessments."

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Engaging Parents in Helping Young Children **Develop Mathematical Thinking** for STEM Fields

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Session Overview

- ➤ What does it mean to Develop Mathematical Thinking?
 - > DMT Framework
 - > Evidence
- **→** Primary Math Assessment
 - **>**6 predictors of future success
- > Parent Portal
- **➤ DMTI Professional Development and Resources**



Developing Mathematical Thinking

FVIDENCE

Task to Think About

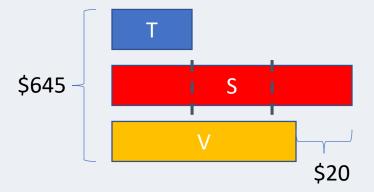
• Solve the following problem:

Tina saved some money.

Sara saved three times as much money as Tina.

Victor saved \$20 less than Sara.

How much money did Victor save if they saved \$645 all together?

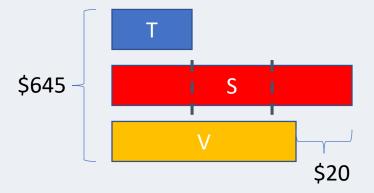




Task to Think About

• Solve the following problem:

$$T + S + V = $645$$
 $T + (T + T + T) + (T + T + T - 20) = 645
 $7T - 20 = 645
 $7T = 665
 $T = 95
 $S = 285



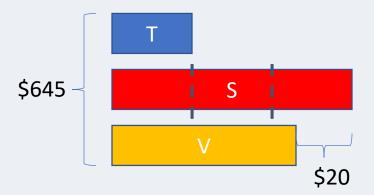


V = \$265

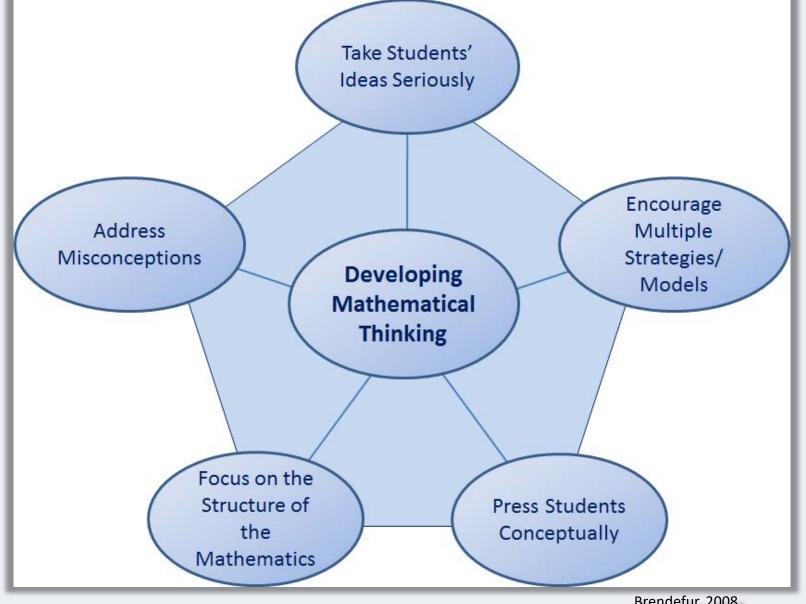
Task to Think About

• Solve the following problem:

$$V = $265$$



DMT Framework



Brendefur, 2008



DMT Makes a Difference

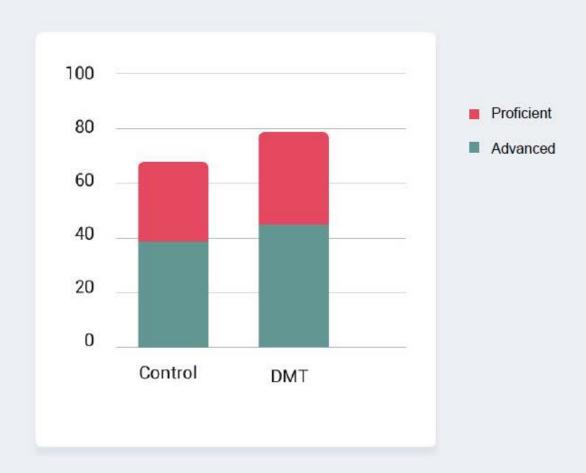
Large Scale Evaluation Results

· 79.2% of students in DMT teachers' classrooms scored proficient or advanced compared to 65.7% in control teachers' classrooms · These differences are statistically significant (z=2.603, p < .01)

RMC Research Corp.

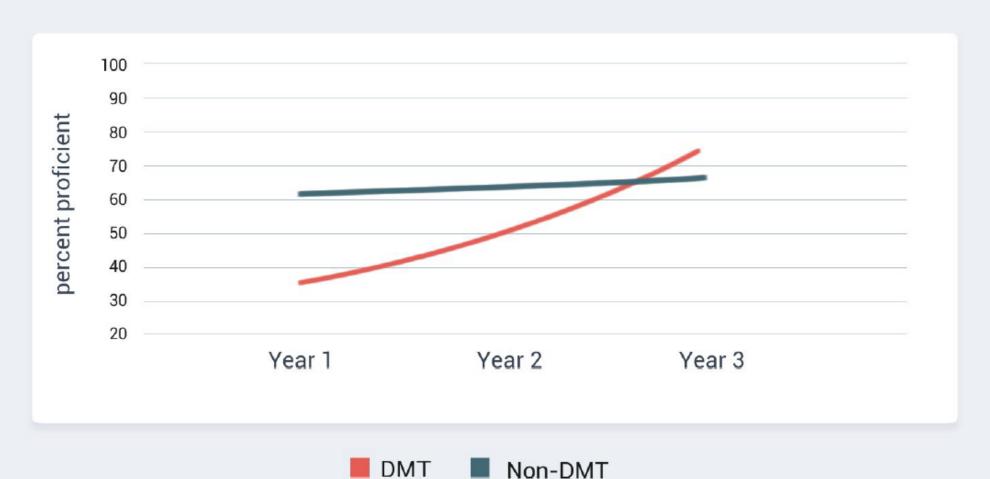
Standardized Achievement Test

Control vs. DMT





English Language Learners' Proficiency: Grades 3 - 8

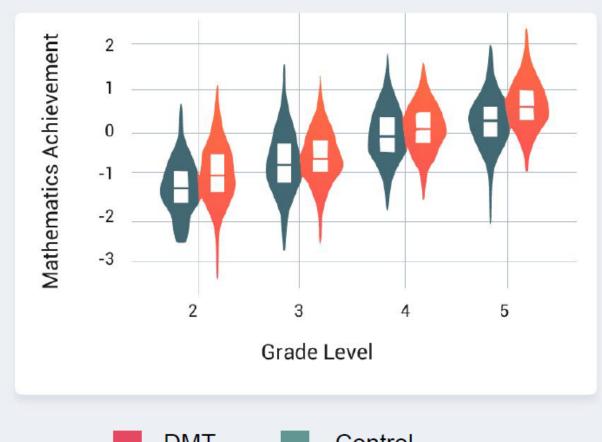




IES Grant - Randomized Design (2012-2015)

Through an Institute for Educational Science (IES) grant, 8 schools were randomly assigned to receive DMT professional development over a 2 year period compared to a control group.

Using a standardized test, students in grades 2 - 5 increased their achievement levels with an average of 2 standard deviations above the control group.









DMTI Curricular Resources Make a Difference

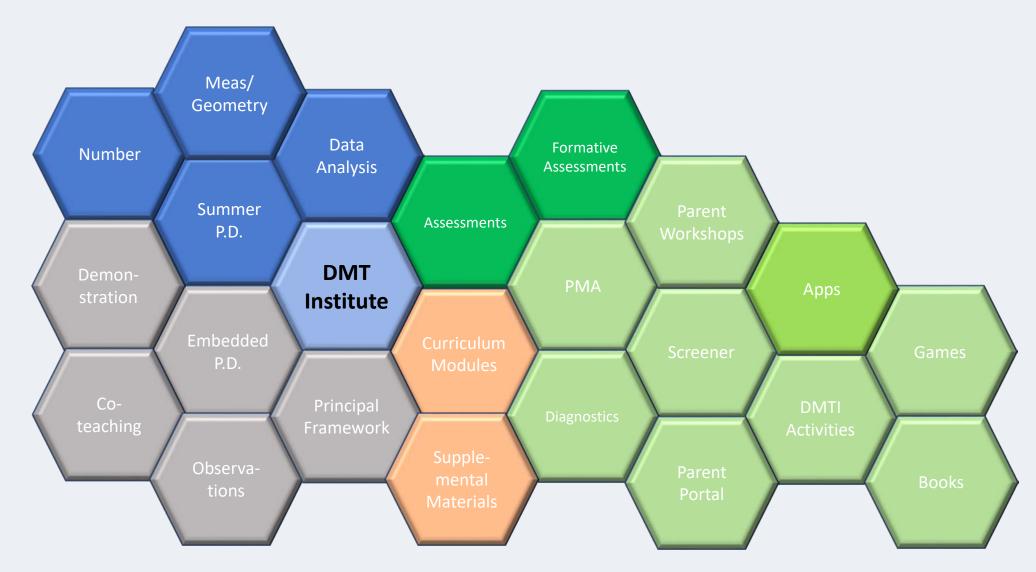
Results from a statewide standardized achievement test showed DMTI teachers outperforming their grade level colleagues.

Teacher D participated in DMTI professional development and implemented the curricular resources, while the other teachers did not.





Developing Mathematical Thinking (DMT) Institute





What does it mean to Develop Mathematical Thinking?

 DMT is built on a theoretical foundation drawing from three major learning theories:

Cognitive Theories

Social Interactional Theories

Behaviorism

DMT as a structure...





Primary Math Assessment (PMA)

Purpose and Overview of the PMA

- 6 Dimensions
- Screener and Diagnostic
- Classroom Reports
- Parent and Community Engagement
- Activities and Resources



What do you think are the greatest math predictors of whether a student will be *successful* in mathematics later in school and in STEM fields?

Interpreting Context

Number Facts

Number Sequencing

Measurement

Relational Thinking

Spatial Reasoning



6. Number Sequencing and Identification



5. Number Facts

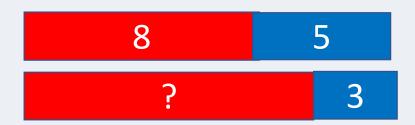


4. Interpreting Context

There are 8 black ants and 5 red ants. How many more black ants are there than red ants?



3. Relational Thinking

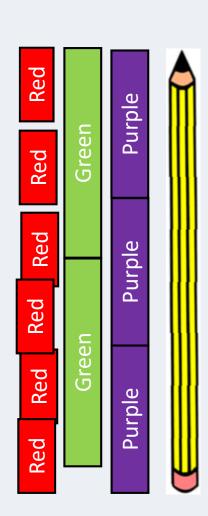




2. Measurement

Which measurement is correct?

- Unit
- Iterate
- Partition
- Transitivity
- Zero

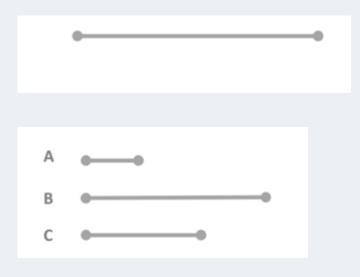




2. Measurement

If the top line is split into 4 equal size pieces, which of the lengths would match 1 piece?

- Unit
- Iterate
- Partition
- Transitivity
- Zero

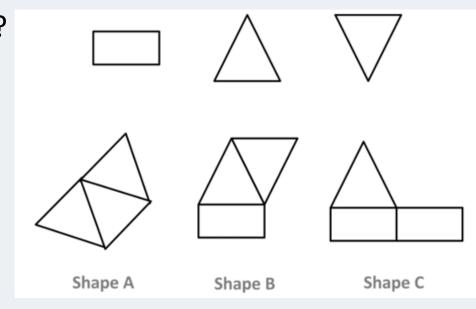




1. Spatial Reasoning

Which shape can I make with all the shapes to the right?

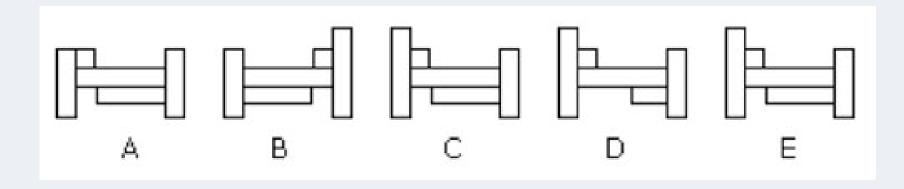
- Compose
- Decompose
- Rotation
- Congruence



1. Spatial Reasoning

Which shapes are exactly the same?

- Compose
- Decompose
- Rotation
- Congruence





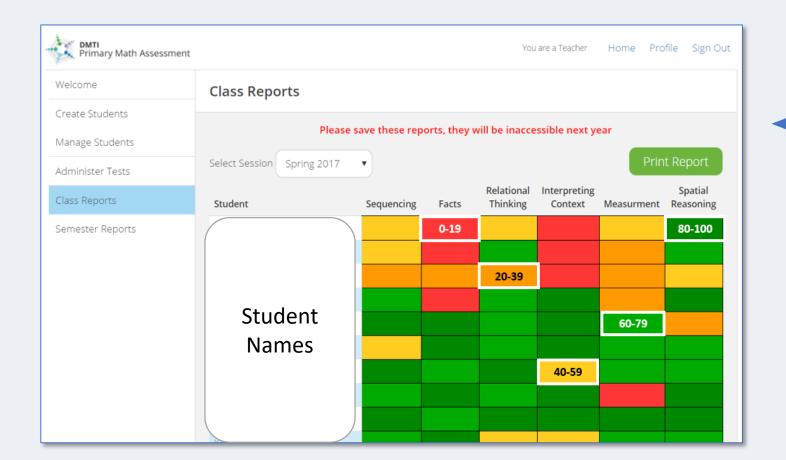
- 6. Facts
- 5. Sequencing
- 4. Interpreting Context
- 3. Relational Thinking
- 2. Measurement
- 1. Spatial Reasoning

(Brendefur et al., 2015)



PMA Screener

REPORTS

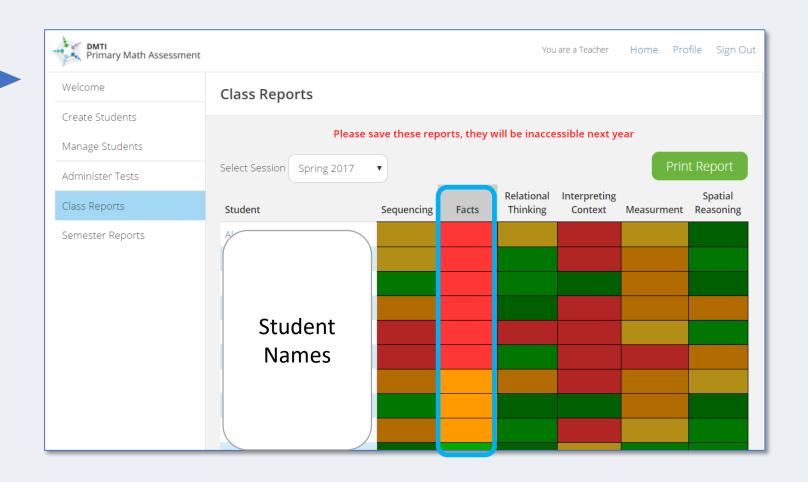


Class Report provides a color-coded grid to represent the students' quintile placement for each of the six dimensions assessed by the PMA. The quintile ranges are presented by moving the cursor over the individual cell. Teachers have the option to print the report with quintiles shown and can update their student roster by using the Create and Manage tabs.



Sorting Feature is

available by selecting the heading for any of the six dimensions. Teachers can immediately have the student roster sorted by quintiles beginning with the lowest quintile. This feature highlights groups of students in greatest need of instructional interventions for the specific dimension.





Recommended

Suggested Curricular Priorities and Instructional Support

Measurement

Class average: 50%



First Grade

Me and the Measure of Things

Literature

Joan Sweeney

The energetic narrator of *Me Counting Time* and *Me on the Map* is back, this time introducing young readers to the units of measure. between a cup and an ounce? What gets measured in bushels and when do you use a scale? Easy-to-understand text and playful corresponding to the differences between wet and dry measurements, weight, size, and length. And all information is conveyed in a unique perspective, using everyday objects and situations. *Me and the Measure of Things* makes measurement fun–and comprehensible!

Parent Measurement

Activity

Measuring Length

Activity

Match It!

Activity

Find it in the Room

Activity

Covering the Window

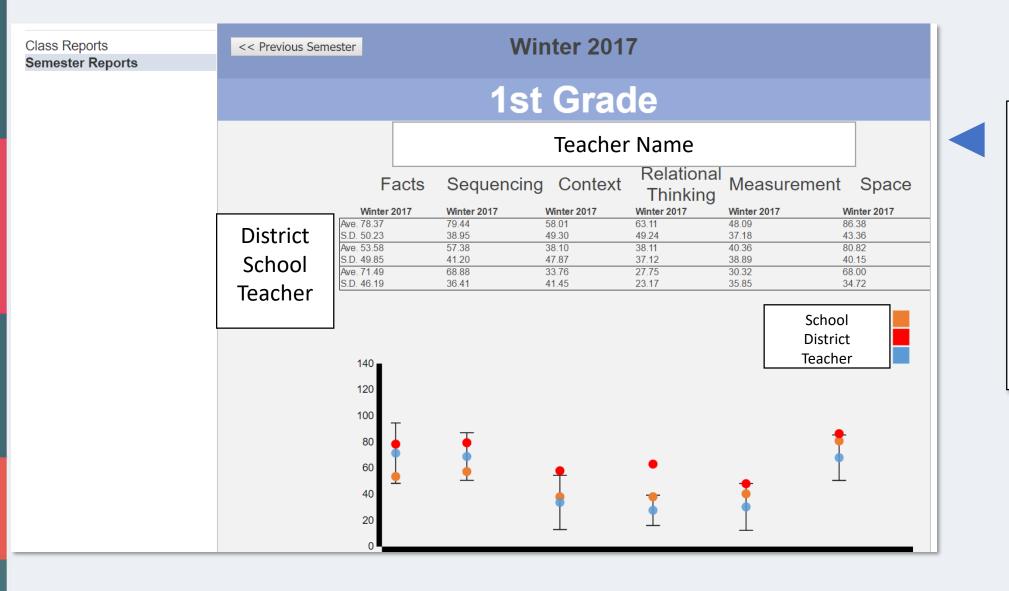
Activity

Cover the Shape

Activity

Recommendations suggest specific activities (individual, small group, or whole class) to do with students struggling on this dimension. In addition, suggestions are made on which targeted games could be played and targeted children's books to read.



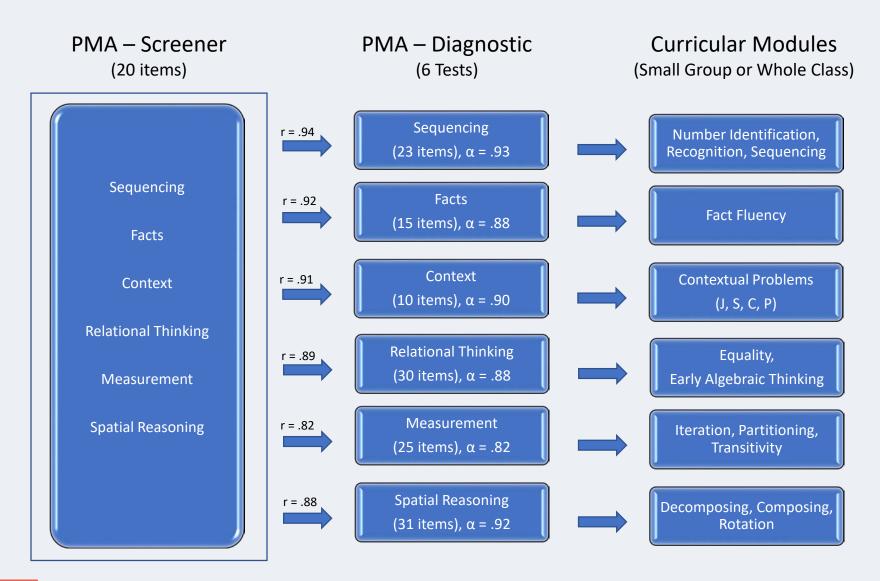




show a teacher's classroom results as compared to the school and district. The error bars indicate the norm range for each of the six dimensions. Classrooms are blue, districts are red and the schools are orange.



Reliabilities and Correlations





Developing Mathematical Thinking

PARENTS, CAREGIVERS AND COMMUNITY

Engaging Parents and Community

Parent/Caregiver Workshops

www.DMTinstitute.com

Topics (2 – 4 hours)

- K-2 Number and Structure
 - Counting
 - Fluency for Addition and Subtraction
- 3-5 Number and Structure
 - Fluency for Multiplication
 - Fractions
 - Decimals
- 6-8 Number and Structure
 - Ratio and Proportion
 - Algebraic Reasoning



Engaging Parents and Community

Parent Portal

MyMathSuccess.com

- Primary Math Assessment (PMA) Screener
 - For parents of Kindergarten, first, and/or second grade students
 - Provides reports and prioritizes activities
- DMTI Activities
 - Specific to each of the six predictive domains
 - Includes suggested questions to ask and vocabulary to use
- Focused Work on Each Domain for 2 months
 - Notified bi-monthly of 1 DMTI activity to do together
 - Suggested Game to purchase and play
 - Suggested Book to purchase and read



Engaging Parents and Community

Basic Math Pack









Advanced Math Pack

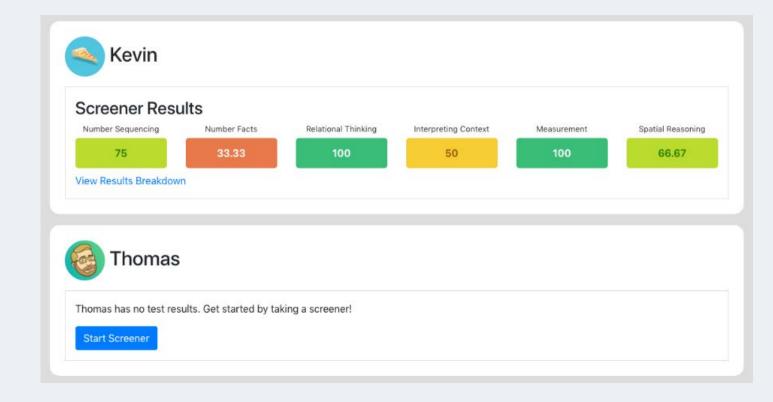






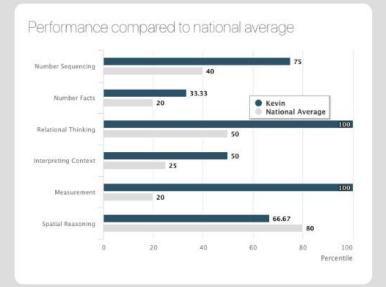
Parent Portal

 After the child is screened the results are ready to view and suggestions are automated





Screener Results for Kevin



Summary Table 75% Number Sequencing Number Facts 33.33% Relational Thinking 100% Interpreting Context 50% Measurement 100% Spatial Reasoning 66.67%

Number Sequencing



Chutes and Ladders

You and the character on your pawn can see the square marked 100, but it's not so easy to get there. If you land on a good deed, you can shimmy up a l...

VIEW ON AMAZON



One Hundred Angry Ants

One hundred hungry ants march off single file to sample a picnic, but when the going gets too slow, they divide into two rows of fifty, then four rows...

VIEW ON AMAZON



Slide, collide and score to win the Sorryl Game. Kids draw cards to see how far they get to move one of the pawns on the board. If they land on a Slid...

VIEW ON AMAZON



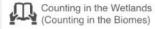
One is a Snail, Ten is a Crab

Sayre, A.P. and Sayre, J.

If one is a snail and two is a person, we must be counting by feet! Just follow the sign to the beach, where a bunch of fun-loving crabs, lounging dog.

VIEW ON AMAZON

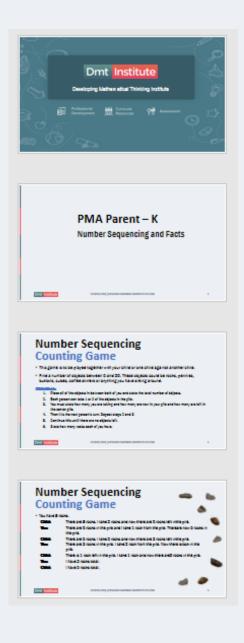




McKissack, F. Jr. and McKissack, L. Beringer

Counts wetlands animals from one to ten and provides information about the different animals found in the

VIEW ON AMAZON





Number Sequencing Counting Game



You have 8 rocks.

Child: There are 8 rocks. I take 2 rocks and now there are 6 rocks left in the pile.

You: There are 6 rocks in the pile and I take 1 rock from the pile. There are now 5 rocks in

the pile.

Child: There are 5 rocks. I take 2 rocks and now there are 3 rocks left in the pile.

You: There are 3 rocks in the pile. I take 2 rock from the pile. Now there is rock in the

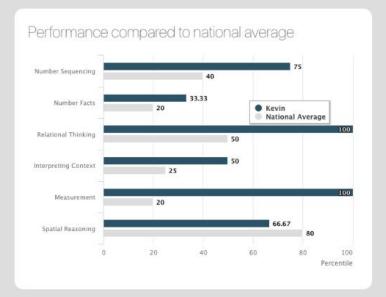
pile.

Child: There is 1 rock left in the pile. I take 1 rock and now there are 0 rocks in the pile.

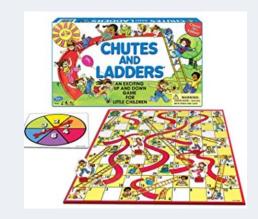
You: I have 3 rocks total.

Child: I have 5 rocks total.

Screener Results for Kevin



Summary Table 75% Number Sequencing 33.33% Number Facts Relational Thinking 100% Interpreting Context 50% Measurement 100% Spatial Reasoning 66.67%



Number Sequencing



You and the character on your pawn can see the square marked 100, but it's not so easy to get there. If you land on a good deed, you can shimmy up a l...

VIEW ON AMAZON



One hundred hungry ants march off single file to sample a picnic, but when the going gets too slow, they divide into two rows of fifty, then four rows...

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VIEW ON AMAZON



Dmt Institute

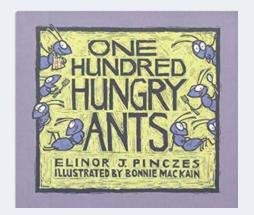
Counting in the Wetlands Counting in the Wetlands (Counting in the Biomes)

Counting Game

McKissack, F. Jr. and McKissack, L. Beringer

Counts wetlands animals from one to ten and provides information about the different animals found in the

VIEW ON AMAZON



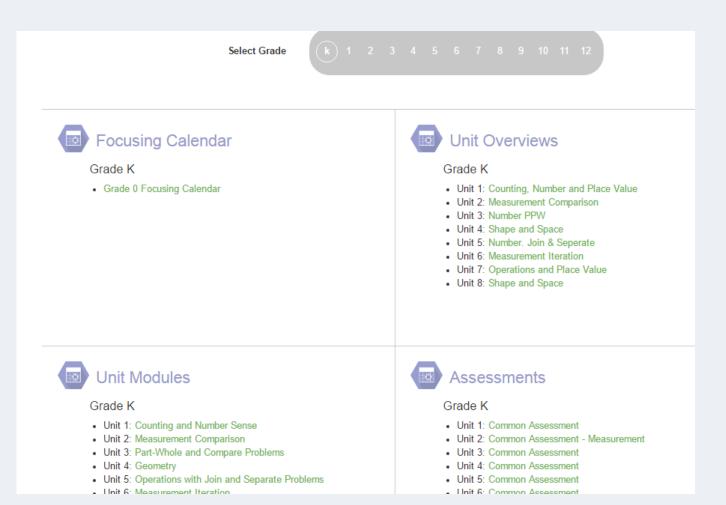


DMTI Curricular Resources

FOCUS CALENDARS, UNIT OVERVIEWS, MODULES AND ASSESSMENTS

Central Access Point

- www.dmtinstitute.com
- After logging in, users are given access to all available materials regardless of grade level.
- This supports intervention and extension activities and informs teachers about the progression of content across grades.





Module Sequence

- Lesson 1: Counting Forward and Back
- **Lesson 2:** Part-Whole Situations
- Lesson 3: Part-Whole: Practice
- Lesson 4: Part-Whole: Writing Contexts
- Lesson 5: Part-Whole: Iconic Models
- Lesson 6: Solving Compare Situations:
 Context
- Lesson 7: Solving Compare Situations:
 Practice

- Lesson 8: Solving Compare Situations:
 Iconic Models
- Lesson 9: Solving Compare Situations:
 Symbolic Models
- Lesson 10: Solving Compare Situations: Making Models and Justification
- Lesson 11: Compare Situations: Pocket Survey
- Lesson 12: Part-Whole and Compare Situations: Summary and Varied Practice









Tia and Frances are planting a garden. They start by planting carrots and peppers. There are 47 carrot seeds and 81 pepper seeds. How many more pepper seeds did they plant than carrot seeds?

Model this situation.

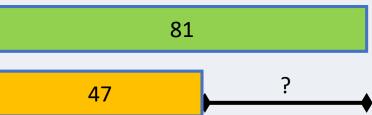
Are there more carrot or more pepper seeds?

More pepper seeds.

Write a number sentence for this situation.

Now, answer the question.

34





Compare Situations

Explain how each of Tia's models work using the word bank to the right.

Number Line +3 +30 +1 47 50 8081 3 + 30 + 1 = 34

Word Bank

Unit

Decompose

Compose

Equation

In the number line model, Tia added 3 to 47 to get 50. Then she added 30 to get to 80. Then she added 1 to get to 81. She then composed 3 + 30 + 1 to get 34.

There are 34 more green been seeds than carrot seeds.



Compare Situations: Practice Extension

Word Bank

Unit
Decompose
Compose
Equation

Using the word bank, explain how you solved each of the four problems.

Problems	Explanation
1. Tia planted 26 green peppers and 46 carrots. How many more carrots did she plant than green peppers?	
2. Frances planted 75 green peppers and 55 carrots. How many more green peppers did he plant than carrots?	
3. Tia planted 65 green peppers. She planted 35 more carrots than green peppers. How many carrots did she plant?	
4. Frances planted 70 green peppers. He planted 52 fewer carrots than green peppers. How many carrots did he plant?	







Compare Situations: Practice

Use the compare problem worksheet to solve the following problems. Model each situation first, write an equation and then solve it using one of the methods listed.

Problems	Number Sets	
1. Tia planted 26 green peppers and 46 carrots. How many more carrots did she plant than green peppers?	(38, 47) (75, 125) (107, 184)	
2. Frances planted 75 green peppers and 55 carrots. How many more green peppers did he plant than carrots?	(84, 15) (134, 54) (163, 89)	
3. Tia planted 65 green peppers. She planted 35 more carrots than green peppers. How many carrots did she plant?	(80, 25) (72, 29) (102, 17)	
4. Frances planted 70 green peppers. He planted 52 fewer carrots than green peppers. How many carrots did he plant?	(143, 52) (185, 90) (162, 34)	

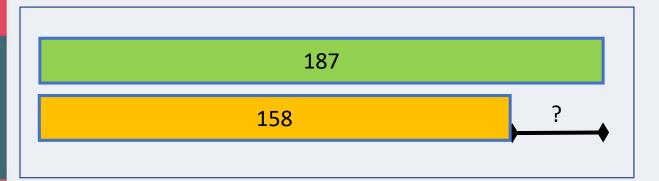


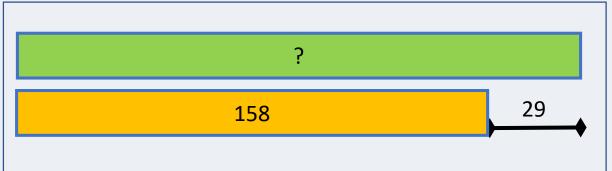


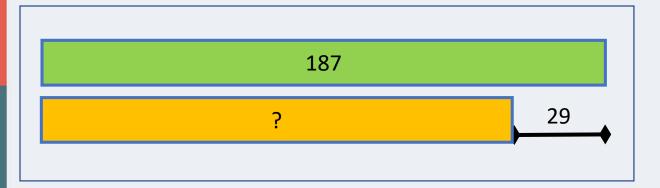


Compare Situations: Model Matching

Match the following compare models – bar model, equation and story problem.









Lesson 12: Part-Whole Situations

Story Problem	Bar Model	Equation	How I solved the problem
There were 28 children swimming in the pool. 18 of the children were girls. How many were boys?			
	? 31 14		
		136 + 19 = ?	
	? 18		

Lesson 12: Compare Situations

· ·			
Story Problem	Bar Model	Equation	How I solved the problem
A farmer has 38 carrots and 53 peppers. How many more peppers does the farmer have than carrots?			
	53 ?		
		36 – 19 =	
A farmer has a garden with 85 animals. There are 32 more chickens than pigs. How many chickens and pigs are on the farm?			

DMT in Schools

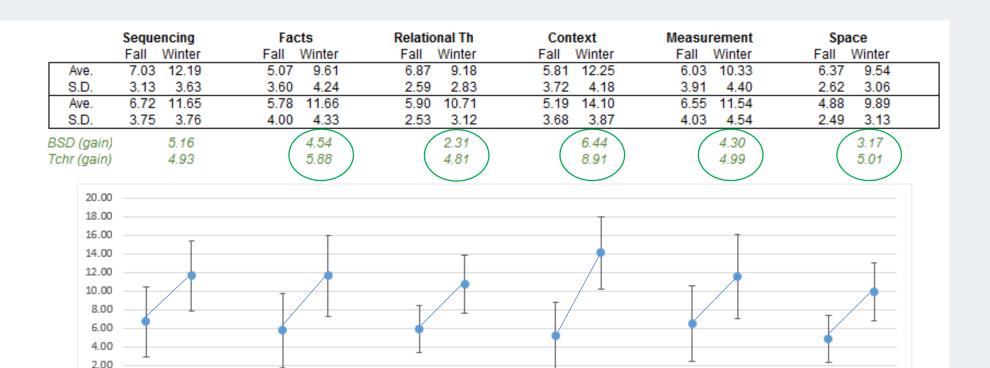
- Professional Development Courses and Workshops
- - Unit Studies
- - In-Class Support
- Resources
- Focusing Calendars
- Unit Overviews
- - Curricular Modules
- Common Assessments
- - Primary Mathematics Assessment: Screener and Diagnostic



K-2 PMA Data

Kindergarten – School A

School Information

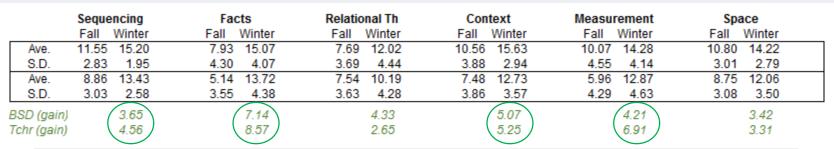


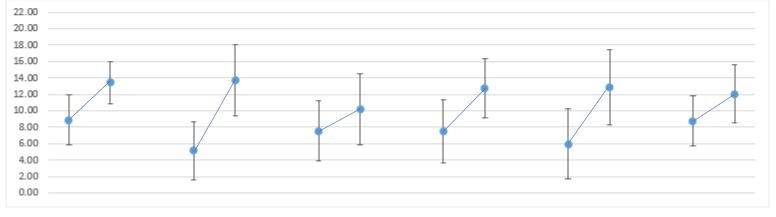


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First Grade – School A

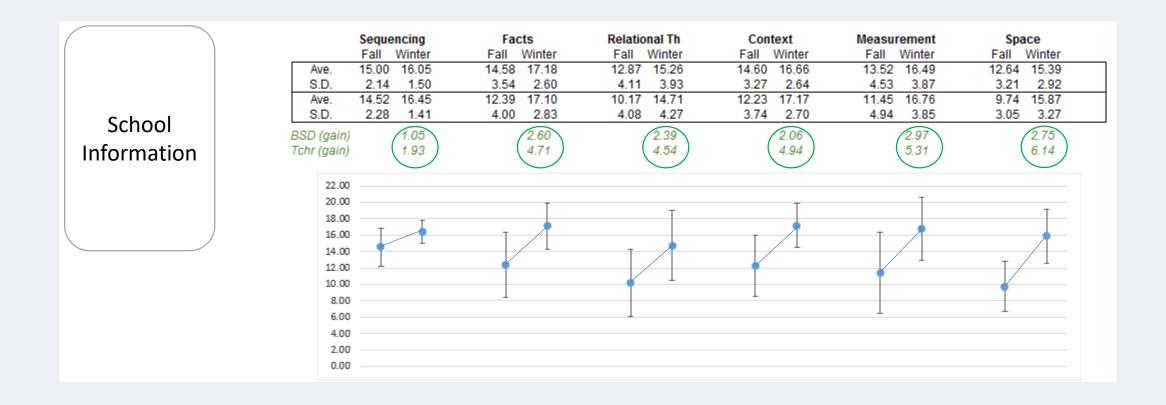
School Information







Second Grade - School A





References

- Number Sense/Sequencing: (Baroody, 1987; Blote, Lieffering, & Ouwehand, 2006; Butterworth, 2004; Clements & Sarama, 2007; Desoete, Ceulemans, Roeyers & Huylebroeck, 2009; Geary et al., 1999; Geary, 2010; Jordan, Glutting & Ramineni, 2010; LeFevre et al., 2006;)
- Number Facts: (Beishuizen & Anghileri, 1998; Geary, 2004; Geary, 2004; Passolunghi & Siegel, 2004)
- Contextual Problems: (Ashkenazi et al., 2013; Hatano, 2003; Carpenter, Franke & Levi, 2001; Jitendra et al 2013; Montague, 2007; Van Dooren, de Bock, Vleugels & Verschaffel, 2010; Verschaffel, Greer & DeCorte, 2007)
- **Relational Thinking**: (Carpenter, Franke, & Levi, 2003; Driscoll, 1999; Sarama and Clements, 2008; Sarama & Clements, 2009; Stephens, 2006)
- Measurement: (Cramer, Post, & del Mas, 2002; Kamii & Clark, 1997; Lehrer, 2003; Lehrer, Jaslow & Curtis, 2003; McClain, Cobb, Gravemeijer & Estes, 1999; National Research Council, 2001; Watanabe, 2002).
- Spatial Reasoning: (Battista, 1981; (Cheng & Mix, 2014; Clements & Sarama, 2007; Geary, Hoard, Bryd-Craven, Nugent & Numtee, 2007; Holmes, Adams & Hamilton, 2008; Lee, 2005; McLean & Hitch, 1999).



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Professional Development



Curricular Resources



Assessment

Brendefur and Strother (2018)

For more information contact Dr. Brendefur at jonathan@dmtinstitute.com

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