

# VARIATIONS IN SECOND-GRADE STUDENTS' NUMBER SYSTEM KNOWLEDGE OUTCOMES

PRESENTATION FOR 2018 USU RESEARCH WEEK

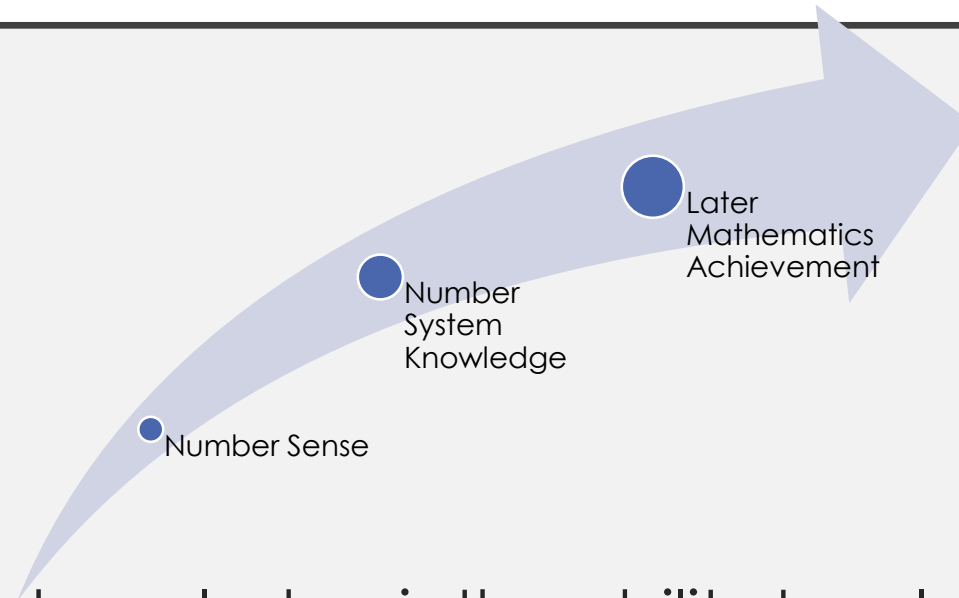
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Members of the Early Mathematics Research Group (EMRG)

Mentor: Jessica F. Shumway, Ph.D



# OVERVIEW

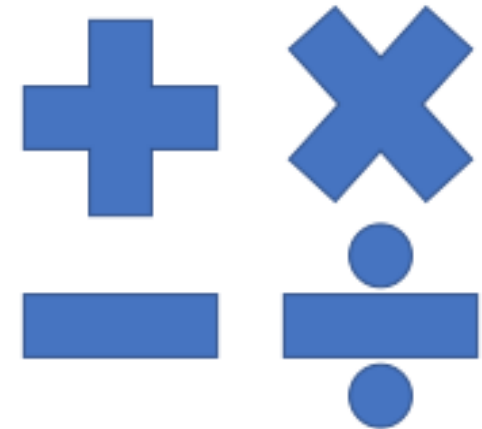
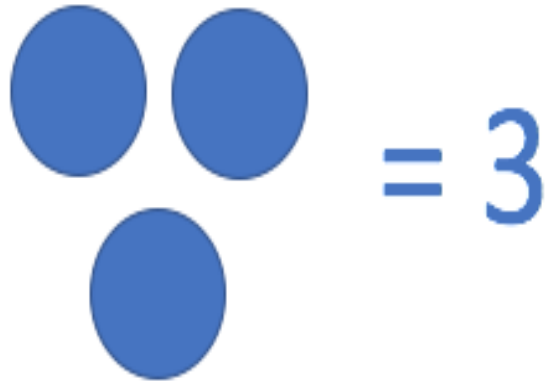


- Number system knowledge is the ability to relate quantities to their respective numerical representations, understand relations among those numbers, and use that knowledge to manipulate quantities through operations (Geary et al., 2013).

# NUMBER SYSTEM KNOWLEDGE



$$a < b$$



## LITERATURE REVIEW

- Early NSK is a predictor of adolescent functional numeracy (Geary et al. , 2013).
- Current research focuses on preschool and kindergarten number sense instructional interventions (e.g., Jordan et al., 2012).
- There is a need for further research on interventions in primary elementary grades (K-2).

## PURPOSE AND RESEARCH QUESTION

- The long-term goal of our study is to help **improve instructional methods** for developing number sense.
- The focus of today's presentation is on one aspect of our larger project: the initial quantitative analysis on test scores.
- RQ: What are the variations in students' Number System Knowledge outcomes after they participate in the instructional treatment?

## Participants

- 5 second-grade classes from the Intermountain West area
- 75 participants
- 2 cases per class (11 case studies)

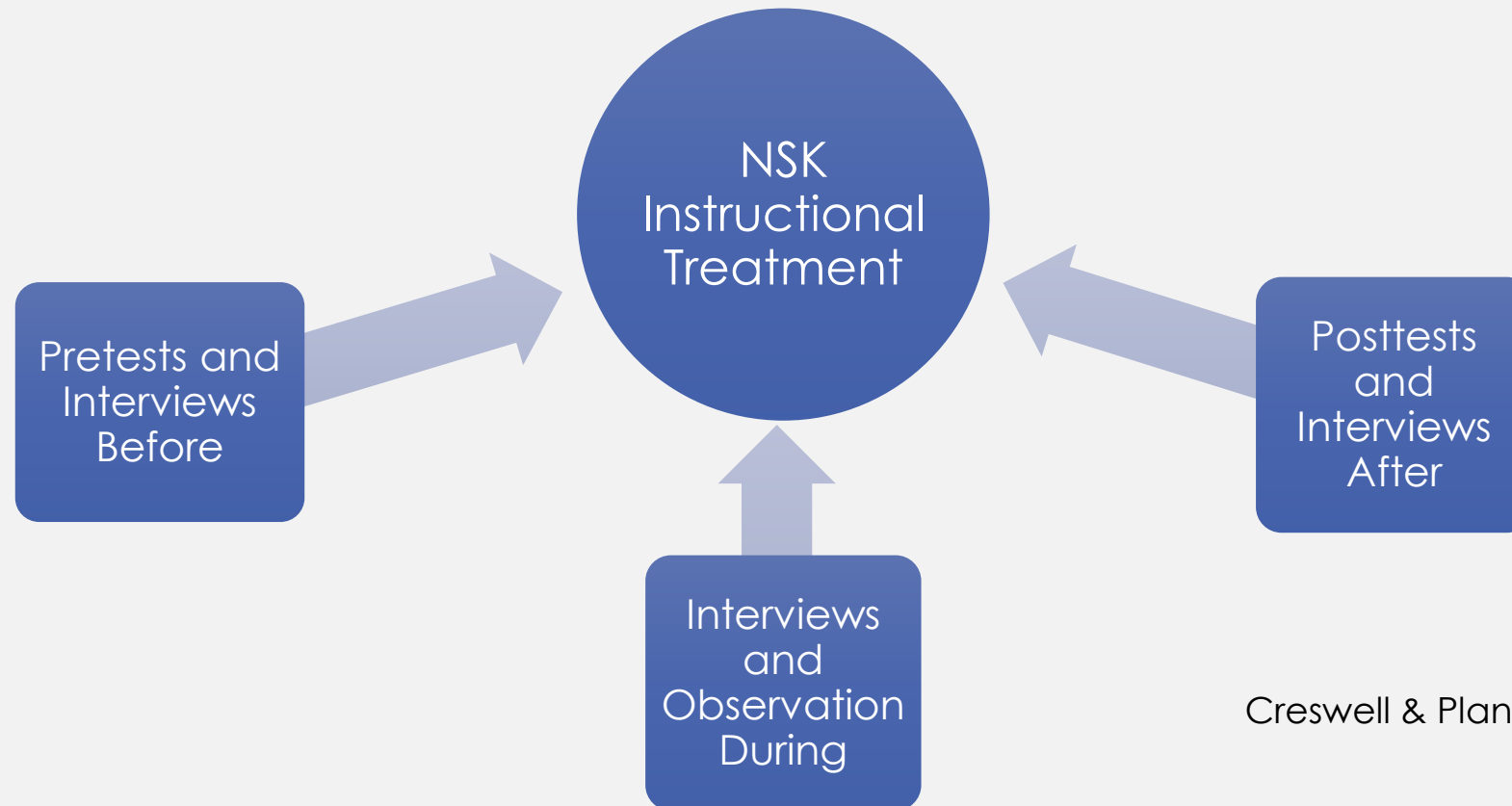
## Setting

- Regular mathematics instruction in second-grade classrooms
- Intervention took place at meeting area or at desks as the warm-up activity to the mathematics lesson

## Methods

- Pretest – Instructional Treatment - Posttest
- Mixed methods study (collected quant & qual data)

# MIXED METHODS STUDY OF A CLASSROOM-BASED INSTRUCTIONAL TREATMENT



Creswell & Plano Clark, 2011

MIXED METHODS STUDY OF A  
CLASSROOM-BASED INSTRUCTIONAL  
TREATMENT



Test Scores  
(Quantitative  
Data)

Interviews and  
Observations  
(Qualitative  
Data)



NINE- WEEK INSTRUCTIONAL TREATMENT

Show Quick Image

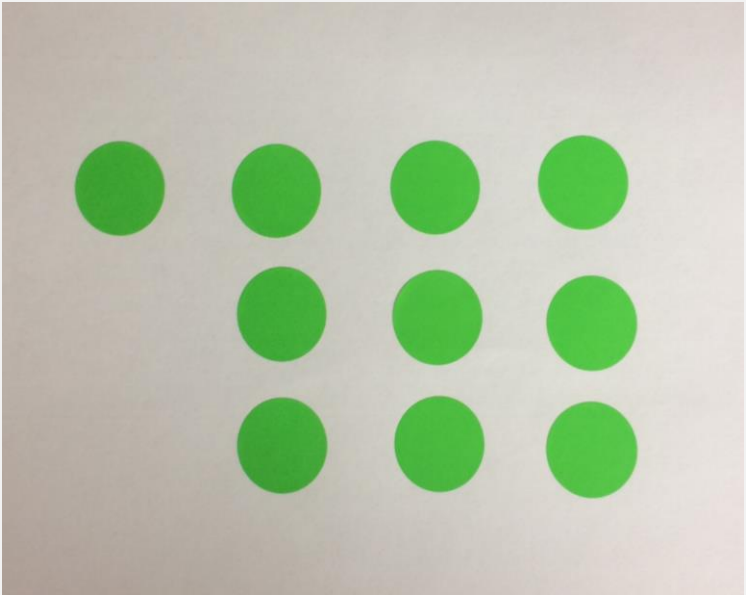
A light blue downward-pointing arrow indicating the flow from the first step to the second.

Pair-Share Discussion

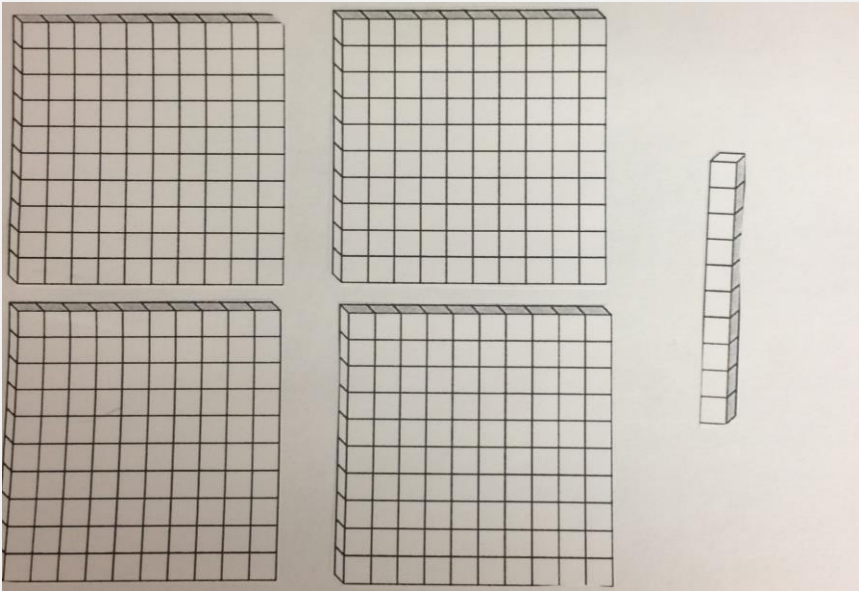
A light blue downward-pointing arrow indicating the flow from the second step to the third.

Whole-Class Discussion

# EXAMPLES OF INSTRUCTIONAL TREATMENT TEACHING EPISODES



Week 1



Week 4



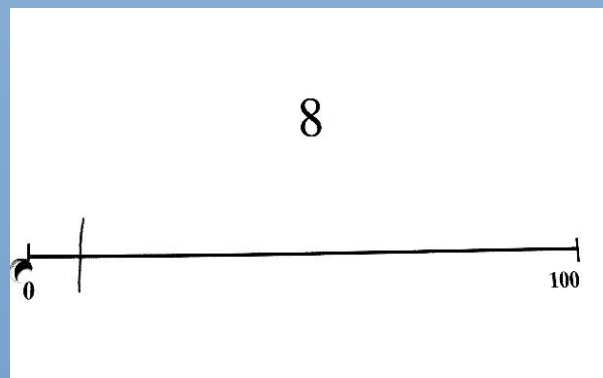
Week 8

# DATA SOURCE: NSK PRETEST AND POSTTEST

*Circle* all of the groups that add up to 9.  
Work as quickly as you can.

9

Number Sets  
Test



Number Line  
Estimation

Add.

$\begin{array}{r} 8 \\ + 3 \\ \hline 11 \end{array}$	$\begin{array}{r} 6 \\ + 7 \\ \hline 13 \end{array}$	$\begin{array}{r} 4 \\ + 9 \\ \hline 13 \end{array}$	$\begin{array}{r} 6 \\ + 5 \\ \hline 11 \end{array}$	$\begin{array}{r} 8 \\ + 2 \\ \hline 10 \end{array}$
$\begin{array}{r} 4 \\ + 8 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ + 9 \\ \hline \end{array}$	$\begin{array}{r} 0 \\ + 6 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ + 1 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ + 7 \\ \hline \end{array}$
$\begin{array}{r} 5 \\ + 8 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ + 6 \\ \hline \end{array}$	$\begin{array}{r} 9 \\ + 5 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ + 4 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ + 9 \\ \hline \end{array}$
$\begin{array}{r} 6 \\ + 8 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ + 5 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ + 3 \\ \hline \end{array}$	$\begin{array}{r} 4 \\ + 7 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ + 4 \\ \hline \end{array}$

Computational  
Fluency

# DATA ANALYSIS

Descriptive  
Statistics



Paired-  
Samples  $t$   
test



Visual  
Analysis

# RESULTS

## RESULTS: OVERALL DESCRIPTIVE STATISTICS AND PAIRED-SAMPLES *T* TEST



The *t* test results showed a significant gain from pretest to posttest,  $t(74) = 18.21$ ,  $p < .001$  with a large effect size of 2.10.

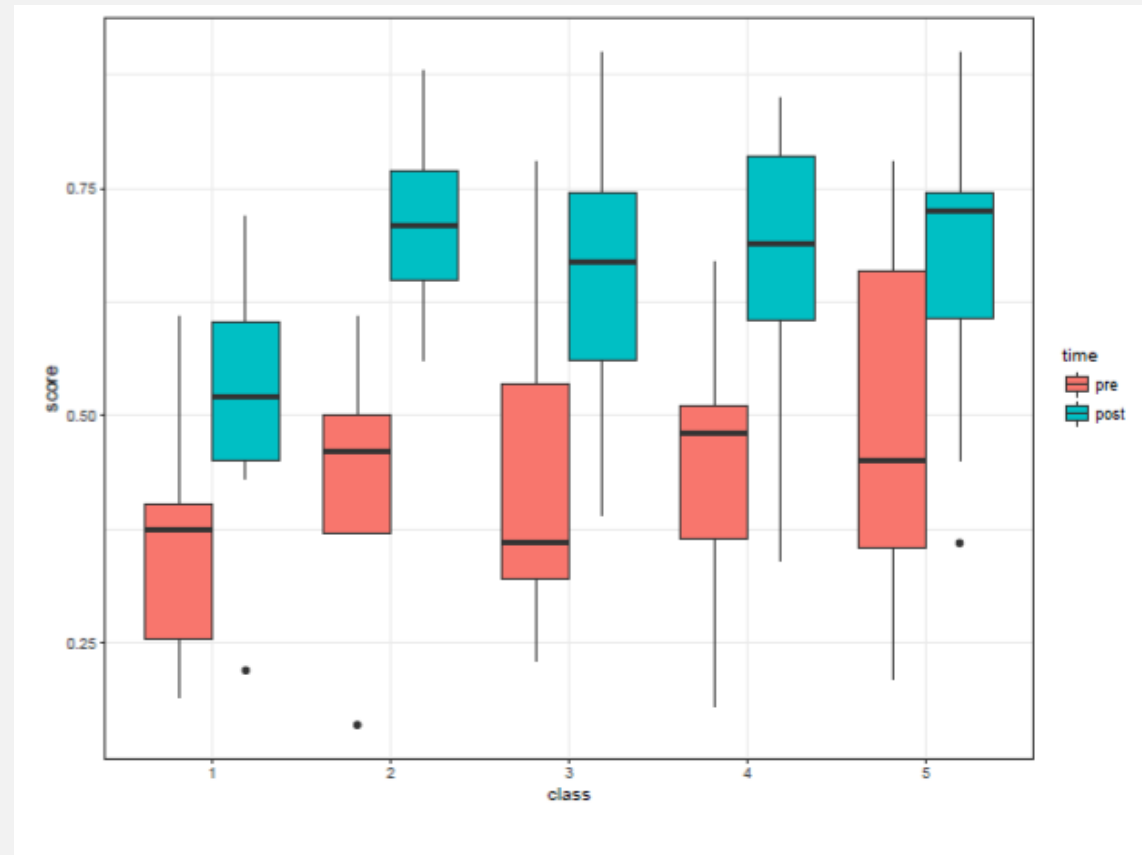
## RESULTS: DESCRIPTIVE STATISTICS BY CLASS

TABLE 1

*Mean Score on Number System Knowledge Test (NSK) and Standard Deviation for Five Second Grade Classes*

Class	NSK Pretest		NSK Posttest	
	M	SD	M	SD
1	34	10	52	13
2	44	11	71	10
3	43	15	64	14
4	45	14	65	16
5	48	19	68	15

# RESULTS: VISUAL ANALYSIS BY CLASS





# RESULTS: VISUAL ANALYSIS FOR CLASS 1

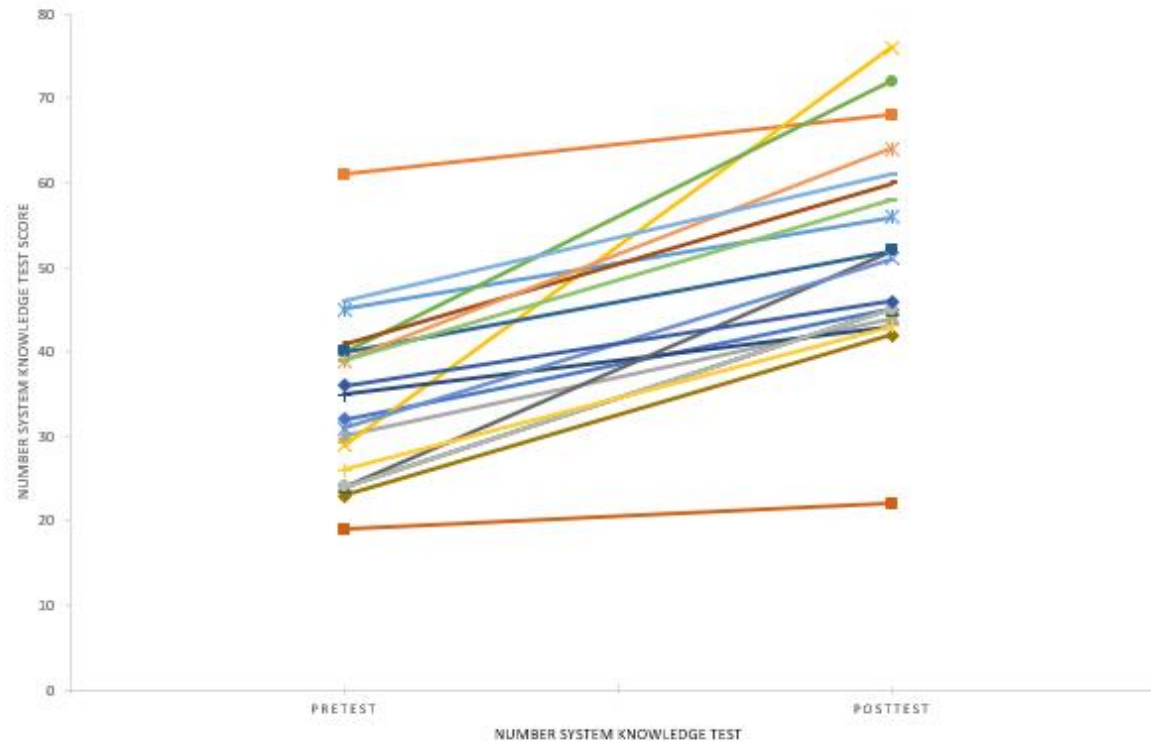


Figure A. Pre and Posttest scores of Class 1

# RESULTS: VISUAL ANALYSIS OF CASES

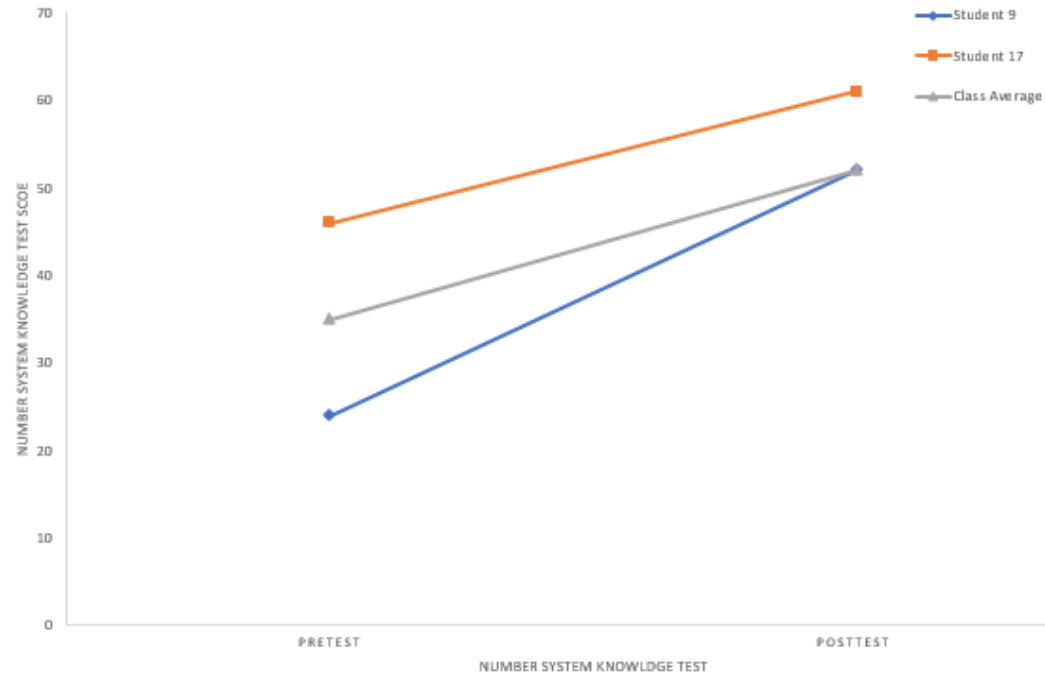


Figure K. Class 1: Target students' pre and posttest Number System Knowledge Test scores compared to the class average.

## CONCLUSIONS

- Students made significant growth in their NSK learning outcomes. However, we cannot parse out what factors caused this growth.
- Our next step is to analyze the qualitative data to better understand how and why learning occurred.
- The goal of our results is to help improve instructional methods for developing number sense.



**We are members of the  
Early Mathematics  
Research Group  
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THANK YOU FOR ATTENDING!

- Questions?
- References:
- Geary, D. C., Hoard, M. K., Nugent, L., & Bailey, D. H. (2013). Adolescents' functional numeracy is predicted by their school entry number system knowledge. *PLoS ONE* 8(1): e54651. doi:10.1371/journal.pone.0054651
- Jordan, N. C., Glutting, J., Dyson, N., Hassinger-Das, & Irwin, C. (2012). Building kindergartners' number sense: A randomized controlled study. *Journal of Educational Psychology*. Advance online publication. doi: 10.1037/a0029018.