RICE UNIVERSITY
SCHOOL MATHEMATICS PROJECT

What to Look for in an Effective 21st-century Mathematics Classroom?

Characteristics and Support

Maria Franshaw
Elementary Mathematics Specialist and Curriculum Coordinator
River Oaks Baptist School
Doctoral Candidate
Houston Baptist University, Class of 2019

Imagine you're standing by the water's edge.

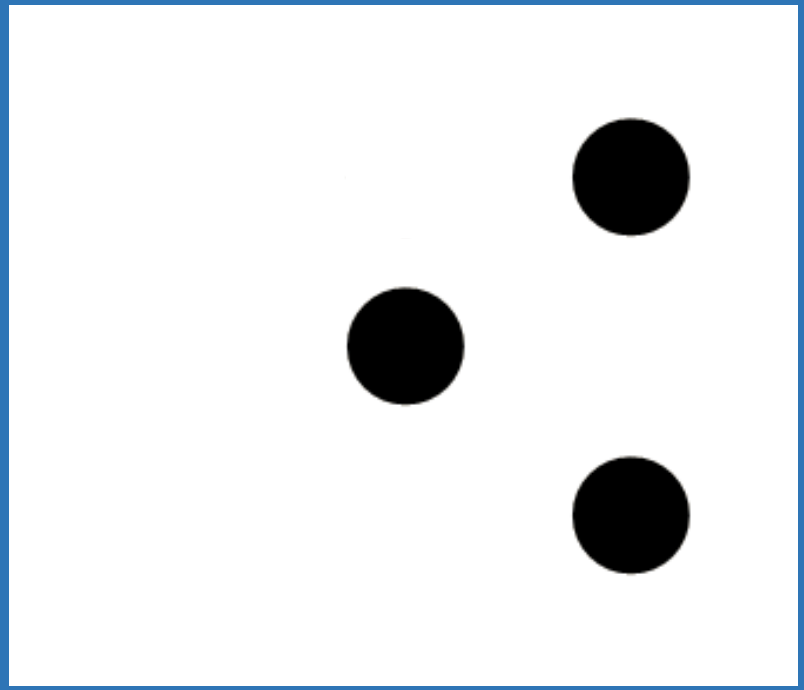
Briefly describe your *water's edge* to a seat neighbor.

water's edge

share

1) Take a look at the picture on the next slide.

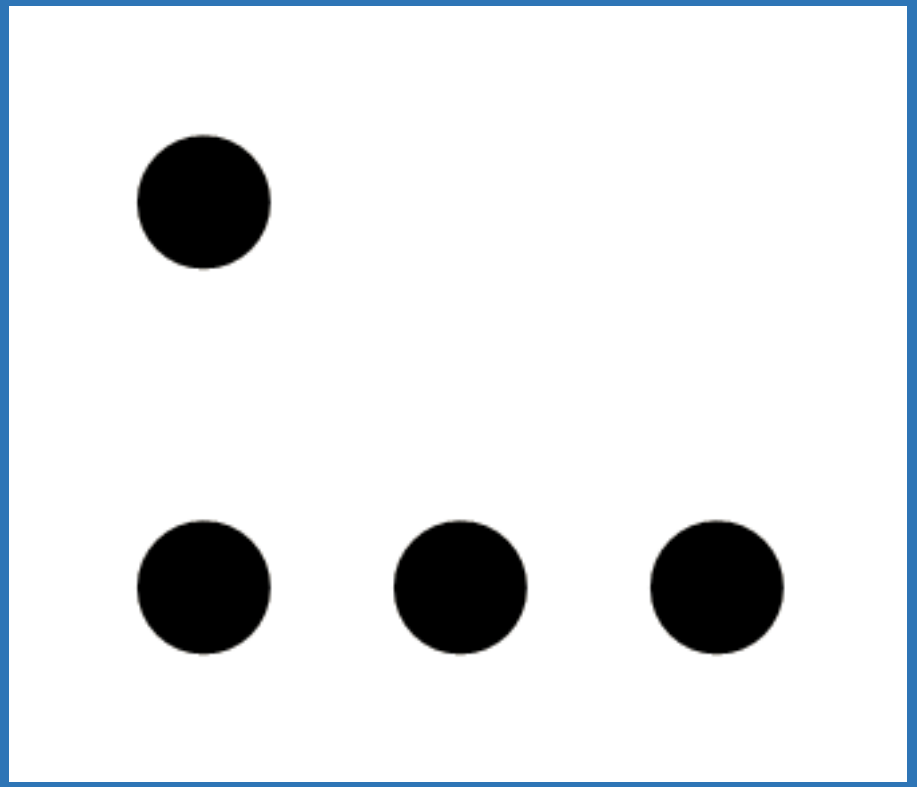
2) Hold up your fingers to show me the quantity you see.



3

1) Take a look at the picture on the next slide.

2) Hold up your fingers to show me the quantity you see.



4

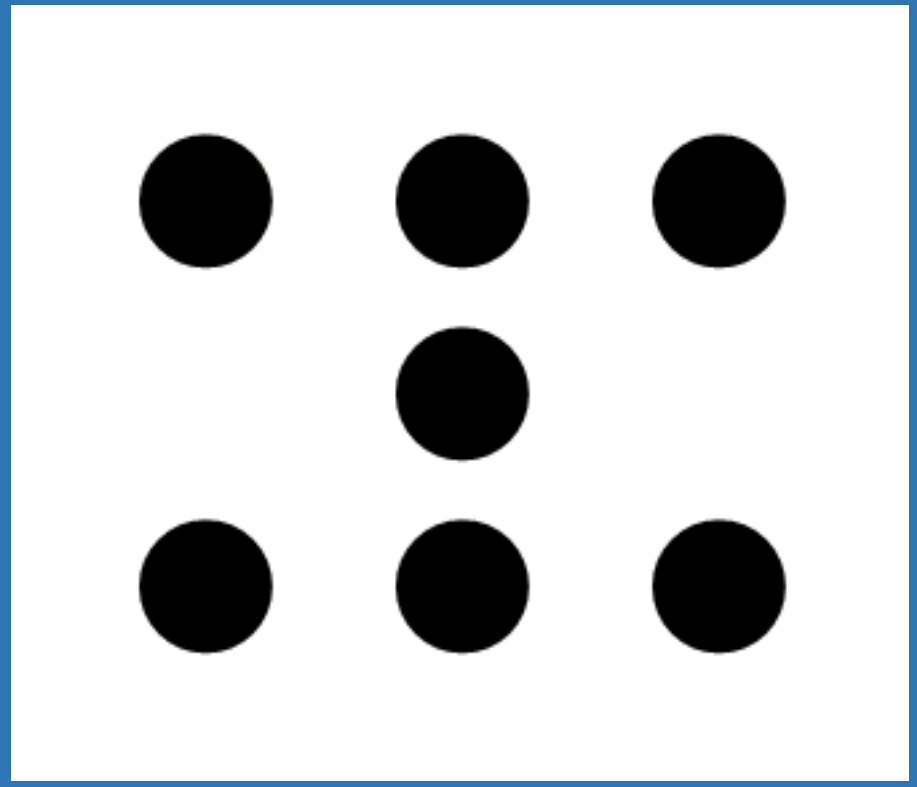
Talk to a different seat neighbor and briefly compare your experiences.

- *water's edge*
- dot card quantities

Take a quick look

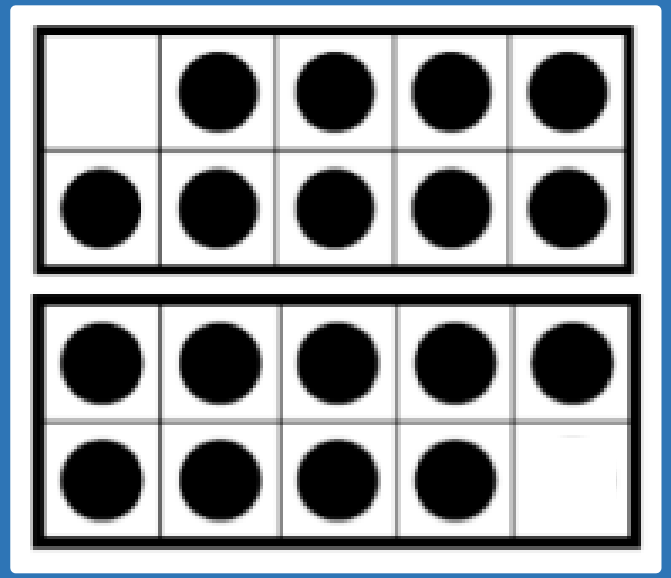
at the

next slide.



Ask one seat neighbor
what quantity s/he saw and
how s/he saw it.

And take one more quick look.



Ask a different seat neighbor

what s/he saw

and

how s/he saw it.

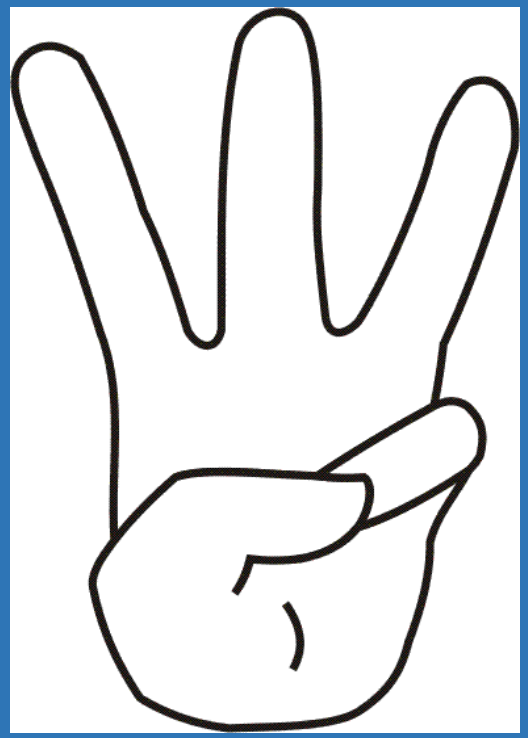
Compare your dot card activity experiences.

- Showing your answer to the teacher
- Sharing thinking with your neighbor

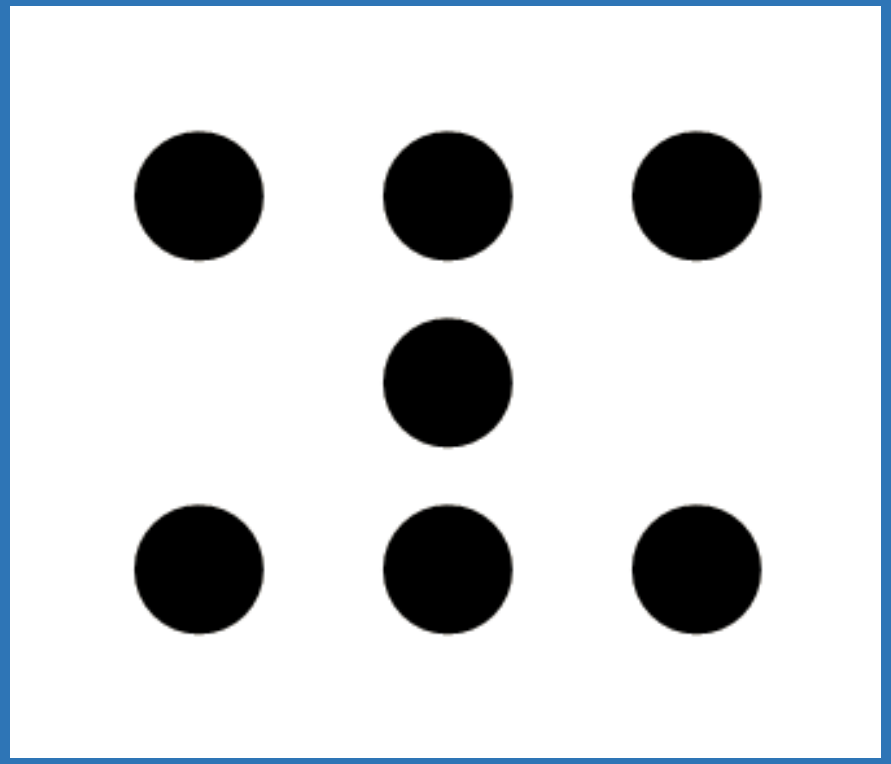
Quick recap of activity

Mathematics Content

Perceptual Subitizing



Conceptual Subitizing



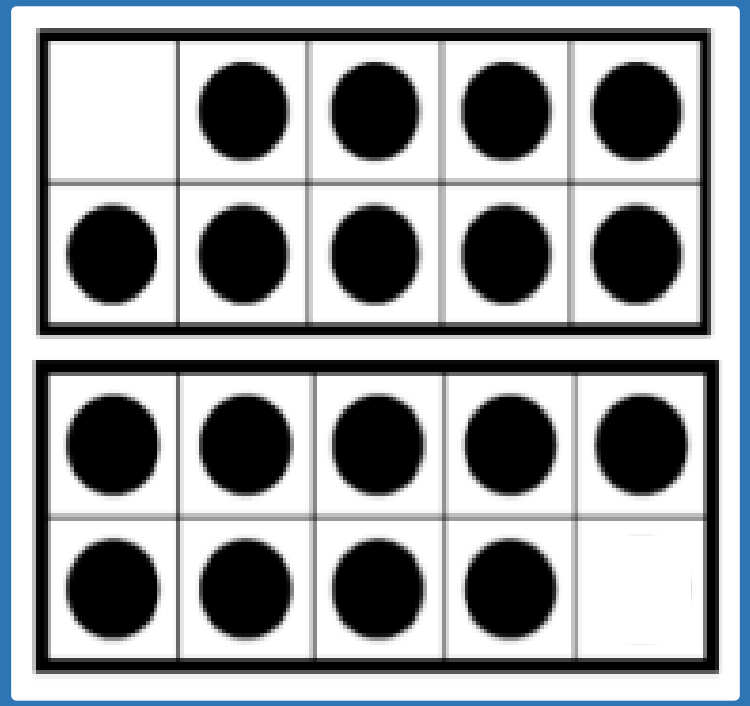
2 + 2 + 3 = 7

3 + 3 + 1 = 7

3 + 2 + 2 = 7

3 + 4 = 7

4 + 3 = 7



$5 + 5 + 4 + 4 = 18$

$4 + 5 + 4 + 5 = 18$

$6 + 6 + 3 + 3 = 18$

$9 + 9 = 18$

$20 - 1 - 1 = 18$

$20 - 2 = 18$

Overview

- Rationale
- Standards
- Depth of understanding
- Students' needs
- Ambitious learning and ambitious teaching
- Professional development

Rationale

21st-century mathematics requires thinking that is

- Conceptual and representational
- Flexible and fluent
- Enlarging and empowering
- Accurate, effective, efficient

RICE UNIVERSITY
SCHOOL MATHEMATICS PROJECT

Numeracy is as important as Literacy

Numeracy, like literacy, is important.

Number sense: Mathematics
as Phonemic awareness: Reading

Fluency: Computation
as Fluency: Comprehension

Mathematics TEKS include Content and Process **Standards**

Process Standards

- "…describe ways in which students are expected to engage in the content."
- "The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional."

http://ritter.tea.state.tx.us/rules/tac/chapter111/index.html

Process Standards

- Apply mathematics to problems
- Use a problem-solving model that involves analyzing, formulating, determining, justifying, and evaluating
- Communicate mathematical ideas, reasoning, and multiple representations

http://ritter.tea.state.tx.us/rules/tac/chapter111/index.html

What this looks like in the classroom:

- Teachers emphasizing both mathematical content and process standards
- Students increasingly able to communicate mathematical ideas orally and in writing
- Teaching through problem solving rather than teaching problem solving/application in isolation

Depth of understanding

Engaged through real-world contexts and experiences

1 2 3

Norms for Students Building Depth of Understanding

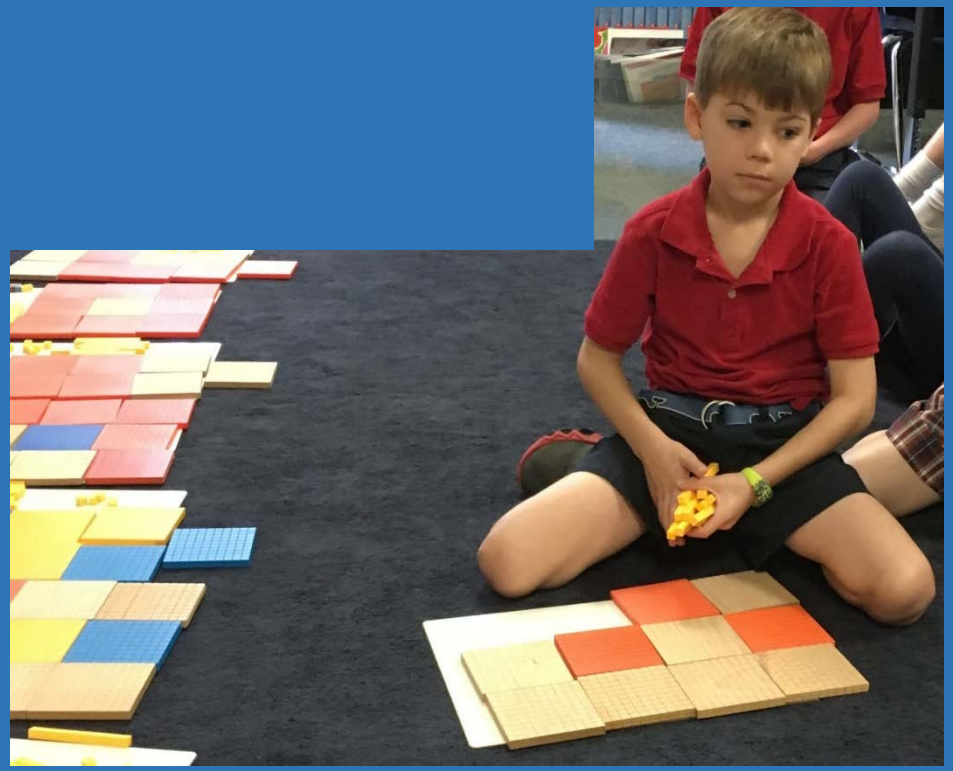
- Explaining thinking, not just procedures
- Understanding relationships among strategies
- Using errors to rethink, explore, and learn
- Emphasizing collaboration with mathematical discourse and individual accountability (agree/disagree to consensus)

Kazemi and Stipek, 2010

Inquiry-based instruction positively predicts student achievement which supports decades-long efforts to refocus mathematics on inquiry and conceptual understanding.

Blazar, 2015


06 11 2010



What this looks like in the classroom:

- Students work with manipulatives (*not just watching the teacher use manipulatives*)
- Teachers model how to talk about mathematical thinking and ideas and how to hold students accountable for math talk
- Teachers plan learning for all stages of the instructional sequence, which includes scaffolding and differentiating

Students' needs

Cognitive

Affective

Experiential


HIGH DIVE
20 FEET

Working with manipulatives empowers students to reflect on their mathematics learning experience and greatly reduces anxiety.

Boggan, Harper, & Whitmire, 2010

Instructional tools

- Manipulatives
  - Commercially purchased
  - Classroom available or found objects
  - Teacher-made
- Virtual Manipulatives

What this looks like in the classroom:

- Range and variety of activities to make student thinking and learning visible
- Learning along the instructional sequence
- Questioning that redirects or expands thinking and opens learning (rather than closes learning)
- Mathematical conversations including dis/agreements with reasoning and justification

Ambitious Learning Goals require Ambitious Teaching

Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010

Ambitious Learning Goals

- Mathematical proficiency
- Conceptual understanding
- Procedural fluency
- Strategic competence
- Adaptive reasoning
- Productive disposition

Kilpatrick, Swafford, & Findell, 2001

Rand Mathematics Study Panel, 2003

US Department of Education, 2008

Ambitious Teaching

- Connects process and content standards
- Manages social aspects of ambitious learning goals
- Develops ongoing structures to support students constructing deeper understanding
  - Well-designed procedures
  - Complex learning goals
  - Ongoing judgments and adjustments

Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010

$$37 + 48 = 30 + 7 + 40 + 8$$
$$= 30 + 40 + 7 + 8$$
$$= 70 + 15$$
$$= 85$$

Vertical Connections

$$(11x + 4) + (5x + 17) = 11x + 5x + 4 + 17$$
$$= 16x + 21$$

What this looks like in the classroom:

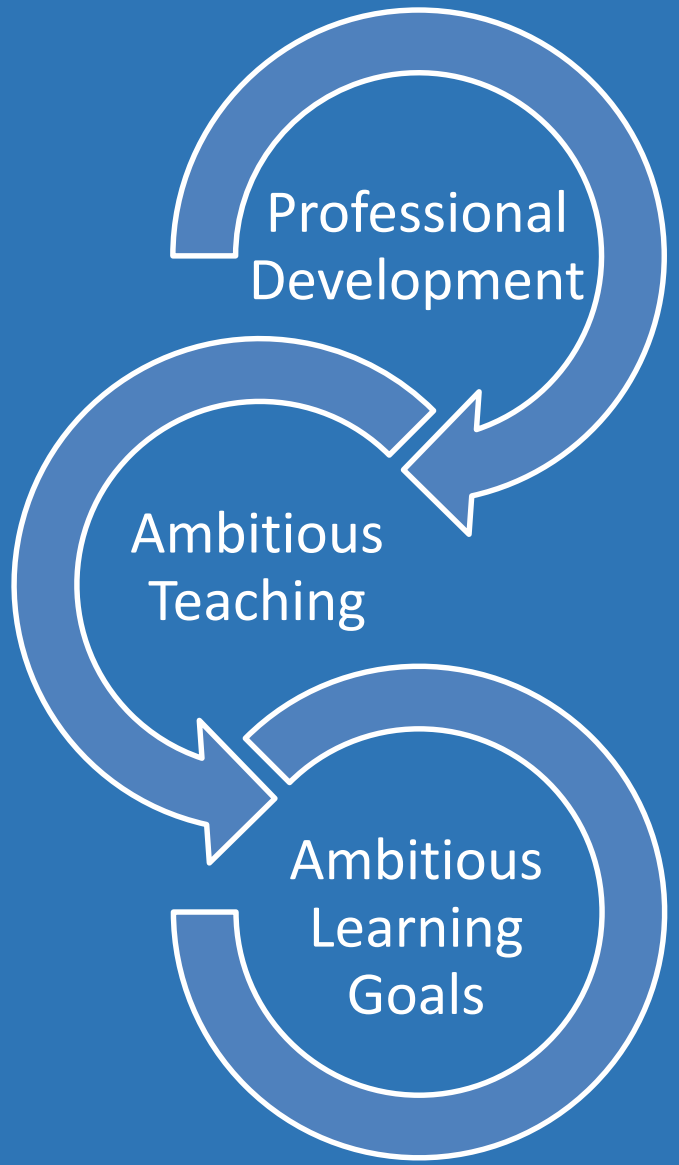
- Co-creating mathematical thinking (Leinhart & Steele, 2005)
- Eliciting information from students while maintaining clarity of mathematics
- Supporting and encouraging productive struggle (disequilibrium and discomfort)

What this looks like in the classroom:

- Teacher circulating around the classroom
- Teacher sitting/kneeling to interact at student's level whenever possible
- "Never Say Anything a Kid Can Say" (Reinhart, 2000)

Professional Development that Supports Ambitious Teaching and Ambitious Learning Goals

Darling-Hammond and Richardson, 2009


Professional Development
Ambitious Teaching
Ambitious Learning Goals

What high-quality mathematics PD looks like:

- Focuses on content and process standards
- Provides hands-on learning (like students!)
- Includes time for reflection
- Is sustained and job-embedded (Hammond and Richardson, 2009)

RICE UNIVERSITY
SCHOOL MATHEMATICS PROJECT

Effective 21st-century Mathematics Classrooms for all!

References

Blazar, D. (2015). Effective teaching in elementary mathematics: Identifying classroom practices that support student achievement. *Economics of Education Review, 48,* 16-29.

Boggan, M., Harper, S., & Whitmire, A. (2010). Using manipulatives to teach elementary mathematics. *Journal of Instructional Pedagogies, 3*.

Darling-Hammond, L., & Richardson, N. (2009). Teacher learning: What matters? *How Teachers Learn, 66*(5), 46-53.

Kazemi, E., & Stipek, D. (2010). Promoting conceptual thinking in four upper-elementary mathematics classrooms. *The Elementary School Journal, 102*(1).

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.) (2001). *Adding it up: Helping children learn mathematics*. Washington, DC: National Academy Press.

Lampert, M., Beasley, H., Ghousseini, H., Kazemi, E., & Franke, M. (2010). Using designed instructional activities to enable novices to manage ambitious mathematics teaching. In M. K. Stien & L. Kucan (Eds.), *Instructional Explanations in the Disciplines*. Boston, MA: Springer.

Leinart, G., & Steele, M. D. (2005). Seeing the complexity of standing to the side: Instructional dialogues. *Cognition and Instruction, 23*(1), 87-163.

Piaget, J. (1936). *Origins of intelligence in the child.* London: Routledge & Kegan Paul.

Rand Mathematics Study Panel. (2003). *Mathematical proficiency for all students: Toward a strategies research and development program in mathematics education*. Santa Monica, CA: Rand.

Reinhart, S. C. (2000). Never say anything a kid can say! *Mathematics Teaching in the Middle School, 5*(8), 478-483.

US Department of Education. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: US Department of Education.

RICE UNIVERSITY
SCHOOL MATHEMATICS PROJECT

Maria Franshaw

Elementary Mathematics Specialist and Curriculum Coordinator

mfranshaw@robs.org

 @mfranshawftk

Doctoral Candidate (Graduation, Spring 2019)

mfranshaw@hbu.edu