Deep Learning: Math Immersion PreK–12
December 11, 2019
8:45–10:45 am

Denise Gregory, Math314
Jeff Kennedy, Math314
Beverly Velloff, SDUC
Achieving equity in K-12 education is a pressing and complex social challenge. Ensuring all children participate in high-quality educational programs is the key to expanding economic opportunity for our kids and growth in our community.
our mission

The mission of Math314 is to improve mathematics teaching and learning in our region by designing programs that develop educators who foster equitable learning environments.

Math314 supports teachers in becoming learners and leaders who encourage inquiry, risk-taking, and conceptual understanding by experiencing mathematics in rich and meaningful ways.
Welcome! Who’s in the room?
Our Outcomes for Today

- Participants will explore a professional development model focused on building deep conceptual understanding for teachers and students.

- Participants will analyze student thinking and unpack standards, develop vertical alignments of expectations, and reflect on instructional practices.

- Participants will identify opportunities to embed this professional development model to meet their school’s needs.
Deep Dive into Mathematics Instruction

U.City Vertical Math Immersion Goal Statement:

All math teachers will engage in the planning, teaching, and reflection of mathematical lessons that builds conceptual understanding of essential learning objectives. (PK–2 Number Systems, 3–5 Fractions, 6–8 Expressions & Equations, 9–12 Algebraic Reasoning)

- Increase mathematical discourse in all classrooms
- Develop deep conceptual understanding with all students
- Appropriately scaffold and challenge students based on the mathematical learning progression
Purpose of Math Immersion

- Provides the space and the time to focus on math instruction versus a curriculum
- Work in vertical teams
- Capitalize on misconceptions
- Build vertical awareness of progressions
- Develop classrooms structures that promote discourse
AIM: Increase the number of students scoring proficient/advanced on the MAP assessment in grades 3-8, ACT, and Algebra I & II EOC.

Overall District Goal: All math teachers will engage in the planning, teaching, and reflection of mathematical lessons that builds conceptual understanding of essential learning objectives. (PK-2 Number System, 3-5 Fractions, 6-8 Expressions and Equations, 9-12 Algebraic Reasoning)

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**Discourse**
- Increase mathematical discourse in all classrooms

**Conceptual Understanding**
- Develop deep conceptual understanding with all students

**Learning Progressions**
- Scaffold and challenge students based on the mathematical learning progression

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**Selecting and Sequencing Student Responses**
- 5 Practices for Orchestrating Productive Math Discussions (Smith and Stein)

**Mathematical Talk (Number Talks and Guided Questioning)**
- Visible Learning for Mathematics: What Works Best to Optimize Student Learning (Hattie Fisher & Frey)

**Connecting Student Thinking and Mathematical Concepts**
- 5 Practices for Orchestrating Productive Math Discussions (Smith and Stein)

**Strategic Use of Manipulatives**
- Visible Learning for Mathematics: What Works Best to Optimize Student Learning (Hattie Fisher & Frey)

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**Anticipating & Monitoring Student Responses**
- 5 Practices for Orchestrating Productive Math Discussions (Smith and Stein)

**Selecting Mathematical Tasks**
- Visible Learning for Mathematics: What Works Best to Optimize Student Learning (Hattie Fisher & Frey)

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**Discourse**
- Discourse Rehearsal PD Math EdCamp
- Coaching sessions
- Teacher Reflections on video of their facilitation of a discussion

**Mathematical Talk (Number Talks and Guided Questioning)**
- Intro to Number Talks
- Number Talk Discussion Rehearsal
- Guided Questioning

**Connecting Student Thinking and Mathematical Concepts**
- Assessment Item Sort
- M. Standards Sort
- Analysis of student videos for conceptual thinking

**Strategic Use of Manipulatives**
- How to use _____ to teach _____

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**Anticipating & Monitoring Student Responses**
- How to anticipate student thinking

**Selecting Mathematical Tasks**
- Finding HQ Tasks in your Curriculum
Washington University’s Math314 Partnership

AIM: Math instruction in University City classrooms will include conceptual understanding, realizing that there must be a balance between all three aspects of rigor (conceptual understanding, application, and procedural fluency).

- Increase teachers’ conceptual understanding and content knowledge
- Shift teachers to a growth mindset (belief that students can handle conceptual learning)
- Teachers understand the connection between procedural fluency and conceptual understanding.

Engage teachers in math tasks as a learner of mathematics
- Facilitate teachers in Sort and analyze assessment items or standards
- Teachers anticipate conceptual misunderstanding
- Teachers can identify tasks that promote reasoning and problem solving
- Teachers sequence math discussions in real time during a lesson to advance students’ understanding

Work on building a Mathematical Growth Mindset
- Frame mindset as an equity issue for teachers
What is STEM IQ Math Immersion? How will we know Math Immersion is working?
Lesson Study 2015 - 2018
What is Math Immersion?
How will we know Math Immersion is working?

Lesson Study 2015-2018
Math Immersion 2018-2019
Math Immersion Cohort Meeting
What is Math Immersion?
How will we know Math Immersion is working?

Lesson Study 2015-2018

Math Immersion 2018-2019

Vertical Curriculum Alignment
Math Immersion Learning Progression Analysis
What is Math Immersion?
How will we know Math Immersion is working?
# Vertical Student Learning Videos

## PreK: Conceptual - Procedural
**Teacher:** Dawn Pulsipher

<table>
<thead>
<tr>
<th>Student</th>
<th>Strategy Used to Solve the Problem</th>
<th>Understanding and How to Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>“This one has three and this one has four.” (So you counted them?) “I didn’t count them I just knew.”</td>
<td>Understands that numbers answer the problem. Can do one to one by sight.</td>
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<td>Student 2</td>
<td>“There’s three on the bottom and one on the top” - She broke down the total number to show the group that had more</td>
<td>She understands how to break a whole (the total number of blocks) into a smaller group (the blocks on the bottom) to solve a problem.</td>
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<td>Student 3</td>
<td>Counted each set.</td>
<td>Can do one to one by sight. Can anticipate a math problem by seeing the set up. (“Count how many?”)</td>
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<td>Student 4</td>
<td>Visually looking for larger amount. “I just know”</td>
<td>Can’t yet verbalize that numbers or counting is linked to the question of more.</td>
</tr>
<tr>
<td>Student 5</td>
<td>Counted the blocks</td>
<td>Can count by sight. Knows numbers answer the question “more” and 4 is more than 3.</td>
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What is Math Immersion? How will we know Math Immersion is working?
Math Immersion Instructional Strategies

All math teachers will engage in the planning, teaching, and reflection of mathematical lessons that builds conceptual understanding of essential learning objectives. (PK-2 Number System, 3-5 Fractions, 6-8 Expressions and Equations, 9-12 Algebraic Reasoning)

<table>
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<tr>
<th>Instructional Goals</th>
<th>Discourse</th>
<th>Conceptual Understanding</th>
<th>Learning Progressions</th>
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<tr>
<td>Based on: Principles to Actions: Ensuring Mathematical Success For All (NCTM)</td>
<td>Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments</td>
<td>Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time become skillful in using procedures flexibly as they solve contextual and mathematical problems.</td>
<td>Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions and uses the goals to guide instructional decisions.</td>
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<td>5 Practices for Orchestrating Productive Mathematics Discussions (Smith &amp; Stein)</td>
<td>Selecting and Sequencing Student Responses (Anticipation Guides) (BCJ)</td>
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<td>Mathematical Talk (Number Talks and Guided Questioning) (UCHS, BWMS, &amp; FP)</td>
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<td>Strategic Use of Manipulatives (PER)</td>
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<td>Selecting Mathematical Tasks (JP)</td>
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Each school will focus on one Math Problem of Practice and one of the instructional strategies supported by the researched base text.
What is Math Immersion?
How will we know Math Immersion is working?

Lesson Study 2015-2018
Vertical Curriculum Alignment
Math Immersion 2018-2019
Math Immersion 2019-2020
EDCAMP @ Ucity
What is Math Immersion?
How will we know Math Immersion is working?

Lesson Study
2015-2018

Math Immersion
2018-2019

EDCAMP @ Ucity

Math Immersion
2019-2020

Vertical Curriculum Alignment
What is Math Immersion?
How will we know Math Immersion is working?
What is Math Immersion?
How will we know Math Immersion is working?

IMPACT:

175 Educators

100% of all PreK-12th math teachers and support staff

2716 Students
Vertical Standards Sort

- Deepen cohort’s understanding of a vertical strand
- Unpack grade level expectations using aligned assessment items
- Encourage discussion of similarities and differences between grade levels.
Vertical Standards Sort

Read each of the assessment items.

Discuss in your group what grade level the question aligns.

Put the questions in order Prek – Alg 2

[Diagram with numbers and grade levels]
Vertical Standards Sort

- What did you notice?
- What did you wonder?
- What will your teachers take away?
Turn and Talk

Describe what conceptual and procedural mean to you?
Conceptual Understanding

● Refers to an integrated and functional grasp of mathematical ideas.

Students...
● Know more than isolated facts and methods
● Understand why a mathematical idea is important and the kinds of contexts in which is it useful.
Procedural Understanding

- Refers to knowledge of procedures.
  - when and how to use them appropriately
  - skill in performing them flexibly, accurately, and efficiently.

- Learning procedures with conceptual understanding makes learning easier, less likely to make common errors, and less prone to forgetting.
Missouri Learning Standards-Math

Conceptual

Kindergarten Operations and Algebraic Thinking

K.OA3 Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawings, and record each decomposition by a drawing or equation.

First Grade Operations and Algebraic Thinking

First Grade Operations and Algebraic Thinking

Procedural

First Grade Operations and Algebraic Thinking

1.OA6 Demonstrating fluency for addition and subtraction within 10.

Second Grade Operations and Algebraic Thinking

Second Grade Operations and Algebraic Thinking

2.OA2 Fluently add and subtract within 20 using mental strategies. By the end of 2nd grade, know from memory all sums of two one-digit numbers.
Without paper or pencil solve:

99 + 17 =
Conceptual - Procedural

Marilyn Burns
Math Reasoning Inventory

Describe what strategy each student used to solve the problem.

Describe what each student understands and how you know.
Without paper or pencil solve:

99 + 17 =
Conceptual - Procedural

Marilyn Burns
Math Reasoning Inventory

Describe what strategy each student used to solve the problem.

Describe what each student understands and how you know.
Pre-K

1. Looks at his own and another child’s blocks and determines who has more blocks.
## PreK: Conceptual - Procedural

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### Describe what strategy each student used to solve the problem.
- Student 1: Looking and counting (visually to three, manually to 4)
- Student 2: Visual estimation or counting in her head ("Because I see it.")
- Student 3: Rearranges the set of 4 blocks to make a square
- Student 4: Visual: "Because I just know."
- Student 5: It could be she’s understanding that more is a bigger number, or she is saying she knows the answer because she’s “big girl.”

### Describe what each student understands and how you know.
- Student 1: Procedural: She understands 4 is more than 3 and can prove it with counting
- Student 2: Conceptual: You can tell which is more by looking
- Student 3: Procedural: Could be proving “more” by showing a greater surface area
- Student 4: Concept of “more” can be figured out in her head without counting
- Student 5: She understands that more is a bigger quantity, and that the bigger you get the more you know.
## Post

### PreK: Conceptual - Procedural

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- **Student 1:** “This one has three and this one has four.” (“So you counted them?) “I didn’t count them I just knew.”
- **Student 2:** “There’s three on the bottom and one on the top” – She broke down the total number to show the group that had more.
- **Student 3:** Counted each set.
- **Student 4:** Visually looking for larger amount. “I just know”
- **Student 5:** Counted the blocks.

### Describe what each student understands and how you know.

- **Student 1:** Understands that numbers answer the problem. Can do one to one by sight.
- **Student 2:** She breaks the whole (total number of blocks) into smaller groups to solve a problem.
- **Student 3:** Can do one to one by sight. Can anticipate a math problem by seeing the set up. (“Count how many?”)
- **Student 4:** Can’t yet verbalize that numbers or counting is linked to the question of more.
- **Student 5:** Can count by sight. Knows numbers answer the question “more” and 4 is more than 3.
Video Reflection
Planning for Your School

Identify a problem in your district that could benefit from a systemic approach to deep learning as a solution.

What would be your elevator speech to the superintendent/school board?
thank you

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#Math314
schoolpartnership.wustl.edu
Take our 3 minute survey!

kickup.co/2019LF

SESSION ID: 3219

NOTE: Session ID should be in all CAPS and is case-sensitive.

Your responses power our report.