Math Instructional Strategies

Presented by Leila Rosemberg
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California Adult Literacy Professional Development Project

Agenda

- Participant Poll
- NRC Strands of Mathematics Proficiency
- College and Career Readiness Standards (CCR)
- Sample Lesson: Countdown Game
- Reducing Math Anxiety
- Sample Lesson: Teaching Slope with Your Body
- Manipulatives, Visual Aids and Graphic Organizers
- Sample Lesson: Positive and Negative Integers
- Six Areas of Math Skills
- Sample Lesson: Human Fractions
- Wrap-Up and Evaluation

National Research Council (NRC)
Math Proficiency Strands

Book: Adding it up: Helping children learn mathematics
College and Career Readiness Standards (CCR) X NRC Math Standards

<table>
<thead>
<tr>
<th>CCR</th>
<th>NRC Math Standards</th>
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<tbody>
<tr>
<td>1. Make sense of problems and persevere in solving them</td>
<td>a. Adaptive reasoning</td>
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<td>2. Reason abstractly and quantitatively</td>
<td>b. Strategic competence</td>
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<td>3. Construct viable arguments and critique the reasoning of others</td>
<td>c. Conceptual understanding</td>
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<td>4. Model with mathematics</td>
<td>d. Productive disposition</td>
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<td>5. Use appropriate tools strategically</td>
<td>e. Procedural fluency</td>
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<tr>
<td>6. Attend to precision</td>
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<tr>
<td>7. Look for and make use of structure</td>
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<td>8. Look for and express regularly in repeated reasoning</td>
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Teach Conceptual Understanding

Make Sense of Problems and Persevere in Solving Them
Reason abstractly and quantitatively
Look for and make use of structure

• Comprehension of mathematical concepts, operations, and relations

Examples:
• Teach vocabulary thoroughly and explicitly.
• Ask students to express the concept in multiple ways (e.g. draw, calculate, make a story problem).
• Make concept maps.
NRC Strand: Procedural Fluency

Attend to precision
Use appropriate tools strategically

Skill in carrying out procedures flexibly, accurately, efficiently, and appropriately

EXAMPLES:
- Peer coaching
- Detect errors
- Mental gymnastics to promote flexibility with numbers

Teach Procedural Fluency: Countdown

Play Countdown in small groups or whole class to promote using numbers flexibly.

http://www.youtube.com/watch?v=ioFpQ05577E
Try It Out: Countdown

• Directions
  • Choose a group of starting numbers and a target number. See who can get closest to the target number by adding, subtracting, multiplying, and/or dividing the starting numbers.

• Example
  • Starting numbers: 2, 4, 5 Target number: 12
    • 4x5=20, and 2x4 = 8, then 20 – 8 = 12
    • 5 x 2 = 10 and 10 + 2 = 12

• Let’s try one together.

Teach Procedural Fluency: Countdown

There’s a 99¢ app. for Countdown.

Example: 100X4+400X2+800+75=875-5=870-5=865+2=867

Credits: Photo is from http://www.nowgamer.com/features/993966/top_8_game_show_apps_for_ipad_and_iphone.html

Credit: mathgametime - http://www.mathgametime.com/games/countdown_numbers

Example: 100X4+400X2+800+75=875-5=870-5=865+2=867
**NRC Strand: Strategic Competence**

Construct viable arguments and critique the reasoning of others
Use appropriate tools strategically
Look for and express regularity in repeated reasoning

**Ability to formulate, represent, and solve mathematical problems**

**Examples:**
- Use questioning strategies to deepen thinking.
- Teach problem solving strategies.
Teach Strategic Competence

Construct viable arguments and critique the reasoning of others
Use appropriate tools strategically
Look for and express regularity in repeated reasoning

Mathematics is especially useful when it helps you predict, and number patterns are all about prediction. What will the 50th number of this pattern be?

2, 4, 6, …

Credit: http://www.learner.org/teacherslab/math/patterns/number.html

Teach Strategic Competence

Adult students can start to understand functions, such as f(x) = 2x + 2, where x is the numerical sequence 0, 1, 2, 3,.... They begin with simple in-out machines and gradually adapt their understanding to the abstractions of algebra

<table>
<thead>
<tr>
<th>X</th>
<th>f(X)= 2 X+2</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>f(0)= 2*0+2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>f(1)= 2*1+2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>f(2)= 2*2+2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>f(3)= 2*3+2</td>
<td>8</td>
</tr>
</tbody>
</table>

Credit: http://www.learner.org/teacherslab/math/patterns/number.html

Teach Strategic Competence: Student Strategy Cards

Guess and Check.


Credit: http://mason.gmu.edu/~jsuh4/teaching/resources/cards.pdf
NRC Strand: Adaptive Reasoning

Reason abstractly and quantitatively

Capacity for logical thought, reflection, explanation, and justification

Examples

- Encourage students to discuss math and give them the language to do so.
- Reflect on problem solving.
- Make posters to prove solutions.
- Use “Convince Me” worksheets.

NRC Strand: Productive Disposition

Model with mathematics

Habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy.

Examples:

- Connect math to real life as you teach.
- Link math to other subjects.
- Ask students to share with the class their own examples of when they use math in real life.

* Dr. J. Suh at http://mason.gmu.edu/~jsuh4/teaching/convince.htm
Teach Productive Disposition: Real Life Connections

Teaching Tips to Reduce Math Anxiety

1. Prioritize skills to be taught.
2. Make connections to students’ lives.
3. Take time to address vocabulary issues.
4. Focus on core concepts.
5. Select user-friendly books.
6. Individualize instruction.
7. Use appropriate technology.
8. Be flexible with teaching techniques.
9. Provide students with test-taking strategies.
10. Become familiar with NRC and CCR math proficiency attributes to support student learning.
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Math Vocabulary Anxiety

- Math is NOT a universal language as commonly believed.
- Teaching math vocabulary explicitly helps your English Language Learners as well as your native speakers.

Math Vocabulary Anxiety

*Do these instructions make you anxious?*

To change a **mixed number** into an **improper fraction**, simply multiply the **denominator** by the **whole number** and add the **numerator** to the resulting **product**.
Reduce Math Vocabulary Anxiety
Example: Slope Vocabulary

Cross left arm over right.
Right arm represents x-axis.
Left arm represents line.
- Left arm at 45° is a positive slope.
- Left arm at 90° is an undefined slope.
- Left arm at 130° is a negative slope.
- Left arm at 0° is a 0 slope.

TRY IT
Communities of Practice: Mathematical Instructional Strategies, Highlights Session

Manipulatives, Visual Aids, and Graphic Organizers

Manipulatives, visual aids, and graphic organizers are especially helpful for English language learners because they allow students to demonstrate high quality math thinking with relatively low language demand.

1. T-chart for adding and subtracting positive and negative integers
2. Compare and contrast diagram / Venn diagram
3. Graphic organizers for word problems
4. Hierarchical graphic organizer
5. Vertical number elevator
6. Order of operations ladder
7. Sequence chart
8. Box multiplication chart
Example of Using a Visual Aid
-6 + 2

Example of Using a Visual Aid
4 + (-3)

Example of Using a Visual Aid
(-2) + (-3)
Math Skill Areas

1. Number Sense
2. Measurement and Geometry
3. Statistics, Data Analysis, Probability
4. Algebra and Functions
5. Math Reasoning
6. Algebra I

Highlight Math Skill Area

1. Number Sense
2. Measurement and Geometry
3. Statistics, Data Analysis, Probability
4. Algebra and Functions
5. Math Reasoning
6. Algebra I

Example:

\[ \frac{5}{10} = 0.5 \]
\[ \frac{21}{5} = 4 \frac{1}{5} = 4.20 = 420\% \]
\[ \frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} \]

Number Sense: Human Fractions

- Quick, kinesthetic activity
- Teaches equivalent fractions
- Best once a day for several days

~ Kate Nonesuch, 2006
Human Fractions

1. Form groups of any size as long as half of the people are wearing $x$.
2. Ask each group: “What fraction of the people in this group are wearing $x$?”
3. Count groups to check
4. Write the fraction on the board
5. Combine small groups into bigger groups in order to write more fractions on the board until entire class is combined.

~ Kate Nonesuch, 2006

Human Fractions

1. What fraction of the people are wearing colored shirts?
2. What is the ratio of light shirts to colored shirts?
3. What fraction of the people are women?
4. What is the ratio of men to women?
5. What is the ratio of men to total?

Reflect

• Vocabulary page with definition, pictures, and real world connection
• Concept math
• Mental gymnastics – Countdown game
• Solving word problems with thinking blocks
• Convince me worksheet
• What math happened to you?
• Slope Vocabulary using your body
• T-chart for adding and subtracting positive and negative integers
• Human Fractions
Human Fractions

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T-chart for adding and subtracting positive and negative integers

<table>
<thead>
<tr>
<th>Negative (-)</th>
<th>Positive (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="negative.png" alt="Negative" /></td>
<td><img src="positive.png" alt="Positive" /></td>
</tr>
</tbody>
</table>

Slope Vocabulary using your body

- **POSITIVE SLOPE**
- **ZERO SLOPE**
Communities of Practice: Mathematical Instructional Strategies, Highlights Session

~ Dr. J. Suh at http://mason.gmu.edu/~jsuh4/teaching/convince.htm

THINKING BLOCKS

Credit: http://www.mathplayground.com/ThinkingBlocks/thinking_blocks_modeling%20_tool.html
Example: \( 100 \times 4 = 400 \times 2 = 800 + 75 = 875 - 5 = 870 - 5 = 865 + 2 = 867 \)

Credit: mathgametime - http://www.mathgametime.com/games/countdown-numbers

Concept Maps

VOCABULARY PAGE

Dr. J. Suh
http://mason.gmu.edu/~jsuh4/teaching/vocab.htm
Communities of Practice: Mathematical Instructional Strategies, Highlights Session

**Reflect**

- Vocabulary page with definition, pictures, and real world connection
- Concept math
- Mental gymnastics – Countdown game
- Solving word problems with thinking blocks
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**CALPRO Offerings**

- Regional Community of Practice (CoP)
  - Hybrid training that includes some online and two face-to-face workshops
- Online Self-Paced Course

To host or participate in a regional CoP, please contact Dr. Cherise G. Moore at cmoore@air.org

You can visit the CALPRO website for more information at: www.calpro-online.org

**Closing**

- Today’s highlight session was the tip of the iceberg. Join a Community of Practice to get even more teaching ideas grounded in best practices. How? Read your handout.
- Please fill out the evaluation.
- Thank you!

EVALUATION