Making Middle Grade Mathematics Accessible

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General Purpose of MSP

To improve academic achievement of students in mathematics and science by strengthening the quality of mathematics and science instruction.

To encourage partnerships between institutions of higher education and high-needs schools.
Getting Started

• What are some instructional obstacles that cause difficulties for students?

• List math topics that cause difficulties for your students.
Student Difficulties in Math Class

- Copying Shapes
- Writing Legibly
- Writing in Small Spaces
- Recalling Math Facts
Worksheet
Work – around
Strategies for Worksheets

- Spacing
- Boxes
- Highlighting
- Font
- Keep problems together
Practice without Worksheets

• These are, These Aren’t

• Lining Up Dominoes

• Matching
Classroom Strategies

• Multiple Choice

• Highlighters

• Give the answers; student work on procedures
Struggling students can generate math ideas!
Instructional Strategies

Use of Concrete-Representational-Abstract (CRA) instructional sequence

- Concrete “doing” stage
- Representational “seeing” stage
- Abstract “symbolic” stage
FRACTIONS
Division of Fractions

$5 \div \frac{1}{3} = ?$

$5 \cdot 3 = 15$

Why?
Division of Fractions

\[ 5 \div \frac{1}{3} = ? \]

\[ 5 \cdot 3 = 15 \]

Why?
Division of Fractions

\[ 5 \div \frac{1}{3} = ? \]

\[ 5 \times 3 = 15 \]

Why?
Multiplication of Fractions

\[ \frac{1}{2} \cdot \frac{6}{7} \]
Multiplication of Fractions

\[
\frac{1}{2} \cdot \frac{6}{7}
\]

\[\begin{array}{ccc}
\frac{1}{7} & \frac{1}{7} & \frac{1}{7} \\
\end{array}\]

\[\begin{array}{ccc}
\frac{1}{7} & \frac{1}{7} & \frac{1}{7} \\
\end{array}\]
Your Turn

\[
\frac{1}{3} \quad \frac{6}{10} \cdot
\]

or

\[
\frac{3}{4} \quad \frac{8}{11} \cdot
\]
Two-fifths of the employees at a very large company has Type A blood. If \( \frac{1}{2} \) of the company’s employees donate blood what fraction will donate type A blood.

Blue = company
Two-fifths of the employees at a very large company has Type A blood. If $\frac{1}{2}$ of the company’s employees donate blood what fraction will donate type A blood.

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Two-fifths of the employees at a very large company has Type A blood. If $\frac{1}{2}$ of the company’s employees donate blood what fraction will donate type A blood.

Blue = company
Yellow = Employees with Type A blood
Two-fifths of the employees at a very large company has Type A blood. If \(\frac{1}{2}\) of the company’s employees donate blood what fraction will donate type A blood.

Blue = company
Yellow = Employees with Type A blood
Equations with Fractional Coefficients

\[
x = \frac{6}{5} \cdot \frac{5}{1}
\]

\[
x = 30
\]
Equations with Fractional Coefficients

\[ \frac{52}{25} \times x = 6 \cdot \frac{5}{2} \]
Equations with Fractional Coefficients

\[ x = \frac{30}{2} \]

\[ x = 15 \]
Equations with Fractional Coefficients

\[
\frac{2}{5} \quad x = 6
\]
Equations with Fractional Coefficients

\[ \frac{2}{5} \times 6 = 12 \]

\[ 6 \times 3 = 18 \]

\[ x = 15 \]
Instructional Strategies

Your Turn

\[ \frac{1}{4} \times x = 3 \]

or

\[ \frac{3}{7} \times x = 12 \]
Algorithms

Algorithms *without* understanding
- Errors practiced and hard to break
- Extensive practice time
- Limited retention
Algorithms

Algorithms *with* understanding

– Conceptual development
– Reduction in practice time
– Extended retention and application

PERCENTS
Percents

\[ x \times 3 \]

\[ 0\% \quad 25\% \quad 50\% \quad 75\% \quad 100\% \]

\[ 0 \quad 20 \quad 40 \quad 60 \quad 80 \]
Percents

\[\div 10\]

\[0\% 5\% 10\% 20\% 30\% 40\% 50\% 60\% 70\% 80\% 90\% 100\%\]
Percents
Percents

\[
\frac{x}{35} = \frac{60}{100}
\]
Percents

If 60 is 100% then 6 is 10% and 3 is 5%. Multiply 5% by 7 to get to 35% and 3 by 7 to get 21.
I know 10% is 6 and 5% is 3, so

\[
\begin{align*}
10\% & \quad 6 \\
10\% & \quad 6 \\
10\% & \quad 6 \\
5\% & \quad 3 \\
35\% & \quad 21
\end{align*}
\]
Percents

Sarah earns $1800 a month and pays $430 for rent. What percent of her income goes for rent?
Percents
Percent Increase

• A golf shop pays its wholesaler $40 for a certain club, and then sells it for $75. What is the markup rate?

\[
\begin{array}{c|c|c}
\text{0%} & \$40 & \$75 \\
\hline
0 & 100\% & x \\
\end{array}
\]
Emily bought a pair of jeans for $40.00. If the sales tax is 7%, what was the total bill?

\[
\frac{40}{100} = \frac{x}{107}
\]
Percent Decrease

Due to the downturn in the economy, the attendance at the conference was down 25%. If the attendance last year was 2300, how many people attended this year?
SLOPE
and
SLOPE-INTERCEPT
EQUATIONS
Payday at Planet Adventure

Rachel receives $9.00 for wearing a funny costume to work. She then receives $5.00 an hour.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Rachel’s Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
</tr>
<tr>
<td>7</td>
<td>44</td>
</tr>
<tr>
<td>8</td>
<td>49</td>
</tr>
<tr>
<td>9</td>
<td>54</td>
</tr>
<tr>
<td>10</td>
<td>59</td>
</tr>
</tbody>
</table>
Payday at Planet Adventure

Rachel worked 3 hours and received 24 hours. Another day she worked 5 hours and received 35 dollars. How much did she receive for each hour she worked?

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</tbody>
</table>
Payday at Planet Adventure

Rachel worked 3 hours and received 24 dollars. Another day she worked 5 hours and received 34 dollars. How much did she receive for each hour she worked?

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
</tr>
</tbody>
</table>
Payday at Planet Adventure

<table>
<thead>
<tr>
<th>X (hours)</th>
<th>Y (pay)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
</tr>
</tbody>
</table>

\[
y = \frac{10}{2} = 5 \text{ dollars per hour}
\]
Finding Slope

\[
\begin{array}{cc}
x & y \\
2 & 13 \\
5 & 22 \\
\end{array}
\]

\[
y = \frac{9}{3} = 3
\]

\[
x = 3
\]

Public Schools of North Carolina
Finding Slope

\[
\begin{array}{c|c}
8 & -4 \\
\hline
-6 & 6 \\
2 & 2 \\
\end{array}
\]

\[
y = \frac{-4}{8} = \frac{-1}{2}
\]
Writing linear equations in slope-intercept form

\[ y = mx + b \]

The y-intercept is the number being added or subtracted after the slope is multiplied by an x-coordinate.

**Slope**

\[ \frac{-1}{2} \]

\[ \frac{-1}{2} \cdot -6 = 3 \]

\[ 3 + ____ = 6 \]

\[ 3 + 3 = 6 \]

\[ y = \frac{-1}{2}x + 3 \]
What we know About Mathematics Teaching and Learning

• Connections of mathematical ideas
  – Graphic organizers

• Manipulatives should be used

• Mix up problems on tests!

• Make sure students are having to make decisions about the mathematics they are doing.
Strategies for Developing Mathematical Understanding

1. **Allow mathematics to be problematic for students.**

   - All students need to struggle with challenging problems
   - Teacher must refrain from doing too much of the mathematics
   - Problem solving leads to understanding!
Strategies for Developing Mathematical Understanding

2. Focus classroom activity on the methods used to solve problems.

• Opportunity for students to share one’s own method
• Hear alternative methods of solving a problem
• Examine the advantages and disadvantages of these different methods (efficiency)

Class discussions should revolve around sharing, analyzing, and improving methods. Mistakes become sites for learning.
Strategies for Developing Mathematical Understanding

3. Determine *what* mathematical information should be presented and *when* this information should be presented.

- Presenting too much information too soon removed the problematic nature of problem
- Presenting too little information can leave the students floundering
Encouraging Mathematical Discourse

- Use effective questioning
- Be nonjudgmental about a response or comment
- Let students clarify their own thinking
- Require several responses for the same question
- Require students to ask a question when they need help.
- Never carry a pencil.
- Partner quizzes!!!
But Most Importantly…

Never Say Anything a Kid can Say!!
Before You Leave…

• 3 – List 3 new things you learned from this session

• 2 – Select 2 things you’ll try with your students

• 1 – What is the 1 thing you can’t wait to run out of here and try?
Thank You!

http://math.ncwiseowl.org/home

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