Problem Solving – The “Heart” of Common Core

I. Goal/Objective.

The teachers in the staff development meeting will demonstrate knowledge of, analyze, and apply the “heart” of the Common Core objectives through problem solving techniques in mathematics.

II. Math Concepts

Analyze and demonstrate knowledge in problem solving skills as defined by Polya, NCTM standards, and Common Core Standards for Mathematical Practice by grade.

III. Materials


Dyess - staff development, power point.pptx

[If you are unable to access the power point, copies of the slides are provided on pages 4 - 8]

b. Note cards with Polya’s problem solving strategies, one each of Polya’s problem solving strategies on each card.

c. “Constructing Numerical Equations” practice sheet to apply the problem solving strategies of Polya.

d. Five small “goody bags” of individually wrapped candy for each table to share as they explain their strategies and have successfully solved their problems.
IV. Management

a. Things to prepare ahead of time.
   i. Give my Principal a copy of my staff development plan and a copy of the materials used, to ask permission to address the math teachers at my school for a staff development.
   
   ii. Make note cards for 5 tables of teachers with one each of Polya’s problem strategies on each card.
   
   iii. Five (5) copies of “Constructing Numerical Equations”, one for each table.
   
   iv. Presentation equipment and power point.
   
   v. “Goody bags”

b. Participant groupings.
   
   i. I will have 5 tables, for groups of 5 teachers each. Each table will be color-coded (red, yellow, green, blue, and purple).
   
   ii. I will place 25 color tiles, 5 each of the five color tiles into a small shopping bag.
   
   iii. As teachers enter the meeting room, they will choose a color tile from the shopping bag without looking and be seated at the table with the corresponding color.

c. Time Frame.
   
   i. The staff development plan will be approximately 45 minutes to 1 hour.
v. Procedure

a. Introduction

1. Introduction to staff development, “Heart of the Common Core - Problem Solving” using the power point presentation.

2. Tell the teachers that today they will be practicing the problem solving skills as outlined by the Common Core Standards, NTCM standards, and Polya’s problem solving strategies.

b. Content Activities

i. Give each group a set of the 4 strategies of Polya, with one strategy written on each card.

ii. Give each group of teachers a copy of “Constructing Numerical Equations” problem solving activity.

iii. Instruct each group to have one reader for the problem and give each teacher in the group one strategy card.

iv. Teachers are to solve their problems demonstrating application of the problem solving strategies. The reader will then report on how each group solved the problem and give an answer.

v. After each problem is solved, the teachers will pass the job of reader and the note cards, in a clockwise direction around the table, until each teacher in each group has had a turn practicing each skill.
vi. One person in each group will then explain one problem, the strategies used, and give an answer to each problem.

c. Closure

i. Use the power point to review Common Core Standards to solve problems.

ii. Ask teachers if they believe the problem solving strategies will deepen understanding, reasoning skills, and math skills to solve problems.

iii. Ask teachers what math objectives would apply to the problem solving strategies.

iv. Teachers are given a copy of “Standards for Mathematical Practice by Grade” to highlight their grade level and review the critical areas of each grade to be taught with the problem solving strategies.
Common Core Standards in Math – Making Sense of Problems and Persevere in Solving Them

Mathematically proficient students:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Polya’s Problem Solving Techniques

- Understand the problem
- Devise a plan
- Carry out the plan
- Look back
Step 1 – Understand the problem

- **FIRST – STUDENTS HAVE TO UNDERSTAND THE PROBLEM**, teachers should ask:
  - Do you understand all the words used in stating the problem?
  - What are you asked to find or show?
  - Can you restate the problem in your own words?
  - Can you think of a picture or diagram that might help you understand the problem?
  - Is there enough information to enable you to find a solution?

Step 2 – Devise a Plan

There are many reasonable ways to solve a problem, the trick is choosing the best strategy, this requires problem solving practice.

- Guess and Check
- Make an orderly list
- Eliminate possibilities
- Use symmetry
- Consider special cases
- Use direct reasoning
- Solve an equation
- Look for a pattern
- Draw a picture
- Solve a simpler problem
- Use a model
- Work backwards
- Use a formula
- Be ingenious
Step 3 – CARRY OUT THE PLAN

• Students should be encouraged to persist with the plan that has been chosen. If it continues not to work discard it and choose another. Don’t be misled, this is how mathematics is done, even by professionals.

Step 4 – Look Back

• Students gain many skills by taking the time to reflect and look back at what they have done, what worked, and what didn’t. Doing this will enable them to predict what strategy to use to solve future problems.
The National Council for Teaching of Mathematics provides standards that state the goals for mathematics in the K-12 curriculum.

- Students learn to value mathematics
- Students become confident in their ability to do mathematics
- Students become mathematical problem solvers
- Students learn to communicate mathematically
- Students learn to reason mathematically
Constructing Numerical Equations

Last week at work, Carlos earned 7 dollars more than Tyrone.

1. Who earned more money?
   a) Carlos    b) Tyrone

2. Suppose Tyrone earned 27 dollars. How much did Carlos earn?
   a) 7 dollars  b) 20 dollars  c) 34 dollars  d) 189 dollars

3. Consider each of the following. Do the numbers represent amounts of money that Carlos and Tyrone could have earned last week?

<table>
<thead>
<tr>
<th># of $ that Carlos earned</th>
<th># of $ that Tyrone earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes  no a) 2</td>
<td>yes  no 9</td>
</tr>
<tr>
<td>yes  no b) 7</td>
<td>yes  no 1</td>
</tr>
<tr>
<td>yes  no c) 8</td>
<td>yes  no 1</td>
</tr>
<tr>
<td>yes  no d) 14</td>
<td>yes  no 2</td>
</tr>
<tr>
<td>yes  no e) 23</td>
<td>yes  no 30</td>
</tr>
<tr>
<td>Yes  no f) 30</td>
<td>Yes  no 23</td>
</tr>
</tbody>
</table>

4. Consider each of the following. Is it another way to express this sentence?
   "Carlos earned 7 dollars more than Tyrone."
   a) For every dollar Tyrone earned, Carlos earned 7 dollars.
   b) The amount that Tyrone earned plus 7 dollars equals the amount that Carlos earned.
   c) Tyrone earned 7 dollars less than Carlos.
   d) Carlos earned 7 times as much as Tyrone.
   e) The amount Carlos earned was 7 dollars greater than the amount Tyrone earned.
   f) Carlos earned more than Tyrone.

5. Consider each of the following. Does the statement have the same meaning as this sentence? "The amount Carlos earned is 7 dollars more than the amount Tyrone earned."
   a) (amount Carlos earned) = 7 dollars > (amount Tyrone earned)
   b) (amount Carlos earned) + 7 dollars >= (amount Tyrone earned)
   c) (amount Carlos earned) > (amount Tyrone earned)
   d) (amount Tyrone earned) = (amount Carlos earned) + 7 dollars
   e) (amount Carlos earned) = (amount Tyrone earned) + 7 dollars
   f) (amount Tyrone earned) = (amount Carlos earned) - 7 dollars
6. Suppose that □ stands for the amount Carlos earned and ◊ stands for the amount Tyrone earned. Write an equation that means “Carlos earned 7 dollars more than Tyrone.”
   Equation

7. Suppose that □ stands for the amount Carlos earned and ◊ stands for the amount Tyrone earned. Consider each of the following. Does it mean the same as this sentence? “Carlos earned more than Tyrone.”
   yes no a) □ > ◊
   yes no b) □ = ◊
   yes no c) ◊ > □
   yes no d) □ + ◊

8. Greg is paid 10 cents for each newspaper he delivers. Consider each of the following. Is the information necessary for figuring out how much money Greg makes each week delivering newspapers?
   yes no a) The selling price of each newspaper
   yes no b) The number of pages in the newspaper
   yes no c) The number of people who live in Greg’s town
   yes no d) The number of papers Greg delivers each week.

9. In the following problem, cross out all information that will not help you figure out how far Joan traveled on her bicycle trip.
   Last Saturday Joan went to her aunt’s house on her bicycle. She left home at 9:00 a.m. and rode until 9:30 a.m. At 9:30, she stopped for a break and bought a bottle of juice for 75 cents. After a 15-minute break, Joan continued on her bicycle, arriving at her aunt’s house at 10:30 a.m. Her average speed for the trip was 8 miles per hour. How many miles did Joan travel in all?

10. The Maple High School soccer team won half as many games as the basketball team won. The basketball team won 12 games. Consider each of the following. Does the equation show how many games the soccer team won?
   yes no a) Number of soccer games won = 12 X 2
   yes no b) Number of soccer games won = \( \frac{1}{2} \times 12 \)
   yes no c) Number of soccer games won = \( \frac{1}{2} + 12 \)
   yes no d) Number of soccer games won = 12/2
   yes no e) Number of soccer games won = 12 ÷ \( \frac{1}{2} \)
11. Sasha is 13 years older than Ted. Ted is 8 years old. Which of the following shows how to calculate Sasha’s age?
   a) Sasha’s age = 13 + 8
   b) Sasha’s age = 13 - 8
   c) Sasha’s age = 13 X 8

12. Kevin is 5 years older than twice Barbara’s age. Barbara is 7 years old. Which of the following shows how to calculate Kevin’s age?
   a) Kevin’s age = (5 + 2) X 7
   b) Kevin’s age = 5 > 2 X 7
   c) Kevin’s age = 5 + (2 X 7)
   d) Kevin’s age = (5 X 2) + 7

13. Let □ stand for some number. Which of the following stands for “6 less than the number”?
   a) □ - 6
   b) 6 - □
   c) □ < 6
   d) 6 < □

14. Let ◊ stand for some number. Which of the following stands for “8 less than twice the number”?
   a) 8 - (2 X ◊)
   b) (2 X ◊) - 8
   c) 8 < 2 X ◊
   d) 2 - (8 X ◊)

15. Consider each of the following. Can the equation 5 X 3 + 2 = 17 represent the statement?
   yes  no a) Five tickets at $3 each plus a $2 ticket cost $17.
   yes  no b) Three $5 lunches and a $2 tip come to $17.
   yes  no c) Joe rode his bicycle 5 miles in 3 weeks and 2 weeks later rode 17 miles.
   yes  no d) Jennifer walked 5 miles at 3 miles per hour and then walked 2 more miles for a total of 17 miles.
   yes  no e) Susan is 17, which is 2 more than 5 times the age of her three-