<u>Building Mathematical Thinkers: Mini-Activities</u>

Equation True or False

Objective: 4th grade Algebra – Equations, Properties, and Order of Operations

Theoretical Foundation: When students think about operations they often focus on the steps needed to solve equations. However, operating with numbers fluently involves reasoning about how numbers and operations can be manipulated. This activity requires fourth graders to use their knowledge of operations and their properties, rather than calculation, to determine equality.

Estimated Time: 45-60 minutes

Materials: Copies of Equation Cards for each pair or group of 3 students

Directions:
1. Write the following on the board:
$$24 \times 3 = 24 + 24 + 24$$
2. Ask, "Is this true or false?" and "How do you know?"
3. The emphasis here is that students do not need to work out the numerical values of each side of the equation, rather they should relate multiplication to repeated addition. In other words, both sides mean the same thing.
4. Now write:
$$32 + 826 + 12 = 12 + 32 + 826$$
5. Ask, "Is this true or false?" and "How do you know?"
6. Again the emphasis is not on the actual value of each side, but on what the students know about addition. (This is the commutative property)
7. Show students a third problem:
$$39 \times 22 = (39 \times 10) + (39 \times 2)$$
8. Ask, "Is this true or false?" and "How do you know?"
9. Without needing to work out solutions for each side students should recognize that the right side is less than the left side.
10. After students have demonstrated clear understanding of why the two sides are unequal, ask, "What could I change to make this equation true?"
11. If the students have already had experience with order of operations provide and discuss an example of this as well such as:
$$4 + 6 \times 2 = 4 + (6 \times 2)$$
12. Now explain the directions for sorting the equation cards into two groups: True or False
13. Emphasize that students do not need to work out the answers for these equations. They should just use their reasoning skills and what they know about operations to decide if the equations are true or false.
14. Students ***SHOULD NOT USE PAPER, PENCIL, OR CALCULATOR FOR THIS ACTIVITY!***
15. If you have not done prior work with order of operations please **remove these cards** from the sort.
16. Allow students ample time in pairs or groups of 3 to sort the equation cards.
17. When students finish, lead a discussion with the class about each card OR ask the students which cards were difficult and discuss those. Remember that the students should be doing most of the talking during this discussion.

Differentiation Suggestions:
- Challenge early finishers and advanced students to determine what changes could be made to the False equations so that they would be True. These students could rewrite the equations   on index cards and place them in the true column.
- The numbers of the equation cards are intentionally large to discourage students from using calculation to determine equality. However, struggling students may find these numbers distracting. To prevent a fear of large numbers from interfering with student work, suggest that students use a substitution method. They could write the same equation over beneath the original, but substitute a small number for each large number.

Probing Questions:
- How did you think about this card?
- How can you tell this one is true/false?
- Why is this one true, when this one which is very similar is false?
- What could you change about this equation to make it true?
- What would happen if the parenthesis was here?
- Would this equation still be true/false if all of the multiplication signs were changed addition? If all of the multiplication signs were changed to subtraction?

Assessment:
- How successful are students at using reasoning to determine equality, rather than using calculation?
- What concepts of operations and their properties do students seem to understand clearly?
- What concepts of operations and their properties are students confused about?
- Can students make mathematically correct suggestions to change false equations into true statements?
- Can students write their own examples of both true and false equations?

True or False? Equation Cards

(order of operations cards are last 2 rows, remove if students have no experience with this concept)

$643 \times 0 + 0 = 643 + 0 + 0$	$17x9 = (17x3) + (17x3) + (17x3)$
$32 \times 14 = (32 \times 10) + (32 \times 4)$	$(25 \times 13) - (2 \times 13) = 23 \times 13$
$(62 \text{ d } 4) + 0 = 620 \text{ d } 4$	$48 \times 16 = 16 \times 48$
$269+128=200+100+28+69$	$(5x4) + (5x4) + (5x4) = 15x4$
$621 - 42 = 42 - 621$	$93 \div 3 = (90 \div 3) + (3 \div 3)$
$43x2 + 60 \div 2 = (43x2)+(60 \div 2)$	$628 - (8x9) = 628 - 8 \times 9$
$454 + 2 \times 6 = 2 \times 6 + 454$	$89 \times 13 - 75 = 75 - 89 \times 13$