Solving Single-Variable Equations Part II

Summary

Solve equations by isolating the variable

Main Core Tie

Mathematics Grade 8

Strand: EXPRESSIONS AND EQUATIONS (8.EE) Standard 8.EE.7

Materials

Cups, two-color counters, and balances overheads on transparency and sets for students
Stand-Up Cards for each team

- Jeopardy Game transparency
- Equation War worksheet

Journal page: Solving Equations

Background for Teachers

Enduring Understanding (Big Ideas):
Solving equations
Essential Questions:

How can inverse operations be used to transform an equation to isolate the variable?
What value of the variable will create two equivalent expressions? How can this solution be checked?

Skill Focus:
Use inverse operations to find the solution for an equation
Vocabulary Focus:
equation, inverse operation, isolate the variable, working solve, solution
Ways to Gain/Maintain Attention (Primacy):
Manipulatives, story, game, sketching, graphic organizer

Instructional Procedures

Starter:

Make a good guess for what the value for x will be in the equation below. Check your guess to make sure you have the correct solution.
Indicate what operation was performed to get to step a and b below.
Undo each operation to isolate the variable in this expression. -4v -- 5

Lesson Segment 1: How can inverse operations be used to transform an equation to isolate the variable? What value of the variable will create two equivalent expressions? How can this solution be checked?
A. Model using the inverse operations to isolate the variable and to solve the equation by having students set up the equation and isolate the variable using Cups and Counters (attached) or by using Hands-On Equations (if you have a set). Go through the steps on the Cups and Counters page, having student pairs set-up, solve, represent and record on the worksheet(attached).
B. Sometimes a story or scenario can remind us how to do a procedure. Following is a scenario or story that can help students remember the procedural steps for solving two step equations. Tell and demonstrate the f story. Have the students write all models as journal notes for solving equations.
Xavier's Party
Xavier is having a party. He invites a very close friend and some more casual friends to the party.

Because he can only invite a few, several friends did not receive an invitation. See if you can identify the host of the party-Xavier, the close friends, the casual friends and the friends who didn't get invited at all in this equation: 2x + 4 = 14 (X is Xavier, 2 is the closest friend, 4 is the casual friends, and 14 is the friends who weren't invited.) Can you identify which expression is where the party is happening and which is where there is no party? (The party is the variable expression) The equal sign represents the door to the party. When anyone leaves the party, they go the opposite way they came. So, the inverse operation must be performed to get them out the door.
When the party is over, and people leave, does the host leave? No, the host stays, and the friends leave. Who usually leaves a party first, the casual friends or the closest friends? Usually, the close friends stay to help clean up or to sleep over. So, who would leave the party first (4)? And, when 4 goes out the door, what operation must be used to go out? (subtract). So, four goes out and is subtracted from 14 leaving 10 outside and who is left at the party (2 and the host, X)? Who leaves last (2)? When 2 goes out the door, what operation in used (divide)? So, 2 goes out and divides into 10 leaving only the X at the party and 5 outside the door.
Repeat the scenario as you model the procedure for solving these problems and have the students work on their paper as you model.

-3p 2 = - 8
b/4 + 7 = 10
r/-2 + 9 = 5

C. Movement: Use Stand-Up Cards (#s 1-20, operation signs, equal sign, negative sign) cards to have student teams set up and solve this equation. -2x + 5 = 11. students actually stand holding symbols and move as the variable is isolated.
Cups, Counters and Balances (suggested teaching steps- Linda Bolin)
Make student sets of cups and balances. Use two-color counters for positive and negative integers. Have students: a. build (physical representation), b. sketch (pictorial representation), c. record math symbols (symbolic representation) as you go through each step below. See attached student materials and worksheet.
1) Introduce all pieces. (Scale balance shows equivalent expressions. Dark cup is x. White cup is opposite of x, Two-Color Counters: yellow are positive integers and red are negative integers.)
2) Teach the concept of Balance (equation). Once we set up an equation on the scale indicating equivalency, we must keep it balanced. Demonstrate Balance. Explain "setting-up a problem" where students set up the cups and counters described by an equation. Have students model these "balanced" expressions and make up two of their own.
Ex.
x + 5 = x + 2 + 3
3x + 4 = 3 + 1 + x + 2x
3) Teach concept of exchanging for equal value (simplifying by adding like terms). Have them use balances, sketches and symbols to practice exchanging for equal value.
Use the examples above to exchange 2 + 3 for a 5, or x + 2x for 3x
4) Explain the object of the activity and what constitutes a legal move. Object: <u>Get X, or the variable, alone.</u> Legal moves: Set *up* the problem first. Keep it Balanced, Exchange for equal value (simplify).
5) One-Step Equations (x only, not the opposite of x)
Addition:
x +5 = 7
-4 = x+ 6
5 = - 3 + m
-2 + p = -6
Subtraction: Have them set the problem up as a related addition problem.
x -- 3 = 7

5 = w -- 8
-2 = r -- (-3)
n -- (-5) = 10
Multiplication: (positive coefficient only):
2x = 6
-8 = 2t
3g = 9
12 = 3x
Division: Discuss what half the counters in a cup (or 1/3 the counters) would look like. In order to represent all the counters we would need to multiply by 2 (or by 3). When solving, multiply to put parts back into one whole x; 1/2x • 2 = 1x.
4 = x / 2
b / 2 = -6
-15 = x / 3
-5 = x / 4
6) Demonstrate opposite of x by saying things like, "If x is earning 4 dollars, what is the opposite of x?", or, If x is the temperature dropping 10 degrees, what is the opposite of x?" Review the object of the activity is to find the value for x. Thus, when we get the opposite of x alone, we are not finished until we have determined the value for x.
- x + 2 = 5
- 4 = 5 + (-x)
6 -- x = - 3 (remember to set up related addition)
- 2x = - 8
- 9 = - 3x
- x / 2 = 10
Solving Two-Step equations
7) Two step equations
2x + 1 = 7
10 = 4 + 3x
- 2x -- 5 = 3
x / 3 -- 5 = 4
-3x + 5 = -7
-4 = - x / 2 + 6
Lesson Segment 2: Practice
A. Play Solving Equations Jeopardy (game board attached) Print the game on a transparency and cover the statements with post-its. Divide the class into two teams. Ask a person to choose a category and a value. Reveal that statement. Give students a minute to discuss with team members, then the selected person must ask the appropriate question. If she/he does not, call on a person from the other team to answer. When a person answers correctly, they get to choose another category and value. The team with the most points at the end of a predetermined time period wins.
B. Have student pairs play the Equation War game. Each person writes on a game paper. The players each pick two or three cards (depending on how many boxes need to be filled) from a deck of cards. Using a regular card deck, the Ace can be 1 and the face cards should be pulled. Or, a graphing calculator can be used to generate numbers from 1-10. Each player decides where to place the numbers that they rolled in the boxes for the first equation on the paper. Then, each player solves their equation and players compare solutions to see which player had the greatest solution. They should check each other's work, because the player whose solution is the greatest value, gets a point. They re-roll the dice to get numbers to fill the next equation and continue playing.
Lesson Segment 3: Summarize

Use the "Solving Equations" flowchart journal page or make a foldable for students to summarize the steps to solving equations.

Assessment Plan

performance tasks, observation, quiz

Bibliography

This lesson plan was created by Linda Bolin.

Authors

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