Linear Equations & Inequalities – Evaluation & Supervision

EQUATIONS

Consider quickly introducing simple equations used in elementary school such as using $4 + \Delta = 6$ where they had to find the value that goes into the Δ by guessing and substituting numbers to find a number that worked. Then scaffold to a problem such as $2 \times \Delta + 4 = 14$.

Provide two examples of arithmetic expression to simplify; such as $5 + 3(2)$ and $4 + 30 \div 5 \times 2 + 1$. Explain, not everyone did the operations in the same order & the importance of the having an agreement – the Order of Operations – so everyone does the problem the same way and arrives at the same answer.

Using the elementary example, $2 \times \Delta + 4 = 14$, show them how that looks in algebra. $2x + 4 = 14$. The only change being vocabulary & notation.

Go over the Gift Wrapping Analogy and show that that is used to develop a systematic approach to solving equations in algebra.

Based on the Gift Wrapping Analogy and the Order of Operations, provide students with a systematic strategy for solving all linear equations and have them write it in their notes.

Important Formulas, procedures or strategies should be written and left on the board for reference

Strategy for Solving Linear Equations

Rewrite an equation in $ax + b = c$ format using the Properties of Real Numbers, then use the Order of Operations in reverse using the inverse operations to isolate the variable.

a. Identify what is physically different from $ax + b = c$

b. Get rid of it

Have the students watch you solve two or three equations such as $5x + 1 = 21$; $4x - 2 = 10$, and $\frac{x}{3} - 2 = 8$ as you talk through the problems and inform them of how you are using the strategy and the Properties of real Numbers. Then ask them to solve two or three problems; $4x + 3 = 27$; $10x - 3 = 37$ and $\frac{x}{2} + 5 = 9$.

When introducing equations, use numbers that don't distract students from the concept or skill being taught or bog them down in arithmetic.

After the students are comfortable solving equations, then have them justify each step.

On high stakes tests, students must justify their answers. So after the students are comfortable with solving simple equations, do a couple of more examples by providing justifications making sure the equations solved are horizontally.

$7x + 3 = 31$	Given
$7x + 3 - 3 = 31 - 3$	Subtract Prop Equality
$7x = 28$	Add Inverse/ Combine terms
$x = 4$	Div Prop Equality

Continually reference the strategy developed when doing problems.

Explain that problems cannot be made more difficult – only longer. Scaffold up by providing a couple of examples to be worked out for them using the strategy. Examples such as $5x - 2 = 2x + 19$ and $7x + 3 = 3x - 17$. Have students identify how these equations look physically different than the equations solved previously – comparing and contrasting.

Use the strategy for solving linear equations, step by step, continually referring to that strategy as you are doing each step by speaking out loud as you proceed.

Check student proficiencies by having all students solve equations such as:
$8x - 2 = 3x + 28$ and $10x + 4 = 7x + 25$, then provide exercises for students.

After the students are comfortable with solving equations with variables on both sides of the equation, have them then do a couple of problems that require them to justify their answers.

$6x + 8 = 2x + 4$	Given
$6x + 8 - 2x = 2x + 4 - 2x$	Sub. Prop of Equality (SPE)
$4x + 8 = 4$	Add. Inv. / CLT

$4x + 8 - 8$	$= 4 - 8$	SPE
$4x + 0$	$= -4$	Add. Inv. / CLT
$4x$	$= -4$	Prop of Zero or Add Identity
x	$= -1$	DPE

As you continue to scaffold, continue to reference the strategy for solving linear equations, that is rewrite the equations into $ax + b = c$ format. Taking something you don't recognize and changing that into a pattern you do recognize. Comparing and contrasting the equations.

Introduce equations containing parentheses by asking what is physically different, then have the students follow the strategy.

$3(2x + 1) - 4 = 11$. $4(3x - 2) - 2x = 22$

INEQUALITIES

To ensure student understanding when solving inequalities, redo a few of the equations already solved but with an inequality sign using our same strategy.

To clarify solving inequalities when multiplying or dividing by a negative number, give students a few examples

If $a > b$, then $a + c > b + c$, then get to multiplication

If $5 > 2$, then $5(3) > 2(3)$ ——$\geq$ if $a > b$, then $ac > bc$
However, when multiplying /dividing by a negative number If $5 > 2$,
then $5(-3)$? $2(-3)$

if $c < 0$, and $a > b$, then $ac < bc$

When we multiply or divide by a negative number, to make the statement true, the order of the inequality must be reversed.

DOUBLE INEQUALITIES

The conventional way of reading A double inequality is to read the variable first, then read the inequalities using "and". So, $-2 < x \leq 4$ would be read, x is less than or equal to 4 **AND** greater then -2.

Emphasize "and" and "or" statements with double inequalities and how an "and" statement occurs when the graphs overlap.

While solving double inequalities follows our same strategy, get rid of the double inequality first by using the following:

Solving Double Inequalities

To solve a double inequality, you solve the two inequalities independently, then use the "and" or "or" statement to determine the solution set. In other words, solve the middle to the right of the inequality, then solve from the middle to the left.

ABSOLUTE VALUE

Introduce absolute value as students learned form elementary school, then emphasize in algebra, we are looking for all the values of a variable that makes an open sentence true and therefore must have a more precise definition.

$$|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}$$

To increase student understanding, make the arguments simple, |x|, and scaffold to make longer problems. Then use the definition to the two possibilities – when the argument is positive and when the argument is negative.

Use the following procedure to solve equations containing absolute value using the get rid of it

Solving Equations with Absolute Value

1. Isolate the absolute value
2. Set the positive and negative of the expression inside the absolute value signs equal to the number on the outside creating 2 equations
3. Solve the resulting equations in the ***ax + b = c*** format