3x - 2x Doesn't Equal 1?

Simplifying Algebraic Expressions

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Grade Level	7th – 10th Grade	**Time Frame**	1-2 class period(s)
Subject	Mathematics	**Duration**	100 minutes

Essential Question

How can abstract concepts in math fit together?

Summary

Students will physically model the concept of simplifying algebraic expressions as a class then apply this knowledge to written expressions. This is a great lesson for both introducing the concept as well as remediating like terms, if needed.

Snapshot

Engage

Students will sort various objects into groups and explain their reasoning.

Explore

Using large variable cards, students will stand up and model expressions that the teacher has on the board. After the initial expression, students will regroup and combine similar variables.

Explain

Students will construct the 'rules' for simplifying based on what they did in the Explore activity.

Extend

In small groups, students will continue to model algebraic expressions with note cards, and then translate information to written form.

Evaluate

Students will "Create the Problem" using various answers written on the board.

Standards

Oklahoma Academic Standards for Mathematics (Grade 8)

PA.A.3.2: Justify steps in generating equivalent expressions by identifying the properties used, including the properties of operations (associative, commutative, and distributive laws) and the order of operations, including grouping symbols.

Attachments

- Create the Problem.docx
- Fruit Classification.docx
- Group Problem Worksheet.docx
- Group Problem Worksheet.pdf
- Group Work Small Variable Cards.docx
- Group Work Small Variable Cards.pdf
- K20 PreAlg 3x-2x Row Accuracy Activity.docx
- K20 PreAlg 3x-2x Row Accuracy Activity.pdf
- Large Variable Cards.docx
- Large Variable Cards.pdf
- Row Accuracy Activity.docx
- Row Accuracy Activity.pdf
- Simplifying Algebraic Expressions.docx
- Simplifying Algebraic Expressions.pdf

Materials

- Items to sort: tangram tiles, centimeter cubes, playing cards, fruit, etc. (Be creative and use what you have!)
- Large group cards
- Small group cards and group documentation sheet
- Row accountability problems
- Create the Problem format sheet

Engage

Divide students into groups and give them 10-15 items to sort. (Keep it at around 3-4 different groups of items) Ask students to write an explanation of how they decided to sort their items and, on a dry erase board, make a list of their items and how many of each type they have.

Supply Crisis

If you don't have dry erase boards, paper works just fine. Also, having students document their sorting on a left-hand page of their interactive notebook would be a great left-hand activity and it'll be there for reference when they take their right-hand notes.

Combine two or three groups into one to form larger groups. Give the expanded groups a new board (or piece of paper) and a new color of marker. They should title the new board "RESULT." Ask the groups to come up with new item totals by counting items. Have them compare their RESULT board to their first brainstorm boards of their initial groups and reasons. Have each group present their combined findings.

Such Possibilities

You could use different objects or the same objects within a class. Be creative. Some possibilities include tangram tiles, centimeter cubes, pictures of emojis, playing cards, or pictures of fruit or vegetables.

Leaving Breadcrumbs

While students are presenting, emphasize the use of the objects: "We have 5 SQUARES and 3 TRIANGLES AND THIS IS WHY WE PICKED SQUARES AND TRIANGLES." These will translate easier into what X and Y mean later.

Explore

Set Up

Print copies of the "Large Variable Cards" to use with the Explore activity. Follow the directions on the first page of the attachment for printing and practice problems.

Place the printed copies of the variable cards in stacks (X, -X, Y, and -Y) that are visible to students. Write a simple expression (or the first problem on the handout, 3x + 2y) on the board and ask students to come take one card each to model the expression.

What Model?

For the example 3x + 2y, five students are needed. Three students would hold one 'x' paper each (thus three x's), and two would hold one 'y' paper each (making three x's and two y's).

Add another expression, (x + 5y), and have another set of students model this expression in another area, such that two expressions are being modeled at the same time.

Put a plus sign (+) on the board between the two expressions, and tell the students to figure out how to combine together correctly. Have students determine the final expression and write it on the board.

Academic Language

Technically, the students are demonstrating the communicative property when they rearrange. You know your students best and whether they can handle full academic language 'speak.' This terminology should be mentioned a few times, even if not used exclusively.

Differentiating

If students are at a lower level, print the fruit pictures (or make your own) and start with fruit and then transition to X and Y with later examples.

Continue with this format for a few more examples. After students seem to understand addition, do a few subtraction problems.

The Relationship Between Subtraction And Negatives

Students tend to struggle with understanding subtracting an x as the same thing as a negative x. Therefore, they might need help figuring out that -3x is actually 3 negative x's. Making this connection is a huge mental leap for them, so be prepared. Also, focus on the regrouping step. When students have a positive and a negative of the same term (3x and -3x), both terms get removed from the equation because they form a zero pair. Have students with terms that cancel one another move to the side. Emphasize what is left. For example, 3x - 2x does not leave 1, it leaves 1x.

Pacing

Depending on the level of students and whether this is being used as an introductory activity or a review, you might want to stop here for the day. However, you can continue using this activity throughout the unit for problems such as (4x + 2y) - (5x -3y). Initially, students in the second group will likely pick up 5 positive x's and 3 negative y's. Discuss the negative in front and have the students come back and change their cards to reflect the sign change and then regroup and combine. This activity can also be used to model the distributive property 3(x + 4y). Get three groups of (x + 4y) and then combine them by addition. Continue to do this until students come up with the multiplication shortcut on their own!

Explain

Have students look back on all of the examples and the answers. Students will write, either on paper or in their notebooks, a modified Justified List. That is, they will write what they think the 'math rules' are for the problems and what evidence they have from the examples to justify their 'rules.'

Next, have students group into pairs to compare their 'rules' and edit as needed. Continue the discussion using the Inverted Pyramid strategy by having the pairs form larger groups and then come back together as a whole class. Discuss until there is a class consensus of what the 'rules' are for simplifying expressions.

Extend

Match students in pairs and give them copies of the "Group Problem Worksheet" and "Group Work Small Variable Cards."

Have students take turns modeling each problem in their pairs. For each problem, the team member who did not model the expression should explain conceptually what is happening using the correct math terminology.

Accountable

Move from group to group during the activity, listening to and verifying the accuracy of the explanations. Your wandering around ensures that the students are on task, but it also allows you to remediate students' incorrect perceptions in the moment.

Toward the end of the class period, have students simplify some expressions without the cards. Also, consider simplifying some expressions without performing the actual grouping but by underlining the x terms and circling the y terms (assuming this is an acceptable form of regrouping in your classroom).

Adding On

If you still feel that your students need more, or need a more difficult Extend activity, you can do a Pass the Problem activity using the "Row Accuracy Activity" attachment. Assign students to groups of five. Each student does only ONE step to simplify the expression before passing the problem to the next person in the group, who does the following step. This process continues until the problem is done. This activity not only increases collaboration between students, but also provides both global and step-by-step reinforcement of the simplification process.

Evaluate

Do a Create the Problem activity where you give students the simplified expression (i.e. the answer) and they create a problem that would lead to that answer by following various guidelines (it needs two subtractions, it needs to use the distributive property, etc.). Use the "Create the Problem" attachment as a guide. Have students share some of their problems and emphasize correct use of symbols and vocabulary.

Spiraling

This type of problem would be great as a bell-ringer as you progress through the unit and the year.

Resources

- K20 Center. (n.d.). Create the problem. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f506ae04
- K20 Center. (n.d.). Inverted pyramid. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507a918
- K20 Center. (n.d.). Justified list. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5074d76
- K20 Center. (n.d.). Pass the problem. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f506c28b