Following the Order

Summary

This activity will show students that the order of operations is key in solving multi-stepped equations.

Materials

Index cards
Chart paper
- *Expressions*
- Equation Concentration Cards
- Equation Organizer

Additional Resources
Books
- *Lesson for Algebraic Thinking*
, by Maryann Wickett, Katharine Kharas, and Marilyn Burns; ISBN 0-941355-48-9
- *Every Day Counts Partner Games*
, by Janet Gillespie and Patsy Kanter: ISBN 0-669-51944-8

Background for Teachers

The order of operations is key in solving multi-stepped equations. Students need to see that the result of a calculation depends on the order in which the operations are preformed. Teach students to solve the parenthesis first, then multiplication, division, addition, and subtraction. Students can also use the order of operations to look at balancing equations. They need to know that equations can be written differently but still be equal.

Intended Learning Outcomes

1. Demonstrate a positive learning attitude toward mathematics.
2. Reason mathematically.
3. Make mathematical connections.

Instructional Procedures

Invitation to Learn
Now draw students' attention to the board. Write three numbers on the board (3, 5, 8). Explain that even when we know all of the numbers in an expression the answer might be tricky to find. Ask the students to guess what the answer to this a computation using these numbers is. Take guesses for awhile (if students want a hint explain that you are using two operations, addition and multiplication). After collecting a variety of answers explain that you got the answer 23. Ask students how they could get so many answers. Allow students to talk and discuss.
Instructional Procedures

After students have discussed in small groups, ask students to share their thoughts and write these down on the board. I like to write their ideas in complete sentences to set the standard for students' work.

If students haven't brought up the idea of parentheses, introduce that now. Share with the students how you make this expression equal 23. (3 x 5) + 8 = 23.

Explain that mathematicians have agreed on an order to evaluating expressions. They always use this order. The Order of Operations states that number expressions inside parentheses need to be done first.

Give students an example and have them tell which operation to do first.

Explain to students that today they will be playing a game that requires them to use the order of operations to create expressions. Take a moment to make sure students know what an expression is and what it looks like.
Turn over a number card and explain to students that they need to create an expression that equals this amount. Now turn over six cards and tell students to pick four of the numbers to create the expression. Have students work in their groups to come up with their expression. After students are finished record their expressions on the board.
Have students check to make sure the expressions are true (mathematicians always want true equations).
Pull out another target amount, then discard the four used cards and draw four new ones. Again have the students create an expression using four of the cards. After working in groups have students share expressions and check their work. If students need more practice follow the steps above until students are comfortable.

Introduce the game and score sheet. Show the students how to record their work on the sheet. Emphasize that they must write a complete equation.
Divide students into partners or groups of three and give students time to play.
While students are playing walk around and question students about their work. Have them explain to you why they created equations the way they did or explain another way to do it. Help students to see that there are always many ways to create an equation. If students are struggling, have them use only three cards or make them use all six cards if they need a challenge. After letting them play for awhile, have students use multiplication and division in each equation.
After playing for awhile, gather the class for discussion on what they learned. Ask students to explain what strategies they learned that helped them win. Have them be very specific when describing their process. I would also follow up with a journal entry about what they learned and what they will do next time.
Assign students to take the equations sheet home for practice.
Day 2
To review the order of operations by writing the following equation on the board. 5 x 4 + 2 = 40. Ask students if this is a correct equation and to explain why. Hopefully students will point out that the problem needs parentheses in order to make it correct. If not guide them to do so. Remind students that when there are parentheses it indicates what to do first in a computation.
Explain that today students will be learning about different expressions that equal the same thing. Write the number 20 on the board. Show students that there are many different ways to create an expression that equals 20 (10 + 10, 4 x 5, etc.) and have the students start giving ideas as well.
Pass out index cards, give students a target number, and have groups of students come up with two different expressions that equal the target number.
Take two expressions and tape them on the board. Remove the 20 and put an equal sign between both equations. Ask students if this is a true equation and why. Help students to see that even though the expressions are different they are equal because they both equal the same number.
Pass out the equation organizer and four index cards to partners. Have students each write two expressions that equal each other (or balance), put them on the organizer and draw an equal sign between the two. You can continue to practice this if students are not ready for independent practice.
Pass out the equation concentration cards to the partners. Have them use the same equation organizer to put their cards on.
Model how to turn two cards over, put them on their organizer and see if they balance. If the

cards balance they can be set aside and collected. The person who receives the most cards wins.

Have students take another copy of the concentration game home to play with their family.

Extensions

Curriculum Extensions/Adaptations/Integration

Research where numbers, equations, and variables came from. Have students write a small how-to paper for other students to use when they need help.

Input/Output patterns

Balance equations using the order of operations and variables.

Family Connections

Students teach one of the games to a family member.

Students complete *Expressions* sheet.

Assessment Plan

Have students complete the *Expressions* sheet.

Use performance rubric to check their understanding of expressions and equations.

Listen to students explanation of evaluating expressions.

Performance Rubric

Performance Rubric	1	2	3	4
Use of Vocabulary (e.g. expression vs. equation)	Student does not use math vocabulary.	Student uses some math vocabulary, not necessarily related to topic.	Students use most of the related math vocabulary.	Students use all math vocabulary that relates to the topic.
Logical Processing	Student cannot express the math process.	Student can express some of the steps involved in the related process, it might not be in order.	Student can express most of the steps in the process and they are in a logical order.	Student can express all steps in a logical order.
Interaction	Student does not interact with group when it relates to math.	Student talks with the group, but mostly about other topics. The student does not participate in	The student talks with the group about some of the math topics and helps occasionally to discover	Student talks openly about math and is very active in discovering the new process.

		discovering the process	new processes.	
Listening Skills	Student does not listen to learn.	Student will listen occasionally, but not enough to repeat what was discussed.	Student listens most of the time and can repeat what was heard.	Student can listen attentively, repeat things, and apply what was discussed.

Bibliography

Hildebrandt, C. (1998). Developing mathematical understanding through invented games. *Teaching Children Mathematics*, Page 388-393.

Smith, B.L., & MacGregor, J.T. (1998). What is collaborative learning? In K.A. Feldman and M.B. Paulsen (eds.) *Teaching and Learning* in the Classroom (2nd. ed., pp.585-596). Boston, MA: Pearson Custom Publishing

Games provide students repeated practice that challenges them on their level, along with providing informal assessment for teachers. Games are a way to motivate students without overwhelming them. By working in small groups or with partners students solidify their mathematical understanding and learn from each other.

Authors

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