Problem Solving about Expressions

Lesson Overview

Students learn how to use Strategy Harvest through solving problems, one involving using order of operations (a previously learned concept) and the other problem is a Genie Problem, which can be solved using exponential form (a concept that students are exploring).

Standards Addressed

6.EE.1 Write and evaluate numerical expressions involving whole-number exponents.

Disciplinary Literacy Best Practices

Strategy Harvest

Lesson Plan

Time Required: Two 60-minute Class Periods

Disciplinary Vocabulary:
exponent, whole-numbers, factor, base number, order of operations

Materials Needed:

- Order of Operations Problem (adapted from NCTM)
- Strategy Harvest Template (1 per student)
- Genie Problem (adapted from Illustrative Mathematics)

Assessment:
Completed Strategy Harvest and Student Dialogue

Engage

- As students enter class, have them solve the following problem:

  Nick and Jada were given a problem to solve. Nick told Jada he would get the answer first. Jada was not going to let a boy beat her in completing a math problem. Nick and Jada both completed the problem at the same time but in different ways.

  Let's see if you can complete the problem in a different way. Using the numbers 1, 2, 3, 4, 5, 6, and 8, only once (each), place them in the following problem to make the statement true.

  _____ + _____ x _____ ÷ _____ = _____ x _____ — _____

- After providing 5-7 minutes for students to complete the problem (there should be many solutions for this problem found!), introduce Strategy Harvest.
- Model this strategy with students by sharing your solution with students and asking what feedback they might provide you and have other students come to the board to share their solution and have the class offer feedback to their classmate's solution.
- **Note: The most common mistake on this problem is that many students will not honor the order of operations and many will mistakenly add first. You will see in the video that this can be done but only if parentheses are added.
- Explain to students that in a moment, they will be completing a different problem which can be solved in different ways. They will use Strategy Harvest as a means to share their solutions with each other and provide feedback. (It is a four-box template. In the top left box is where the owner writes his/her solutions. In the other 3 boxes provided is where classmates will write their names and provide their solutions. Each time partners share solutions, feedback is always provided. Encourage feedback to take shape of more than: "good job" or "you got it right". Provide examples such as, "I like your strategy because you chose to do…." Or "Your strategy makes sense because …." Or "I don't understand what you did. Could you explain to me about…?" Feedback is the most difficult part of Strategy Harvest for students and will take time and practice.

Explore

- Students are then introduced to the next problem:

  > After opening an ancient bottle you find on the beach, a Genie appears. In payment for his freedom, he gives you a choice of either 50,000 gold coins or one magical gold coin. The magic coin will turn into two gold coins on the first day. The two coins will turn into four coins (total) at the end of two days. By the end of the third day, there will be eight gold coins (total). The Genie explains that the magic coins will continue this pattern of doubling each day for one moon cycle, 28 days. Which prize do you choose?

- Students are given time to determine prize they would chose and write an explanation of how they determined their choice. (This may take some time, which might take this lesson into a 2nd day.)
- Once every student has committed to an answer, the Strategy Harvest begins.

Explain

- Remind students once again how Strategy Harvest works (especially if this is the 2nd day). Students write their own strategy in the first box of the strategy harvest template. For this particular problem, they will need to write which choice they made (either the 50,000 coins of the one magic coin and write their explanation/strategy within the box. When you call time, students are to move about the room and seek out a partner. Once partnered up, students take time to write their own strategy on their partner's template, making sure to write their name in the box as well. Once strategies are recorded, students then dialogue about their solution, what they chose and why and then offer feedback. (This takes about 5-6 minutes per round to allow for writing of solutions/strategies and dialogue time.) Once the first partnering time is complete, students seek out a new partner and complete another round. This process is completed until all boxes are complete on Strategy Harvest.

Extend

- At the end of class, students are asked to share what they've learned. Were their similar strategies amongst classmates? Did anyone solve the problem different than others? What is the best solution for this problem? Would you rather take the 50,000 coins up front? OR wait the 28 days for the maximum amount?
- Then, proceed to lead the class in a discussion of how this can be solved by using exponents if no one had made that conclusion. How might have using exponents made this problem easier to solve? Would it have saved time? Would your answer have been more precise for those of you who might have said the magic coin didn't catch up until the 17^{th}, 18^{th} or 19^{th} day?

Lesson Reflection

The Order of Operations and Genie Problem is a great lesson to teach students how to use Strategy Harvest. Neither problem has a right or wrong solution as long as the students can explain why they chose their prize or how their solution supports order of operations. Keep in mind, the magical coin will yield more coins than the 50,000 lump sum (which many students want to choose in the beginning); however, every student will not agree with accepting that particular prize. As long as they justify their answer, I accepted.

When doing Strategy Harvest, you may want to limit the amount of time students spend "harvesting" a strategy. I gave my students 5-6 minutes with each person they worked with. It allowed students time to discuss only the strategy they used. Too much time may cause students to discuss other things.

Lesson Authors:

Christy Junkins, 6^{th} Grade Mathematics, Middle School of Pacolet, Spartanburg School District 3 in Spartanburg County, South Carolina

Susie Teague, Education Specialist, S^2TEM Centers SC

**NOTE: The Order of Operations problem (last line and mathematical statement) was found on www.nctm.org

The Genie Problem was adapted from:
https://www.illustrativemathematics.org/illustrations/532

Strategy Harvest	
My Strategy	_____'s Strategy
_____'s Strategy	_____'s Strategy