HOOKED ON PROBLEM SOLVING

Objective: Use properties of operations and problem-solving strategies to do mental calculations, extending beyond fact recall.

Materials: Number tiles with the digits 1-9 (or numbered squares of paper)
5 x 7 index cards
Markers
Tape

Procedures:

1. Have participants arrange their numbered squares into a 3 x 3 array. Ask, "Does the sum of the first two 3-digit numbers equal the third 3-digit number? (Probably not) Is it possible to arrange the digits so that the sum of the first two numbers does equal the third 3-digit number?"

2. Have participants try to create such an arrangement. Hint: Regrouping is an important consideration. For example:

$$\begin{array}{r} 291 \\ +384 \\ \hline 675 \end{array}$$

3. As participants begin to find solutions, have them record the solutions on 5 x 7 index cards with heavy felt-tip markers. Post the solutions. This gives participants a chance to notice duplicates, put the cards in categories, and begin to search for patterns.

4. Once a fairly large collection of data is posted, ask, "How many solutions do you think might be possible? Can you find a pattern that might make the task easier?"

5. Record the patterns noticed as "Conjectures" and ask participants to search for counter examples to test their conjectures. Conjectures that can be logically explained or for which no counterexample can be found can be listed under "Generalizations." Possible examples of conjectures:
   • It is always necessary to regroup to find a solution.
   • Neither a 1 nor a 2 can be the hundreds digit of the answer.
   • The digits in the answers add up to 18. (This pattern is difficult to notice at first. To speed up the process, ask participants to concentrate on the sums.)

6. To summarize ask participants to explain how they arrived at their conjectures and generalizations. Ask questions such as these:
   • Can anyone find a counterexample we haven't thought of?
   • How many possible situations did you find?

- How did you use your patterns and conjectures to find more solutions?
- What strategies did you use to verify that you had found all the solutions?

Extensions:
1. Write a summary statement explaining how to solve the problem.
2. Is it possible to arrange the digits in some way to create problems using operations other than addition? Experiment and record your findings.

Assessment
- teacher observation of participant participation in exploration and discussion
- participants' explanations of strategies to determine patterns
- participants' identification and justification of patterns that led to conjectures and generalizations
- participants' use of conjectures and generalizations to find new solutions
- participant-generated counterexamples to disprove false conjectures.

Additional Resource:
Number Tile Activities
Marcy Cook
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Balboa Island, CA 92662
714-673-5912

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