Partial-Quotients Division Algorithm

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Subject- Mathematics

Grade level: 5

Objectives:

- Students will be able to demonstrate their understanding of traditional division algorithms and partial-quotients division by solving related problems.

Standards: Academic standards for math: Computation and Estimation- 2.2.5.A- Create and solve word problems involving addition, subtraction, multiplication and division of whole numbers. Academic standards for math: Computation and Estimation- 2.2.5.D.- Demonstrate the ability to round numbers. Academic standards for math: Computation and Estimation- 2.2.5.H- Explain multiplication and division algorithms.

Cross-curricular integration: Writing

Materials: Overhead projector, blank transparencies, vis-à-vis markers, math hand-out (5-7 page 53 PA)

Vocabulary:

- dividend- the number that is being divided
- divisor- the number that the dividend is being divided by
- partial quotient-
- quotient- the end result of a division problem
- remainder- a number left over from a division problem because the divisor was too large to go into this number.

Instructional Procedures:

Anticipatory set-

1. Have the following Math Message written on the board: "Amy is 127 days older than Bob. How many weeks is that?" Students may work on this problem until time for class to begin has been called.
2. Have students share their solution strategies.
3. Expect that some students will suggest breaking 127 into "friendly" numbers such as 70 and 57. There are 10 [7s] in 70 and another 8 [7s] in 57. The remainder is 1.
4. Point out to students that in order to answer the Math Message question, they needed to figure out how many 7s were in 127.
5. Tell students that today they will be reviewing the traditional method of division, as well as reviewing the partial-quotients division algorithm.

Developmental Activities-

1. Ask students to identify different ways they could write a division problem. Use 127/7 as an example, if necessary.

2. Review the traditional method for division using, for example, 204/12= 17
3. Write the problem in the traditional form: 7 127. Point out that the *dividend*- the number that is being divided- is 127. The *divisor* - the number that the dividend is being divided by - is 7.
4. Draw a vertical line that will separate subtractions from partial-quotients. The end result should look like this:

5. Suggest that one way to proceed is to use a series of "at least…not more than" multiples of the divisor. A good strategy is to start with easy numbers, such as 100 times the divisor or 10 times the divisor. Give students the following questions or directions:

    - Are there at least 100 [7s] in 127? No, because 100*7 = 700, which is more than 127.
    - Are there at least 10 [7s} in 127? Yes, because 10*7 = 70, which is less than 127.
    - Are there at least 20 [7s]? No, because 20 *7 = 140, which is more than 127.
    - So, there are at least 10 [7s], but not more than 20 [7s]. Try 10. Write 10 * 7, or 70, under 127. Write 10 at the right. 10 is the first *partial quotient*. Partial quotients will be used to build up the final quotient.

6. The next step is to find out how much to divide. Subtract 70 from 127.

    10 is the first partial quotient. 10*7= 70
    Subtract. 57 is left to divide.

7. Now find the number of 7s in 57. Following are two ways to do this:
    - Use a fact family. 8*7 = 56, so there are at least 8 [7s] in 57. Record as follows:

    10 is the first partial quotient. 10 * 7 = 70
    Subtract. 57 is left to divide.
    8 is the second partial quotient. 8*7= 56
    - Ask students if there are other ways to solve this equation? Yes, here is one example.
        * Are there at least 10 [7s] in 57? No, because 10 *7 = 70.
        * Are there at least 5 [7s]? Yes, because 5*7=35

    Next subtract 35 from 57 and continue by asking:
    - How many 7s are in 22? 3

    10 is the first partial quotient. 10*7=70
    Subtract. 57 is left to divide.
    5 is the second partial quotient. 5*7= 35

Subtract. 22 is left to divide.
3 is the third partial quotient. 3*7=21

8. In both cases, the division is complete when the subtraction leaves a number less than the divisor (7 in this example). The final step is to add the partial quotients – the numbers of 7s that were subtracted.

9. Steps 1 thru 6 show that there are 18 [7s] in 127. 18 is the *quotient*. There is 1 left over. 1 is the remainder.
10. Answers to division problems with remainders are usually written in the form "quotient R remainder"- in the example 18 R1. Have students record the final answer in the traditional position above the dividend.
11. Conclude by interpreting the answer. Amy is 18 weeks and 1 day older than Bob.
12. Lead students through several more problems. Example, how many n's are there in m? The n's should be 1 or 2 digit numbers; the m's should be 2 or 3 digit numbers.
13. When students seem to be catching on, ask them to work with partners. Have the class pose a division problem and ask the partnerships to attempt to find the answer.
14. After students have worked with their partners for a few minutes, ask volunteers to share their work with the class. Look for students who got the same result in different ways. Emphasize the following:
    - Students should use multiples that are not too large and are easy to work with. Using such multiples may require more steps, but it will make the work go faster.
    - Students should not be concerned if they pick a multiple that is too large. If it happens, they will quickly realize that they have a subtraction problem with a larger number being subtracted from a smaller number.

Closure-

1. Ask a volunteer to come to the board to solve a problem. Have students from the class help the volunteer to solve the problem. Ask students to identify the divisor, dividend, quotient, and remainder (if there is one).
2. Assign hand-out 5-7 53PA as homework. Do the odd numbers using the partial quotients method and complete the even numbers using the traditional method. Tell students that they must show all of their work on an additional piece of paper.

Assessment: Observe student's ability to correctly be able to solve division algorithms using the traditional method and partial-quotients. Observe students ability to effectively round numbers.

Extension/Enrichment: Students may work on pages 106 and 107 of their workbooks. Students can write in their journals about which method they prefer and why.

Students with Special Needs: Students with hearing disabilities can moved to the front of the class and an audio-amplifying device should be worn. Students with ADD/ADHD could be placed with students who are more task-oriented and understand the information being discussed.

Reflection: *This was the first math lesson that I have ever taught and I thought that it went very well. It was not a lesson I would have typically picked because I was not familiar with the partial quotients method. However, I am happy that I took a chance and tried it. I wish I would have learned this method because it is a lot easier than the traditional algorithm. The students behaved very well, which meant less classroom management on my behalf.* ☺ *I would have spent less time on the review of these division methods and more time on allowing students to solve a few problem-solving questions.*