Understanding Your Child's Mathematics

Division Strategies

American Standard Algorithm in Division &Partial Quotients

Project for Elementary Mathematics
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The American Standard Algorithm in Division is the method that the majority of us learned when we were in school. With all of the previous standard algorithms we have discussed in addition, subtraction, and multiplication, the argument has been made that the mathematics underlying each of those algorithms is sound but *the script* we use to talk our way through it inhibits place value development and masks the mathematics. Fix the script and the algorithms become more mathematically powerful. The American Standard Algorithm in Division has problems once place value is emphasized. The script we use is not merely masking the place value it is based on a false premise in its very initial step. Let me explain. Here's how we learned division:

```
     31 R 6
8 )254
  -24
     14
   -  8
      6
```

The Script:

- *8 does not go into 2, move over a space*
- *8 goes into 25 three times. Place a three above the 5*
- *3 times 8 is 24*
- *25 minus 24 is 1. Bring down the 4*
- *8 goes into 14 one time. Place a 1 above the 4*
- *14 minus 8 is 6,*
- *The answer is 31 remainder 6*

Sound familiar? (This is often called the "Gozinta" Strategy as in "goes into.")

Now let's look at this from the angle of maintaining place value knowledge at all times. Let's review that first step:

- *"8 does not go into 2"*

Let's put the place value back into the language and focus on the mathematics of the number involved:

- *"8 does not go into 200"*

Well, that is not a true statement. In fact 8 does go into 200 25 times! Once the focus is on the place value in the number, the thinking behind the standard algorithm falters. It changes into a significantly different conversation. One can argue that once you get to the second step, "8 goes into 25 3 times," that if you say "8 goes into 25 tens" the place value can be used. However, the very first declaration of ignoring the 200 by pretending it is a two is a serious mathematical flaw. It is important for children to know that 8 can go into 200 a significant number of times.

Let's look at an alternative called the "Partial Quotient" strategy. The difference with this strategy is it allows room for estimation and building closer to the answer instead of needing to be highly precise immediately. The precision is fine tuned over time. Its other benefit is that is maintains the true value of the numbers involved.

Partial Quotients Strategy

The Partial Quotient strategy starts with an estimate of the largest possible amount a child thinks he or she can start with. The more sophisticated the child's number sense, the more precise they can become. The first presentation of this problem will talk through how a more advanced child might sound. I will then walk through more emergent scripts later that demonstrate earlier stages of learning.

8)254	20
- 160	
94	+ 11
- 88	31 *R* 6
6	

The Script:

- *10 8s would be 80 so 20 8s is 160 so that's closer*
- *254 minus 160 is 94*
- *11 8s is 88 which is the closest I can get*
- *94 minus 88 is 6, and no more groups of 8 are possible*
- *So the 20 8s plus 11 8s is 31 8s and there is a remainder of 6*
- *The answer is 31 whole groups of 8 with 6 out of another group of 8 leftover*

This is a very different script. Notice how the place value and number sense is always maintained. Notice in the script how the opportunity to scale up what you know about smaller amounts (8 x 10 is 80) to determine if a larger quantity can be used (8 x 20 is 160). The example above could become even more efficient by recognizing that 30 tens is 240 thus saving even more steps. ***The flexibility of this strategy is that it grows with your child.*** If you are helping your child at an earlier point in the learning, this strategy allows them to calculate in smaller intervals and still determine the correct answer. Let's look at a potential earlier version of this same problem.

8)254	10
- 80	
174	10
- 80	
94	10
- 80	
14	+ 1
- 8	31 *R* 6
6	

The Script:

- *10 8s would be 80*
- *254 minus 80 is 174*
- *I can do another 10 8s*
- *174 minus 80 leaves 94 left*
- *I can do another10 8s*
- *94 minus 80 is 14*
- *Only one 8 is in 14*
- *14 minus 8 is 6, no more groups of 8 can be formed*
- *10 + 10 + 10 + 1 is 31 8s with a remainder of 6*
- *The answer is 31 whole groups of 8 with 6 out of another group of 8 leftover.*

The Benefits:

- Place value is maintained and nurtured at all times
- Partial Quotients allows the child to increase his or her number sense over time without having to be exact from the start.
- The child can grow into more efficient number sense
- There are no misleading mathematical statements that will hinder future learning
- More sophisticated multiplicative thinking is nurtured in this strategy than in the American Standard Algorithm for division

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