

- ▣ Question: What effect does teaching place value differently have on student achievement scores for whole number computation on a high-stakes test?

Teacher comments before and after looking more deeply at place value

Lori

- Before
 - I have no memory of being taught anything during my elementary experience...By my third grade year, the math I was expected to do was more sophisticated because it involved “borrowing” and “carrying.” Numbers were no longer numbers, but instead became baskets of apples needed to complete a recipe... I quickly became adept at crossing out the number in the tens place and putting a “1” in front of the number in the ones place—I had no idea that there was meaning behind what I was being asked to do.
- After
 - I was ultimately taught meaning for what I had been doing all those years as I borrowed and carried apples to my neighbors. I finally came to the realization that each position was assigned a certain value; and by using the positional values of each digit, the whole number operations became new concepts for me. It was exciting to completely make sense of all the traditional algorithms... and to know that I could now enter my classroom with a way of helping students make meaning of the procedure...I honestly couldn’t wait for my school year to begin. And for the first time, I vowed never to talk about apples again!

Amanda

- Before
 - When I began teaching second grade, I assumed that I could teach math operations the same way that I learned them, so I did...Reaching the segment of our curriculum that teaches regrouping, I proceeded to teach regrouping in the fashion that I learned it. We “stacked” the numbers and began with the ones place to add. We wrote the answer in the ones place and moved the “1” to the tens place and so on...For years this is how I taught addition and subtraction and I always wondered why the students never seemed to understand what they were doing.
- After
 - Several days into the program, we heard that we were to learn about place value and operations. Initially, I could not think of anything more I could learn. I discovered that there was a lot I did not know, not only about place value, but also about using place value to correctly compute with whole numbers...[We used] place value and number sense to expand numbers with multiple digits and then to compute each place and combine the places to correctly solve the problem. I had personally never seen any problem worked out like this. It was eye-opening for me. I immediately thought of my students

and how much easier the use of decomposed numbers and place value units would be for them.

Place Value for 245

Hundreds	2
Tens	24
Ones	245

Decomposition of 245

2 hundreds 4 tens and 5 ones	$200 + 40 + 5$
1 hundred 14 tens and 5 ones	$100 + 140 + 5$
1 hundred 13 tens and 15 ones	$100 + 130 + 15$

The bottom two decompositions facilitate subtraction.

Addition Example

$$245 = 200 + 40 + 5$$

$$372 = 300 + 70 + 2$$

Add the place value units:

$$500 + 110 + 7, \text{ and compose the expression to get } 617$$

Subtraction Example

$$245 - 192$$

$$200 + 40 + 5 - (100 + 90 + 2)$$

$$100 + 140 + 5 - (100 + 90 + 2)$$

$$0 + 50 + 3 \text{ OR } 53$$

Multiplication Example

$$245 \times 3$$

$$\begin{array}{r} 200 + 40 + 5 \\ \times 3 \\ \hline \end{array}$$

$$600 + 120 + 15$$

$$\text{OR } 735$$

Division Example

$$92 \div 4$$

$$\begin{array}{r} 20 + 3 \\ 4 \overline{) 80 + 12} \end{array}$$

OR 23

Results

High-stakes test score categories and levels

- Exceeds expectations (871 - 990)
- Meets expectations (800 - 870)
- Does not meet expectations (up to 799)

Impact on Student Learning

Generation of Third Graders	Average Score
2008 - 2009	799
2009 - 2010	851

Conclusions

- One basic change in teaching place value
 - How to understand and use the number of ones, tens and hundreds to decompose numbers in equivalent ways
- Differentiated instruction benefited all students
 - Use of Alternative Algorithm for operations