2009

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Carnahan, M., & Stevens, B. (2009). Conceptual Previews in Preparation for the Next Unit of Instruction. Iowa Council of Teachers of Mathematics Journal, 36, 22-32.

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Understanding meanings of operations and how they relate to one another is an important mathematical goal for students in fourth grade (National Council of Teachers of Mathematics, 2000). Using pictures, diagrams, or concrete materials to model multiplication helps students learn about factors and how their products represent various contexts. The foundation of understanding how operations of multiplication and division relate to one another deepens the understanding of the composition of numbers. Discussing different types of problems that can be solved using multiplication and division is important, along with the ability to decompose numbers. When students can work among these relationships with flexibility, conceptual understanding strengthens. With this said, a group of fourth grade students were introduced to conceptual previews as a new approach of making sense out of multiplication and division so to develop strong images of what happens when numbers are multiplied and divided in small five-minute mini-lessons before the specified unit on multiplication and division.

The Development of the Conceptual Previews

Akin with mini-lessons described by Fosnot and Dolk (2002) and distributed practice by Rathmell (2005), conceptual previews are an instructional practice where a teacher identifies a key concept or big idea from an upcoming unit and develops 10 to 15, five-minute mini-lessons where students explore a concept informally. The mini-lessons may consist of two or three questions related to modeling a concept, representing the concept through the use of a diagram, connecting prior knowledge with the concept, and/or preparing students with some of the basic ideas related to the key concept or big

idea before the upcoming unit begins. Through these mini-lessons, it is the intent for the teacher to bring to the forefront student's prior knowledge and assist in their first steps in the development of new knowledge based upon this existing knowledge when the formal unit begins.

The fourth grade unit, "Packages and Groups" (*Investigations in Number, Data, and Space*, 1998), an investigation in multiplication and division, was the unit of instruction after the use of the conceptual previews used in my classroom for the purpose of this paper. There are three main objectives during this unit. First, students solve and create cluster problems by using the distributive property. Another objective is for students to become familiar with landmark numbers to solve problems. An example would be to use landmarks like 5 or 10 because they are easier to work with or another strategy would be the use of partitioning large numbers to make them manageable for multiplication. Last, students will learn how to solve double-digit multiplication problems and how to solve division problems using multiplication.

For the ten days of previews I developed for the unit, students used the model of an array to begin solving multiplication problems. The students were familiar with making arrays of multiplication problems from a previous unit; however, they did not understand the connection between the arrays and the multiplication algorithm when it came to double-digit multiplication. So to begin the previews for the first day, students used graph paper to represent a multiplication problem like 6 x 8 and then decomposed the numbers in order to think about the factors associated with each number. For the previews on day two and three, students used graph paper again with more difficult multiplication problems and decomposition once again. On the fourth day, students

continued to use graph paper for 10 x 16 purposefully so they could see the patterns of ten. For days five and six, students solved double–digit multiplication problems and they could use the array or a visual representation of the array, and were gradually weaned from the graph paper during the five-minute conceptual previews.

Days seven through ten, students used word problems and were encouraged to solve the problems with the visual representation of the distributive property. The previews were designed to scaffold students' knowledge of arrays, a series of addition, and connect it to the visual model of the distributive property or decomposition of numbers, as a method for solving difficult double-digit multiplication problems.

My Fourth Grade Class

My fourth grade class was located in a Midwestern Iowa town that has experienced an influx of immigrants. I taught in a dual-language school with forty students in two mathematics classes. Twenty-eight of my students were English Language learners. Fifteen percent of my students received special education/resource services. The biggest factor affecting my students was poverty. Eighty-one percent of my students qualified for federal free or reduced lunch. I taught only in Spanish.

Pre-/Post-Assessment of the Conceptual Understanding

I developed a short assessment instrument to gauge the effectiveness of the mini-lessons. If I was going to continue to devote five minutes every day to conceptual previews, I needed to determine if it is worth the time and investment. The following four questions served as the pre-/post-assessment. Not only was I interested in the correct solutions, I also paid particular attention to the type of strategies students used to solve the problems. Additionally, I kept a journal with notes on the activities that took

What does 32 x 21 mean? Use pictures, words, or numbers.
What strategy or strategies can you use to solve 32 x 21?
Estimate the answer to 32 x 21 by rounding both numbers.
Write a list of easier problems that will help you solve 32 x 21.

place each day and journaled reflective comments. I then analyzed for common themes to aid in interpreting student activity during the five-minute mini-lessons and my thoughts as the activities transpired.

Analysis of Implementation and the Results

After the third day of the mini-lessons, I was ready to quit using the conceptual previews. Fortunately for me and my students, we pressed forward. It was a small commitment to make each day so it was worth the time to try something new that research has shown to improve students' conceptual understanding.

Before the fourth day, the students were decomposing numbers, but not making the connection of how it made solving the problems easier. Some were not selecting "nice" numbers based on place value or groups of two or five. Along with the previews, I used the opportunity to highlight various strategies students used to solve each problem, yet most students seemed disinterested in learning from others. Day four they continued to use graph paper as a way to represent 10 x 16. I chose this model so they could see the patterns of ten. After the fourth day I felt more confidence in the previews when many of the students recognized the problem 10 x 16 as 10 x 8 + 10 x 8. We had made progress with this example! Day five and six students solved double digit multiplication problems

and they could use the array or a visual representation of the array, and I gradually weaned them away from the graph paper during the previews.

By day seven, I saw different chunking methods generated by the students and they were listening to one another and creatively trying to think outside of the box. For example, there was the problem 25 x 22. Some students used (10 x 22) + (10 x 22) + (5 x 22). One student recognized 5 x 22 was half of 10 x 22. Others used (25 x 20) + (25 x 2). Some used 25 x 10 + 25 x 10 + 25 x 2. It was exciting to listen to students seek out numerous number sentences.

On day seven students struggled with interpreting the word problem; however, they did not struggle with finding a strategy and solution for the double-digit multiplication problem. Keep in mind, the students have not learned the standard algorithm for double-digit multiplication, but they have a strong visual representation for understanding how to represent its meaning. Days eight through ten proved most difficult when students were asked to work with larger non-five numbers that did not easily separate into halves either.

Results of the Pre-Assessment

For the results of the first question (see table below; an asterisk denotes a correct solution or solution method), many of the students recognized the problem as repeated addition. Others understood the question but responded with 32 groups of 21, or the number 32 twenty-one times and added the numbers. Some attempted a multiplication problem, but did not arrive at the correct solution. I expected students to think of the problem as repeated addition, a typical strategy for fourth-graders; yet one that will prove to be inefficient in the later years.

# Students	Response
*2	Multiplication with correct answer
9	Multiplication with incorrect answer
*12	Repeated addition
1	Skip counting
4	Used an array
7	Wrote 32 groups of 21 with no attempt to solve
2	Addition
3	No answer

For the second question, most of the students attempted to separate the number (30 x 10) + (30 x 10), but could not complete the steps. The most common error came when students tried to take 30 x 20 and 2 x 1. Some tried repeated addition and arrived at the correct answer.

# Students	Response
*3	Distributive property with correct
12	Distributive property with incorrect
*9	Repeated addition
*2	Array
4	Some use of 32 and 21
1	Division
1	Skip counting
9	No answer

For the third problem that asks to estimate the answer, some students correctly choose 30 x 20, but could not complete the multiplication and answered 30 x 20 = 60.

# Students	Response
*7	Estimation correct
6	Estimation incorrect
*7	Repeated addition
9	Repeated addition (60)
11	No answer

Last, to address the issue of cluster problems, the fourth question asked for a list of easier problems. A cluster problem is a set of problems partitioned out of the original equation that make the equation easier to solve. This is a move beyond the visual model and includes various number sentences of the student's choosing. Some students thought of 30 times 20, 20 times 30, 1 times 2, and 2 times 1, but did not know what to do with the equations. Other students separated both numbers; for example, 7 x 16 and 3 x 16 or 2 x 32 and 1 x 32. Most of them left the answer blank.

# Students	Response
*3	List of cluster problems
15	Cluster problems no
1	Wrong cluster problems
6	Addition
15	No answer

The information from the pre-assessment offered insight into places where my students might struggle in the regular unit of instruction, so the two weeks of five-minute conceptual previews should help fill the gaps and hopefully start everyone on the same page feeling success *going into* the new unit on multiplication and division.

Results of the Post-Assessment

With the first question, I was pleased to discover several students used the array as a model for 32 x 21 (see table below for results of their strategy use; again, an asterisk denoted a correct solution and/or strategy). Others tried the distributive property. I believe my wording of the question, "what does it mean" should read, "use a model or picture to show what 32 x 21 means" so students have a clear understanding that I am looking for a diagram; although the second question leads to this idea, as well.

# Students	Strategy
*10	2 strategies: The visual model and distributive
*11	2 strategies: distributive
2	1 strategy: distributive
10	1 strategy: distributive incorrect answer
4	1 strategy: visual model incorrect answer
1	Skip counting incorrect
2	Blank

As with the curriculum I implement and the beliefs I hold towards teaching mathematics, I ask students to provide two strategies to show our thinking when solving most problems. I believe it helps in developing flexibility in their thinking and will lead to making stronger connections across the mathematics discipline and lead to improved use of representations for conceptual development. In the second question on the post-

# Students	Strategy
*12	Wrote 32 groups of 21
*10	Array
*9	Distributive property correct answer
5	Distributive property with errors
3	Skip counting
1	"ways to separate numbers to make them easier to solve

assessment, many students solved the problem with two different strategies. Seven students improved in this two-week period.

For the third question, the array model greatly improved students' estimation skills. More than 75% of the students correctly estimated the product of 32 x 21 compared to 35% on the pre-assessment. In the pre-assessment, most students thought 30 x 20 = 60, but the array model assisted them in thinking about the size of these quantities.

Last, in stark contrast to the pre-assessment, 77.5% of the students used the correct number sentence and solved it correctly, as well. I was not expecting such growth

from five-minute mini-lessons in just two weeks! I did not catch the three students who wrote cluster problems without answers, but if I had, I think they would have been able to solve them, too.

# Students	Strategy
*25	Cluster problems correct
*3	Cluster problems w/o answers
8	Cluster problems wrong
1	Algorithm wrong answer
2	Another strategy correct answer
1	Blank

Conclusion and Implications for Future Work

I felt the conceptual previews and the discussions that took place helped students make the connections between the array as a model for multiplication and the use of the distributive property, or breaking apart the numbers, to make the problems easier to solve an effective approach for accessing students prior knowledge *before* the unit of instruction begins. My students *hit the ground running* and felt confident from the beginning, which often is not the case for a classroom with almost three-fourths English language learners. Compared to years past, the use of just five-minute mini-lessons enabled students to grasp the idea of the array, use it, and progress to the abstract level with the distributive property in just ten days. More students were able to construct various cluster problems or different ways of separating the number sentence because of the conceptual previews than my experience in years past. They were able to develop alternatives and were not stuck with just one way of thinking. The visual model served as a foundation during the previews and subsequent lessons. This allowed for the exploration of other forms of decomposing the numbers; for example, halves, tens, and

fives. Some students who did not have a working strategy on the pre-assessment had two strategies by the end.

I think the unit was clearer to me once I had my specific thinking strategy planned. I continued to build and refer to the model with a sense of purpose. Having the students post and discuss their strategies assisted the students in visualizing other ways to represent numbers and they were able to learn from each other.

Often times when a new unit of instruction begins, it takes several days for students to get into the swing of what they are learning. Mathematics textbooks either do not help in developing prior knowledge when chapters skip around from algebra to data or geometry, or they overload the text with too much review making it impossible to know where to begin. Conceptual previews offer an approach for teachers to assess what students know and understand about the upcoming unit and plan activities accordingly. In reflecting upon my approach in using conceptual previews for multiplication and division before the unit "Packages and Groups," I would give the pre-assessment first to understand what my students understand and then tailor the ten-day previews to fit their needs. The pre-assessment should be given first with the development of the conceptual previews after results of the pre-assessment are understood.

It is difficult to know if the mathematics students were learning during the current unit of instruction while the conceptual previews were taking place suffered in anyway. End of unit assessments did not indicate any unusual affects as a result of redirecting five minutes of math class to other concepts and skills. It is also important to note whether the upcoming unit took less time to teach and whether scores on end of unit assessments were vastly different than years prior. Unfortunately, data that could address this was not

collected. Therefore, one implication of this research would be for future researchers to administer an end-of-the-unit assessment after the conceptual previews but before the upcoming unit to assess pre-unit conceptual understanding. This information may shed light on the opportunity to lessen the length of time needed to teach the unit as the result of the conceptual previews, offering additional time in the year to incorporate topics often eliminated.

Creating conceptual previews forced me to think critically about the mathematical concepts and representations that are important in teaching for understanding. The previews promoted class discussion and an opportunity to discuss efficient ways of multiplying. With many strategies, the students were exposed to multiple levels of thinking thus encouraging flexibility in their thinking. Multiplication and multiplication of two-digit numbers are big ideas for fourth grade and require a great deal of time developing the concepts and skills. This is one reason why I chose this unit assuming the conceptual previews might shorten the time spent or strengthen the conceptual understanding of multiplication.

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