Helping Students Learn Multiplication Combinations

Composition of numbers is the foundation of computational fluency. Fluency means that combinations are quickly accessible mentally, either because they are immediately known by students or because the calculation that is used is known, thus essentially automatic.

Developing fluency requires a balance and connection between conceptual understanding and computational proficiency (NCTM 2000). Children should master the basic facts of arithmetic that are essential components of fluency with paper-and-pencil computation, mental computation and estimation. At the same time, however, mastery should not be expected too soon. Children will need many exploratory experiences, and the time to identify relationships among numbers and efficient thinking strategies to derive answers to unknown facts from known facts. Practice to improve speed and accuracy should be used but only under the right conditions; that is, practice with a cluster of facts should be used only after children have developed an efficient way to derive answers from those facts (NCTM 1989).

Students need to know basic facts. Students need to understand what it means to multiply and divide before the facts can become automatic, but understanding does not necessarily lead to this automaticity. Students need to understand relationships between and among the facts if the facts are to become automatic.

According to John Van de Walle there are three components essential to promoting meaningful fact mastery. These components are:

1. Help children develop a strong understanding of number relationships and of the operations.
2. Develop efficient strategies for fact retrieval through practice.
3. Provide drill in the use and selection of those strategies once they have been developed (Van de Walle, 2006, p. 95).

Strategy practice must directly relate to one or more number relationships. A strategy is most useful to students when it is theirs, built on and connected to concepts and relationships they already know. Van de Walle suggests several number relationships that help children develop an understanding. These strategies should be made explicit in the classroom.

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Strategies for multiplication facts are:
a. using repeated addition
b. skip-counting by multiples, patterns found in multiples
c. doubling
d. using partial products
e. using five-times and ten-times
f. doubling and halving
g. patterns found in 9s
h. factoring and grouping flexibly
I. properties of mathematics (commutative, associative, distributive, identify)
j. using known facts to find unknown facts

It is imperative that students completely understand the commutative property. For example: 8 x 2 is related to the addition fact 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 but the same relationship also applies to 2 x 8. Many of the fact strategies are more obvious with the factors in one order than in the other, but turnaround (commutative property) facts should always be learned together.
(Van de Walle 2006)

Models/Tools
Pictures in a context (found in books. Examples: *Amanda Bean's Amazing Dream* ; *Each Orange has Eight Slices; The Best of Times; The Doorbell Rang*
Manipulatives for grouping and creating arrays
100 grid for finding multiples of factors
Number line
Ratio tables/T-charts
Money
Array with tiles, array with grid paper, open array
Problems in context
Technology (calculators; appropriate computer programs)

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Application (*critical for students to develop skills, concepts and deepen understanding of multiplication and division*)

Problem Solving in relevant contexts
Higher Order Questioning
Classroom Discourse; Student Discussions
Asking Why to support a culture of reasoning and justification
Variety of Structures for story problems
Playing Games
Making Conjectures
Number Talks (True/False Statements, Balancing Equations)
Inverse Operations
Multiple Representations
Problem -oriented assessments; constructed response assessments

Using strategies to solve problems develops over time. It is through class discussions that students begin to match strategies to numbers in problems. Helping students make connections should be an objective of the classroom teacher. "Students do not immediately see these connections and may not see them at all unless they are examined and discussed" (Huinker, 2003). Van de Walle suggests that teachers need to plan lessons in which specific strategies are highlighted (Van de Walle, p. 96).

Two Approaches to Fact Strategies

1. Use simple story problems designed in such a manner that students are most likely to develop a particular type of strategy, as they solve it. During discussions, focus attention on the methods that are most useful.
2. Develop lessons around a special collection of facts for which a particular type of strategy is appropriate. Discuss how these facts might all be alike in some way, or suggest an approach and see if students are able to use it on similar facts.

Drilling Facts
Drill activity is appropriate for students who have a strategy that they understand and know how to use but have not yet become facile with it. Drill with an in-place strategy focuses students' attention on that strategy and helps to make it more automatic (Van de Walle, 2006).

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