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Math Content for Struggling Students

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Topic: Response to Intervention in Elementary-Middle Math
Practice: Foundations of Arithmetic

Highlights

- Critical concepts in mathematics for K–5 students
- Focus on whole numbers, including strategic counting, place value, operations
- Understanding what operations and algorithms mean, how they work, why they work
- Focus on rational numbers for students in grades 4–8, including solving story problems
- Importance for students receiving Tier 2 and Tier 3 interventions to understand mathematical reasoning

About the Interviewee

Sybilla Beckmann is professor of mathematics at the University of Georgia. She has a Ph.D. in mathematics from the University of Pennsylvania and taught at Yale University as a J. W. Gibbs Instructor of Mathematics. Dr. Beckmann has done research in arithmetic geometry, but her current main interests are the mathematical education of teachers and mathematics content for students at all levels, but especially for pre-K through the middle grades. Dr. Beckmann developed

three mathematics content courses for prospective elementary school teachers at the University of Georgia and wrote a book for such courses, *Mathematics for Elementary Teachers*, published by Addison-Wesley, now in a second edition. She is interested in helping college faculty learn to teach mathematics content courses for elementary and middle grades teachers, and she works with graduate students and postdoctoral fellows toward that end. As part of this effort, Dr. Beckmann directs the Mathematicians Educating Future Teachers component of the University of Georgia Mathematics Department's VIGRE II grant. Dr. Beckmann was a member of the writing team of National Council of Teachers of Mathematics' Curriculum Focal Points for Prekindergarten Through Grade 8 Mathematics; was a member of the Committee on Early Childhood Mathematics of the National Research Council and coauthor of its report, *Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity*; and has worked on the development of several state mathematics standards. Recently, Dr. Beckmann taught an average sixth-grade mathematics class every day at a local public school in order to better understand school mathematics teaching. Dr. Beckmann has won several teaching awards, including the General Sandy Beaver Teaching Professorship, awarded by the College of Arts and Sciences at the University of Georgia.

Full Transcript

I am Sybilla Beckmann, professor of mathematics at the University of Georgia. In mathematics there are some ideas that are so important and so pervasive throughout the discipline that students really do have to master those ideas in order to be able to continue on. For students in K through five who are struggling in mathematics, the IES [Institute of Education Sciences] Practice Guide on Response to Intervention in Mathematics recommends that the focus be on numbers and operations, and fraction, rational number ideas in grades 4 through 8, precisely because these topics are so important, so central, and so essential to any kind of mathematical ideas that students will be doing in the future.

Whole Numbers

A focus on whole numbers means, first of all, that especially for the very youngest students, they need to understand that numbers can be used to tell us how many things are in a collection. Gradually, as they begin to get a little bit older, they need to understand the importance of place value in the decimal system, by which we bundle or we think of numbers as bundled in groups of 10, and successive bundling in groups of 10.

To help students understand place value and the decimal system, simple objects such as toothpicks or any other small object that you can bundle and put together can be helpful. So for example, here are toothpicks, and to represent the number 234, we can show four ones, so four single toothpicks and then three bundles of 10, so each one of these bundles could be broken up or unbundled to make 10 individual ones, and it shows that this number three, this digit three, stands for three bundles of 10, and then the digit two that stands for 200 is represented with two bigger bundles; each of these bundles consists of 10 bundles of 10. So here we're starting to see the structure of the decimal system is repeated bundling in tens. So that

would be the first component in understanding whole numbers.

Also important, of course, then, are operations on whole numbers: addition and subtraction for the younger children, and then as they get older into the upper grades towards third, fourth, and fifth grade, multiplication and division as well. As part of understanding the operations, students need to understand how the various operations work, why they work, especially what the operations mean. So when we're adding and subtracting, what does that mean and what kinds of problems does it solve? To understand the algorithms for addition and subtraction and the algorithms for multiplication and division, those involve extremely important reasoning.

An algorithm is basically a recipe for completing a calculation or carrying out a calculation. So you're familiar with, for example, the addition and subtraction algorithms. This is the process by which we determine how to add or subtract two multidigit numbers. So there is a certain order in which you carry out the steps, and there is a logic to those steps; however, often times when we're simply carrying out the steps, it's easy to forget or not necessarily be thinking about the logic that underlies those steps.

Rational Numbers

For students in grades 4 through 8 who are struggling with mathematics, the IES Practice Guide on Response to Intervention in Mathematics recommends that these students focus on rational number ideas. *Rational numbers* means, basically, the fractions and the decimals in addition to the whole numbers. First of all, those students should understand what fractions mean, what they stand for.

Part of a focus on rational numbers is to be able to solve a variety of story problems using a variety of contexts and different situations using those numbers, using fractions, finite decimals, and percents. For students in Tiers 2 and 3 who are struggling with mathematics, it is very important that they understand the reasoning behind the methods of calculation that they're learning. The reasoning and the ideas that are embedded in those calculation methods is essential and is used in more advanced mathematics. So by learning those ideas, by learning those lines of reasoning, students are actually preparing to learn other ideas in algebra, for example, or in geometry also, that are similar and that use a similar type of reasoning.