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Instructional Strategies for Struggling Algebra Students

Bonnie Grossen, Ph.D. • November 2008

Topic: National Math Panel: Major Topics of School Algebra

Practice: Multiple Paths

Highlights

- Instructional principles that guide the weaving together of algebra with preparatory skills
- Small segments within a lesson—review of facts, development of algebra concepts, practice
- Well-organized curriculum to facilitate continued practice and review
- Review: massed review initially (adequate practice), distributed review which leads to retention, cumulative review
- Student-centered/small group vs. teacher-centered/explicit instruction
- Explicit instruction as more democratic than student-centered discovery
- Making math strategies conspicuous and using guided prompting
- Providing table lookups for students who are weak with multiplication facts
- Value of well-engineered textbooks

About the Interviewee

Bonnie Grossen, Ph.D. is Executive Director of the Center for Applied Research in Education (CARE) affiliated with the University of Oregon. In that capacity, she is leading a professional development team in implementing best practices for math and science instruction in middle and high schools serving high-need

schools in the South Pacific, California, Florida and other states.

Dr. Grossen has over 50 scholarly publications: over 30 reports of original research studies published in peer-reviewed journals such as *International Review of Education, South African Journal of Education, Journal of Learning Disabilities, School Psychology Review, Journal of Research in Science Teaching,* over 10 chapters in books, and 20 reviews and syntheses of research. The thrust of her research work is to improve higher-level thinking and problem solving for all students, including students with disabilities, and research in math and science instruction. Most recently her work has focused on turning low-performing middle and high schools around by implementing the findings of scientific research.

She has presented at over 50 national conferences, including keynotes presented at over 20 conferences. She has worked with the American Federation of Teachers over several years in aligning their professional development program with the latest research on effective instruction.

Full Transcript

I am Bonnie Grossen, Executive Director for the Center for Applied Research in Education, also known as CARE, and CARE is affiliated with University of Oregon.

In weaving together basic skills with algebraic concepts, there are some important instructional principles that kind of help guide that process. And one is that you don't have to have the same topic occur for the whole lesson. It's good to have some tracks so that you might have 10 or 15 minutes segments where you are working on something you began yesterday. For example, well, students who don't know their math facts, you don't want to do a whole period on math facts. You might do three minutes of a review of multiplication facts. Have another little track that is developing an algebraic concept, like maybe an algorithm for finding an unknown in a certain position. And then as they're learning some of the basic skills, you don't want to have the conceptual problems require skills they haven't learned because the success is an important part of making them willing to put out the effort. As they feel successful, then they put out a lot more effort, and everything starts to work together. So the curriculum has to be extremely well organized and review built in.

Review should be massed initially. When students are learning a concept, they should have enough practice so that they actually can do the algorithm or do the procedure. Then after that, the review should be distributed. We find that distributed practice leads to retention, and that means just a few problems everyday, not a whole page of one type. And then it should be cumulative; the different things students have learned in the past should be reviewed in this distributed practice. And the practice shouldn't take up the whole period. It should be another one of those little segments in the instruction.

One of the issues we have in math education, and all education as a matter of fact, is when to use student-centered, or small group, instruction and when to have teacher-centered, or explicit, instruction. And one thing is quite clear; explicit instruction is more democratic than student-centered discovery groups.

When students have to figure out the concept without any initial presentation from the teacher, then some students get the concept and others don't. And even if the teachers comes in and ask questions, it's hard for the teacher to respond to the kids who are not getting it when there are some that are getting it. And it just ends up being a focus on those who are getting it and the teacher feeling like the class got it when actually there is a large number of them who are still confused. So, the most democratic method for initial presentation is, we say, make the strategy conspicuous. And that can be explicit. That can be the teacher illustrating on the board, but there are other ways also to make math strategies conspicuous. The appropriate place for students to do group work is in applications or in making the review more interesting. Structured activities where the students work together to monitor each other's practice and have little challenges, and that makes the review and practice interesting. And then having students work together in groups where they're applying the concepts they learned to maybe more complex applications where they can put their heads together to figure out how the things they've learned might apply to this new situation.

A real important tactic for teachers to use is scaffolding, and however strategies are made conspicuous, the students may often need continuous scaffolding or some guided prompting. So if teachers are completely involved with students while they're working, after they have finished working, looking at their work all the time and responding to that, they're doing a kind of formative assessment. One of the things we've done with students who are weak with their multiplication facts, we've put little tables in the back of their book that they could refer to that have the factors across the top and bottom and the multiples on a little grid sheet, rather than giving them calculators. Calculators are more opaque. One of the things that's become very popular in high schools is, for students who are not quite ready for algebra, the school will take the regular algebra course that's taught over a year and divide it into four pieces and take the first piece, the first quarter and then teach it in a full semester to students who are behind and thereby taking two years to get through algebra. Now when you do that, you don't have anything engineered into that textbook that helps the teacher teach those missing basic skills. You're just going more slowly through the same algebra course. And we have found that if you really spend sometime engineering the instruction, planning the examples, and building in some of that pre-skill instruction into the textbook, it can be very helpful for the teacher. A well-engineered text is going to help the teacher make progress more efficiently and effectively. High schools need to provide, for students who don't have the pre-skills for algebra, a course that's designed specifically for them, that is engineered to teach the pre-skills they are missing, the concepts of proportions and ratios and the relationship between decimals, fractions, and percents. Those kinds of things are built-in as they are being led into algebra, rather than just taking the standard algebra course and dividing it into chunks and taking two years to teach that same content. There has to be a smarter design to the curriculum to catch those kids up, and it can be done. We know it can be done.