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ABSTRACT

Findings are reported from a six-year study of seven expert mathematics teachers who taught in elementary schools in very poor neighborhoods with "difficult" students or in economically depressed areas with high unemployment. Compared with novice teachers, the expert teachers used time more wisely, organized lessons better, and knew their content and how to help children learn it. Each of these aspects is discussed with specifics noted. The three aspects are intertwined, and expert teachers know how to combine the three so that their students are successful. (MNS)

Research in Brief

Chester E. Finn, Jr., Assistant Secretary
William J. Bennett, Secretary

How the Experts Teach Math

Many students don't like math because they don't understand it. Kids who love math -- and are very good at it -- often have great teachers who can explain not only how to add and subtract but also the underlying concepts.

What makes a good math teacher? Several qualities, according to researchers at the Learning Research and Development Center (LRDC) at the University of Pittsburgh. LRDC is funded by the Education Department's Office of Educational Research and Improvement (OERI).

LRDC researchers spent 6 years studying seven expert math teachers who taught in elementary schools in very poor neighborhoods with "difficult" students or in economically depressed areas with high unemployment. They discovered that expert math teachers and novices proceed quite differently.

Wise Use of Time

Expert math teachers use almost all of the class time for math rather than for settling down and getting organized. It often takes beginning math teachers up to 4 minutes to pass out papers. In contrast, experts take less than 30 seconds. Novices can take as long as 15 minutes to correct the prior day's homework; experts take 2 or 3 minutes. Why the difference? Novice teachers often get distracted. For example, they stop to talk with students or make comments about their work that are unrelated to the task at hand.

Good teachers stretch the classroom hour by "stealing" time from blank spaces in the day. They play math games in the few minutes before recess when children are normally restless. Or they practice drills while the youngsters are lining up for lunch or the bus.

They assign "useful" homework -- math problems that let students practice what they have learned from that day's lessons. In contrast, less successful teachers may assign problems they have not yet explained to the students. Consequently, the homework either doesn't get done or the students do it wrong.

Expert teachers constantly drill students on what they have learned in class. This not only reinforces lessons, but helps students gain confidence. Most expert teachers cover at least 40 problems a day through games, drills or written work. Novice teachers, on the other hand, may cover only 6 or 7.

Organized Lessons

Good teachers know what they are going to teach and how they are going to teach it. They are unusually good at constructing a series of lessons that explains the content that needs to be learned. Their lessons are clear, accurate, and contain lots of examples and demonstrations.

They establish routines so that students know what is expected of them and what will take place during the lesson. Consequently, the teacher can get right to work teaching rather than explaining how the lesson will proceed. These teachers know what routines are needed to support a lesson. An expert teacher's daily routine might include reviewing homework, doing some drills, presenting a new concept, illustrating the concept at the blackboard, orally guiding the class through some sample problems, and finally, having the students do work at their desks.

Expert teachers use good, tightly organized demonstrations that clearly relate to the content being taught. They help their students understand what they are learning and why.

Although routines are important, they are not set in concrete. Good math teachers are flexible and willing to spend more or less time on each segment of the routine, depending on students' needs.

Students with expert teachers are rarely "lost" during a math lesson; they know what is happening, what is going to happen, and what they are supposed to do.

Know Their Content

Good math teachers know their subject. They know what children are going to find difficult and what materials or examples they can use to help them understand the content. Good teachers explain to students the problem, the solution, and when to use a specific process. Students come away from a successful

lesson knowing what they can do now that they could not do before and when to use the new process.

Expert math teachers set agendas to help guide them through a lesson. An agenda is a mental note pad teachers use to plot their moves, as well as those of their students, during a lesson. One item on an expert's agenda might include time to solve problems at the blackboard. This involves selecting children, sending them to the board, choosing problems, monitoring the students, and explaining corrections. Experts don't list all of these details in their agendas.

Novices, on the other hand, list a lot of moves in their mental notebooks. Consequently, they get so bogged down they often lose place during a lesson. Both they and their students end up confused.

Experts use concrete objects students can see and feel to help them learn the material better. These teachers know exactly which objects, such as blocks, can help students grasp a math concept. For instance, a teacher might demonstrate addition by having two piles of blocks -- one with four blocks, another with three. To help children see what happens when they add, the teacher would push the two piles together.

Novices often are just one step ahead of the students and don't really know why certain things are done -- "Why do we bring down a number in long division?," for example. Their explanations of new material often are fragmented and incomplete. Sometimes this lack of knowledge gets them into trouble because the material they use to explain something is more complicated than the concept they originally set out to explain.

These three aspects of expert teaching -- wise use of time, organized lessons, and content knowledge -- are intertwined. You can't have one without the others. For example, teachers with organized lessons but a lack of classroom management won't have time to teach their lessons.

Expert teachers know how to combine the three so that their students successfully learn math.

A copy of the complete set of studies, "Cognitive Skill of Teaching on Expertise in Math Teaching," is available from Dr. Gaea Leinhardt, University of Pittsburgh, Learning Research and Development Center, Pittsburgh, PA 15260. Please enclose a self-addressed label.

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