tioner that the decision to do so was made at the higher level of their school system and is supported by teacher effectiveness research. Does research support whole-class reading instruction in the grade-level book?

If one examines both reading instructional research and teacher effectiveness research, two findings seem most supported by the research: (1) students learn more from being taught directly by teachers than from working individually (Rosenshine and Stevens, 1984), and (2) students must have consistent and high success on daily instructional tasks in order to learn (Berliner, 1981; Cunningham, 1985).

Obviously, the first research finding stands in strong opposition to the practice of individualized instruction so widely advocated from the late 1960s to the early 1980s. In fact, this finding is one of the main justifications for the return to whole-class reading instruction. Since the research shows that the more time learners spend working independently, the less they learn, it is logical to assume that more learning would occur if the teacher could teach all students at one time as if they were all alike.

Perhaps, if all students were alike, that assumption would hold true. Unfortunately, the second finding from research shows that students must be given tasks they can complete with high success or they will not learn. In fact, millions of children in schools all over America cannot do grade-level work regardless of how much whole-class teacher direction they receive. Anyone who is aware of how reading was taught in the 1930s, 40s, and 50s can attest that these students are doomed to failure if they receive whole-class, grade-level reading instruction.

Herein lies the dilemma of schooling—and not just today's dilemma, but that of yesterday and tomorrow as well. A classroom typically has one teacher and a number of students with a range of abilities. Research will always support the indispensability of the teacher (Finding #1), but it will also always support the need for individualized instruction to meet the needs of students with different abilities (Finding #2). Neither individualized instruction nor whole-class instruction alone has ever worked for reading, and neither ever will.

What then is the solution? How can students have teacher-directed instruction and high success rates when individual differences in instructional level and rate of learning are a constant part of human variation?

The solution is not that tried so often prior to the 1960s. Placing children in classes by ability or moving them around at reading time so that all children in one class are at a certain level is a tried and untrue solution. Predictable and serious shortcomings of this type of organization are decreased motivation and self-concept of students, time lost while children change classes, and lack of ability for integration across the curricular areas.

The solution is one common to many teachers and school systems: try to achieve a balance and compromise with the conflicting needs. Many schools achieve a balance by assigning teachers no more than three reading levels in their class. Many teachers "trade" a few children at reading time to reduce their group to a managable size. Some individualized instruction is always appropriate for children on both ends of the achievement continuum. Other activities—writing and listening comprehension, most clearly—which are needed by everyone and in which all students can be successful are best carried out in whole-class groups.

The idea that all children would profit by individualized instruction ignored the practical constraint of one teacher and many children. The pendulum appears to be swinging all the way over to whole-class/every-child-on-the-same-page-of-the-same-book-instruction. This swing, however, is not supported by research.

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Patricia M. Cunningham is Associate Professor, Department of Education, Wake Forest University, Box 7266, Winston-Salem, North Carolina 27109. **James W. Cunningham** is Associate Professor, School of Education, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514.

Science

JOHN E. PENICK AND ROBERT E. YAGER

Textbooks Can Supplement the Curriculum

A man may as well expect to grow stronger by always eating, wiser by always reading.

—Jeremey Collier (1650–1726).

As we identify outstanding school science programs through the Search for Excellence in Science Education of the National Science Teachers Association, we ask the same question, "What texts do you use in your program?" The answer is almost invariably the same, "We use all we can find." They also use

them in nontraditional ways. Students are reading more but studying their "official" text less.

We have found no exemplary science programs where the book *is* the curriculum. Teachers and developers of exemplary programs make statements like, "We supplement our curriculum with textbooks." A great deal of meaning exists in this simple, yet profound, statement. These teachers are telling us that, as we have always known, the curriculum is far more than a book and that no book could ever fully meet the needs of any isolated group of students. Teachers are using texts as broad references, not as guides. They are putting more of themselves and local relevance into the curriculums.

For instance, teachers in West Nyack, New York, recognized that their traditional biology class was lacking the human emphasis that might make it more interesting, useful, and controversial. In creating a curriculum for "Mankind: A Biological and Social View," these teachers found many contemporary, relevant articles dealing with everything from evolution to architecture, from energy to primate behavior. They also brought in films, outside speakers, and a variety of unique ways for presenting and teaching the material and invited students to share in locating and identifying teaching materials. In addition, they found appropriate texts in sociology, biology, and anthropology. Rather than becoming the core of the curriculum, these texts are sources of additional information. Students learn to generate ideas and check them against the ideas of others, including authors of texts, other students, teachers, and the public. In the process, students become more self-reliant, confident, and capable of independent decision making.

Some teachers, such as John Christensen at Cherry Creek High School in Colorado, or the curriculum team in the Jefferson County Public Schools (Colorado) have developed their own hardcover textbooks. But these texts are not at all like commerically available texts. We have also found a number of instances where students study science topics in groups of four. Each student reads a different textbook and independently identifies additional materials. The final task of the students? Reconciling differences in the texts and, during examinations, citing various points of view with appropriate references. These students are learning far more about science than what is in one mere textbook; they are learning to use their texts as references, much as a scientist would. In doing so, they rely more on their own abilities and local sources of information and less on the text as the sole source of knowledge.

By placing the traditional text in a supplementary role, teachers have more time for other resources—and for students. And their students learn to discriminate among ideas, use their own judgment, and make decisions. Teachers are also in a better position to take advantage of learning opportunities for students while increasing their own learning.

John E. Penick and **Robert E. Yager** are Professors of Science Education, Science Education Center, The University of Iowa, Iowa City, Iowa 52242.

Mathematics

STEPHEN S. WILLOUGHBY

Will Calculators Rot Our Minds?

About 20 years ago I was in the office of an accountant. During the conversation he wanted to know the product of 10 and 78. He walked to a large machine on the table about five feet from his desk, pushed some buttons, and returned to inform me that ten times 78 is 780.

I was amazed that a person who worked with numbers for a living could be so lacking in number sense that he would prefer to go out of his way to use a calculator rather than perform so simple a multiplication in his head. I supposed that the exercise was good for his body, but I wondered if a bit of mental exercise might not do his mind some good.

Today, calculators are everywhere. For about five dollars you can buy a calculator the size of a credit card that will do everything but wash the windows. In light of these changes in technology, should we redouble our efforts to keep calculators out of the schools? According to every report on the subject from professional mathematics and mathematics education groups since 1975, we should accept the calculator in mathematics classrooms with open arms. We should not only let children start using calculators at an early age, but we should actively teach them to use calculators and encourage them to do so.

The main argument against using calculators in schools is that they will discourage students from using their minds, that we will graduate people who are unable to think quantitatively and who depend on calculating devices. This argument has merit, but if we continue to teach mathematics as