can write more quickly by hand dislike typing their work; and when those students do type, they will not revise. Fortunately, students in grades 4–6 need only to reach a typing speed of 10 gwm (gross words per minute) to avoid frustration with keyboarding. (Gross words per minute refers to the number of keystrokes per minute divided by five, disregarding errors).

How can keyboarding instruction best be effected? Experts recommend varying lengths of time needed for keyboard instruction, but Koehnke notes that a sound, research-based time frame for upper elementary school children seems to be "a combination of teacher instruction and microcomputer software tutorial, 35 minutes a day, for four weeks—with scheduled times for review and refresher activities."

Numerous software programs for teaching keyboarding are available, and several states (e.g., Alaska and New York) have developed curriculum guides on keyboarding instruction. Koenke discovered among elementary curriculum supervisors a growing interest in the teaching of keyboarding. A survey of elementary supervisors in the Pacific Northwest showed 44 percent in favor of teaching keyboarding in the elementary school. Finally, regarding the training of teachers to teach keyboarding, many districts are using high school business teachers as resource persons for inservice training in teaching proper keyboarding techniques.□

1. From a forthcoming article in *English Education*, the journal of the Conference on English Education, NCTE.

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Mathematics

STEPHEN S. WILLOUGHBY

Specialists for Elementary School

By the end of my first day as a fifth-grade teacher, I felt inadequate. I thought I was doing quite well teaching mathematics, science, and physical education; and reasonably well teaching social studies, reading, and writing. Music, art, and galoshes were my downfall.

I'd never claimed to be a Nietzschean superman, but I had had a pretty good liberal education. In retrospect, I've decided that an adequate fifth-grade teacher must be a true Renaissance person with infinite patience and energy, a passion for clerical details and discipline problems, and a masochistic desire to be described as inadequate by every national commissioner, state legislator, or other politician in need of a quick headline. Of course, the fifth-grade teacher should also expect and welcome professional advice from every person who has graduated from, or ever hoped to graduate from, the fifth grade.

Specialization as Solution

Physicians and attorneys have partially resolved the matter of needing huge amounts of knowledge by specializing—as have secondary and post-secondary educators. But many elementary educators have resisted specialization because they believe children are better off socially and psychologically if they have to relate to only one adult in school. I agree with this belief as it applies to the first few years of school, although I know of no supporting research evidence even for that level; but I question its validity in the upper elementary grades. Indeed, many schools already employ specialists in physical education, art, and music with no apparent harm to the children's psyches.

Recent international studies suggest that children in the United States fall further behind in mathematics during elementary school than at any other time. Yet only about half of the states require students to take any college course in mathematics or mathematics education to become elementary school teachers. Most elementary school teachers tend to be more verbal than quantitative—both in inclination and in preparation; they must meet substantial requirements in language arts and humanities. There would be more elementary teachers whose favorite subject is mathematics if prospective teachers could specialize in mathematics and look forward to teaching only (or mostly) mathematics.

A Modest Proposal

Over the past five years several professional organizations and major conferences have called for certifying and hiring elementary mathematics specialists. I believe they are correct. Initially there is no need to require a major in mathematics. Simply choose teachers who like mathematics, enjoy teaching it, and have an aptitude for it. Then help them supplement their preparation and have them teach only mathematics. Perhaps they could also help teachers of the earlier grades improve their mathematics teaching.

I urge the National Science Foundation to fund institutes to facilitate the preparation of elementary specialists in mathematics. In the 1950s and '60s such institutes were not available for elementary teachers because there were about 1.2 million of them and their half-life at the time was about three years (that is, after three years, half of them would no longer be teaching). Thus, funding institutes for elementary teachers seemed like pouring money into a black hole. Since then, the half-life of elementary school teachers has increased substantially. If institutes were limited to present and prospective specialists, they could positively influence the preparation *and* the attitudes of those who teach mathematics in elementary schools.

Such institutes should require that the participants and their school systems commit themselves, for at least three years, to trying the specialization idea. Such a commitment would mean participants would teach only mathematics and, perhaps, have some free time to help teachers of other grades improve their teaching of mathematics. The specialists probably could also act as leaders in setting goals and choosing textbooks and tests for mathematics.

An institute should continue over an extended period of time (two summers and an intervening inservice academic year, for example) so that teachers could work as specialists during their participation and so that institute faculty could visit their schools.

If the United States is to compete in the world marketplace and if our citizens are to contribute capably to the welfare of the world, our precollege schools must prepare many more people in mathematics far better than is now the case. Preparing and employing elementary mathematics specialists is a cost-effective way for the federal government and local school systems to work with universities to improve both the quality and the quantity of precollege mathematics education.□

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Reviews

Practical Strategies for the Teaching of Thinking

Barry K. Beyer
Newton, Mass.:
Allyn and Bacon, Inc., 1987

—Reviewed by Robin B. Hobbs, Baltimore City Public Schools, Baltimore, Maryland.

Beyer presents a clear, precise road map for instructional practice. His book's premise is that the goal of teaching thinking is to help students become proficient, independent thinkers. Grounding his presentation in research and learning theory, Beyer makes a logical, sequential, and compelling case for explicit instruction in the skills and the operations of thinking.

The bulk of the book provides practical strategies for teachers who want to make the teaching of thinking a reality in their classrooms. With numerous examples, Beyer includes strategies for inductive, directive, and developmental instruction. He clarifies the major components of these instructional frameworks, including introduction, guided practice, and autonomous use of each. He also gives thorough consideration to follow-up practice lessons, teaching-for-transfer, and methods to help students control and direct their independent thinking.

Elementary and secondary teachers, curriculum writers, and administrators will find a wealth of useful guidelines with implications for curriculum writing. Beyer practices what he preaches; he makes the teaching of thinking explicit.

Available from Allyn and Bacon, Inc., 7 Wells Ave., Newton, MA 02159.

Improving Classroom Practice Using Innovation Profiles

K. A. Leithwood and D. J. Montgomery
Ontario, Canada:
The Ontario Institute for Studies in Education, 1987

—Reviewed by Shirley M. Hord, Southwest Educational Development Laboratory, Austin, Texas.

"What is it (the innovation)?" and "What am I to do with it?" are questions we repeatedly ask when introduced to a change in school and classroom practices. Ever since Berman and McLaughlin in the Rand Change Agent Studies reported on "mutual adaptation," researchers and practitioners interested in planned change have given increased attention to the identification and articulation of the characteristics, components, dimensions, features, and variables of innovations. Leithwood and Montgomery—like Hall, Loucks, Wang, and others—have developed an instrument for describing the innovation to users and for portraying teachers' use of it in classrooms.

The book, and its concepts and procedures, are carefully, thoughtfully, and very thoroughly developed. The rich detail and the time- and energy-demanding analyses required of the processes presented may be at once the book's greatest strength and most serious practice-related shortfall. Developing a profile, for example, in one of the book's case studies required 80 teacher days and 20 secretarial days, although development of a profile in another school case required only six to eight days from persons knowledgeable about the program. The authors report that employing a finished profile to interview a teacher about innovation use requires two hours.

The authors' elaboration of the process for generating an innovation profile may be valued most by curriculum and other program developers whose responsibility is, or should be, to communicate clearly what an innovation is and what the expectations are for its use. Certainly, the directions for