

# CONTENT KNOWLEDGE

## A Key Factor in School Improvement

By Hannah Slovin

School improvement is a complex endeavor involving many factors, including teachers' knowledge of the subject matter. In her book highlighting differences between elementary-school mathematics instruction in China and the U.S., Liping Ma made a compelling case for the importance of upgrading teachers' content knowledge. She says, "Not a single teacher was observed who would promote learning beyond his or her own mathematical knowledge" (*Knowing and Teaching Elementary Mathematics*, 1999, p. 54).

Ma's study of content knowledge led her to conclude that "a teacher's subject matter knowledge may not automatically produce promising teaching methods or new teaching conceptions. But without solid support from subject matter knowledge, promising methods or new teaching conceptions cannot be successfully realized" (p. 38).

Elementary teachers are not the only ones whose mathematics content knowledge is key to school improvement efforts. Course assignments in secondary schools sometimes put teachers in situations that result in content needs. Someone who has been teaching algebra for years may be asked to teach a section of geometry or calculus. In other cases, secondary teachers are assigned to teach outside their subject areas. Broadening the content that students are expected to learn creates a need to upgrade the content that mathematics teachers can effectively teach. For example, many teachers may not have had college coursework in probability and statistics or transformational geometry, topics that are now considered a key component of secondary mathematics curricula.

National standards for mathematics education stress teaching for understanding. This means replacing superficial and fragmented coverage of many topics with in-depth treatment and connection of important ideas. But teachers find it difficult to teach using methods they have not experienced themselves as learners. Some elementary school teachers, particularly those in the lower grades, have changed their mathematics teaching practice to reflect more hands-on and problem-solving approaches. However, these same teachers have problems presenting mathematics content beyond arithmetic except as they learned it. For the large majority of teachers, advanced mathematics was taught using lecture, demonstration, and practice. Consequently they have difficulty broadening their view of algebra and geometry to include developmentally appropriate approaches for teaching these topics to younger students.

Teaching for understanding at any grade level depends on teachers' ability to see mathematics from the perspective of stu-

dents' needs. How effectively teachers design questions, select instructional and assessment tasks, evaluate student learning, and make instructional decisions is related to how well they understand the content they are teaching. Teachers need professional development that provides authentic learning experiences. Role playing the learning process, using already familiar content to practice new instructional approaches, is not enough. Before teachers can make the significant changes necessary to improve mathematics teaching and learning, they



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▷ Use of effective instructional strategies, like problem solving, are vital to school improvement in the area of mathematics.

must go through the process of learning new content in a standards-based learning environment.

An example of such a professional development institute is Reshaping Mathematics with the Hawai'i Content and Performance Standards II (HCPS II) offered during the summer through the University of Hawai'i at Mānoa. Participants learned new content using problem-solving processes to build conceptual understanding. Debriefing sessions throughout the course enabled participants to reflect on instructional strategies. This teacher-as-learner experience allowed professional developers to introduce pedagogical issues including asking questions, using multiple representations, grouping, pacing, and challenging all students. Texts for the institute are available through CRDG ([www.hawaii.edu/crdg](http://www.hawaii.edu/crdg)).

Improvement of mathematics instruction depends on teachers' access to appropriate professional development. Opportunities to explore substantive mathematical content through inquiry-driven instruction will help teachers develop the necessary confidence and skills to implement a program that builds conceptual understanding.

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