Aspiring middle school teachers in the United States take fewer math courses and are less knowledgeable in the subject than their counterparts in South Korea, Taiwan, and other countries. That gap in teacher preparation, coupled with curricular differences, could help explain achievement disparities between American students and their peers in other industrialized nations, researchers say.

The preparation of teachers to impart high-level mathematics skills at the middle and high school levels has been gaining attention as U.S. business leaders and policymakers express worries about the ability of schools to train a globally competitive workforce.

Now, in a study released this week, researchers are offering data on teacher education that hint at the extent of the problem.

The study of those on the brink of becoming middle school math teachers in the United States and five other countries—Bulgaria, Germany, Mexico, South Korea, and Taiwan—concludes that American teachers are ill prepared for the task.

“Our future teachers are getting weak training mathematically and are just not prepared to teach the demanding mathematics curriculum we need for middle schools if we hope to compete internationally,” said William H. Schmidt, a Michigan State University researcher who conducted the study. Another international study, released this week by the American Institutes for Research, looks in part at the intersection between math achievement and science learningRequires Adobe Acrobat Reader, which experts say suggests the broader importance of good math instruction.

In Mr. Schmidt’s study, U.S. teachers scored significantly lower than those in all countries except Mexico on knowledge tests in algebra and functions, which are considered critically important for teaching middle school math.

The teacher-candidates from the United States and Mexico also reported that their undergraduate programs covered less content in advanced math, analysis, and algebra than the other countries’. The American teacher-candidates were also less equipped for the practical aspects of teaching math to middle school students than their counterparts in all but Germany.

Moreover, teachers who pursue certification specific to middle school education, as opposed to elementary or secondary programs, are the least primed of all.
“If you look at Taiwan and South Korea, whose students typically perform well on international tests, their teachers are very well prepared in terms of mathematics,” Mr. Schmidt said, noting that middle school teachers in the U.S. programs in the study took about half as many math courses as their counterparts in Taiwan and South Korea. “Then if you look further, [the Taiwanese and South Koreans] are getting quite extensive coverage of the practical aspects of math pedagogy and general pedagogy as well.”

Math-Science Connection

The study is the precursor to a larger examination of K-8 teacher education in 20 industrialized countries that Mr. Schmidt will begin next year.

Mr. Schmidt cautions that his findings are based on a small sample of students in each of the countries, including 2,500 American students in 12 colleges and universities, a group that is not considered representative of the United States’ 1,200 teacher education institutions.

The topic has also been a concern of the federal National Mathematics Advisory Panel, which highlights in its preliminary recommendations, released last month, the need for “systematically improving teacher-preparation programs, as well as professional-development strategies for teachers already in the field.” ("Draft From National Math Panel Covers Broad Scope of Topics," Dec. 5, 2007.)

An upcoming survey of the math content of teacher education programs by the National Council on Teacher Quality will look at course requirements in the subject at more than 70 teacher colleges.

The study of U.S. performance on international science tests, by the Washington-based AIR, outlines successively lower rankings of U.S. students on international assessments as they age. U.S. 4th graders, for example, were ranked higher among participating countries than U.S. 8th graders on the 2003 Trends in International Mathematics and Science Study tests, while 15-year-olds were outperformed by even more countries on the Program for International Student Assessment, or PISA.

The report attributes part of the decline to inadequate math skills, noting that “the United States’ consistently low international mathematics scores are one explanation for declining U.S. science performance in the upper grades.”

“As the science becomes more mathematically inclined as students move to the physical sciences and chemistry, they are going to be at a disadvantage if they don’t have the math background,” said Steven Leinwand, an author of the AIR report.

Mr. Schmidt’s study of the backgrounds, course-taking patterns, and math knowledge of teacher-candidates found that those in Taiwan and South Korea cover greater math content, similar to that required of math majors, in about the same time span as four-year programs in the United States.
Content and Pedagogy

But beefing up American teacher-preparation programs is not simply a matter of adding more math classes, some experts say. Sometimes state requirements can get in the way.

Mark Ellis, an assistant professor of education at California State University-Fullerton, said that California’s strict requirements for teacher education prevent education programs from adding more courses. With a maximum credit load and required classes in teaching English-learners and working in diverse classrooms, the Fullerton program has struggled to infuse more math for middle school teachers. A new master’s-degree program in teaching middle school math has been added to give teachers more intensive preparation, he said.

“One of our constraints is that we have to help [teacher-candidates] understand the kinds of students they are going to be working with and the kinds of strategies they’re going to need to help them be successful,” he said. “But what the study makes clear is that [math content] has to be coupled with courses in pedagogy and understanding the content in a teaching context.”

Mr. Schmidt’s findings confirm the view that more math content, as such, is not the answer

“There are people who advocate the view that all you need to do is find people who are trained in mathematics and put them in the classrooms, and they will be fine,” Mr. Schmidt said. “In these other countries, nobody leaves out math pedagogy or general pedagogy. It takes a knowledge not just of mathematics, but how you bring that mathematics to kids.”

Related Stories

* For more stories on this topic see Curriculum and Learning.
* For background, previous stories, and Web links, read Professional Development.