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Why Johnny Can't Compute

by Lynn Arthur Steen

Headlines told the bad news: U.S. students came in dead last in yet another international study of school mathematics. Four times as many Korean teen-agers as U.S. teen-agers scored above 600 on this carefully standardized comparison of 13-year-olds from around the world.

What's worse, our students felt good about it. Whereas only one-fourth of the Korean youngsters claimed that they were particularly good in math, two-thirds of U.S. students felt this way.

Crisis headlines enable merchants of nostalgia to beguile the public with offers of quick fixes. Change the textbooks; turn off the TVs; lengthen the school year; test the teachers; require more courses. Unfortunately, there is no simple cure for bad news. Instead of band-aids and slogans, we need careful analysis and long-term goals that deal with the entire system of mathematics education.

The title of the recent international study tells it all: "A World of Difference." What we can learn from international comparison -- as uncertain and invidious as they may be -- is that nations and individuals are different. Much of what we take for granted appears very different when seen through the perspective of international comparisons:

Students in other countries study different mathematical topics at different times and in different orders. Our pattern of eight years of arithmetic followed by one year of algebra, then one of geometry is not the only way, nor -- according to the evidence -- the best way for children to learn mathematics.

Although the cultural attitude that "girls can't do math" continues to infect adult society and to inhibit full achievement of women in many mathematics-based careers, the evidence from international studies shows that in most countries teen-age girls perform just as well as boys on mathematics. These studies prove that our biases are unfounded.

Although adults tend to think of mathematics as a subject for school rather than as an activity for life, mathematical and statistical ideas permeate our lives. International studies show that in every country, children know parts of mathematics that their teachers claim they were never taught. Learning mathematics goes on not just in school, but in the home, on the playground, and in the entire social and cultural milieu of the growing child.

Differences in classroom practices alone cannot explain differences in learning. Similar practices may be found in high-achieving countries and in low-achieving countries. Dissimilar practices abound, but are not an effective predictor of results.

What these studies do reveal is the immense complexity of mathematics education. In the United

States, as in most countries, mathematics involves 10 to 15 percent of the total educational effort of the nation, ranging from primary school through graduate schools, from teacher education to technological institutes. Teachers, tests, texts, parents, government and industry all play essential roles in shaping the educational environment for mathematics.

In the center of this environment are our children -- children who live in the United States, not in Korea or Japan, and who will work in the next century, not in the present one. Our children must learn more mathematics -- not to catch up with our competitors, but to ensure opportunity both for themselves and for our nation. To work effectively and live intelligently, citizens of the 21st century need mathematics.

Mathematics is especially important as the language of science and technology. Unless current degree patterns change significantly, the United States faces a net shortfall of approximately 750,000 scientists and engineers by the turn of the century. According to Census Bureau estimates, however, fewer than one in five new workers in the year 2000 will be white males, who now earn more that three of four advanced degrees in mathematics and in the mathematics-based sciences.

Concerns of equity have joined common cause with those of economic reality. Together, they compel us to action. We cannot continue as we have in the past, nor can we solve our problems by imitating Korea or Japan. We must forge our own strategy, guided by new national standards for school mathematics, yet rooted in the American tradition of local school initiative.

Both international studies and the wisdom of practice show that school mathematics must relate effectively to the society in which children live. In an age of calculators, children should learn when to use calculators (and when not to). In an age of data, children should measure, record and study data. In an age of science, children should explore, investigate, discover, question and conjecture.

School mathematics as a sterile ritual of paper-and-pencil work sheets is as outdated for modern society as monastic scribes are for modern business. Advancing technology, changing applications and mathematical discoveries have immeasurably enriched the power of mathematics and its impact on society. Students who enter the work force without benefit of this power are vocationally impoverished. Schools must teach mathematical tools for the future, not just rituals of the past.

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