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Scientific Competency Through Fun

Concern for the scientific education of the children of the United States is much in the news. Recent test scores of American children in comparison with those of their Japanese and European counterparts have created part of the alarm, and lower enrollments in science programs at college and graduate levels have added fuel to the fire. The argument that global competitiveness requires more scientists is being used to add pressure for expanded mathematics and science programs. But there should be a second reason for expansion: fairness, which requires that all children start out with an equal chance for a good education. Part of the reason for the low American test scores is that many schools are underfunded, and most of these are located in regions where the underprivileged and recently arrived immigrants tend to accumulate. Those are precisely the groups who most desperately need the education system to provide the basis for equality of opportunity.

Fortunately, producing an adequate supply of scientists and giving scientific literacy to the nonscientists can be accomplished by the same means—teaching excellent science to every child at the elementary school level. Expanding the base of the pyramid in this way will increase the number of students who emerge from their academic training as the scientists of the future. It will also provide vital background for those who never go on to scientific careers. Voters, judges, and insurance salemen can have an understanding of the complexity of the scientific world, as well as the ability to operate the computers and sophisticated equipment that even the most menial jobs will require in the future.

If scientific competence is to be extended to all, then the teaching of mathematics in the elementary schools will have to be a fundamental target. Although mathematics may become a minor tool for many adults, even some in science, almost invariably scientists say they did well in mathematics in elementary school; those intimidated by science say, in disproportionate numbers, "I was never good at math." The myth that mathematics must be difficult lends its study an element of Greek tragedy, in which catastrophic failure inevitably lurks somewhere down the road. It seems essential, therefore, that programs in elementary school mathematics be made to be fun and be taught in an atmosphere of leisure to remove the anxiety that is so often self-fulfilling. Gambling in elementary school may sound like the ultimate in degradation, but playing with cards and rolling dice can introduce principles of probability; flipping coins can be associated with Gaussian distribution; cutting through spheres and cones and squares can teach solid geometry on personal computer screens. A recent report of the National Academy of Sciences* supports such programs and gives excellent advice on how to improve the teaching of science. Studies indicate that there are a higher number of men than women among computer enthusiasts, suggesting a possible bias of many early computer games, which tend to be oriented toward conventional male interests—war, sports strategy, and car races. So it appears that mathematics must be developed as fun before it can be required as an essential.

To those who argue that such programs would mean more time spent on mathematics than on other subjects, such as English, history, and social studies, the answer is, yes, because mathematics is different and intrinsically more difficult. This difficulty arises not necessarily because of higher conceptual challenges but because the skills of mathematics are cumulative. If one learns the history of Greece poorly, that has a minor effect on learning the history of Rome. But if one fails to understand fractions, the ability to complete more advanced calculation, such as algebra or trigonometry, is fatally impaired.

It is time to recognize that smokestack industry, with its large manual labor force, is disappearing. To be fair to our youth who will not be scientists, and to provide a broader base for future personnel in science, we must develop excellent programs at the elementary level. This improvement requires more money for schools, better salaries for teachers, and more demanding curricula. But all of that may not help unless there are imaginative changes in instruction that will make science fun and build confidence while helping students to a real understanding of scientific approaches. We have tried money without imagination, and it has failed. We have provided imagination without money, and it has failed. Perhaps this time, by analyzing the problem deeply, we can provide both ingredients simultaneously. It might be fair, effective, and fun all at the same time.—DANIEL E. KOSHLAND, JR.

*National Research Council, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education* (National Academy Press, Washington, DC, 1989).