

Educating for Numeracy: A Challenging Responsibility

Ordinary citizens must deal with numbers and data every day. Drawing from information amassed and analyzed by computers, news media are filled with graphs and charts explaining the economy, health risks, educational results, and consumer protection. Governments explain budgets, social programs, and defense strategies with elaborate analyses of averages and changes in averages. Most jobs use numerical tools. Investing, credit, insurance, and taxes are immersed in data and rates of change. Political debates, laws, and court decisions abound in probabilistic decision making. Polling has become an influential and continuous activity.

Quantitative literacy (QL) is the ability to understand and use quantitative measures and inferences that allow one to function as a responsible citizen, productive worker, and discerning consumer. There are strong indications, beyond litanies of anecdotes, that many U.S. high school and college graduates have not achieved QL. Even though the mathematics and statistics underlying everyday quantitative materials may be elementary, the contextual uses are sophisticated, surpassing the abilities of most adults.

Recent national and international surveys have reported very low levels of quantitative literacy among U.S. adults, both in absolute terms and in comparison with levels in other countries. Discussion of these surveys and other indicators is contained in a new book, *Mathematics and Democracy*, edited by Lynn Steen and available from the Mathematical Association of America.

Educating for QL has received little attention in either school or college curricula. Current efforts are scattered and results are uncertain, partly because the rapid escalation of quantification in society is a recent phenomenon. No doubt the necessary mathematics and some statistics have been in school and college courses. The difficulty in achieving QL is effecting transference of knowledge of mathematics and statistics to hundreds of everyday contexts, a well-known difficulty within college curricula. Achieving this transference will require considerably more contextual teaching of mathematics, as well as help from other disciplines.

Mathematics curricula in schools and colleges are ill designed to teach QL. Most colleges have put a low priority on the general education courses that are most suited to teaching QL. The sequence of mathematics courses from early high school through college calculus is linear and hurried, with no time to teach the mathematics in context, to help students develop the habits of mind necessary to interpret real-life situations in quantitative terms. Students are told that they will use the mathematics later, either in another mathematics course or in other disciplines. Mathematics courses become routes to somewhere else, not destinations themselves. Many, if not most, students end up stranded on the roadside, having mathematical skills that they are unable to use or to relate to their everyday lives.

Mathematics has a privileged place in the school curriculum, being the only subject other than English that is required and tested in every grade K-10. Statistics is now a part of this

privileged place; the NCTM (National Council of Teachers of Mathematics) Standards include data analysis and probability at all grade levels. This privileged place entails responsibility to contribute significantly to QL. Other school disciplines will also need to help.

QL has no specific place in most college degree programs. When it does, it often is mistakenly equated with mathematics, statistics, or other quantitative disciplines. However, the power of mathematics is its abstractness and its generality; QL is anchored in real-world data. Likewise, other disciplines have their own bounds that constrain conveying QL.

Most colleges require some mathematics as part of general education. Very often these requirements are satisfied by service courses designed for specific majors; such courses may be part of the calculus-centered sequence. General education and service courses can contribute significantly to QL by connecting academic material to real-world contexts and by teaching skills students will need to be productive citizens. The responsibility to do this is shared with general education and service courses of the other disciplines—sciences, social sciences, arts, and humanities.

Educating for QL is difficult—transference is the acid test of understanding. Coordinated teaching across the curriculum, which has improved the teaching of writing, is evidently also needed to educate for QL. Creative new methods and additional research are needed to discover how to measure QL. Mathematics should lead the effort to meet these challenges because of its centrality in college education, the size of its faculty, its traditions of teaching students from all disciplines, and its kinship with QL.

Some colleges are making efforts to promote QL by adapting traditional courses, offering new courses, or teaching QL across the curriculum. The programs are sometimes controlled by mathematics departments, but sometimes not. A national forum on QL was recently convened at the National Academy of Sciences, and a National Numeracy Network (NNN) is being formed to promote QL education. Both of these had their impetus outside mathematics at the Woodrow Wilson Foundation. Many college and university mathematics faculty have joined the effort alongside collegiate faculty from other disciplines. These collaborations need to increase.

Although daunting in many respects, the QL challenge is an opportunity for mathematics both to meet an important and growing responsibility and to increase support for mathematics. Students will appreciate seeing immediately the relevance of the mathematics they are studying. As interdisciplinary and applied work has infused new energy into mathematics research, teaching for QL can create excitement and collaboration among different disciplines in general education. The need for QL among Americans will grow. As society becomes more quantitatively complex, citizens will need more skills to be informed participants and productive workers.

The U.S. mathematics community should apply its vast talent to the challenge of raising quantitative literacy.

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