

Numeracy in an International Context

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As the recent intrusion of computer-generated data has transformed the way Americans live, work, and learn, so has it influenced countries around the world. The inevitable questions about appropriate new goals for mathematics education that are suggested by the transforming impact of computers are not confined to the United States. These issues arise in every country, although the responses vary greatly because of the different historical and cultural roles played by mathematics in different nations.

Several papers in this volume cite the two-decade-old report *Mathematics Counts* (Cockcroft 1982) as the source for the term “numeracy,” described there as an educational goal with two attributes. First is an “at homeness” with numbers, by which is meant “an ability to make use of mathematical skills to cope with the practical demands of everyday life.” Second is an ability “to understand information that is presented in mathematical terms.” Although the term numeracy predates this reference, the Cockcroft report is widely regarded as the first major document to urge that numeracy—what we call quantitative literacy—be a priority for mathematics education.

More recently, the Organization for Economic Cooperation and Development (OECD) has undertaken through its Program for International Student Assessment (PISA) to define and assess student knowledge and skills in reading, mathematical, and scientific literacy (see www.pisa.oecd.org). PISA defines mathematical literacy as “the capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgments, and to engage in mathematics in ways that meet the needs of an individual’s current and future life as a constructive, concerned, and reflective citizen” (OECD 1999, 41). The PISA literacy tests were administered for the first time in 2000 (NCES 2002).

Some years earlier, the International Adult Literacy Survey (IALS) began using a three-part definition of literacy encompassing prose, document, and quantitative elements (OECD 1995). A follow-up study known as ALL (Adult Literacy and Lifeskills survey; see nces.ed.gov/surveys/all) is being administered internationally during 2002 and 2003. ALL focuses on numeracy not as a portfolio of passive skills but as an active pattern of behavior, such as managing situations, solving problems, and responding to quantitative information, which could be said to characterize numerate adults (Gal et al. 1999).

Those in the United States who pay attention to mathematics education have heard much in recent years about TIMSS, the Third International Mathematics and Science Study, which has recently been repeated under the name TIMSS-R (see nces.ed.gov/timss). These aforementioned studies—PISA and ALL—illustrate that international concern about mathematics is not limited to the traditional mathematics curriculum that is assessed, more or less, through the TIMSS studies. Concern about numeracy and literacy also are very much present in other countries.

Indeed, there is quite active international interest in defining and assessing students’ quantitative and mathematical skills, especially at the school-leaving level, because quantitative competence influ-

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ences to a great extent the effective preparation of each nation's workforce and university students. For most of the past century, mathematics educators around the world have worked together through the International Commission on Mathematical Instruction (ICMI) to learn from each other both about effective approaches to mathematics education and about the different roles that mathematics plays in different societies (see elib.zib.de/IMU/ICMI/). Both mathematics and mathematics education are truly international subjects, although in the latter, cultural influences necessarily play a much larger role.

It should come as no surprise, therefore, that just as the rise of a data-driven culture has forced the United States to rethink decades-old traditions of school mathematics, so similarly motivated changes are underway in other countries. It is enlightening and sometimes empowering to see how differently mathematics can be viewed from the perspective of other traditions. We realize, after such study, that certain things we take for granted are largely arbitrary, whereas approaches we can hardly imagine are, in some nations, routine.

It is for these reasons that we invited contributions to this Forum from several mathematics educators in other nations, especially those closely associated with the international work of ICMI, PISA, and ALL. The papers in this section offer a wide variety of international perspectives that, although failing to fairly represent everything of significance in mathematics education around the world, at least illustrate forcefully the wide variety of issues, approaches, and concerns.

Mogens Niss of Denmark, secretary of ICMI during the 1990s, addresses the issues directly in a paper entitled "Quantitative Literacy and Mathematical Competencies." Niss argues for a broad PISA-like definition of "mathematical" literacy that would encompass most of what other authors in this volume refer to as "quantitative" literacy. In particular, Niss argues, if the objectives of mathematics education were organized around competencies such as reasoning, modeling, and communicating mathematically—rather than, for example, around content such as algebra, geometry, and calculus—school graduates would be far better able to navigate thoughtfully the turbulent waters of democratic debate and decision making. (See pp. 217–222.)

Michel Merle, in "Defining Mathematical Literacy in France," writes about the current work of a national commission on the teaching of mathematics in France that is chaired by former ICMI President Jean-Pierre Kahane. The charge to the commission, motivated by the same forces that led to this Forum on quantitative literacy, is how to restructure school mathematics in ways that take into account the impact of computers. The Kahane commission (Kahane 2002), as Merle describes, argues for a mathematics

syllabus dominated by four content areas: geometry ("the education of vision"); computation (both approximate and exact, including its relation to reason); statistics ("stochastic literacy"), and computers (especially data structures and algorithms). (See pp. 223–225.)

A. Geoffrey Howson, also a former secretary of ICMI, in "What Mathematics for All?," takes on what he and many others see as a disastrous decline in the mathematical competence of British school-leavers. He attributes this undisputed decline to many causes, among which is the "piece of tape" curricular philosophy in which all students study ("snip off") a certain length of a subject (a piece of tape) whose courses and examinations are designed for a university goal they never reach. Howson suggests that for most, a (QL-like) curriculum deliberately designed to focus on "the mathematics of citizenship, culture, personal finance, health, . . ." would yield greater success. (See pp. 227–230.)

Mieke van Groenestijn of the Netherlands writes about the ALL literacy assessment project, focusing in particular on the ALL characterization of numerate behavior in adults. Using ALL's rather detailed description as a foundation, van Groenestijn examines the problem of educating adults for numerate behavior, which is far different from passive (or worse, inert) knowledge. She notes that because adults learn principally through action, a predisposition to numerate behavior can best be learned in real-life situations. (See pp. 231–236.)

Ubiratan D'Ambrosio of Brazil, a former vice president of ICMI, takes note of the political and cultural roles played by mathematics in all countries and at all ages, especially the recent role of "data control and management" as a tool for excluding "cultures of the periphery." D'Ambrosio, who years ago introduced "ethnomathematics" as a way to "restore cultural dignity" in societies whose mathematics was invisible in school, here advocates a three-part endeavor he calls "literacy, numeracy, and technocracy" as a means of providing access to full citizenship. (See pp. 237–240.)

These glimpses of how mathematics educators in other nations are coming to terms with the new demands of numeracy, mathematics, and citizenship open a window on approaches that move well beyond those normally considered in U.S. curriculum discussions. In addition, by revealing great differences in fundamental assumptions and objectives concerning mathematics education, they suggest important limitations on the inferences that can safely be drawn from comparative international assessments. To the degree that numeracy and mathematics are important features of our culture, differences in national traditions will necessarily create significant differences in both the objectives and outcomes of mathematics education.

References

- Cockcroft, Wilfred H. 1982. *Mathematics Counts*. London: Her Majesty's Stationery Office.
- Gal, Iddo, Mieke van Groenestijn, Myrna Manly, Mary Jane Schmitt, and Dave Tout. 1999. *Numeracy Framework for the International Adult Literacy and Lifeskills Survey (ALL)*. Ottawa, Canada: Statistics Canada.
- Kahane, Jean-Pierre, et al. 2002. *Commission de réflexion sur l'enseignement des mathématiques: Présentation des rapports et recommandations*. Retrieved January 25, 2002, at: <http://smf.emath.fr/Enseignements/CommissionKahane/RapportsCommissionKahane.pdf>.
- National Center for Education Statistics (NCES). 2002. *Outcomes of Learning: Results from the 2000 PISA Assessment of 15-Year-Olds in Reading, Mathematics, and Science Literacy*. Washington, DC: Office of Educational Research and Improvement, U.S. Department of Education.
- Organization for Economic Cooperation and Development (OECD). 1995. *Literacy, Economy, and Society: Results of the First International Adult Literacy Survey*. Paris: OECD.
- Organization for Economic Cooperation and Development (OECD). 1999. *Measuring Student Knowledge and Skills: A New Framework for Assessment*. Paris: OECD.