MATHEMATICS and
DEMOCRACY
MATHEMATICS and DEMOCRACY

The Case for Quantitative Literacy

Prepared by
THE NATIONAL COUNCIL ON EDUCATION AND THE DISCIPLINES

LYNN ARTHUR STEEN
Executive Editor
The goal of the National Council on Education and the Disciplines (NCED) is to advance a vision that will unify and guide efforts to strengthen K–16 education in the United States. In pursuing this aim, NCED especially focuses on the continuity and quality of learning in the later years of high school and the early years of college. From its home at The Woodrow Wilson National Fellowship Foundation, NCED draws on the energy and expertise of scholars and educators in the disciplines to address the school–college continuum. At the heart of its work is a national reexamination of the core literacies—quantitative, scientific, historical, and communicative—that are essential to the coherent, forward-looking education all students deserve.

The Woodrow Wilson National Fellowship Foundation

Founded in 1945, the Woodrow Wilson National Fellowship Foundation is an independent, nonprofit organization dedicated to the encouragement of excellence in education through the identification of critical needs and the development of effective national programs to address them. This combination of analysis and translation into action is the Foundation’s unique contribution. Its programs include fellowships for graduate study, professional development for teachers, educational opportunities for women and minorities, relating the academy to society, and national service.
CONTENTS

CONTRIBUTORS
Design Team vii
Authors viii

PREFACE
Mathematics, Numeracy, and Democracy xiii
Robert Orrill

The Case for Quantitative Literacy 1
The Quantitative Literacy Design Team

The Emergence of Numeracy 23
Patricia Cline Cohen

Connecting Mathematics with Reason 31
Joan L. Richards

Numeracy, Mathematics, and General Education 37
An Interview with Peter T. Ewell

Reflections on an Impoverished Education 49
Alan H. Schoenfeld

The Emperor’s Vanishing Clothes 55
Dan Kennedy
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerical Common Sense for All</td>
<td>61</td>
</tr>
<tr>
<td>Wade Ellis, Jr.</td>
<td></td>
</tr>
<tr>
<td>Mathematics and Numeracy: Mutual Reinforcement</td>
<td>67</td>
</tr>
<tr>
<td>Alfred B. Manaster</td>
<td></td>
</tr>
<tr>
<td>Connecting Theory and Practice</td>
<td>73</td>
</tr>
<tr>
<td>An Interview with James H. Stith</td>
<td></td>
</tr>
<tr>
<td>Quantitative Literacy for the Next Generation</td>
<td>79</td>
</tr>
<tr>
<td>Zalman Usiskin</td>
<td></td>
</tr>
<tr>
<td>Encouraging Progressive Pedagogy</td>
<td>87</td>
</tr>
<tr>
<td>Larry Cuban</td>
<td></td>
</tr>
<tr>
<td>Achieving Numeracy: The Challenge of Implementation</td>
<td>93</td>
</tr>
<tr>
<td>Deborah Hughes-Hallett</td>
<td></td>
</tr>
<tr>
<td>Setting Greater Expectations for Quantitative Learning</td>
<td>99</td>
</tr>
<tr>
<td>Carol Geary Schneider</td>
<td></td>
</tr>
<tr>
<td>EPILOGUE</td>
<td>107</td>
</tr>
<tr>
<td>Embracing Numeracy</td>
<td></td>
</tr>
<tr>
<td>Lynn Arthur Steen</td>
<td></td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>117</td>
</tr>
</tbody>
</table>
CONTRIBUTORS

Design Team

The following contributors were members of the Design Team formed to look into the meaning of numeracy in contemporary society. Led by Lynn A. Steen, the Design Team developed the first part of this book, “The Case for Quantitative Literacy.”

Gail Burrill is director of the Mathematical Sciences Education Board at the National Research Council in Washington, D.C.

Susan Ganter is associate professor of mathematical sciences in the Department of Mathematical Sciences at Clemson University in Clemson, South Carolina.

Daniel L. Goroff is professor of the practice of mathematics and associate director of the Derek Bok Center for Teaching and Learning at Harvard University.

Frederick P. Greenleaf is professor of mathematics in the Department of Mathematics at the Courant Institute of New York University in New York City.

W. Norton Grubb is David Gardner Professor of Higher Education Policy, Organization, Measurement, and Evaluation in the Graduate School of Education of the University of California at Berkeley.

Jerry Johnson is professor and chairman of the Mathematics Department at the University of Nevada at Reno.

Shirley M. Malcom is head of the Directorate for Education and Human Resources Programs at the American Association for the Advancement of Science in Washington, D.C.
Veronica Meeks teaches mathematics at Western Hills High School in Fort Worth, Texas.

Judith Moran is associate professor of quantitative studies and director of the Mathematics Center at Trinity College in Hartford, Connecticut.

Arnold Packer is chair of the SCANS 2000 Center at Johns Hopkins University in Baltimore, Maryland.

Janet P. Ray is a professor at Seattle Central Community College in Seattle, Washington.

C. J. Shroll is executive director of the Workforce Development Initiative at the Michigan Community College Association in Lansing.

Edward A. Silver is professor of mathematics in the Department of Mathematics in the University of Michigan School of Education in Ann Arbor.

Lynn Arthur Steen is professor of mathematics in the Department of Mathematics at St. Olaf College in Northfield, Minnesota.

Jessica Utts is a professor in the Department of Statistics at the University of California at Davis.

Dorothy Wallace is professor of mathematics in the Department of Mathematics at Dartmouth College in Hanover, New Hampshire.

Authors

The authors listed below were invited to comment on the case statement developed by the Quantitative Literacy Design Team.


Larry Cuban, professor of education at Stanford University, studies the history of school reform, including curriculum, governance, and technology. Among his recent publications is Reconstructing the Common Good in Education: Coping with Intractable American Dilemmas (coeditor with Dorothy Shipps), 2000.

Wade Ellis, Jr. is a mathematics instructor at West Valley College, in Saratoga, California. He is interested primarily in the use of technology in learning and teaching mathematics. His most recent publication is “Technology and Calculus’
Peter T. Ewell is a senior associate at the National Center for Higher Education Management Systems (NCHEMS). He concentrates on the educational effectiveness of colleges and universities through applied research, policy development, and direct consulting with both institutions and state systems of higher education. His recent publications are “Achieving High Performance: The Policy Dimension” in W. G. Tierney (ed.), The Responsive University, 1998, and “Identifying Indicators of Curricular Quality” in J. G. Gaff and J. L. Ratcliff (eds.), Handbook of the Undergraduate Curriculum, 1996.


Dan Kennedy is Lupton Professor of Mathematics at the Baylor School in Chattanooga, Tennessee. He is interested in all areas of education reform, particularly as they affect the transition from high school to college. He is coauthor of Calculus: Graphical, Numerical, Algebraic (Finney, Demana, Waits, Kennedy), 1999, and Precalculus: Graphical, Numerical, Algebraic (Demana, Waits, Foley, Kennedy), 2000.

Alfred B. Manaster is professor of mathematics at the University of California, San Diego. His professional activities are largely focused on the learning, teaching, and assessment of mathematics in courses from algebra through calculus. He serves as the director of California’s Mathematics Diagnostic Testing Project and he was a member of one of the writing groups for NCTM’s Principles and Standards for School Mathematics, 2000. His most recent research publication is “Some Characteristics of Eighth Grade Mathematics Classes in the TIMSS Videotape Study” in The American Mathematical Monthly, November 1998.


Alan H. Schoenfeld is the Elizabeth and Edward Conner Professor of Education at the University of California, Berkeley. His research is concerned with the nature of mathematical thinking, teaching, and learning. Schoenfeld was a writing group leader for Principles and Standards for School Mathematics and he has written, edited, or coedited books on mathematics education, including four volumes of Research in Collegiate Mathematics Education (1994, 1996, 1998, 2000); Mathematical Thinking and Problem Solving, 1994, and Cognitive Science and Mathematics Education, 1987.

James H. Stith is the director of the Physics Resources Center at the American Institute of Physics. His areas of interests are physics education (program evaluation and teacher preparation and enhancement) and student recruitment and retention. His recent publications include “Having a Private Conversation in a Crowded Room” in C. Stanley (ed.), Large Class Instruction (in press); “Getting Actively Involved in Professional Organizations” in S. M. McBay (ed.), Scholarly Guideposts for Junior Faculty, 2000, and “Interdisciplinary Communication and Understanding” with J. H. Grubbs in D. C. Arney (ed.), Interdisciplinary Lively Application Projects (ILAPS), 1997.

Robert Orrill is the Executive Director, National Council on Education and the Disciplines (NCED), and Senior Advisor at The Woodrow Wilson National Fellowship Foundation (WWNFF), Princeton, New Jersey. NCED brings together university faculty and secondary school teachers to address issues of educational continuity in the later years of high school and the early years of college. Formerly Executive Director of the Office of Academic Affairs at the College Board, Mr. Orrill was chief liaison with the academic community, both at the secondary and postsecondary levels and across the full range of disciplines. Among his numerous publications are: *The Future of Education: Perspectives on National Standards in America*, 1994; *The Condition of American Liberal Education: Pragmatism and a Changing Tradition*, 1995, and *Education and Democracy: Re-imagining Liberal Learning in America*, 1997.

Lynn Arthur Steen is professor of mathematics and senior adviser to the academic vice president at St. Olaf College in Northfield, Minnesota. His current work is focused on numeracy—the quantitative and mathematical requirements for contemporary work and responsible citizenship. He is the editor or author of many books and articles on mathematics and education. Most recently he edited *Why Numbers Count: Quantitative Literacy for Tomorrow’s America*, 1997. Earlier volumes include *On the Shoulders of Giants: New Approaches to Numeracy*, 1991; *Everybody Counts*, 1989; *Calculus for a New Century*, 1988.