

# Planning a Conversation about Quantitative Literacy and Teacher Education

Bernard L. Madison\*  
*University of Arkansas*

*Can bad numbers do good?*

— From Wingspread discussions

The task was ambitious, some would say hopeless: create a productive two-day conversation among thirty scholars—most strangers to the others—about two virtually disjoint—some would say unrelated—components of US education. One component, teacher education, is a staple of US education, confined in multiple bureaucracies, spread across higher education but governed by schools of education, and firmly entrenched as a national priority. The other, quantitative literacy (QL), has no academic home, is poorly understood and hardly recognized by either academe or the US public, but nonetheless considered important, even critical. And to what end? Better education for QL and for teachers, of course. But what concrete outcomes of the conversation could make a dent in these enormous and operationally unconnected enterprises? Recommendations from much more extensive conversations about narrower issues are often no more effective than shouting into the wind, so even if the

---

\*Bernard L. Madison is professor of mathematics at the University of Arkansas, having served as department chair (1979–89) and dean of the Fulbright College of Arts and Sciences (1989–99). He has recently directed major NSF-funded national faculty development projects in assessment and the mathematical education of teachers (with Alan Tucker). Having written or edited several articles and books on quantitative literacy and assessment, he is currently writing materials for and assessing learning in a case based course in quantitative reasoning. A native of Kentucky with a Ph.D. degree from the University of Kentucky, Madison was professor of mathematics at Louisiana State University prior to going to Arkansas as department chair.

conversation resulted in an unlikely consensus on what should be done, recommendations to educators and policymakers was not a goal. Rather, beyond the valuable outcome of strangers no longer being strangers, the concrete communal outcome sought was a list of questions that institutions might address to audit their programs of teacher education and QL education: a small beginning step on what is likely a long journey.

## The new kid and the old hand . . .

For a decade a small loosely organized group of interested folks led by historian Robert Orrill had strived to make QL better understood and a priority of both school and college. Some of these were mathematicians, some statisticians, but several other disciplines were also involved. A national forum in 2001 brought together 130 scholars and policy makers to focus on QL education at the juncture of high school and college (Madison & Steen, 2003). Much of the forum discussion tossed about the meaning of QL, where responsibility for QL education lay, and the relationship of QL to mathematics and statistics. The smaller conversation of thirty was to build on this beginning, eventually engaging a larger and more diverse audience.

For a century schools of teacher education had graduated tens of thousands of teachers as US education thrived. But recent international comparisons showing weakness in US education, especially mathematics education, had spurred rethinking of the mathematical education of teachers. One of the glaring weaknesses appeared to be in QL-related areas such as solving contextual problems (OECD, 2003; 2006). Perhaps the time was right for merging the comparatively youthful discussion of QL with the age old but re-invigorated discussion of teacher education.

In this context, the workshop, Quantitative Literacy and Its Implications for Teacher Education scheduled for Wingspread Conference Center in Racine, Wisconsin, June 22–24, 2007, was structured during December 2006 and January 2007 to integrate the recent initiatives on education for QL and the mathematical education of teachers. The QL initiative centered on projects of the National Council on Education and the Disciplines (NCED) over the past decade, which included the 2001 publication *Mathematics and Democracy*. The teacher education initiative grew around publication of *The Mathematical Education of Teachers* report in 2001 by the Conference Board of the Mathematical Sciences (CBMS). Both of these publications emphasize developing habits of mind, one a habit of mind to understand and use quantitative information in everyday life and the other a mathematical habit of mind required to teach mathematics well. Beyond these tangential

connections, however, the discussions of mathematical teacher education and QL have had little obvious overlap. The Wingspread workshop was a first step toward synergistic cooperation between teacher education and QL education where teacher education is not restricted to mathematical education.

## Why QL and teacher education together ...

The obvious reason why teacher education and QL education should be considered together is that K–12 education is responsible for much of QL, and K–12 teachers need to be able to guide students toward QL. Although QL should be an aim of education across all subjects in K–12, a large part of the responsibility falls to K–12 mathematics, which includes data analysis, statistics, and probability. Although part of the aim of the workshop was to elicit support from several disciplines in preparing K–12 teachers better in QL, the primary focus was on the mathematical education of teachers as a means of preparing them as QL educators.

The mathematical education of teachers has received considerable recent attention because there is growing evidence that it can be improved through the collaboration of mathematicians and mathematics educators. Education for QL has received attention because of the growing demands on US residents to understand, utilize, and react to quantitative information and analyses in their daily lives. This growing demand increases the need for stronger quantitative education in K–12 and in college. An important component of the student population for this stronger quantitative education consists of future teachers. Consequently, teacher education and QL education are intertwined in ultimate purpose but loosely connected in educational practice.

Everyday contextual situations are heavily utilized in early school mathematics (and non-mathematics) studies but become much less evident in middle school, high school, and college mathematics. The data analysis, statistics, and probability strand in school mathematics does maintain some everyday contextual connections, but in college statistics courses are usually separate from mathematics courses. Many college statistics courses are methodological or theoretical and have minimal everyday connections. As a consequence of these circumstances, there seem to be advantages from merging the two efforts.

For example, improved mathematical education for teachers results from connecting the mathematics of the college classroom to the mathematics of teaching in school, and QL education is largely about connecting learning and reasoning in mathematics and other college disciplines' classrooms to contextual situations in the contemporary world. Another example is that resolving QL

situations requires data analysis and a process similar to the scientific method both of which teachers should understand and utilize. This similarity would provide additional coherence in problem solving in and beyond school. A third example of an opportunity for synergism is to understand the relationship between mathematical proficiency and QL. A very nice model of mathematical proficiency that seems very adaptable to QL is given in *Adding It Up*, where mathematical proficiency is described as five intertwined threads of conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (Kilpatrick, Swafford, & Findell, 2001).

These and other analogies and connections, plus the opportunistic circumstance of being involved in both the QL and teacher education initiatives, prompted my October 2006 proposal to the Johnson Foundation for the workshop. The proposal had its origin in a small gathering I attended in August 2006. Then Johnson Foundation President Boyd Gibbons invited several people<sup>1</sup> to the Wingspread Conference Center in Racine, Wisconsin, to discuss a series of conferences to craft a new vision of high school through college education from a “clean slate.” That discussion, which focused largely on revitalization of undergraduate liberal education, identified several possible conference topics. Among those topics, quantitative literacy was reasonably prominent as a subject for curricular innovation. The proposal for the QL and Teacher Education workshop was a follow-on result largely because of opportunistic funding possibilities, but also because of the potential educational connections and synergisms.

## Focusing the conversation . . .

In order to focus the discussion on QL and teacher education rather than on one or more of the meaning of QL, assessment of QL, liberal education, and assessment of liberal education, the workshop steering committee<sup>2</sup> commissioned seven papers on aspects of QL and teacher education. Three of the seven—on situational learning, teacher certification, and fractions—were directly related to teacher education. In the end we had eight papers<sup>3</sup> since proposed co-authors of the fractions paper, Milo Schield and Alan Tucker, had very different perspectives, so they decided to produce two papers. Historian Robert Orrill and psychologist Neil Lutsky would write on words and numbers—Orrill from the perspective of the humanities and Lutsky on argument and numbers based on experience with a Carleton College initiative. Sociologist Joel Best would address numbers and public policy, British physicist-turned-mathematics-educator Hugh Burkhardt agreed to discuss situated learning, Corrine Taylor investigated the QL needs in business and industry, and Frank Murray would re-

late QL and teacher certification. The initial drafts of each of these papers were reviewed by at least two workshop participants, and the authors responded to the reviews with a workshop draft. Each paper would be the subject of a session at the workshop, and the authors would produce a final draft in light of these discussions.

With the essays commissioned, the steering committee set about the task of inviting participants. With a dozen of the thirty slots committed to authors and committee members, filling out the participant list for an effective workshop was replete with options. Even though the workshop focused on US undergraduate education, there were numerous relevant perspectives—teacher educators, professional societies, assessment experts, policy makers, undergraduate education specialists, and scholars from the humanities, social sciences, sciences, arts, engineering, business, mathematics, and statistics. Eventually we invited participants from more than a dozen disciplines representing a wide spectrum of interests and expertise.

To move the discussion of QL education forward, the workshop call assumed knowledge of several previous publications on QL and teacher education. These included *Mathematics and Democracy* (Steen, 2001), *Quantitative Literacy: Why Numeracy Matter for Schools and Colleges* (Madison & Steen, 2003), *Achieving Quantitative Literacy* (Steen, 2004) and *The Mathematical Education of Teachers* (CBMS, 2001). In addition, of course, the eight commissioned papers were distributed to participants prior to convening on June 22, 2007.

## The workshop program ...

What workshop program would fuel a productive conversation among thirty (eventually this became thirty-one) scholars from multiple disciplines? The commissioned papers provided a foundation, but each participant was expected to have some session leadership role, giving rise to three plenary panels—one highlighting classroom experiences, one on the institutional audit, and the third on influencing the establishment. The eight commissioned papers were discussed in two parallel sequences of two sessions, pairing the two papers on words and numbers, two on fractions, two on situated learning and teacher certification, and two on QL in business and public policy. This was promising, but how would the workshop begin? Who would set the stage for the conversation?

The steering committee agreed on Richard J. Shavelson, Stanford University, who had recently written on his extensive involvement in the innovative Collegiate Learning Assessment. When invited, Professor Shavelson

asked how we would suggest that he address the issues of teacher education and QL. To help construct a response to this, one member of the steering committee wrote me describing a recent paper by Shavelson.

What [Professor Shavelson] gives in that paper is a broad and multidimensional view of the multiple forms of knowledge and related goals of education, juxtaposed with the comparatively narrow focus of commonly used tests on a small part of that broad domain. In fact, he argues that there is a disconnect between what matters most in education and what we are now testing. This, to my mind, draws a broad and radical framework in which to locate teacher preparation broadly (all fields) and specifically (quantitative reasoning). It also sets up especially challenging issues for teacher education since teachers are now pressured to “teach to tests” that are unaligned with the most important uses of knowledge. (Knowing this, what are the ethical responsibilities of educators and higher education overall?) So, I would ask him to spell out the big problem outlined above—offer a few thoughts on teacher preparation—and then share with us his thoughts on how we might create worthy assessments that would be worth teaching to.

Since we were promoting a truly interdisciplinary conversation, we wanted also to relate QL to both pre-professional and liberal education. We turned to Deborah Hughes Hallett who has extensive experience in QL education in mathematics at Harvard University and the University of Arizona, and in public policy at the John F. Kennedy School of Government. She agreed to lead a plenary conversation following Shavelson’s presentation to help open up issues for discussion in subsequent sessions.

The two plenary opening sessions, the three panels, the four commissioned paper sessions, and a summing-up session completed the program. The big question remained as to how the papers, the program, and the participants would interact in the inspirational retreat environs of the Wingspread Conference Center.

### Summing up: Wingspread would make it work ...

Was the task ambitious or hopeless? Could such a diverse group of thirty-one scholars from more than a dozen disciplines hold a productive conversation on two rather disconnected components of education? The commissioned papers were extraordinary, due largely to the talents and knowledge of the authors rather than guidance from the steering committee, and the papers covered sufficient intellectual ground to underwrite a conversation. The program was set, again with minimal guidance from the steering committee on the contents of the various sessions. In the end, the ingredient that would provide seasoning sufficient for success was the environs of Wingspread<sup>4</sup>. The first words in the program

booklet provided the key: “The setting at Wingspread is designed to reduce outside distractions to allow you to focus on the conference issues at hand.” Wingspread would provide some of the magic that would make this workshop on QL and teacher education fit its model of “small meetings of thoughtful and rigorous inquiry convened in an atmosphere of candor and purpose.”

Needless to say, issues in QL and teacher education constitute an agenda for decades, and a two-day workshop—even in an idyllic and inspirational setting—can only prompt and guide further work. In the article following this, Lynn Steen will focus on what the workshop produced from these and other possibilities.

As the foregoing indicates, developing the workshop involved the attention and work of several people. First, the steering committee members listed in the second endnote and in the front matter of this volume molded the program and commissioned the papers. The commissioned papers were reviewed by at least two workshop participants and at the workshop itself by participants. The high quality of these papers is due to the creativity of the authors and the care and insights of the reviewers. Each workshop participant was assigned a role as session leader, presenter or reporter, and all were carried out splendidly with minimal guidance from the steering committee. My appreciation goes to the Johnson Foundation, its emeritus president Boyd Gibbons, who got me involved in this venture, its current president Roger Dower, and staff members Carole Johnson and Barbara Schmidt. In addition to subsidy by the Johnson Foundation, the workshop was made possible by the NSF-funded PMET project of the MAA. The PMET coordinator at the University of Arkansas, Tami Trzeciak, handled all the pre-workshop communications with participants and the Johnson Foundation staff. Working with co-editor Lynn Steen is always educational and pleasant, and the MAA programs and editorial staff—Michael Pearson, Elaine Pedreira, and Beverly Ruedi—made the volume happen. Thanks.

Special thanks are owed to Robert Orrill whose curiosity, persistence, and deceptively simple questions which defied simple answers launched the QL movement that has now spread to multiple disciplines, scores of campuses, and thousands of students.

## References

- Steen, L. A. (Ed.). (2001). *Mathematics and democracy*. Princeton, NJ: National Council on Education and the Disciplines.
- Madison, B. L., & Steen, L. A. (Eds.). (2003). *Quantitative literacy: Why numeracy matters for schools and colleges*. Princeton, NJ: National Council on Education and the Disciplines.

- Steen, L. A. (2004). *Achieving quantitative literacy*. Washington, DC: Mathematical Association of America.
- Conference Board of the Mathematical Sciences (CBMS). (2001). *The mathematical education of teachers*. Providence, RI: American Mathematical Society and Washington, DC: Mathematical Association of America.
- Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). *Adding it up*. Washington, DC: National Academies Press.
- OECD. (2003). Program for International Student Assessment. Paris, France: Organization for Economic Co-operation and Development (OECD). [www.pisa.oecd.org](http://www.pisa.oecd.org)
- OECD. (2006). Program for International Student Assessment. Paris, France: Organization for Economic Co-operation and Development (OECD). [www.pisa.oecd.org](http://www.pisa.oecd.org)

## Endnotes

<sup>1</sup> Andrew Delbanco (Columbia University), Michele Dominy (Bard College), Timothy Fuller (Colorado College), Stanley Katz (Princeton University), Bernard Madison (University of Arkansas), Jerry Martin (American Council of Trustees and Alumni), Russell Newman (University of Michigan), Mark Sargent (Villanova University), Carol Schneider (Association of American Colleges and Universities), and Johnathan Williams (The Accelerated School).

<sup>2</sup> The Steering Committee members were Stanley Katz (Princeton University), Bernard Madison (University of Arkansas), Robert Orrill (National Center on Education and the Disciplines), Richard Scheaffer (University of Florida), Carol Geary Schneider (Association of American Colleges and Universities), Lynn Arthur Steen (St. Olaf College), Corrine Taylor (Wellesley College), and Alan Tucker (State University of New York at Stony Brook).

<sup>3</sup> The eight commissioned papers by Joel Best, Hugh Burkhardt, Neil Lutsky, Frank Murray, Robert Orrill, Milo Schield, Corrine Taylor, and Alan Tucker plus the opening session plenary presentation by Richard Shavelson make up the bulk of this report.

<sup>4</sup> Wingspread was built in 1939, in Racine, Wisconsin. It is the last of Frank Lloyd Wright's prairie houses and his largest single-family residence. Wright designed Wingspread for the family of H. F. Johnson, Jr., who lived there from 1939 to 1959. In 1959, Mr. Johnson established The Johnson Foundation, designating Wingspread as its educational conference center. The Guest House, where conference participants stay, was constructed in 2002.