Will Everybody Ever Count?

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Because of our consistent poor performance in international comparisons of education, the United States is awash in concern about assessment: How can we know whether things are getting better, whether we are making progress towards our goals? Although most of the public still accepts scores on national multiple-choice tests as the key indicator of educational progress, many thoughtful educational leaders—including, fortunately, our Secretary of Education—are aware that new goals for education require new approaches to assessment.

It is in this context of a national mania for measuring results that I approach my topic today—to reflect, nearly three years after its publication, on the goals of *Everybody Counts.* This 1989 report of the National Academy of Sciences was followed in a matter of weeks by publication of the NCTM *Standards,* more formally titled *Curriculum and Evaluation Standards for School Mathematics.*

The coordination of these reports was no accident: their paired publication was intended to convey both the image and reality of significant and unprecedented cooperation among teachers and research leaders. The challenge posed by the National Academy—representing the nation's leading scientists—to ensure that *all* students receive a high quality mathematics education was answered by NCTM—representing the nation's mathematics teachers—with a framework for reform built on a common core curriculum for all students.

It is absurd to ask now, only 32 months later, whether the United States has achieved the goals of *Everybody Counts*, or whether we can find in assessment data any evidence of reasonable progress towards these goals. Although we do see many outward signs of progress, not least the rhetorical commitment of President Bush and Education Secretary Lamar Alexander, it will take years for today's actions to translate into tomorrow's results.

So I come before you not to report on the past but to speculate about the future. In the spirit of our current debate about how best to conduct assessment, I shall approach my question—will everybody ever count?—from different assessment perspectives. I begin with our current testing norm: multiple choice.:

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Will everybody ever count?
      A. Yes.
      B. No.
      C. Some will, some won't.
      D. Only the ''educationally advantaged.''
      E. Only the ''math geniuses.''
      F. Maybe by the year 3000.
      G. Some of the above.
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I guess the safe answer is "G. Some of the above." We know that some students approach education with advantages that others don't have—from home, family, community, traditions. So not everybody has an equal opportunity to succeed in mathematics. Unequal opportunity is one among many reasons why the President's target of becoming "Number One" in mathematics and science by the year 2000 is widely regarded as unrealistic and unattainable. It may indeed take another millennium to ensure success if that is to be our target.

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We can make our question a bit more suitable to higher-order thinking by asking for an estimate, with justification:

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   By the year 2000, what percentage of the U.S. adult
population will be numerate?  Justify your estimate with
evidence from current performance and well-founded
projections.
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Data from the National Assessment of Educational Progress (NAEP) support very pessimistic projections. This study uses four benchmarks that correspond, very roughly, to what students should know about mathematics as they leave grades 3, 5, 8, and 10. As would be expected, twelfth grade students diminish in achievement as the standards increase:

1990 NAEP Assessment
(Twelfth Grade Students)

Level	**Grade**	**Percent**	**Descriptor**
200	3	100%	Addition and subtraction of whole numbers
250	5	91%	Multiplication and two-step problem solving
300	8	46%	Fractions, decimals, percents, geometric measurement
350	10	6%	Elementary algebra, geometry, statistics, and probability

It appears from these data that the United States has now achieved nearly universal numeracy as the term was understood over a century ago—the 'rithmetic of primary school. That's not much of an accomplishment, but even it is an exaggeration, since many students—about 25%—drop out of school prior to the twelfth grade. Since the mathematical achievements of these students are marginal at best, one may safely assume that school dropouts are concentrated at the lower NAEP achievement levels. These considerations yield revised estimates for the quantitative literacy of America's young adults:

Level	**Grade**	**Percentage**
200	3	90%
250	5	75%
300	8	40%
350	10	5%

The gap between today's reality and the NCTM vision is indeed overwhelming: the *Standards* clearly challenge us to raise the 5% at level 350 to 100%. If this is what it means for everybody to "count," we will have a long wait indeed—perhaps even beyond the year 3000. However, if we mean merely the old-fashioned basics of school arithmetic, as much of the public seems to expect, then the goal of universal numeracy appears to be within grasp.

The estimated profile of 90–75–40–5 of young adult numeracy slips to approximately 80–50–20–1 for Black, Hispanic, and other at-risk minority students. The NAEP data shows similar depression in the performance of children who grow up in poverty, in rural communities, and with relatively uneducated parents. Achievement in coming years will be attenuated further by the direct and indirect effects of hundreds of thousands of crack babies who will come of age as children in our public schools.

Before we can expect every child to "count," we need to ensure equal access to quality education. The ratio of public resources spent per child on school education varies by over 4:1 from one district to another in the United States. Perversely, those districts whose children are in greatest need devote the fewest resources to education. Although in some cases lack of resources can be attributed to lack of political will to support education, in most instances it is due to uneven distribution of resources: the same conditions of family and community poverty that make the job of schools unusually challenging also conspire to reduce the resources available for education. To assure that each child has appropriate opportunity to learn, the resources available to schools must be sufficient to meet the needs of the children they serve.

The message of *Everybody Counts* is the message of equality—of opportunity to learn and of expectation for achievement. The reality of U.S. schools is what Jonathan Kozol has aptly termed "savage inequity." So one projection we can make with great confidence, based on data from many current sources: unless all children are provided equal opportunities to learn, only the advantaged few will achieve our nation's goals for mathematics education. Just as business requires a level playing field for international competition, so children need a level field for successful learning.

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Careful analysis of data from current national and international assessments leads inevitably to reflection on goals and intentions. Mathematical achievement is multi-dimensional; it can be tracked in terms of seat-time, content levels, procedural knowledge, attitudes, or higher-order thinking skills. We know that seat-time diminishes exponentially after mathematics becomes an elective subject, with a half-life of about one year: each year after tenth grade, the number of students studying mathematics is about half of what it was the previous year. This decline tracks well a precipitous collapse of student attitudes towards mathematics: whereas in grade five mathematics is one of the best-liked school subjects, by twelfth grade it is the least-liked.

The NAEP data, which is collected not only at 12th grade but also at 4th and 8th grades, show that schools do succeed in teaching nearly everyone the lowest level skills but that they have very little success in teaching higher-order skills. Four years after children have been taught simple arithmetic, virtually all know it. But four years after having been taught higher arithmetic (decimals, percents, area), only 40% know it.

The data show that children's learning of mathematics progresses well only for the first half of their school years—until they encounter percents and puberty. Thereafter, for half the population, learning virtually stops, attitudes reverse, and mathematics quickly becomes a filter rather than a pump for higher education.

This suggests that our original question would be more useful if framed in a way that elicits not just an answer, but an analysis of assumptions, context, and evidence:

Should Everybody Count?

> The nation's scientific and educational establishment argues in Everybody Counts and in the NCTM Standards that every child should study a common core of mathematics for 11-12 years, and that it is reasonable to expect of teacher and students that all who work hard will succeed.
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> Many politicians have picked up this theme, urging that the United States make a commitment to become ''Number 1'' in world-wide comparisons of mathematics and science. They argue that in a global marketplace we have no choice but to match our education to world-class standards.
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> Others, including nationally syndicated columnists, have argued that the central goal of Everybody Counts is unnecessary and counterproductive. They assert that only a few will need advanced mathematics and that the majority are poorly served by mathematics requirements that demonstrably weaken attitudes, increase drop-out rates, and destroy enthusiasm for learning.
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> Write an op-ed column supporting one or the other of these two views, or some other position of your choosing. Support your argument both with evidence and citations as well as by careful critique of critics' arguments.

The critics of *Everybody Counts* and the *Standards* include *Washington Post* columnists William Raspberry and Coleman McCarthy, in addition to many leading mathematicians and scientists. They advance different arguments based on their very different perspectives, but reach essentially the same conclusion: that instead of taking as a goal that everyone would reach the NAEP level 350—which is a plausible interpretation of what *Everybody Counts* and the *Standards* are saying—that we should instead set different national targets for each different NAEP level.

Public policy arguments in favor of differentiated targets are based primarily on economic considerations. The marketplace requires (and will pay for) only a certain number of people at each level, so any national policy that exceeds these market-dictated minimums is a costly and unnecessary impediment to our nation's ability to compete in a global economy. The economists' argument is, in effect, that the goal of *Everybody Counts* can be achieved only at the price of a permanent unfavorable tilt in the playing field of economic competition.

Many mathematicians and scientists advance similar views derived from their analysis of the personnel pipeline of science and technology: since it will be very difficult to marshal sufficient human and financial resources to ensure an adequate supply of world-class scientists and engineers, we should not risk diminishing this key resource for national competitiveness by unnecessary re-direction of effort to less scientifically productive segments of the educational pipeline.

A related argument against equal mathematical expectations for everyone is that if policy and resources are devoted to this vast and apparently unattainable goal, the result may well be that "perhaps nobody will count," to quote the title of one widely-read critique of *Everybody Counts*.

Yet another argument often voiced in opposition to programs whose goal is "mathematics for all Americans" is based on the well-known failings of the "back-to-basics" movement. Any policy whose goal is that every child should meet minimal expectations most likely will result in reduced opportunities for those who are ready and able to exceed the minimum. Too often, minimum standards become maximum achievement.

On the other side, in support of unflinching expectations for all, is evidence from many sources that all students learn more when standards are high. Reduced expectations for students who are not performing at satisfactory levels only results in further reduction in achievement. The NCTM goal of a common core curriculum for all students, differentiated by approach and depth but not by objectives, is a realistic strategy to raise standards without increasing dropouts.

Further evidence of the need for common standards can be seen in the destructive effects—both on individuals and on society—of practices that reward the economically advantaged with an education that provides, through mathematics, the means to greater economic power, while denying this opportunity to those who most need it. Absent real equality of opportunity, differentiated targets will do little but reinforce the entrenched economic and class differences of society.

Finally, one must consider the metaphor of digging wells so as to pump ground water to the surface for productive use. If instead one can raise the water table, then springs that formerly may have required considerable effort to locate and pump will begin flowing naturally. So it is with interest and inclination for the study of mathematics and science. As more students achieve better learning in mathematics, greater numbers will move forward with accelerated interest and performance, thus filling the scientific pipeline by natural means without the need for perpetual special interventions.

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Clearly the slogan "Everybody Counts" is simplistic. If by "count" we mean those parts of mathematics that really count in our global society, then not everybody will count now or in the future. National goals, whether stated in terms of minimal or average expectations, can easily be implemented in ways that have consequences inimical to the broad goals of education. To understand the goals of the *Standards* in a constructive and reasonable way, we need to think not just about minimums and averages, but also about variation.

Effective national goals must take into account the inevitable variability introduced from numerous sources, including family, school, community, and region. As I understand it from

Geoffrey Howson's recent book, the national curriculum introduced in the United Kingdom describes attainment targets in terms of levels (ten in all) based not just on averages, but also on variability. Although I gather that many aspects of this new U.K. curriculum are quite controversial, the recognition of variability seems like an entirely reasonable approach for any program that seeks to establish national "standards."

One consequence of expectations that take into account both averages and variability would be guidelines more sophisticated than that "everybody" counts. Such guidelines would have as their intent not that all achieve identically, but that all schools and all children make consistent, measurable progress towards the goal of mathematical power for all. This suggests two important goals for educational and public policy:

- Each year each school should increase the percentage of its children who achieve at different levels.
- Public resources should be used to equalize opportunity for effective instruction.

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Even as we recognize variability as an essential attribute of national goals, we must also recognize that diversity is inherent in the methods we use to measure progress towards these goals. Some students learn to do well on the timed, short answer instruments that form the basis for most national and international tests of numeracy. Others, undoubtedly the majority, learn only to hate such instruments. Wise policy must acknowledge the importance of these differences.

Despite overwhelming public support for simplistic "report cards" based on traditional, objective tests, such instruments are neither appropriate indicators of mathematical power (as defined by the NCTM *Standards*) nor suitable measures of quantitative literacy. At best they represent a contemporary perversion of the nineteenth century ideal of the third R—'rithmetic.

Whereas contemporary tests offer little of lasting value, the goals of the NCTM *Standards* comprise the rich diversity of mathematics in practice:

- Students who value mathematics will readily discern its importance in approaching ordinary, authentic problems of daily life and work.
- Students who reason mathematically will habitually apply informed critical judgment to issues about which they read, think, and debate.
- Students who can communicate mathematically will be fluent in reading, writing, speaking, and listening in contexts that are rich in numerical, graphical, and symbolic information.
- Students who can solve problems will be able to formulate issues in suitable mathematical terms, to select appropriate strategies, to find appropriate solutions, and to work with others to reach consensus on recommendations that are both effective and logical.
- Students who are confident of their abilities in mathematics will approach problems flexibly, will acknowledge their own limits, and will be receptive to opportunities to learn new mathematics.

Assessment based on these goals would reflect the diversity of mathematical practice and at the same time amplify the diversity of student strengths. Such assessment would be a worthy test of how many can "count"—whether it be few, many, or most. Any measure of mathematical performance that does not reflect these goals is fatally flawed—at best incomplete, at worst duplicitous.

Effective assessment intended to monitor progress towards the goals expressed in the NCTM *Standards* will require an enormous variety of methods, including:

- *Observation* of students both in class-related activity and in informal situations.
- *Discussion* with students to see how they think and express themselves.
- *Assignments* to interpret mathematically rich ideas presented in writing and orally.
- *Writing* that expresses solutions to problems, both routine and challenging.
- *Reasoning* expressed through written argument and mathematical proof.
- *Calculation* in symbolic, computer, numerical, calculator, and graphical forms.
- *Team work* by classmates who argue, compromise, cooperate, and reach consensus.

For many reasons, systematic assessment based on these varied methods is simply not practical. Few teachers have experience in this type of assessment; testing large numbers of students would be very expensive; and persuasive comparisons among schools or states would be nearly impossible. Yet this type of wholistic, authentic, performance-based assessment is essential if one is to determine how much progress we are making towards the goals of *Everybody Counts* or the NCTM *Standards*.

Ordinary tests of any sort will never give more than a partial answer. Authentic assessment that is embedded in instruction will yield a rich analysis of student performance that cannot be summarized on any linear scale. Any measure of student attainment that is consistent with the goals of the *Standards* will be more like a college admissions portfolio than like a score on the SAT exam. Effective measurement must be both multi-dimensional and multi-faceted, both narrative and numerical, both observational and open-ended. The ultimate measure of learning will be students' performance in subsequent courses and jobs. Variability in achievement can then be calibrated against the demands of life and work. Performance in practice is the true performance-based assessment.

Thus the difficulty of teaching effectively in a manner consistent with the NCTM *Standards* is matched—indeed, exceeded—by the difficulty of assessing the goals of these same *Standards.* So instead of asking "Will everybody ever count?", we might instead ask "How will we know if everybody counts?" That can be the subject of a future lecture, perhaps in the year 2000.

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