Commentary on Education Legislation: A Mathematical Perspective

In the years since the Bush administration's No Child Left Behind (NCLB) Act, it has become increasingly clear that federal policy can affect the general climate in American schools. Improvements in student mathematics performance have been isolated and minimal, a fact that is not surprising considering that the policies in NCLB were primarily determined by those with partisan political agendas, not mathematicians or teachers. The interested parties, not to mention the American public, seem to agree that students are not performing adequately in math, yet the question of what to do about the problem remains. In March the Obama administration released *A Blueprint for Reform*, its vision for rewriting NCLB, once again making the pipeline to higher education the subject of Congressional debate. Mathematicians can best guide this debate by addressing the shortcomings of NCLB and lobbying for reform in the mathematics preparation of college-bound students.

Unfortunately, it is difficult to identify specific learning outcomes from NCLB because of its ubiquitous implementation. That is, because no adequate control group exists, changes in mathematics proficiency cannot be directly attributed to NCLB. However, an analysis of teacher responses and resulting trends show a problematic shift in classroom teaching. The results of a survey of Washington, DC-area middle school mathematics teachers a few years after NCLB had been in effect indicated that most teachers had increased the time spent on standardized test preparation but had not meaningfully engaged with their students in mathematics lessons. Teacher interviews then identified a third effect: a narrowed mathematics curriculum that selectively discarded material known not to be on standardized tests.

These trends are related. High-stakes assessments provoke test training, which forces teachers to abandon potentially important and relevant material; this, in turn, limits mathematically engaging activities that are unfortunately too time-consuming. Now is the time for the mathematics community to voice its concern.

Reactions by those involved in NCLB provide a controversial context for these trends. Pat O'Connell Ross, the highest federal official responsible for school mathematics in the Bush administration's U.S. Department of Education (USDE), responded by suggesting that mathematics teaching "is very rarely teaching for understanding"; she nevertheless defended NCLB: "if they're [teachers] not teaching better, that's not NCLB's fault." But Cathy Seeley, president of the National Council of Teachers of Mathematics (NCTM) at the time, remarked that "most of the additional test preparation…has been the lower level kind…where you can do some things that will help test scores next week or this month or even this year, but that might not be serving students well for the future." She and David Klein, a leading "back-to-basics" advocate, agreed that NCLB provided little incentive for directly engaging students in learning more. Representative Chris Van Hollen (D-MD) noted that it was obviously "a mistake to [teach to] a test that the teacher did not feel was actually measuring mastery of the material."

Regrettably, Obama's *Blueprint* appears to resolve only slightly the problems of NCLB. Those in higher education should pay attention to the evolution of the next education legislation because it will directly affect the mathematics that their incoming students will have been exposed to and understand. The belief that teachers of mathematics should be competent in the subject matter will be important, but a continued dependence on standardized assessments as a measure of achievement will perpetuate the dangerous cycle described above, leading to a narrow and disconnected curriculum. Both teaching and learning will be compromised. But if testing mandates are restructured so that tests are deemphasized, the focus can return to the material itself, thereby improving performance.

New education law should promote good mathematics teaching, which cannot be accomplished by simply telling teachers or schools what to do. The long debate over the merits of reform-oriented and traditional mathematics instruction developed some consensus on what good mathematics teaching is, and legislation should address important aspects of contemporary mathematics education such as engagement and conceptual understanding. It should provide incentives for teachers to be connected to and involved in research on mathematics teaching and learning. And while standardized assessment may be a necessary evil of centrally controlled education, its regulation should be softened, and incentives should exist for meaningful, formative evaluation. Even with good standards and standards-based tests, if the stakes are too high, then goals can become blurry and education compromised.

Lastly, it is important that new education law consider possible adverse effects. Under NCLB, schools must meet specific established benchmarks in the form of *Adequate Yearly Progress*, and their failure to meet them can result in action by the state or school district. As an example, consider that more than two hundred teachers in Washington, DC, were fired by the district in July 2010, many allegedly over NCLB-related issues. Later explanations cast doubt on the proffered justification for the firings, and the resulting controversy became politicized to the extent that genuine reform of the system has been jeopardized.

The innate pressure in the system creates an environment in which teachers are more inclined toward unethical teaching practices. The practice of teaching to the test and

the existence of cheating by teachers and administrators by guiding test-takers to the correct answers or making available advance copies of tests have been documented. When it is in the best interest of each state to have larger percentages of proficient students, standards can be relaxed and tests watered down so that more students pass. The Common Core Standards recently adopted by a number of states may represent a start in reducing this tendency, as most states will be judged by the agreed-on national standards. Another negative influence lies in the emphasis on the proficiency threshold. It has been shown that in order to optimize the number of students labeled as proficient, schools and teachers may focus on students near the cutpoint. Students perceived to be well above or hopelessly below that cutpoint may not receive attention equal to that given to their peers.

Perhaps most importantly, new legislation must incorporate the input of both teachers of mathematics and mathematicians. Van Hollen said that "the teachers are… essential to making anything successful," yet 70 percent of the teachers in the survey did not support NCLB. They argued that NCLB is "making teaching [mathematics] a difficult profession" and that "teachers get no support to achieve [NCLB's] goals," producing a "one-size-fits-all format of teaching." This is not an appropriate setting for future math majors.

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Letters to the Editor

Cartan, Europe and Human Rights

I was surprised to read some erroneous information in the paper "Cartan, Europe, and human rights" in the September 2010 issue of the *Notices*. I am referring in particular to the information regarding the 1950 International Congress of Mathematicians, held in Cambridge, Massachusetts. Jean-Pierre Bourguignon writes:

"The visa application Laurent Schwartz had made to attend the ICM where he was to receive the Fields Medal had been set aside by the U.S. Embassy in Paris. In order to exert maximum pressure, Henri Cartan collected the passports of all the French ICM participants and threatened that there would be no French participation if Schwartz was not allowed to enter the United States."

There are a few wrong assertions in this sentence, for instance that Henri Cartan collected passports (they in fact were boat tickets) and that this concerned all the French participants (of course, a few French participants decided they would go to Cambridge in any case). A useful piece of information, the fact that Cartan was acting as the president of the Société Mathématique de France, is missing.

But the main error is the name of the French mathematician to whom the State Department refused to give a visa. There had indeed been a problem with Schwartz's visa, but it had been solved. The problem concerned Jacques Hadamard, who was eighty-five and a vice president of the Congress. He had spent the wartime in the States and was by 1950 considered a dangerous communist, and thus the State Department did not want to give him a visa.

References for that are numerous (Schwartz's autobiography *A Mathematician Grappling with His Century*, the biography *Jacques Hadamard: A Universal Mathematician* by Mazia and Shaposhnikova, to quote only accessible sources).

This error appeared in the original publication of Bourguignon's piece in the *Newsletter of the European Mathematical Society*, and it is surprising that it was not corrected before publication in the *Notices*. That Hadamard was considered a dangerous figure by the U.S. government seems unbelievable today… so unbelievable, that this episode seems to have disappeared from the collective memory of French mathematicians. But the fact that such a thing seems unbelievable does not prevent it from happening again in the future. This is the reason why I find it important to correct the error.

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Remembering Paul Cohen

Regarding the recent article "Remembering Paul Cohen" in the *Notices*, I hope that the following few further reminiscences might be of interest. My educational path somewhat paralleled Paul's, since I was a student at Stuyvesant High School and did my graduate work at the University of Chicago, albeit in both cases about four years later than Paul. I had already heard about Paul while at Stuyvesant from the coach of the Math Team, Mr. Greenberg, who was still raving about Paul's abilities in mathematics a few years after Paul had graduated. While I was a graduate student at Chicago I attended Paul's lecture about his then new solution of Hilbert's First Problem, the Continuum Hypothesis.

I did not, however, meet him personally until the early 1970s, when I frequently visited Stanford as a result of collaborations with Jim Milgram. I

was perhaps most amazed at Paul's universal thirst for knowledge in *all* areas. As one example, on my second visit to Stanford I was met by Jim at the San Francisco airport, and he told me we were also picking up Paul, who was arriving about the same time. On the drive back to Stanford, I was first of all surprised that Paul remembered me (we had just met briefly a couple of years previously), and secondly that he also remembered that I was living in Alberta, Canada. He then totally amazed me when he asked me for many details about all of the native Indian tribes of the province (he already knew the names of these tribes), followed by questions about the mean temperatures in Calgary and Edmonton during the winter months.

Although I did not have any direct mathematical interaction with Paul, we did share the common hobby of magic. I always make a point of telling my students which tricks I learned from Paul Cohen when I show them in class. In closing, it seems fitting to quote my colleague Sashi Srivastava in Kolkata (Calcutta), "There has been much wonderful mathematics developed in the twentieth century, but what Paul Cohen did with his principle of forcing goes beyond that, it was 'divine inspiration'."

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Response to Underwood Dudley

I recently had the opportunity to reread Underwood Dudley's essay on the purpose of mathematics education. On the one hand I was tickled by it and found its main argument compelling: as an instructor at a community college, I have scrupulously refrained from insulting my students' intelligence by suggesting that they might use the quadratic formula in any way outside of a mathematics classroom.

But I do have two objections to make. The first is that there is one unambiguous application of algebra in many workplaces: spreadsheets. While not everyone who uses a spreadsheet knows how to enter formulas, at least one person in every workplace presumably has (or should have) the algebraic skill to do so. Knowing (some) algebra then becomes a valuable tool for job advancement.

The second objection is that algebra may not be used in many jobs, but there is no question that it acts as a barrier to access to many jobs—particularly the most desirable and empowering ones.

This is hardly controversial: college entrance exams like the SAT and ACT are heavy on algebra; an overwhelming majority of colleges and universities also require students to pass a math placement exam, or suffer through one or more quarters of remedial algebra (even if their intended path is an associate's in child development, so that they can work at Head Start). At the other extreme, think about the engineer's licensing exam, which includes a paper-and-pencil test on integral and differential calculus, differential equations, and matrix operations—none of which the working engineer would ever dream of doing by hand. Finally, consider that many (most?) people who try to get graduate degrees in the social "sciences" these days are required to use statistics at a fairly sophisticated level for their thesis, one that would be immeasurably helped by a solid understanding of algebra.

In short, the broader society has another answer to the question "What is mathematics for?" It is a mechanism by which we screen out people who are (overwhelmingly) poor (and disproportionately people of color) from participating meaningfully in our economic arrangements.

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Speaking with the Natives Redux

I was disappointed to read in the October 2010 issue in Gerald B. Folland's article "Speaking with the natives" the sentence "As far as I know, that unfortunate bit of whimsical nomenclature has not caused us any serious embarrassment yet, but if it does, I suggest that its perpetrators be sentenced to a year of hard labor teaching remedial algebra." This is an arrogant, snide remark about a large number of teachers and students. Here is what I know. The teachers of what we call developmental mathematics are dedicated educators who care for their students, who care for mathematics, and who are excellent teachers. They do an important task for mathematics departments for which they deserve the respect of the mathematical community. I believe that we should encourage and appreciate the teaching and learning of mathematics at all levels.

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Correction

The September 2010 issue of the *Notices* featured a series of four articles under the heading "A Tribute to Henri Cartan". The photographs for these articles were kindly provided to the *Notices* by the family of Henri Cartan. Unfortunately, this information was not included in the article.

In the particular article entitled "A tribute to Henri Cartan", the photo caption on page 948 was truncated. It should have read "Nicole and Henri Cartan, Paris, 1961". The caption for the photograph on page 947 should have read "Henri Cartan, at his home desk in Paris, 1981".

—Sandra Frost
Managing editor