

Teachers, Exams, Standards: AMS Committee on Education Examines Issues

“It is almost a disaster.” Irwin Kra’s blunt words summed up the basic impression that many mathematicians have about the state of K-12 mathematics education. The last several years have seen a growing sense of urgency within the mathematical community about the poor quality of mathematics instruction in the nation’s schools, as well as efforts on the part of mathematicians to help address the problems. At the same time, mathematics departments today are taking seriously the need to improve their own teaching. In particular, the role that math departments play in preparing future teachers of mathematics is increasingly being seen as one of the keys to improving mathematics education at all levels.

As attention to education has increased within the mathematical community, the AMS Committee on Education (COE) has become a focal point for discussions and debate. The COE is a policy committee, not an action committee, so its primary role is to stay abreast of developments in education and to provide advice when needed. The annual COE meetings, held each fall in Washington, DC, and arranged by the AMS Washington Office, are one of the main venues for finding out about developments in mathematics education that are pertinent to the interests of mathematicians. The most recent COE meeting, held in October 2004, attracted about fifty representatives from mathematics departments all over the country.

One of the most unusual developments discussed at the COE meeting came in the presentation by Kra, who recently retired from the State University of New York at Stony Brook and is currently the executive director of a new organization called Math for America (MfA). MfA was founded by James Simons, whose name is attached to the Chern-Simons invariants in geometry and who won the AMS Veblen Prize in 1976. Simons, who used to be on the faculty at Stony Brook, made a fortune by establishing a successful financial investment company and in recent years has become a major financial supporter of mathematics research at several major universities

and institutes. MfA is his first large-scale venture into mathematics education.

Founded in February 2004, MfA has already committed over \$25 million of private funds to improve mathematics education in New York City public high schools over the next five years. With this commitment, MfA will award about forty Newton Fellowships each year to mathematically sophisticated young people and people who want to change careers, to enable them to enroll in MAT programs and become high school mathematics teachers in New York City. The fellowships will pay for graduate mathematics education programs at partner universities, currently Queens College and New York University, and will also provide stipends, in addition to the regular salary paid by the schools, during the fellows’ first four years of teaching. In addition, for each of the next five years, the Newton Master Teacher Fellowship Program will award about ten four-year fellowships of \$50,000 each to mathematics teachers in New York City public schools to nurture them to become leaders in improving mathematics education.

The initial focus is on New York City simply because the group behind MfA consists mainly of New Yorkers, and they believe they can make progress in their home base. Plans call for expansion of the fellowship programs to other cities, and MfA will eventually seek federal funding for a national program. COE member Paul Sally of the University of Chicago, who has led mathematics education improvement programs in Chicago for many years, commented that it could take MfA a decade to gain enough experience to expand its programs nationally. Kra did not disagree but added: “We think there is a crisis out there. We want to see change as quickly as possible. We are impatient.”

Another group that is making a mark in mathematics education is Achieve, a nonprofit organization that helps the states raise standards and improve assessment. Laura McGiffert, director of Achieve’s mathematics program, described the results of an Achieve study of high school exit

examinations. Twenty-four states now require that students pass such exams in order to graduate, and today there is a lot of pressure on schools to use this kind of testing to show they are doing a good job. What is the mathematical content of these exit exams? Achieve studied the exams in six states, looking at the exams themselves rather than relying on what the states said was on them. What it found is that the tests focus on material that students in most other countries learn in the 7th or 8th grades rather than in high school. Most of the tests are multiple-choice, are not very demanding, and do not probe very deeply the students' reasoning and problem-solving skills. The study concluded that, while the exams are at a reasonable level, they should not be made any easier and should be strengthened over time.

Another study discussed at the COE meeting is one conducted by the Mathematical Sciences Education Board of the National Academy of Sciences. On the committee preparing the study is Donald Saari of the University of California, Irvine, who made a presentation before the COE. The study explored the question, Is the effectiveness of mathematics curricula being adequately evaluated? There was no attempt to evaluate the curricula themselves; rather, the goal was to evaluate the evaluations of the curricula. The study focused on nineteen curricula, thirteen of which were funded by the National Science Foundation (NSF) and the remainder of which were the products of commercial curriculum developers. The committee began with a collection of seven hundred evaluations of these nineteen curricula. Upon closer inspection, they found that around five hundred of those "evaluations" were really not evaluations at all but were such things as editorials, product descriptions, and progress reports. Of the remaining two hundred evaluations, another fifty were eliminated as not being sufficiently rigorous and quantitative.

The study concluded that these 150 evaluations are not adequate to say with certainty whether the curricula are effective. Furthermore, the committee found that there are no standards for evaluating the effectiveness of mathematics curricula. The report attempts to fill this gap by offering a framework for curricular evaluation. One component of this framework is content analysis, in which the disciplinary content of mathematics curricula is evaluated for clarity, accuracy, mathematical depth, and balance. Content analysis "is a place where we mathematicians can and should have a voice," Saari commented. The report, *On Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations*, is now available on the web at <http://www.nap.edu/books/0309092426/html>.

For its meeting the COE organized a panel on the NSF's VIGRE (Vertical Integration of Research and Education) program. VIGRE has helped many

mathematics departments energize the teaching of graduate and undergraduate students and the training of postdocs. During the panel, four representatives of mathematics departments spoke about their VIGRE activities: University of Wisconsin at Madison, Texas A&M University, University of California Los Angeles, and University of Arizona. Representatives of the NSF's Division of Mathematical Sciences (DMS) presented the disheartening news that, of the thirteen VIGRE grants that are expiring in 2005, at most five will be renewed. The DMS is well aware of the pain the ending of these grants will cause to the departments affected. However, that pain may be eased by two new programs that have aims similar to VIGRE: Research Training Groups and Mentoring Through Critical Transition Points. DMS officials say that the total amount of funding DMS is now putting into such training programs has actually increased.

During the COE meeting, the president of the American Mathematical Association of Two-Year Colleges (AMATYC), Susan Wood of J. Sargeant Reynolds Community College, described AMATYC's update of the "Crossroads" report, which lays out standards for two-year college mathematics. In addition, former COE chair Roger Howe of Yale University described an effort by a small group of mathematicians who are working on a document that will provide guidance for development of mathematics standards. The meeting ended with a panel in which four speakers representing a range of institutions discussed issues and challenges in undergraduate education in mathematics. What the COE meeting showed above all is that, unlike in years past, it is now taken for granted that mathematicians must pay attention to education. Future students, future teachers, and the future of the field itself all depend on it.

—Allyn Jackson

Committee on Education

Arthur Benjamin, Harvey Mudd College
 Sylvia T. Bozeman, Spelman College
 John B. Conway, National Science Foundation
 Robert Daverman, University of Tennessee (ex officio)
 David Eisenbud, Mathematical Sciences Research Institute (ex officio)
 John H. Ewing, AMS (ex officio)
 Robert Greene, University of California Los Angeles
 Jane M. Hawkins, University of North Carolina
 Roger Howe, Yale University
 Carole B. Lacampagne, National Research Council
 W. James Lewis, University of Nebraska
 William McCallum, University of Arizona (chair)
 Paul J. Sally Jr., University of Chicago
 Michael Starbird, University of Texas at Austin
 Alejandro Uribe, University of Michigan
 Karen Vogtmann, Cornell University
 Hung-Hsi Wu, University of California Berkeley