Mathematics Education as a Commitment

Patricia S. Wilson
Jeremy Kilpatrick
University of Georgia

We have been pleased to see the efforts of mathematicians, many of them working through the Mathematicians and Education Reform Forum, to improve the teaching and learning of mathematics in America's schools. Although these efforts are often accompanied by sharp criticisms of current practice, they have, for the most part, been sincere and well directed. Teachers and university mathematics educators need the help of mathematicians, and they need to work productively with them. In fact, the pool of mathematicians engaged in activities related to school mathematics ought to be much larger than it is.

In this article, we discuss some ideas for attracting more mathematicians to the enterprise of mathematics education. Mathematics educators of all types need the expertise that mathematicians can provide. We want our field to attract their interest. But a problem that often goes unrecognized is how difficult it is to get beyond an interest to the process of making a commitment. Mathematics education might seem like a reasonable hobby, but our experience shows that it takes time and sustained effort if people are to make a lasting contribution to the field. As E. G. Begle once observed, "Mathematics education is much more complicated than you expected, even though you expected it to be more complicated than you expected."

The Center for Proficiency in Teaching Mathematics

Through the Center for Proficiency in Teaching Mathematics (CPTM), we have had a number of opportunities to work with mathematicians on improving mathematics teaching. CPTM is a National Science Foundation-funded center that brings together mathematics educators and mathematicians at the University of Georgia and the University of Michigan as well as colleagues in partner school systems, colleges, and universities. To improve the education and professional development of teachers of mathematics, we focus on the leaders who provide that education and professional development. We work to support and increase the effectiveness of the many different

kinds of people who work with teachers of mathematics. Underlying the Center's focus is basic research and development on what constitutes high-quality professional education for teachers. We design and study approaches to teachers' learning, with particular emphasis on:

- The development of teachers' mathematical knowledge for teaching
- Situating teachers' professional learning in practice

Teachers of mathematics need a special kind of mathematical knowledge if they are to answer students' questions effectively, recognize alternative solutions or proofs, generate useful representations and examples, choose an optimal counterexample, or challenge a student's conjecture with a focused question. Good teaching demands an extensive, connected, and elaborated knowledge of mathematics. A teacher cannot be successful if he or she knows some mathematical procedures but has only a sketchy understanding of foundational ideas. As the report on the mathematical education of teachers (Conference Board of the Mathematical Sciences, 2001) says, mathematics courses for teachers should help them develop a deep understanding of the mathematics they will teach, and they need opportunities to continue to develop that understanding throughout their professional lifetimes.

Developing Commitment

Addressing the complexity Begle observed requires the commitment of both mathematicians and mathematics educators. We see at least three venues for developing that commitment and the accompanying expertise: (1) doctoral education, (2) faculty development, and (3) collaborative work.

Doctoral Education

Part of the answer to better teacher preparation lies in the preparation of those who will teach mathematics to teachers. Doctoral students in mathematics who are preparing for positions in colleges and universities will be likely to teach classes that enroll prospective teachers. If those doctoral students had an opportunity to learn more about mathematics education, they would be much better prepared. At the University of Georgia, our mathematics education program now offers a graduate certificate for doctoral students in mathematics. It requires participants to complete 15 semester hours of coursework and field experience. The program includes courses in

mathematics education theory and research, a course in mathematical problem solving with technology, observations in schools (grades K–12), opportunities to assist with mathematics content and methods courses for prospective teachers, and elective courses in mathematics education. In earning the certificate, graduate students in mathematics work alongside graduate students in mathematics education who will one day be their colleagues. The impact of such collaboration and experience extends beyond the graduate program. For example, when seeking employment in a mathematics department, a Ph.D. graduate who has assisted with courses for prospective teachers, visited schools, and acquired some knowledge of issues in mathematics education will be better prepared to teach virtually any course than someone who lacks that experience.

Faculty Development

College and university faculty members can deepen their knowledge of mathematics education in a variety of ways. For example, the project Preparing Mathematicians to Educate Teachers (PMET; see Katz & Tucker, 2003, or the Web site http://www.maa.org/pmet/index.html) promotes faculty development through activities that include workshops and mini-courses on the mathematical education of teachers. It is also building regional networks and providing mini-grants to individual mathematicians.

CPTM has offered two summer institutes in which mathematicians were invited to wrestle with the complex issues of helping teachers learn mathematics. Both institutes allowed the mathematicians to observe the mathematical instruction of teachers and then to analyze and discuss what they had seen. They focused on the teachers, how they were taught, and the mathematics they were taught. Learning from each other, the mathematicians and mathematics educators engaged in productive discussions of such matters as proof, definitions, operations with rational numbers, and problem solving.

In addition to the institutes, CPTM has encouraged mathematicians to learn about mathematics education through postdoctoral fellowships and visiting professorships. A mathematician who has spent a year engaged in courses, research, and public school service with colleagues in a mathematics education program can begin

to understand the nature and scope of work in mathematics education. At the University of Georgia, faculty members in mathematics and mathematics education organized seminars in which a mathematician or a mathematics educator presented a topic of mutual interest. At the University of Michigan, faculty members hosted a study group of mathematicians and mathematics educators from around the state who met to examine mathematics instruction. These examples of ongoing, mutual education demonstrate a commitment by mathematicians that is improving mathematics instruction. As a final example, those mathematicians at any institution who teach doctoral students in mathematics education and who serve on their doctoral committees get excellent opportunities to learn about issues in mathematics education.

Collaborative Work

Collaborative work between mathematicians and mathematics educators is being encouraged by the U.S. Department of Education and by the National Science Foundation. Many funding agencies now recommend or require collaborative work as part of the grant process. Universities are setting up task forces to examine the reward structure for collaborative work across colleges and with school districts so that mathematicians who have been taking the time to work with mathematics educators and in schools can be rewarded appropriately for their time and effort. Mathematicians who want to learn more about mathematics education—its history, status, issues, and research—can find funding to support collaborative endeavors. We have found in CPTM that collaborations with mathematicians in designing courses, working with public schools, and helping state agencies design curriculum standards have been both productive and mutually rewarding.

Sustaining a Commitment

We see the opportunities discussed above as examples of ways in which more mathematicians might be attracted to mathematics education as a field in which to do some of their work. We have been heartened by the response of our colleagues in mathematics who have taken the time to work with us on problems of mathematics education. But much more is needed on everyone's part. On the one hand, more mathematicians need to be encouraged to contribute to the improvement of mathematics teaching and learning. They need to be shown that they can make a

difference in schools, and the mathematics community needs to value and recognize the time and commitment that mathematicians contribute in order to make a difference. On the other hand, mathematics educators need to be more open to, and positively disposed toward, working with mathematicians in collaborative efforts. Mathematics educators need to be reminded that their field has always demanded continual input from the mathematics community. Otherwise, it cannot continue to grow and develop, nor can it be useful to society.

References

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