

Introduction to Recommendations for Teacher Preparation

The following three chapters on the mathematical preparation for teachers at various grade levels take a different approach than the recommendations of the 1991 MAA teacher preparation report *A Call for Change*. That report was built around a broad inventory, stated in general terms, of the mathematical knowledge and reasoning that K–12 teachers need in order to teach mathematics well. This report augments those recommendations, by giving more attention to the mathematical conceptions of K–12 students and how their teachers can be better prepared to address these ideas. The conceptions that prospective teachers often bring to college classes also get considerable attention.

Grade level. The next three chapters are organized around three common U. S. grade groupings: elementary grades (1–4), middle grades (5–8), and high school (9–12). A distinctive teacher preparation program is proposed for each grouping.

Teachers need to study the mathematics of a cluster of grade levels, both to be ready for the various ways in which grades are grouped into elementary, middle, and high schools in different school districts, and to understand the larger mathematical learning context in which the mathematics taught in a specific grade fits. Consequently, mathematics programs for teachers need some breadth in the grade levels they target. This report calls for mathematics specialists beginning at least by 5th grade, so that, for example, a mathematics specialist might teach all of the 4th and 5th grade students in a small K–5 elementary school.

Curriculum. The mathematical education of teachers proposed in the following chapters is meant to prepare knowledgeable, flexible teachers who are able to effectively educate students in mathematics, using a variety of current and future mathematics curricula. This document is particularly supportive of the NCTM *Principles and Standards for School Mathematics*, as well as other recent national reports on school mathematics.

Developing deep understanding. There are a number of statements in this report about prospective teachers acquiring a “deep understanding” of school mathematics concepts and procedures. The emphasis is on the mathematics that teachers need to know but also there is a recognition that teachers must develop “mathematical knowledge for teaching.” This knowledge allows teachers to assess their students’ work, recognizing both the sources of student errors and their students’ understanding of the mathematics being taught. They also can appreciate and nurture the creative suggestions of talented students. Additionally, these teachers see the links between different mathematical topics and make their students aware of them. Such teachers are also more able to excite students about mathematics. Some

mathematicians may react skeptically to setting these goals for prospective teachers, because, in their experience, prospective teachers, like many other students in introductory mathematics courses, seem to struggle to gain a minimal understanding of the basic concepts. Indeed, it is only realistic to expect such knowledge to develop over years of professional study, undertaken alone, with other teachers, and in continuing education classes. However, its foundation—deep understanding of school mathematics—must be laid during preservice education.

Chapters 3, 4, and 5 in Part 1 of this report outline this mathematical foundation. Chapters 7, 8, and 9 (Part 2 of this report) describe this mathematical knowledge in greater detail and illustrate how the need for it arises in teaching. Part 2 is intended for those faculty members who will teach courses in the foundations of school mathematics or who want to broaden their backgrounds in school mathematics instruction. These chapters are also intended to be useful to mathematicians, in general, to make them aware of the pedagogical issues connected with “mathematical knowledge for teaching.”

Proof and justification. Mathematicians need to help prospective teachers develop an understanding of the role of proof in mathematics. In the Reasoning and Proof standard, *Principles and Standards for School Mathematics* says “Proof is a very difficult area for undergraduate mathematics students. Perhaps students at the postsecondary level find proof so difficult because their only experience in writing proofs has been in a high school geometry course.” Prospective teachers at all levels need experience justifying conjectures with informal, but valid arguments if they are to make mathematical reasoning and proof a part of their teaching. Future high school teachers must develop a sound understanding of what it means to write a formal proof.

Terminology. To avoid confusion, the report uses the following terminology:

Student refers to a child in a K–12 classroom.

Teacher refers to an instructor in a K–12 classroom, but may also refer to a prospective K–12 teacher in a college mathematics course (“prospective teacher” is also used in the latter case).

Instructor refers to an instructor of prospective teachers. In this report, that person will usually be a mathematician.