Preface

The turn of the century has seen a dramatic increase in attention to the mathematics education of young children. This book is the result of a unique gathering of a diverse group of professionals involved with early childhood mathematics. In this preface, we describe this recent focus of attention, the conference that brought the professionals together to discuss critical issues in early mathematics education, and the result of their collaborative work—this book. Thus, this book includes the combined wisdom of experts, including mathematicians; mathematics educators; researchers; curriculum developers; teachers and policy makers regarding the mathematics education of our nation’s youngest learners.

Mathematics in Early Childhood

Why is there such a surge of attention to mathematics in early childhood? First, increasing numbers of children attend early care and education programs. In 1999, 70 percent of 4-year-olds and 93 percent of 5-year-olds were enrolled in preprimary education, up from 62 and 90 percent, respectively, in 1991 (U.S. Department of Education, 2000, p. 7). Several states are instituting universal prekindergarten education, with about 1 million students enrolled in 1999, and that number is increasing (Hinkle, 2000). Various government agencies, federal and state, provide financial support for prekindergarten programs designed to facilitate academic achievement, particularly in low-income children.

Second, there is an increased recognition of the importance of mathematics (Kilpatrick, Swafford, & Findell, 2001). In a global economy with the vast majority of jobs requiring more sophisticated skills than in the past, American educators and business
leaders have expressed strong concern about students’ mathematics achievement (these concerns are echoed in international comparisons of mathematics achievement Mullis et al., 1997). Further, the mathematics achievement of American students compares unfavorably with the achievement of students from several other nations, even as early as kindergarten. Some cross-national differences in informal mathematics knowledge appear as early at four to five years of age (Klein & Starkey, this volume).

Third, differences are not just between nations. Cross-cultural differences within the U.S. raise trouble equity concerns: “Children from different sociocultural backgrounds enter elementary school at different levels of readiness for a standards-based mathematics curriculum” (Klein & Starkey, this volume). This raises serious concerns of equity regarding children’s prekindergarten experiences and elementary schools’ readiness to adapt instruction to children at different levels of mathematical development. As mentioned, many government-funded programs serve low-income children, who often experience difficulties in mathematics and are at increased risk of school failure. Many of these children later experience difficulty in mathematics (Bowman, Donovan, & Burns, 2001; Natriello, McDill, & Pallas, 1990). For these children especially, the long-term success of their learning and development requires quality experience during their early “years of promise” (Carnegie Corporation, 1998). These children need to build the informal knowledge that provides the basis for later learning of mathematics. Thus, equity demands that we establish guidelines for quality early mathematics education for all children.

Fourth and finally, research indicates that better mathematics education can and should begin early. Research shows that higher quality programs result in learning
benefits into elementary school, including in mathematics. Unfortunately, most children are not in high-quality programs (Hinkle, 2000). This is critical. Even prekindergartners show a spontaneous interest in mathematics. Caring for them well, in any setting, involves nurturing and meeting their intellectual needs, which includes needs for mathematical activity (Bowman et al., 2001; Kilpatrick et al., 2001). Early interventions in mathematics can prevent later learning difficulties in school for all children (Fuson, Smith, & Lo Cicero, 1997; Griffin, this volume).

For all these reasons, there has been much recent interest in, and attention to, the learning of mathematics before elementary school at both the prekindergarten and kindergarten levels. According to the Glenn Commission report (2000), “at the daybreak of this new century and millennium…the future well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically” (p. 6).

In 2000, the National Council of Teachers of Mathematics (NCTM) revised its standards to include prekindergartners for the first time (2000). States are creating or modifying their own mathematics standards and curriculum guidelines for prekindergarten and kindergarten children. Nevertheless, at present, most teachers and caregivers do not know what to do about mathematics for the young children with whom they work.

**The Conference on Standards for Prekindergarten and Kindergarten Mathematics Education**

As federal, state, and professional organizations begin this new enterprise, there are many opportunities to create developmentally appropriate mathematics education for prekindergarten and kindergarten children. At the same time, there is the danger of a
veritable Babel of standards, some of which may be developmentally inappropriate for young children. A lack of consistency across various standards and guidelines will continue to produce “mile wide and inch deep” (National Center for Education Statistics, 1996) curricula as publishers struggle to meeting a variety of different content standards and guidelines. At the early years, such lack of consistency has a special danger of producing incoherent and developmentally inappropriate curricula.

Therefore, early communication between, and coordination of efforts by, the relevant educational leaders and agencies is critical. A group of educators¹ decided to begin with a conference on standards for prekindergarten and kindergarten mathematics education. This work was funded by grants from the National Science Foundation and the ExxonMobil Foundation to the State University of New York at Buffalo.

The Conference on Standards for Prekindergarten and Kindergarten Mathematics Education was held on May 15-17th, 2000, in Arlington, VA. This was a historic event: To our knowledge, it was the first conference to have ever brought together such a comprehensive range of experts in the diverse fields relevant to the creation of educational standards. Participants included representatives from almost every state developing standards for young children’s mathematics; federal government officials; mathematicians; mathematics educators; researchers from mathematics education, early childhood education, and psychology; curriculum developers; teachers; policy makers; and representatives from national organizations such as the NCTM and the National Association for the Education of Young Children (NAEYC).

¹ The initial idea for the conference was generated by Douglas H. Clements, Julie Sarama, Herb Ginsburg, Carole Greenes, and Robert Baillanz. Clements wrote the proposals and obtained the funds for the grant. Clements and Sarama, along with the Conference Coordinator, Ann-Marie DiBiase, ran the conferences and coordinated the work.
The purpose of the Conference was to facilitate early communication between, and ultimately coordination of efforts by, the educational leaders and agencies that are developing mathematics standards, curricula, and teaching methods for young children. We also wished to facilitate communication between those developing standards and experts in related fields, with an emphasis on the latest research findings concerning early mathematical thinking and education. Using resources such as research from a variety of disciplines, a compilation of standards and goals from various U.S. states (see the Appendix), and the recent NCTM Principles and Standards for School Mathematics (PSSM), the main goal was to work collectively, to help those responsible for framing and implementing early childhood mathematics standards.

All audiotapes of the presentations and discussions, especially those of the working groups, were transcribed and studied along with the papers presented at the conference. Based on these sources, the senior editor (Clements), with advice from the other editors (Sarama and DiBiase), produced an initial draft of the main points and recommendations that emerged from the conference. An 18-person working group was selected with the goal of representing the same groups participating in the original conference (i.e., U.S. state departments of education, teachers, researchers, etc., as previously described). This working group met at the ExxonMobil Foundation site in Irving, TX, in October 2000 to critique and complete this draft.² This draft was then disseminated to a representative sample of the main conference’s participants for their

reactions. The editors then incorporated advice from these participants into a final report, which is Part I of this book.

The reader will note that this book has its roots in the initial conference, which emphasized mathematics education in the prekindergarten and kindergarten years. However, because many of the speakers and participants discussed NCTM’s full range of prekindergarten to grade 2, the standards and recommendations we provide covers all these ages.

**What Different Readers Will Find in the Book**

One main group of readers are those who create standards, scope and sequences, and curricula for young children, as well as professional development materials and activities for their teachers. This includes school district administrators and curriculum coordinators, curriculum writers, publishers of mathematics education material, and teacher leaders. You will find comprehensive summaries of research that provides specific guidelines for your work in each of these fields. Part One includes research-based recommendations that frame the important ideas in the field, detailed developmental guidelines for the mathematics development of children from 2 to 8 years of age, and suggestions for standards, curriculum, teaching, assessment, professional development, and policy. The chapters in Part Two elaborate on each of these themes.

The book should also be of interest to undergraduate or graduate students, early childhood trainers or teacher educators, and faculty in mathematics education. It contains summaries of research in early childhood mathematics, as well as thoughtful articles on essential issues, that are not available elsewhere. These are connected to practical implications that provide valuable integration among theory, research, and practice.
For all readers, the contributions from a wide variety of disciplines and perspectives should be both illuminating and thought provoking. The next section describes the organization and content of the book.

**Organization of the Book**

The book is organized into two main parts and an online appendix. Part One, *Major Themes and Recommendations*, consists of conclusions drawn from the expertise shared at the Conference and specific recommendations for mathematics education for young children. These recommendations provide specific guidelines for policy, curriculum, and teaching, and thus are intended to facilitate the creation of standards and curriculum materials for early childhood mathematics that are consistent and inclusive, and are developmentally appropriate—attainable yet challenging—for young children. Part Two includes a compilation of papers written by the invited presenters, organized into coherent sections and introductory notes by the editors introducing and connecting these papers.

Thus, *this book offers a framework for thinking about mathematics education in PK-2 (Part One) and substantive detail regarding young students' understandings of mathematical ideas (Part Two)*. Curriculum developers, mathematics supervisors, personnel in Departments of Education, and teachers may find their attention first drawn by Part One. There we lay out a coherent approach to curriculum, grounded in the best current understandings of the literature. To make that framework come alive for children there needs to be greater depth—more substance behind the coherent outline. That substance will be found in Part Two. Research students and faculty may find their attention first drawn by the richness of detail regarding student thinking that appears in
Part Two. It is worth noting, however, that Part One offers an important way of seeing the forest for the trees—of seeing how the detail fits within the big picture.

Both Part One and Part Two are organized into five sections. *Standards in Early Childhood Education* deals with general policy and pedagogical issues related to the creation and use of standards for young children, including different types of standards and the advantages and disadvantages of standards for the early childhood years.

*Mathematics Standards and Guidelines* includes research summaries about young children’s development and learning of specific mathematical topics and builds on this knowledge base to describe the “big ideas” of important mathematical topics at several, progressive, levels of detail, designed for different readers. *Curriculum, Learning, Teaching, and Assessment* includes descriptions of approaches to curriculum, instruction, and assessment that have been supported by research and expert practice. *Professional Development* describes research and expert practice that addresses the dire need for better preparation of teachers and child care workers. Finally, *Towards the Future: Implementation and Policy* presents issues and recommendations that we believe must be considered when putting all these recommendations into practice.

The appendix is available online only, at [http://www.gse.buffalo.edu/org/conference/](http://www.gse.buffalo.edu/org/conference/) (see “Writings on Project”). This includes several valuable additions. The first two articles are reactions to the conference from two participants taking different perspectives, Debra Borkovitz and Jennifer Ware. The third and fourth items are the agendas that were followed for the main and follow-up conferences. The fifth item is a useful document on state standards (compiled by Ann-Marie DiBiase), which includes links to each U.S. State’s web site for educational
standards, as well as personal contact information for a representative from each of the States. Note that another helpful resource on the Web site are the biographical sketches of authors and conference panelists (see the link directly above “Writings on Project”).

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Douglas H. Clements, for the Editors

References


