Preface

OVERVIEW

In today's complex society, mathematical literacy is a necessary cornerstone in schools, the workplace, and everyday life. Mathematical literacy involves more than the ability to execute a procedure. It involves a deep conceptual knowledge of mathematics and an ability to apply this knowledge in a variety of contexts. Mathematical literacy is for everyone—*all* students and *all* adults. To achieve the level of mathematical literacy that will provide students with the confidence and competence they need to be productive citizens, teachers' knowledge of mathematics and effective strategies to teach it are pivotal. Teachers must be given the tools and support they need to understand the knowledge base of mathematics that underpins the standards, the research that contributes to an understanding of how students perceive and learn mathematics, and ways to translate theory into practice.

Achieving mathematical literacy for the diverse students who make up today's classrooms is facilitated when teachers have a strong interest and desire to acquire an extensive professional knowledge base. Coupled with this desire, teachers need new tools and processes to help them access and apply this professional knowledge base in their practice. *Mathematics Curriculum Topic Study: Bridging the Gap Between Standards and Practice* provides such tools, processes, and applications.

The Curriculum Topic Study (CTS) approach was adapted from the experiences of co-author Page Keeley in working with the American Association for the Advancement of Science's (AAAS) Project 2061's procedure for the study of a single benchmark. That procedure involves a rigorous analysis of a benchmark's key ideas and the associated research, and it uses Project 2061's resources, including *Science for All Americans, Benchmarks for Science Literacy,* and *Atlas of Science Literacy,* all of which include mathematics, science, social science, and technology, under the umbrella of *science literacy.* The Project 2061 study procedure was modified and expanded for the CTS Project to create a set of topic study guides with preselected readings linked to a specific purpose used in a process called Curriculum Topic Study (CTS). CTS focuses on topics instead of a single learning goal, and it includes additional reference materials such as the *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM], 2000), a sourcebook for cognitive research, *The Research Companion to Principals and Standards for School Mathematics* (NCTM, 2003), and an adult mathematics content trade book, *Beyond Numeracy* (Paulos, 1992), authored by a mathematician.

Mathematics Curriculum Topic Study draws on and extends the outstanding work of AAAS/Project 2061 and NCTM's national mathematics education standards

development and distribution by building a bridge between the development and dissemination of standards and their purposeful use in the classroom. It is an example of how professional developers have been able to draw on the research and development work done by AAAS and the NCTM and connect it to the immediate needs of teachers and professional developers. CTS draws on the current knowledge base regarding effective professional development for mathematics teachers—addressing the need for greater focus on content, standards, and research in how students learn.

In using CTS, teachers actively seek information from standards and research to provide all students the opportunity to learn and enjoy mathematics. They see the standards and research as providing a wealth of information from highly respected individuals in the mathematics education community and capitalize on the knowledge and expertise in ways that improve the teaching and learning of mathematics.

We have facilitated educators' use of Curriculum Topic Study's practical tools and processes in a variety of contexts and schools and with teachers at various levels of experience in teaching. We have observed how teachers build a common understanding of the standards and research and bring that understanding to life in their classrooms, schools, and districts. We have learned how educators used Curriculum Topic Study to align curriculum, plan instruction, and design assessments that are congruent with the recommendations that come from renowned researchers, practitioners, and policy advocates in the mathematics community. Curriculum Topic Study has moved national standards documents, as well as state standards and frameworks, beyond rhetoric and off the shelf and into the hands and minds of education professionals, who use them routinely and purposefully in their practice.

The *Mathematics Curriculum Topic Study's* tools and processes were originally designed for and piloted with the Maine, New Hampshire, and Vermont teachers participating in the National Science Foundation (NSF)-funded Northern New England Co-Mentoring Network. We wanted to provide a common focus, by topic, to examine implications across states, each of which has a different set of standards and frameworks. The *Mathematics Curriculum Topic Study* pilot was expanded to include the Maine Governor's Academy for Science and Mathematics Education Leadership, a State Mathematics and Science Partnership Project: Mathematics: Access and Teaching in High School (MATHS), and various other mathematics professional development programs offered through the Maine Mathematics and Science Alliance.

After we saw the initial impact of using the *Mathematics Curriculum Topic Study* process with educators, and being encouraged by our national professional development colleagues, we submitted a grant proposal to the NSF's Teacher Professional Continuum Program. This grant, *Curriculum Topic Study—A Systematic Approach to Utilizing National Standards and Cognitive Research,* was awarded to the Maine Mathematics and Science Alliance (MMSA) in May 2004. The MMSA and our partner, WestEd, are working with several professional development organizations, universities, teachers, and teacher educators over the next four years to develop Curriculum Topic Study into a set of science, mathematics, and professional development materials that will be available nationally. The Science Curriculum Topic Study book, *Science Curriculum Topic Study: Bridging the Gap Between Standards and Practice,* was published in February 2005, with the National Science Teachers Association as a copublisher. It has been heralded as "the missing link" by the science education community. In addition to a science and mathematics Curriculum Topic Study book, a *Facilitator's Guide to Using Curriculum Topic Study* will be

produced for science and mathematics professional developers and other facilitators of science and mathematics teaching and learning. There is also a companion Web site, www.curriculumtopicstudy.org. To learn more about this NSF-funded project, please visit the Web site.

NEED

Engaging mathematics educators in scholarly thought and purposeful use of standards and research on student learning is critical to improving student achievement. National and state standards and an expanding body of cognitive research have been available to teachers since the start of the standards-based wave of mathematics education reform. However, what has been missing is a systematic process not tied to any one project, which includes vetted readings and a set of tools to collectively and deliberately use them in practice.

In addition, the new "highly qualified teacher" requirements set by *No Child Left Behind [NCLB]* make this a critical time for teachers to have the tools and processes they need to continuously develop as professionals. In this *NCLB* age of standards and high-stakes accountability, it is not enough to be guided by a list of state standards or a topical alignment to ideas in mathematics.

To seek continuous improvement toward the goal of improving student learning in mathematics requires educators to understand the standards and use research when planning instruction. If your goal is to become a standards- and research-based educator, *Mathematics Curriculum Topic Study* provides the tools and processes needed to help you develop and draw on a common knowledge base in mathematics that can be used in a variety of curricular, instructional, and assessment applications.

AUDIENCE

The primary audience for this book is K–12 teachers, preservice teachers, preservice higher education faculty, professional developers, and mathematics education specialists. Sections of the book and the CTS process may also be useful to administrators, mathematicians working on curriculum development and education reform projects, parents (especially home-schoolers), standards revision committees, and assessment developers.

ORGANIZATION

The book is divided into six chapters. Chapter 1 provides an introduction to CTS and a description of the knowledge and research base that anchors the development and design. It includes a rationale for the importance of studying a curricular topic and why topics were chosen as the focus.

Chapter 2 takes the reader on a tour of a CTS guide. It describes the different features of a CTS guide and provides descriptions of the resources that are used in the process.

Chapter 3 describes the ways users of CTS engage in the process. It describes how to get started and defines the different purposes and outcomes a user must identify before beginning the process. It describes an instructional model for adult learning used in the process, based on the learning cycle. Individual and group use is addressed, and guiding questions are provided to accompany the resources.

Chapter 4 describes the various professional contexts in which CTS can be used. Embedded throughout this section are various examples and tools that teachers can use, such as improving content knowledge, curriculum, instruction, assessment, professional development, and leadership.

Chapter 5 describes how CTS has been used in actual practice. Real-life vignettes are described that illuminate the different ways people have used the information they derive from CTS.

Chapter 6 is the core of the book. It contains the 92 CTS guides, arranged in eight different categories. The study guides are reproducible for use with other teachers and professional developers.

The resources section contains additional resources that complement CTS, as well as some of the worksheet templates described in the chapters.

HOW TO USE THIS BOOK

The primary goal of this book is to provide mathematics educators with ready-to-use study guides that have a common format and include vetted sections in the content, standards, and research resources for reading about, studying, and reflecting on a mathematics topic. It is an essential companion to help you to use the standards to which you may already have access and to incorporate other professional mathematics education resources into your professional library. Educators who are familiar with the CTS approach can immediately access and use the guides in Chapter 6. Others will find it helpful to read Chapters 1 through 5 first to get a clear sense of how and why the guides were developed and of how they can be used effectively. This is not intended to be a "how to" book for professional developers who are interested in ways to facilitate use of CTS in their professional development settings. Such a book will be developed as part of the Curriculum Topic Study Project in 2006–2007. In the meantime, professional developers can use this book to learn about the process and practice using it. Higher education faculty can encourage their students to use this book to plan their lessons and gain a deeper understanding of standards- and research-based teaching and learning in preparation for the reality of teaching in schools and classrooms.

CTS provides tools and processes for use in improving teachers' understanding of the topics they teach. Rather than providing a step-by-step guide to designing curriculum, instruction, and assessment, CTS promotes inquiry among educators in discovering new knowledge about teaching and learning mathematics. It is an involved process that may seem complex and time consuming at first. But then again, it is complex and time consuming because learning is complex and takes time. Superficial knowledge and dabbling around with fun activities are different from developing a deep, professional knowledge of mathematics. The latter makes the CTS investment in time and intellectual energy worth it. Like any complex endeavor, it gets easier, becomes internalized, and proceeds much more quickly after multiple

opportunities to practice and share strategies and learning with others. Our advice is to start small at first. Try one section and one resource in a CTS guide. Reflect on what you learned and try a new topic using two or more sections and additional resources in the CTS guide. Add a few more sections and resources, and before you know it, the training wheels will be off! You will be well on your way to cycling satisfactorily through a rich and invigorating process and body of knowledge that is sure to have an impact on you, your colleagues, and—most important of all—your students.

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