Preface

The five of us—Tonia Land, Corey Drake, Molly Sweeney, Natalie Franke, and Jennifer Johnson—came together through a research project funded by the National Science Foundation. The purpose of the original research was to discover and understand how teachers use curricular resources in instruction. Through this work, while it was not the stated focus of our study, Corey and Tonia developed a particular interest in the many different ways in which Jenny, Molly, and Natalie used number choice in their classrooms. They recognized the benefits of number choice and used it in ways that made the mathematics accessible, equitable, and differentiated.

Through the original research, we became aware of the lack of number choices in curriculum materials, and that made us recognize that not all students are able to access the mathematics of a problem at their level. We began thinking about and discussing the following questions: What types of numbers allow an entry point for all of the students? Does the sequence of numbers in the progression influence how a child solves the problem? Does size or the relationship between the numbers help develop relational thinking? Do the numbers allow the students to vary their strategies and utilize the properties of operations? With these questions in mind, we began our journey of crafting purposeful number choices and progressions to meet the needs of students and improve teaching practices.

Through mutual support and cooperation, the five of us began taking a deeper look into the Common Core Standards, examining our classroom practices, and investigating student work.

We share a common belief about mathematics teaching and learning in that first and foremost students should be doing the mathematical work in a classroom. Children best engage with this mathematical work when presented with rich, worthwhile mathematical tasks guided by teacher questioning.

The Teaching Principle in *Principles and Standards for School Mathematics* (NCTM 2000) states the following about "worthwhile tasks":

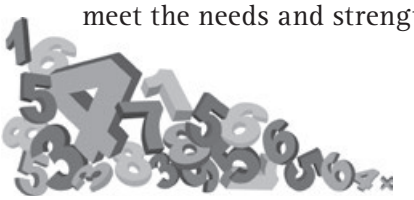
> In effective teaching, worthwhile mathematical tasks are used to introduce important mathematical ideas and to engage and challenge students intellectually. Well-chosen tasks can pique students' curiosity and draw them into mathematics. ... Regardless of the context, worthwhile tasks should be intriguing, with a level of challenge that invites speculation and hard work. Such tasks often can be approached in more than one way ... which makes the tasks accessible to students with varied prior knowledge and experience. (NCTM 2000, pp. 18–19)

In this book, we suggest that the work of teaching elementary mathematics with and through worthwhile tasks is more manageable—and more accessible to

all students—through a focus on number choice. We define *number choice* as the strategic use of numbers and number combinations in the context of problem-solving tasks. This book provides examples of and strategies for using number choice, based on our teaching experiences and research, to "engage and challenge students" with problems that "can be approached in more than one way."

Multiple resources, including textbooks, curriculum materials, supplemental materials, and professional development books for teachers, exist to aid in the selection, adaptation, and enactment of worthwhile tasks. However, few of these resources provide specific information about how to choose or adapt numbers within these problems. Even fewer suggest strategies for using productive numbers in the context of worthwhile tasks in ways that are responsive to children's mathematical strengths and needs. To be clear, it is often the case that the number choices in these resources are very thoughtful and strategic, and are designed to address specific mathematical goals and to progress logically over time. However, the rationales for these number choices are often not shared with readers, making it difficult for teachers to apply the rationales to other problems. (An exception is *Number Talks* (Parrish 2010) that provides many examples of strategic number choices, as well as some insights into the rationales behind those choices, specific to the number talk instructional structure.) Furthermore, single number choices are not likely to be responsive to all twenty-five or thirty children in any given classroom, and therefore, there is a need for strategies for choosing multiple numbers for single problems. This book is intended to address these gaps by providing explicit methods and examples for using number choice to address the mathematical content, strategies, and practices in the Common Core State Standards for Mathematics.

This strategic approach to number choice is closely connected to our more general view of successful mathematics teaching and learning: Children make sense of mathematics through engaging with well-written, or "worthwhile," tasks and problems, and this sense-making process then supports the development of computational fluency. Our approach is supported by our own experiences as teachers and researchers as well as by prior research (e.g., Carpenter et al. 1999; Fosnot and Dolk 2001a, 2001b, 2002). We feel that successful mathematics teaching and learning can be accomplished through the use and adaptation of well-designed instructional resources, including those published by Carpenter and colleagues and Fosnot and colleagues as well as recent Common Core Standards–based curriculum materials. However, we suggest that these resources must be adapted to be responsive to individual children and groups of children, and that a focus on number choice is an effective strategy for achieving this kind of responsiveness. In this book, we provide examples and strategies to show how a focus on number choice can not only address multiple aspects of the Common Core Standards (or others) but also meet the needs and strengths of individual students.



The Common Core State Standards (NGA Center and CCSSO 2010) provides frameworks for organizing addition/subtraction and multiplication/division problems as part of the standards for mathematics content. The frameworks describe and provide examples for all the common addition/subtraction and multiplication/division situations. For example, equal group problems can have either the product unknown, group-size unknown, or number of groups unknown. These frameworks provide significant direction for selecting, adapting, and writing problems of different types, in much the same way that the research on Cognitively Guided Instruction (Carpenter et al. 1999) has done. However, the standards provide minimal direction for selecting numbers for problems. In first grade, students are to add and subtract within 20. Students in second grade are to add and subtract within 100. In third grade, students are to multiply and divide within 100. These recommendations lack specificity in terms of—

- the progression of number choices within these broad landmarks (e.g., 20 and 100);
- the properties of numbers that might be considered in choosing or adapting numbers for problems (e.g., decade or non-decade numbers that combine to make ten and doubles); and
- the ways to introduce and sequence numbers to build students' mathematical understandings.

In addition to mathematics content, the Common Core also calls for students to develop specific mathematical strategies (e.g., strategies based on place value) and mathematical practices (e.g., reason abstractly and quantitatively). However, again, the standards do not provide guidance in how to choose or adapt numbers that would support students' development of mathematical strategies or practices. We have written this book to provide that guidance, and we illustrate how a focus on number choices can be productive in addressing three primary aspects of the Common Core: 1) mathematics content, 2) mathematics solution strategies, and 3) mathematics practices.

Because of our own work on number choice and the many questions we have received from teachers about number choice, we realized there were few resources to support teachers in incorporating purposeful number choice into their mathematics teaching. And so the five of us collaborated for more than a year to create this resource to help others on their number choice journey.

The book is divided into seven chapters. Chapter 1 lays the groundwork for understanding and using number choice by analyzing the number choices of a particular problem and rewriting them to address the development of mathematics content, strategies, and practices as described in the Common Core. Chapter 2

explains the multiple number choice structure and how it can be used to differentiate instruction. Chapter 3 discusses how to use number choice and curriculum materials to support the mathematical practices. In chapters 4 and 5, we return to previous problems and examine additional examples, concentrating the discussion on mathematical strategies. Chapter 6 builds on the work of Carpenter and colleagues (2003) and Jacobs and colleagues (2007) in relational thinking by discussing how number choices in contextualized word problems can develop relational thinking skills. In chapter 7, we provide various tools for assessing students and their engagement with number choices. Throughout each of the chapters, we discuss how the work with number choices can be used with curriculum materials.

Ultimately, our goal is for students to become fluent in mathematics and to be flexible thinkers who choose a strategy based on the numbers in a problem, seeking and using relationships in numbers when problem solving. Fosnot and Dolk describe mathematicians and people with good number sense as ones who "would look at the numbers first to decide on a strategy" (2001, p. 115). When teachers pose purposeful number choices, they provide students with opportunities to become confident and successful mathematicians. We hope this book will be helpful as you begin introducing number choices to your students. Enjoy!