

Preface

Middle school students are at the beginning of their academic transition from the somewhat concrete realm of elementary school mathematics to the more abstract mathematics required in preparation for high school. The middle school curriculum—with its emphasis on connecting arithmetic concepts to ratio and proportion, beginning notions of “variable” and algebra, statistical thinking, number, and geometric concepts—provides rich opportunities for students to learn and do mathematics through problem solving. Middle school students can benefit from both independent and collaborative problems-solving opportunities. As stated in *Principles and Standards for School Mathematics* (NCTM 2000): “Problem solving in grades 6–8 should promote mathematical learning. Students can learn about, and deepen their understanding of, mathematical concepts by working through carefully selected problems that allow applications of mathematics to other contexts” (NCTM 2000, p. 256).

Building on NCTM recommendations (NCTM 2011), the Common Core State Standards for Mathematics (CCSSM) further develop the standards for how students should go about doing mathematics, and thus include standards for “mathematical practice” in addition to standards for “mathematical content.” Teachers have the new challenge of maintaining an environment conducive to problem solving in their classrooms while meeting the requirements of the Common Core State Standards. The purpose of this book is to provide a guide for middle school teachers in their efforts to implement these standards, both for mathematical content and for mathematical practice. As the title suggests, there is an emphasis on meeting the standards through a problem-solving approach, not only as a means of practicing what has been learned but as a tool to “build new mathematical knowledge” (NCTM 2000, p. 52). Overall, the Common Core State Standards for Mathematics are well suited for a problem-solving approach.

To develop mathematical problem-solving skills and to support the Common Core Standards, we highlight two approaches. First, rich problems are presented that provide an entry point for lessons, and not simply an opportunity to practice what has already been learned. Our hope is that teachers will use these problems to launch lessons and allow the embedded mathematics to be revealed through classroom discourse. The second approach is to present a carefully designed series of expressions and questions that allow mathematical ideas to emerge. We note that each section does not have an equal treatment of the two approaches, as certain concepts and problems lend themselves differently to each. Problems were written with the interests of middle school students in mind.

The Common Core State Standards emphasize both conceptual and procedural understanding, and attention to the underlying structure of mathematical concepts and procedures (NGA Center and CCSSO 2010). The standards do not advocate any particular type of teaching or pedagogical approach. Implicit, however, in their Standards for Mathematical Practice (as listed on page vi) is a student-centered approach that facili-

tates students' ability to communicate with each other in order to create arguments and critique the arguments and reasoning of others.

This book is organized by the major CCSSM content areas for grades 6–8, with a chapter for each of four domains—Ratio and Proportion, The Number System, Geometry, and Statistics and Probability—and a fifth chapter combining the domain of Expressions and Equations with that of Functions. Each chapter includes several problems (labeled “tasks”) for each domain, with each task targeting specific clusters of standards. The book has thirty-eight tasks in all. Although every domain required of all students is represented, not every individual standard or cluster is incorporated. Interesting problems that lend themselves to meaningful implementation of content standards have been included. Our intent was not to be exhaustive, but to present exemplary problems as models for teachers. At the end of each section, the Standards for Mathematical Practice best met by the problems in the section are discussed. Although the temptation for busy teachers may be to only look at the tasks themselves, we hope that teachers also read the discussion of the problems. The discussion sections provide ideas for implementing the tasks, possibly modifying them, and avoiding common misconceptions related to the concepts inherent in the tasks. In many cases, the modifications make suggestions about how to implement the problem on a different grade level.

This book is intended for use by middle school mathematics teachers looking for support in implementing the CCSSM. It may be used to enhance a traditional text for students, providing a source for rich problems to motivate and launch lessons as well as to exemplify mathematics learning through problem solving. In many cases, suggestions for modifying or extending the problems are given so that instruction may be differentiated. Teacher educators may use this book as a supplemental text in a methods or curriculum course for preservice teachers in middle school mathematics. This would help preservice teachers become familiar with the Common Core State Standards for Mathematics and how they may be implemented. Finally, teachers should find the CCSS Overview for Middle and High School Mathematics, found in the appendix, helpful in providing a “vertical” overview of the major content areas and how they are emphasized through the middle and high school grades.