Preface

The 13th edition of *A Problem Solving Approach to Mathematics for Elementary School Teachers* is designed to prepare outstanding future elementary and middle school teachers. This edition, heavy on concept and skill based, has an emphasis on active and collaborative learning. The content has been revised and updated to better prepare prospective students as future teachers in their own classrooms.

**National Standards for Mathematics**

- **Common Core State Standards (CCSS) for Mathematics** The National Governors Association spearheaded the effort to develop the *Common Core Standards* (2010); they are used in this text to highlight concepts. The complete text of the *Common Core Standards* is found at www.corestandards.org.
- **Principles and Standards** The National Council of Teachers of Mathematics (NCTM) publications, *Principles and Standards of School Mathematics* (2000) and *Principles to Actions: Ensuring Mathematical Success for All* (2014) are guides for the book. The complete text of the NCTM *Principles and Standards* can be found online at www.nctm.org.

**Our Goals**

- To present appropriate mathematics in an intellectually honest and mathematically correct manner.
- To use problem solving as an integral part of mathematics.
- To approach mathematics in a sequence that instills confidence and challenges students.
- To provide opportunities for alternate forms of teaching and learning.
- To provide communication problems to develop writing skills that allow students to practice reasoning and explanation through mathematical exposition.
- To provide core mathematics for prospective elementary and middle school teachers in a way that challenges them to determine why mathematics is done as it is.
- To provide core mathematics that allows instructors to use methods integrated with content.
- To assist prospective teachers with connecting mathematics, its ideas, and its applications.
- To assist future teachers in becoming familiar with the content and philosophy of national standards.

The 13th edition provides instructors a variety of approaches to teaching, encourages discussion and collaboration among future teachers and with their instructors, and aids the integration of projects into the curriculum. Most importantly, it promotes discovery and active learning.

**New to This Edition**

- The Chapter Opener Problems use examples from social media and are more relevant and engaging.
- Chapter 3 has been completely reorganized to more closely model the way operations are taught in elementary school. See Content Highlights for more details.
- The Mathematical Connections portion of the exercise sets has been reorganized and upgraded to reflect current thinking in mathematics education.
- StatCrunch has been referenced where relevant to provide the opportunity for students to interact with data.
- All chapters have many new solved examples and new problems in assessments.
- The treatment of many topics has been enhanced to reflect a tighter connection to the CCSS.

Examples include

- Chapter 1: Expanded the Four-Step Polya Problem-Solving Process with input from Standards for Mathematical Practice. The process is referred to in examples throughout the chapter and the book. The section on patterns has been shortened.
- Chapter 2: The section on valid reasoning has been revised. Logical reasoning is now an integral part of Chapter 2.
- Chapter 5: Now includes a definition of addition for integers that uses absolute value—including because it is one of the techniques used in operations on integers in CCSS.
- Chapter 6: As called for in CCSS, a section on Using Bar Models to Solve Rational Proportion Problems has been added.
Sample preface. Not for distribution.

Chapter 8: Algebraic Thinking is streamlined, with greater emphasis on variables and equation solving.
Chapter 10: Reorganization and the inclusion of misuses throughout the chapter more clearly follow recommendations of statistical educators.
Chapter 13: Due to the central role of measurement in geometry, Chapter 13, Area, Pythagorean Theorem, and Volume, has been moved to come before Chapter 14, Transformations.

The chapter summary charts are more comprehensive as resources for students.
New media assets are available in MyLab Math. All media assets include assignable questions.
Completely new section lecture videos incorporate the various resources found in the MyLab Math course, such as animations and IMAP videos.
Common Core in Action videos
Animations library
Math Education Insights videos
Common Core Assessment Analysis questions enable students to analyze real CCSS assessment questions.
Mindset materials support students in developing a math mindset and an understanding of how important it is to do so with their future students.

Content Highlights

Chapter 1 An Introduction to Problem Solving
This chapter has been reorganized and shortened to make it friendlier. The section on patterns has been shortened.

Chapter 2 Introduction to Logic and Sets
This section on logic works hand in hand with the ideas of set operations and enhances reasoning. Set theory and set operations with properties are introduced as a basis for learning whole number concepts. The section on Valid Reasoning has been shortened.

Chapter 3 Numeration Systems and Whole Number Operations
This chapter has been reorganized to model more closely the way the operations are taught in elementary school. The chapter opens with a brief overview of different numeration systems and an emphasis on place value through the study of different bases. New addition models were added. Subtraction models were extensively expanded. Now multiplication with algorithms is followed by division. Operations in different bases, mental math, and estimation are included with each operation as well as the whole number properties for each operation.

Chapter 4 Number Theory
In the 13th edition, a separate chapter on number theory does not depend on integers, which are introduced in Chapter 5. Concepts of divisibility with divisibility tests are discovered. Prime numbers, prime factorization, greatest common divisor and least common multiple as well as the Euclidean Algorithm are explored with many new exercises added. A module on Clock Arithmetic is available online.*

Chapter 5 Integers
This chapter concentrates only on integers, their representation, their operations, and properties.

Chapter 6 Rational Numbers and Proportional Reasoning
This chapter has been revised to follow many recommendations in the Common Core Standards. Videos showing elementary students learning fraction concepts are included so that future teachers can observe what happens when elementary students absorb what is taught and how they work with those concepts. Proportional reasoning, one of the most important concepts taught in middle school mathematics, is covered in great depth in its natural setting. A new section on using Bar Models to Solve Ratio and Proportion Problems has been added.

Chapter 7 Decimals, Percents, and Real Numbers
This chapter focuses on the decimal representation of rational numbers and their operations. Percent applications are solved with percent bars. Mental math and estimations with percents are also included. The chapter also includes a development of real numbers.

Chapter 8 Algebraic Thinking
With an introduction to real numbers moved to an earlier chapter, the chapter now gives a review of algebra needed to teach in grades K through 8. This includes work in the coordinate plane. A module on Using Real Numbers in Equations is available online.*

* Online modules are available in MyLab Math or at www.pearsonhighered.com/mathstatsresources
Chapter 9 Probability
This chapter discusses the probabilities of single stage and multistage experiments. Counting techniques have been expanded in this edition. StatCrunch references link to applets providing a hands-on way for students to interact with probability concepts.

Chapter 10 Data Analysis/Statistics: An Introduction
Chapter 10 has been reorganized and simplified. Designing Experiments/Collecting Data is based on Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A preK–12 Curriculum Framework (2005) by the American Statistical Association. In the following sections, data, graphs, examples, and assessment exercises have been updated and new material added. The action formerly called Abuses of Statistics has been integrated into earlier sections in this edition. StatCrunch references aid students in data display.

Chapter 11 Introductory Geometry
This chapter allows students to explore some ramifications of different definitions in mathematics used in schools. Linear measure is introduced to emphasize its importance in the curriculum. Also symmetries are introduced as a concept to form geometrical definitions. The Networks module is now offered online.*

Chapter 12 Congruence and Similarity with Constructions
Congruence and constructions sections have been expanded to allow more exploration. Many new exercises have been added. A module on Trigonometric Ratios via Similarity is available online.*

Chapter 13 Area, Pythagorean Theorem, and Volume
Concepts of linear measure are included with the topics of area, the Pythagorean Theorem, and volume. Many topics have been shifted and new material added. Assessment sets and examples have been updated.

Chapter 14 Transformations
The order of the geometry chapters has been changed, with transformations now being the subject of the final chapter. Tessellations have been added to the section on translations and rotations. Reflections, glide reflections, and dilations follow this section.

Features
In creating the 13th edition of this text, we used strengths of previous editions, incorporating feedback from users, and making improvements to better prepare future teachers for teaching mathematics.

Learning the Mathematics in the New Standards
- New! In this edition, we have made judicious cuts to even more effectively bring key ideas to the forefront. A streamlined narrative keeps students focused on the important ideas.
- Chapter openers from social media are thought-provoking and set the tone to prepare students for the material ahead.
- Learning Objectives at the beginning of every section focus student attention on key ideas.
- Problem-Solving Strategies are highlighted in italics and are used throughout the text to help students put the strategies to work.
- Chapter Summaries are organized in a student-friendly chart format for easy reference. These summaries also provide specific pages for additional help on individual concepts.
- Chapter Review questions allow students to test themselves.

Focusing on the Standards for Mathematical Practice
- The Activity Manual includes classroom-tested activities and a pouch of perforated, printed color manipulatives.
  - Activity Manual annotations in the Annotated Instructor’s Edition clarify when specific activities should be used for each lesson, making it easier to teach a more hands-on course.
  - The manual is available as a value-pack option. Ask your Pearson representative for details.
- Now Try This exercises follow key examples and help students in their learning, facilitate the development of critical thinking and problem-solving skills, and stimulate class discussion. Answers are in both the Annotated Instructor’s Edition and student text.

* Online modules are available in MyLab Math or at www.pearsonhighered.com/mathstatsresources
• **13 eManipulatives**, available in MyLab Math, allow students to investigate, explore, practice, build conceptual understanding, and solve specific problems without the mess or cost of physical manipulatives. Annotations in the student edition indicate where these eManipulatives are relevant. Exercises related to the eManipulatives are assignable within MyLab Math.

• **Integrating Mathematics and Pedagogy (IMAP)** videos, available in MyLab Math, feature elementary school children working problems. Margin notes in the student edition indicate where these videos are relevant. Exercises related to the IMAP videos are assignable within MyLab Math.

• **New! StatCrunch** technology has been referenced in various chapters as an aid to learning.

### Teaching the Mathematics in the New Standards

- **Common Core State Standards (CCSS)** are cited in sections to focus student attention and provide a springboard for discussion.
- **New! More exercises** have been added, particularly in the reorganized Mathematical Connections exercise sets.
- **Connecting Mathematics to the Classroom** exercises require interpretation and analysis of the thinking of typical K-8 students.
- **Updated! School Book Pages** are included to show how various topics are introduced to the K-8 pupil. Icons within the text link the narrative to the appropriate School Book Page. Students are asked to complete many of the activities on the student pages so they can see what is expected in elementary school.
- **Historical Notes** have been updated to include living mathematicians as well as to add context and humanize the mathematics.

### Assessing the Mathematics Content and Procedures

- **Extensive Problem Sets** are organized into three categories for maximum instructor flexibility when assigning homework and that address the standards.
  - **Assessment A** has problems with answers in the text, so that students can check their work.
  - **Assessment B** contains parallel problems to those in Assessment A, but answers are not given in the student text.
  - **Mathematical Connections** problems include the following categories: Connecting Mathematics to the Classroom, Review Problems, School Book Pages, Group Work, and NAEP sample questions. Odd-numbered answers to Connecting Mathematics to the Classroom, Review Problems, and School Book Pages are in the student answer section.

- **Hundreds of assignable algorithmic exercises.** The MyLab Math course for the 13th edition contains even more assignable exercises to meet students’ needs. Assignable exercise types include the following:
  - **Textbook** exercises—over 2000 algorithmically generated exercises parallel those in the text.
  - **Lecture video** exercises allow instructors to assign the videos with confidence that students will watch them.
  - **New! Common Core in Action** video exercises help students see the content of the CCSS in context.
  - **New! Common Core Assessment Analysis** exercises require analysis and interpretation of sample CCSS exercises.
  - **New! Animations** exercises encourage students to interact with the Animations to support understanding.
  - **eManipulative** exercises require use of the eManipulatives within MyLab Math so students can be familiar with this important teaching and learning tool.
  - **Integrating Mathematics and Pedagogy (IMAP)** video exercises require analysis of student work.
Resources for Success

MyLab Math Online Course for *A Problem Solving Approach to Mathematics for Elementary School Teachers* (access code required)

MyLab™ Math is the teaching and learning platform that empowers you to reach every student. By combining trusted author content with digital tools and a flexible platform, MyLab Math personalizes the learning experience and improves results for each student.

**Unlimited Practice & Unique Assessment**
Over 2000 exercises correlated to the textbook provide immediate feedback, to give students unlimited opportunities for practice.

Additional exercises complement the various media elements in the course, such as Animations, Common Core in Action videos, IMAP videos, eManipulatives, and more. **Common Core Assessment Analysis** questions were developed to require analysis and interpretation of sample CCSS test problems.

**StatCrunch**
Integrated into the MyLab Math course and accompanying eText as an aid to learning, StatCrunch® is a powerful web-based statistical software that allows users to interact with data.

**Learning Tools**
Resources in the MyLab course support the text, including a variety of videos, eManipulatives, animations, and StatCrunch. New Mindset materials support students in developing a math mindset and how to do so with their future students.

[pearson.com/mylab/math](mailto:pearson.com/mylab/math)
Resources for Success

Instructor Resources
Annotated Instructor’s Edition
• Includes answers to text exercises on the pages where they appear, when possible. Answers not on the page are found in the back of the book.
• Provides answers to new chapter opening problems, Now Try This problems, and Mathematical Connections questions.
• Annotations throughout help integrate use of the activities in the accompanying Activity Manual.

Online Supplements
The following instructor material is available for download from Pearson’s Instructor Resource Center (www.pearsonhighered.com/irc) or within the text’s MyLab Math course.

Instructor’s Solution Manual
Brian Beaudrie, Northern Arizona University
• Provides detailed, worked-out solutions to all of the problems in Assessments A and B, Mathematical Connections Review Problems, and Chapter Review exercises.

Instructor’s Testing Manual
• Comprehensive worksheets contain two forms of chapter assessments with answers for each.

Dan Dolan, Project to Increase Mastery of Mathematics and Science, Wesleyan University; Jim Williamson, University of Montana; and Mari Muri, Project to Increase Mastery of Mathematics and Science, Wesleyan University
• Contains answers and teaching suggestions for activities in the student Activity Manual.

PowerPoint Lecture Slides
• Fully editable slides provide section-by-section coverage of key topics and concepts along with examples.
• An Image Resource Library is also available within MyLab Math and contains art files from the text enabling further customization of the PowerPoint lectures.

TestGen®
• TestGen® enables instructors to build, edit, and administer tests using a computerized bank of questions developed to cover all the objectives of the text. Instructors can also modify or add new questions.

Student Resources
Mathematics Activities for Elementary School Teachers: 13th edition
Dan Dolan, Project to Increase Mastery of Mathematics and Science, Wesleyan University; Jim Williamson, University of Montana; and Mari Muri, Project to Increase Mastery of Mathematics and Science, Wesleyan University
ISBN: 0134995619 / 9780134995618
• Provides hands-on, manipulative-based activities keyed to the text that involve future elementary school teachers discovering concepts, solving problems, and exploring mathematical ideas.
• Colorful, perforated paper manipulatives in a convenient storage pouch.
• Activities can also be adapted for use with elementary students at a later time.
• References to these activities are in the margin of the Annotated Instructor’s Edition.

Student Solutions Manual
Brian Beaudrie, Northern Arizona University
ISBN: 0135184207 / 9780135184202
• Provides detailed, worked-out solutions to all of the problems in Assessment A, odd Mathematical Connections Review Problems, and all Chapter Review exercises.
Acknowledgments

For past editions of this book, many noted and illustrious mathematics educators and mathematicians have served as reviewers. To honor the work of the past as well as to honor the reviewers of this edition, we list all but place asterisks by this edition’s reviewers.

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