

PREFACE

Welcome to the third edition of *Teaching Mathematics: Foundation to Middle Years*. In keeping with the aim of the previous two editions, we have written a book for pre-service and practicing teachers; one that will help build mathematical knowledge and confidence to teach mathematics with passion and enthusiasm and respond appropriately to a diverse range of learners, learning needs and learning environments. In response to feedback from lecturers, pre-service teachers, and teachers of mathematics, and new understandings about the ways mathematics is taught, we have made a number of changes.

The major change, a restructure of the chapters, was in many ways the most exciting as it gave us an opportunity to focus on the development of key ideas and strategies in a much more seamless manner. We believe this change will make it easier for lecturers to choose chapters appropriate to the ways in which courses or units are typically structured in pre-service courses and thereby enable pre-service teachers to start preparing for classroom teaching.

Here's an example. The key ideas and strategies needed to teach Measurement and Geometry from F to Year 9 are now considered in three adjoining chapters (Chapters 19 to 21). These new chapters assist teachers at all levels to appreciate how the knowledge, skills and strategies in a particular content strand develop over time. Importantly for these chapters, we have had the opportunity to draw on recent research on mathematical reasoning that has established evidenced-based learning progressions for algebraic, geometrical and statistical reasoning (e.g. Siemon, Callingham, Day, Horne, Seah, Stevens, & Watson, 2018). This has enabled us to build more systematically on the learning progression for multiplicative thinking that informed the Number and Algebra Chapters in Parts 3, 4 and 5 in previous editions, and to include two new chapters, one that builds on exciting new research in the early and pre-school years, and one that considers mathematics across the curriculum with a particular emphasis on the possibilities afforded by investigations in Science, Technology, Mathematics and Engineering (STEM) areas.

The structure of the third edition is described in more detail below.

Setting the scene—Chapters 1 to 3

In Chapter 1, we consider what we mean by mathematics and what it takes to be an effective teacher of mathematics in the primary and middle years of schooling. The standards for excellence in teaching mathematics in Australian schools developed by the Australian Association of Mathematics Teachers (AAMT) have been used to shape this discussion. In previous editions, the standards were considered in Part 6 on entering the profession. In the third edition, this discussion has been brought forward and expanded to recognise the attributes of effective teachers of mathematics and to set the scene for what follows. Chapter 2 has also been

changed and updated to emphasise the many factors impacting student learning from the early to the middle years of schooling. This is an important new approach to what was considered in Chapters 2 and 3 in previous editions.

Chapter 3 is a new chapter that responds to requests to provide more specific advice and support for early childhood teachers. This chapter builds on exciting new research to outline the foundations of an effective mathematics education.

Understanding mathematics teaching—Chapters 4 to 9

These chapters have been reorganised and reshaped to reflect the proficiencies more strongly and to update our consideration of the key pedagogical issues that transcend content areas. Chapter 4 considers what is involved in building understanding and fluency. It builds on and extends *Communicating Mathematically* and *Representing Mathematically* in previous editions. In a similar vein, Chapter 5 focuses on promoting problem solving and mathematical reasoning. It builds on and extends *Thinking Mathematically* in previous editions. Chapter 6 considers issues related to interpreting and responding to data, a key feature of current schooling practice. It builds on and extends *Assessing and Reporting* in previous editions.

Chapter 7 recognises that planning is a key issue that impacts pre-service and practicing teachers on a daily basis. It draws on and extends material considered in *Teaching Mathematics* in previous editions. Chapter 8 on understanding and responding to diversity has been updated to reflect recent research and developments in practice. Chapter 9 is effectively a new chapter although it reflects some of the issues raised previously in *Numeracy Across the Curriculum*.

Teaching Number and Algebra—Chapters 10 to 18

This section represents a major shift from previous editions in that the content is now organised from the early to the middle years of schooling to enable teachers to better understand the nature of the big ideas involved and their development over time. Chapter 10 considers what is involved in developing a sense of Number and Algebra with a particular focus on the big ideas, representations and communication patterns that underpin this key area of the curriculum. Chapter 11 now includes an updated consideration of what is involved in developing algebraic thinking from the early years of schooling to Year 9. This chapter draws on the corresponding chapters in Parts 3, 4 and 5 of previous editions to provide a clearer picture of the big ideas and key issues involved in the teaching and learning of algebra.

Chapter 12 focuses on the big idea of trusting the count and its role in developing early number ideas and strategies. Chapter 13 focuses on the big idea of place value but extends this to include decimal fractions as an extension of the base 10 numeration system. This chapter draws on and updates the relevant sections of the chapters on fractions and decimals in Parts 4 and 5 in previous editions. Chapter 14 focuses on additive thinking as a consequence of the two big ideas of trusting the count and place value. It draws on and updates the chapters on additive thinking in Parts 4 and 5 of the previous editions.

Chapters 15 to 18 focus on the big ideas of multiplicative thinking, partitioning and proportional reasoning respectively. Chapter 15 considers the development of the key underpinning ideas and strategies involved in developing multiplicative thinking from the early years of schooling to the middle years. It draws on and updates the chapters on multiplicative thinking in Parts 4 and 5 of previous editions. Chapter 16 considers the big idea of partitioning and what is involved in developing a deep understanding of fractions and decimals. This chapter builds on and updates the chapters on fractions and decimals in Parts 4 and 5 of previous editions. Chapter 17 is framed by the notion of extending the number line and begins by considering the integers as an extension to the whole numbers. This chapter draws on the relevant sections of Chapter 22 of previous editions to include an updated consideration of strategies for applying the four operations to an extended range of numbers. Chapter 18 considers the big idea of proportional reasoning. While it draws on the relevant section of Chapter 24 in Part 5, this chapter is extended considerably in response to evidence that links multiplicative thinking, partitioning and proportional reasoning to mathematical reasoning at all levels of schooling.

Teaching Measurement and Geometry—Chapters 19 to 21

As indicated at the outset, these chapters have now been reshaped and updated to provide a more seamless discussion of what is involved in developing a deep understanding of the key ideas and strategies that underpin the teaching and learning of measurement and geometry from the early years of schooling to Year 9. Chapter 19 provides an overview of the big ideas and the importance of spatial reasoning in developing a sense of geometry and measurement. Chapter 20 deals with concepts and strategies associated with measurement and Chapter 21 deals with the key concepts, defining properties, and strategies associated with building a deep understanding of geometry. These chapters draw on the corresponding chapters in Parts 3, 4 and 5 in previous editions.

Teaching Statistics and Probability—Chapters 22 to 23

Chapters 22 and 23 have also been reshaped to provide a more seamless discussion of what is involved in developing a deep understanding of the key ideas and strategies that underpin the teaching and learning of statistics and probability from the early years of schooling to Year 9. Chapter 22 draws on the corresponding chapters in Parts 4 and 5 that relate to developing a sense of statistics and probability. Chapter 23 considers the more formal development of the key ideas and strategies.

Features of the third edition

Our stated intention of building knowledge and confidence to teach mathematics well is realised through these essential features:

- An unrelenting focus on the evidence base for teaching and learning mathematics effectively in the primary and middle years of schooling

- Priority given to research-based learning progressions and the big ideas that are informing current practice and future curriculum development
- A clear focus on building mathematical proficiency in terms of conceptual understanding, procedural fluency, problem solving, and mathematical reasoning
- A strong emphasis on effective pedagogical approaches to teaching mathematics, including planning and assessment, interpreting and responding to data, working with diversity, and making mathematical connections across all areas of the curriculum
- Opportunities for pre-service and out-of-field teachers to develop a deeper personal understanding of key mathematics concepts and strategies
- Connections to practice through student work samples, classroom learning activities, and case studies from practicing teachers and school leaders
- A plentiful array of activities and review questions.

Adding depth and relevance to classroom practice are the book's design elements, which have also been revisited and revised for the third edition. They include:

- **Chapter objectives and Key terms:** Sets out the intended learning objectives, introduces the main themes, and lists the key terms used in the chapter.
- **Big ideas:** Describes the key mathematical ideas and/or principles that need to be understood to ensure the learning intentions of the chapter are achieved.
- **Vignettes at the start of each chapter:** A short story about mathematics or mathematics teaching and learning that is relevant to the focus of the chapter.
- **Making connections:** Provides links to the big ideas in mathematics, other disciplines, children's interests and other relevant mathematical learning. A particular emphasis is placed on the type of knowledge pre-service teachers need to successfully pass the Literacy and Numeracy Test for Initial Teacher Education (LANTITE).
- **Teachers in practice:** This is a new feature that has been introduced to capture the wisdom of practice. They take the form of case studies provided by practicing classroom teachers or mathematics educators to provide windows into the realities of classroom experience.
- **Activity:** A plentiful array of activities that pre-service and practicing teachers can use in a range of classrooms. These are generally quite specific and framed for the different school Year levels. They include an emphasis on the use of children's literature and exemplary resources.
- **Try it yourself:** A new feature intended to help pre-service teachers with their own maths knowledge and to build confidence in teaching maths to a wide range of students.
- **Teaching tips:** Practical tips to help pre-service and practicing teachers prepare their lessons with confidence.

- **Linkage:** Helps students navigate their way throughout the book, drawing on information introduced in earlier chapters and then elaborated on in later chapters.
- **Review questions:** Help students evaluate and cement their learning.
- **Extend Your learning:** A new feature intended to demonstrate the leadership role that educators play, through reflective practice. This end of chapter section includes tips for working in groups, criteria for selecting appropriate and effective resources (apps, NRICH, Inquiry Maths, etc), consideration of maths specialist courses, workshops and further professional learning for teachers, ideas for stimulating discussion in a team meeting, team teaching strategies, and mentoring.

We entrust our many years of combined knowledge of mathematics and teaching to the future teachers who are using this book as their text and to those practicing teachers wishing to deepen their knowledge and confidence for teaching mathematics. If we have been able to transfer our joy of mathematics to you, then our efforts in writing the book will be rewarded. We welcome feedback from you to assist the continued development of the book.

Di
Kim
Rhonda
Marj
Dan
Jodie
Margarita
Elizabeth