

PART I

1

Professional Learning for Quality Instruction

Research indicates that the quality of instruction is an important factor influencing student achievement in mathematics and that teacher quality cannot be measured simply in terms of degrees earned by the teachers. We believe that the quality of instruction is critically important and is directly tied to teachers' specialized knowledge of the teaching and learning of mathematics; that is, what is referred to as pedagogical content knowledge (Shulman, 1986). This book aims to be a resource for developing pedagogical content knowledge for teaching arithmetic to 7–11-year-olds. The book is not intended to be a comprehensive curriculum; rather, it provides a fine-grained approach for improving instruction in arithmetic. Critical to our approach is the view of the teacher as a professional practitioner. When teachers are reflective, when teachers engage in professional development, curriculum development, and research, instruction improves. Indeed, we believe that reflective, professional practitioners are the driving force behind improvements in education (Askew et al., 1997; Clarke, 1997; Clarke et al., 1990; Rivkin et al., 2005).

The approach detailed in this book is a major outcome of an extensive programme of research and development over many years. Central to the programme is ongoing, professional collaboration with teachers. We have worked with teachers and instructional leaders in a range of countries including Australia, Canada, New Zealand, Ireland, the United Kingdom and the United States. The research programme derives from an ongoing reflexive relationship between researchers and practitioners working cooperatively to design new approaches to instruction. In this way, our work has been fundamentally influenced by and is deeply indebted to the work of practitioners. We invite teachers to continue to relate to the material in this book as reflective, collegial, professional practitioners. In this chapter, we first discuss ways of using the book for professional learning. We then describe ways of using the book for intervention instruction, for classroom instruction, and for parental involvement (Cobb, 2000; Cobb et al., 2003; Gravemeijer, 1994a; Wright et al., 2007).

Using the Book for Professional Learning and Development

We see teaching as a journey of learning. Teaching thrives when supported by a culture of continual learning, with teachers developing their knowledge of mathematics, as well as their specialized pedagogical content knowledge. For the teacher, the experience of the kind of instruction described in this book is profoundly different from instruction focused on procedures and facts. Learning to teach this way with facility takes several years of dedicated professional development. This book is intended as a resource for such professional development. Professional learning can be accomplished through individual reading, trial and reflection. Learning is typically easier and richer when shared with colleagues



Photo 1.1 Using the book for professional development

in a group, that is, in a professional learning community (PLC). We encourage readers to seek like-minded professionals with whom they can pursue their learning. Learning in a PLC can be organized in various formats, including as a book study, video-stimulated discussion, or curriculum development. To use this book for professional learning, choose one to three domains from Part II as a focus. Three approaches to learning about a domain are described below: observation to develop awareness; making detailed assessments; and pedagogical engineering (Ball and Bass, 2000; Lord, 1994; Mason, 1998; Munn, 2006; Yoshida, 2008).

Developing Pedagogical Awareness

Important professional learning can involve careful observation of student thinking and learning within a domain. The book can serve as a prompt and guide to sharpen awareness. Recommended sources on observation and listening for teaching include Davis (1997), Empson and Jacobs (2008), Mason (2002) and Yackel (2003).

Develop your Awareness of Students' Arithmetic Knowledge and Thinking

Like a naturalist in a forest, be delighted and curious about the variety of students' thinking. Listen carefully, observe closely, take notes. Use the book as a field guide, furnishing details to look for in students' developing arithmetic knowledge: the different ways students think about the number 10, unpacking what knowledge a student uses to do multi-digit subtraction, and so on. Observing your own mathematical thinking helps too.

Develop your Awareness of How Students Learn Mathematics

This book gives some examples of learning moments. Notice when your own students use some new mathematics, for example a more sophisticated strategy 'I did double 8 and 1 more, which is 17' (at the beginning of the term, he only used counting by ones); a new number relationship 'Well 48 is close to 50, so ...' (a month ago, she wouldn't have noticed this). Did this new mathematics arise from rehearsing a procedure, or from trying to solve a problem? Did the student accomplish it in the same lesson it was introduced, or many weeks later? Reflecting on your own mathematical learning helps too.

Develop your Awareness of Your Own Teaching

For example, how do you choose the tasks you pose? When a student can't solve a task in a few minutes, how do you respond? Notice when you fish for a particular answer, or when you lead the student through a procedure, or when you adjust the task, or when you leave the student to keep puzzling. What objectives are behind an instructional decision? Listen to yourself on an audio recording, or watch yourself on video. Observing other mathematics teachers helps too.

Making and Using Assessments

For each domain in Part II, exemplar Assessment Tasks are provided with detailed notes about student responses. Use these to develop a profile of student knowledge of a domain. In turn, in conjunction with the descriptions of trajectories of instruction, develop an individual teaching plan for students. This is a powerful approach to using data to drive instructional decision-making. Developing detailed assessment profiles and teaching plans constitutes significant professional learning (Wright, 2002). Recommended sources on using assessment for professional learning include Ellemor-Collins and Wright (2008), Ginsburg et al. (1998), Munn (2006) and Wright et al. (2006a).

Pedagogical Engineering

Many of the Instructional Activities have been designed by teachers to meet the needs of their students. Our approach encourages teachers to be 'tinkerers' (Gravemeijer, 1994a, 2004) with settings and record their observations, conjectures and reflections about student learning in a journal. These journal entries, along with video clips of instruction and assessment, often become the basis of rich discussions among PLCs. The PLCs provide a supportive forum in which teachers share pedagogical innovations, concerns and solutions. In this manner, the practitioners function as pedagogical engineers, designing, tweaking and testing instructional procedures and materials in order to promote improved student learning. We do not propose that every teacher become a researcher. Nevertheless, we believe that reflective practitioners function as researching practitioners when they think deeply about and tinker with settings and tasks. We hope readers will take licence to further develop the tasks and activities in this book. When practitioners engage in dialogue with other teachers and with researchers they can have a

profound impact on the profession. Recommended sources on pedagogical engineering include Jacobs et al. (2006), Mason and Johnston-Wilder (2006) and Watson and Sullivan (2008).

Using the Book for Intervention Instruction

Much of the material in this book has been developed in the context of intensive intervention with low-attaining students. For intervention, we have found instruction in one-on-one and small group formats (two or three students) to be highly effective. In those formats the instruction can be closely attuned to the students' current levels of knowledge. An intervention programme of daily or near daily sessions over at least 10 weeks is recommended. For each student, select two to four domains as a focus for initial intervention. Use the Assessment Tasks to



Photo 1.2 Using the book for intervention teaching

develop a detailed profile of student knowledge across those domains. Based on the assessment, target instruction to the cutting edge of the student's knowledge. Address all selected domains in every session: knowledge of the domains can develop concurrently and interdependently. The instruction described in each Domain Overview offers a fine-grained progression appropriate for intervention. Critical to intervention instruction is ongoing close observation of students' thinking and strategies. With such intensive, closely targeted instruction in key domains, low-attaining students can develop robust arithmetic knowledge. For a detailed discussion of the methods of one-on-one assessment and teaching for intervention, the reader is referred to the first two books in this series (Wright et al., 2006a, 2006b).

Using the Book for Classroom Instruction

Classroom teachers can draw on the book in a range of ways:

- Use select Assessment Tasks with all students in the class or with targeted students.
- Draw on the set of Assessment Task Groups in one chapter to prepare a unit assessment.
- Use an Instructional Activity with the entire class or in small groups within a learning stations format.
- Engage in pedagogical engineering: try an Instructional Activity then develop and refine it.
- Study a Domain Overview as background for understanding students' learning and strategies.

- Tag key tables and figures to refer to during classroom demonstrations or discussions.
- Use the Resource CD to prepare a kit of key instructional settings for a domain.
- Use a whole chapter from Part II as a basis for a unit of work.
- Use the whole book as a map for a course in arithmetic over three or four years.

Our instructional approach is described in detail in Chapter 2. The approach can be applied flexibly to whole classes or small groups of learners. A central challenge of classroom instruction is managing the range of levels of knowledge across the students. The Instructional Activities in the book include notes about differentiating instruction within the classroom. For further discussion of organizing and managing classroom instruction, see Chapter 1 of the third book in the series (Wright et al., 2006c).



Photo 1.3 Using the book for classroom teaching

Using the Book to Promote Parental Involvement

Much has been said about the importance of promoting parental involvement in schools (e.g. Merttens, 1999). Parental involvement is particularly important when attempting to garner parental support for novel approaches to arithmetic. If teachers do not proactively address this, parents feel alienated and can often inadvertently sabotage a teacher's best efforts. This book can be used to promote improved parental knowledge and engagement. The photocopy black line masters of instructional resources contained on the Resource CD can be used in lieu of traditional homework sheets. The activities are engaging and provide a venue for meaningful practice, so most students enjoy the activities and therefore are more likely to complete the assignments. Parents who have experienced this style of homework activity have reported positive feelings about the experience and have stated repeatedly that they wish homework had been like this when they were young. These resources can also be used for activities during family mathematics nights.

Parent academies or workshops are another method for improving home-school relations. This is critical when schools attempt to introduce mathematics that is unfamiliar to the parents. A popular topic for parent academies is alternative algorithms or semi-formal written strategies. Teachers can forearm parents with knowledge of alternative algorithms before introducing them to students in the classroom. This equips parents to reinforce instruction given in school and provides parents with a rationale for using the alternative algorithms. See Chapter 8: 'Written Computation' for more detail on alternative algorithms.