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Book Reviews

Triangulation: Finding the Method for Teaching Mathematics in the Primary School

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Bobis, J., Mulligan, J., & Lowrie, T. (2004). *Mathematics for children* (2nd ed). Sydney: Pearson Education. 334 pp. ISBN 1741032245

Booker, G., Bond, D., Sparrow, L., & Swan, P. (2004). *Teaching primary mathematics* (3rd ed). Sydney: Pearson Education. 602 pp. ISBN 1741030986

Zevenbergen, R., Dole, S., & Wright, R. (2004). *Teaching mathematics in primary schools.* Sydney: Allen & Unwin. 346 pp. ISBN 1741443586

The bases for this review are three recently published, current Australian mathematics teacher education texts. The strength of the Australian mathematics education community is shown by the collaboration of its members in these three books intended to introduce pre-service and practising teachers to fundamental ideas about teaching and learning school mathematics. The purpose of this review is to consider the degree to which these three books would support best practice by teachers of early childhood mathematics (K-2), as well as to compare and contrast their different approaches to teaching and learning mathematics. The authors are all respected mathematics educators and are representative, currently, of four Australian states: New South Wales, Queensland, Victoria, and Western Australia.

Each of the books is structured similarly, with a beginning section of one or more introductory chapters on what is mathematics in the twenty-first century and theories of how it should be taught, a section containing the majority of the chapters which outline the content of what is to be taught and strategies for teaching this content, and a third section which includes chapters concerned with effective learning, planning, and assessment. Mathematical content and processes are clearly related to age so each book's provision for early childhood mathematics is most apparent in the second section. Although these three sections are not explicitly identified in *Teaching*

Mathematics in Primary Schools, for the purposes of this review the chapters are grouped into these main sections for ease of comparison.

Despite these broad similarities the three books are very different in style and approach. The three books are considered together in the introductory and the effective learning sections but the content sections of each book are discussed separately. Finally my impressions of each book are summarised in the process of triangulating the most appropriate manner of teaching the teachers of early childhood and primary mathematics.

What is Mathematics? How is it Learnt?

Mathematics for Children includes activities for pre-service teachers to reflect on their own memories and to compare their own intuitive ideas about mathematics with the frameworks of Piaget and Dienes, and also the definition given in Mathematics K-6 (NSW Board of Studies, 2002). *Teaching Primary Mathematics* begins with changes wrought by technology and then focuses on numeracy, problem solving, sense making, and communication. The authors of *Teaching Mathematics in Primary Schools* comment on the evolution of school mathematics, concomitant with changes in society and technology, and define mathematics as the study of patterns and relationships, a way of thinking, seeing and organising the world, a language, a tool, a form of art, and finally as power and a social filter.

All three books focus on constructivism as the predominant theory of learning mathematics. Only passing mention is made of the existence of other theories of learning (socio-cultural theory and socially critical theory in *Teaching Mathematics in Primary Schools*). The assumption seems to be that constructivism works best for all students, teachers, and aspects of mathematics. Constructivism is a theory of learning, however, it is not a theory of teaching. As Fosnot (1996) comments, constructivism implies a radically different approach to teaching that "gives learners the opportunity for concrete, contextually meaningful experience through which they can search for patterns, raise their own questions and construct their own models, concepts and strategies" (p. ix). So if, as educators, we value a constructivist theory of learning, we need to show our students what constructivist learning might look like in mathematics and how it would differ from current practice.

The only book that attempts to show what constructivist learning might look like in a classroom is *Mathematics for Children*. Two classroom scenarios are described and one is perceived as more aligned with constructivist learning than the other. The open-ended investigations in the book would also promote constructivist learning. I would, as a teacher, have many questions: Do lessons always need to be investigations? What types of tasks should I use? Should children always work in groups? How much direction should I give? In my opinion, none of the three books shows student teachers how to achieve constructivist learning within the constraints of the

curriculum. The idea of children posing their own questions and constructing their own models, concepts and strategies is not emphasised at all in *Teaching Primary Mathematics* and only minimally in *Teaching Mathematics in Primary Schools*.

One of the tenets of constructivism is that learning is a social process so in these books, group work is promoted as a way of encouraging constructivist learning. However, group work needs to be carefully structured to achieve individual learning. *Teaching Primary Mathematics* and *Teaching Mathematics in Primary Schools* briefly describe types of groups and *Mathematics for Children* includes some information on structuring groups. More detail is required about how a teacher structures group lessons to develop reflection on physical and mental action and to ensure that all children in a group participate and learn.

The Mathematical Content

The mathematical content of each book and its relevance for teachers of early primary years are analysed separately.

Mathematics for Children

Structure and Format. Mathematics for Children emphasises investigations and the strategies that students use to solve open-ended questions. Each chapter begins with an overview and focus questions, and concludes with a summary of the main points and the implications for classroom practice, followed by action and reflection activities for the reader and an extensive reference list. Examples of children's work are used extensively throughout the book to illustrate teaching points. Some of these examples are accompanied by comments from the teachers involved, as well as an analysis of the mathematical content and processes that are relevant to the investigation. Key questions and ways of extension activities are also included for some investigations. About 60% of the book is dedicated to content-the approximate breakdown is whole number (21%), space (8%), measurement (8%), chance (8%), data (8%), and fractions (8%).

Relevance for Early childhood teachers. Mathematics for Children provides ideas and support for early childhood teachers in a chapter on "Constructing early number concepts and relationships" in which there is a wealth of research related to early number. The Learning Framework in Number, which forms the basis of the NSW Department of Education and Training's Count Me In Too program, is briefly outlined, as are addition and subtraction growth points for the Victorian Early Years Numeracy Program. Additional information is provided in some examples of children's work, which illustrate mathematical strategies used by individual 5- to 7-year-olds. The majority of the examples in this book, however, show the work of children in grades three to six, and consequently, most of the related discussion is relevant to teachers of these older students.

Teaching Primary Mathematics

Structure and Format. Teaching Primary Mathematics is the longest of the three books and is a detailed guide to teaching the mathematical concepts, with over three-quarters of the book devoted to content and processes. There are almost no examples of children's work; the illustrations are principally diagrams explaining mathematical concepts and procedures. Number is the major theme of the book (about 40% of the book devoted to the teaching of number, compared to about 20% in each of the other two books) with a strong emphasis on written algorithms. The approximate breakdown is whole number (43%), space (14%), measurement (8%), chance and data (5%) and fractions and ratio (6%).

Chapter format does not appear to be identical and the chapters differ widely in length (e.g., the chapter on computation and estimation is 191 pages while the chapter on chance and data is 30 pages). "Investigate and discuss" boxes, which consist of questions for student teachers to discuss, rather than activities to extend children's thinking, are found throughout the book. A feature of the numeracy chapters in particular, is the provision of suggested sequences for teaching concepts. Such information would be valuable, in particular to student teachers.

Relevance to Early Childhood Teachers. The book emphasises instruction for older grades so there is not much help for early childhood teachers. The exception is Chapter 3, "Numeration for whole number and fraction ideas", which contains some information on early number learning, mainly concerned with linking objects, number symbols and number words, then comparing and ordering numbers. The sequence recommended in this book is the introduction of one-digit numbers, then the numbers 20–99, followed by the teen numbers and large numbers. This sequence does not appear to be in agreement with current research on early counting, and would conflict with that recommended, for example, in the NSW syllabus. In contrast to the other two books, there is almost no mention of number sense and mental strategies in the chapter.

Teaching Mathematics in Primary Schools

Structure and Format. Teaching Mathematics in Primary Schools is the least demanding of the three books to read because it contains few references to research and has a structure of short chapters, combined with small page size and large margins. Topics are separated into single chapters, for example, those dealing with language, diversity and equity, assessment and planning, whereas the other books have incorporated some of this material into other chapters or combined it into one long chapter. Each chapter includes review questions and a short reference list. About 60% of the book is dedicated to content-the approximate breakdown is whole number (22%), space (9%), patterns and algebra (4%), measurement (9%), chance and data (7%) and fractions (10%).

Relevance to Early Childhood Teachers. The chapter entitled "Early number" would be particularly relevant to early childhood teachers. Topics such as pre-number, patterning, subitising and counting are discussed with a model of early arithmetic learning elaborated. I felt that this chapter could have been longer; it covers all the early number concepts, place value and the four operations in only 27 pages. There are some spatial activities for young children on page 315 and the following pages, but otherwise the book is really geared to older students.

Effective Instruction

Working Mathematically

In a sense the whole emphasis in *Mathematics for Children* is on working mathematically. The book includes many excellent examples of investigations that could be used in primary classrooms. The chapter on challenging children to think mathematically gives a overview of aspects that might be considered in planning problem solving activities. *Teaching Primary Mathematics* includes a chapter on problem solving, including a section on planning for problem solving. I particularly appreciated the discussion, not only of the strategies children might use but also of difficulties they may encounter in using these strategies. Work samples are used effectively here to illustrate children's incorrect solutions. The working mathematically chapter in *Teaching Mathematics in Primary Schools* gives a short description and an example of each of the standard problem solving strategies (create a table, make a drawing, etc.). I would have liked the authors to show that students might use different strategies for the same problem, as well as to discuss some of the difficulties students will have in applying these strategies.

Problem posing is, in my opinion, an under-utilised strategy in mathematics and its cursory treatment in these books will not encourage teachers to teach children to pose problems. Both *Mathematics for Children* and *Teaching Mathematics in Primary Schools* include some information about problem posing but I do not feel that it would be sufficient to help teachers implement problem posing in their classrooms.

Planning and Assessment

The chapters on planning and assessment in all three books replicate much of the content of standard texts on beginning teaching; only the examples have been changed to be mathematical. A stronger constructivist focus in these chapters would have been apt, with an emphasis on planning investigations to develop mathematical concepts and assessing that all children are learning in open-ended, and often collaborative, situations. The approach to planning lessons in this section is also fairly standard, for example, in *Teaching Mathematics in Primary Schools*, the types of lessons

described are direct instruction, plan-teach-review and problem based. While the authors question the effectiveness of the plan-teach-review lesson format, they do not give much assistance concerning how to implement effective models of teaching to cater for constructivist learning. Since many experienced teachers have not managed such a transition, I think that student and beginning teachers will need practical assistance early in their campus education in how to set up and maintain a "constructivist classroom".

Catering for Diversity

In *Teaching Mathematics in Primary Schools* the chapters concerned with effective teaching include the importance of language, diversity and equity. The chapter on language addresses some of the complexities of language, for example, that the mathematical meaning of a word may be very different to its everyday meaning, as well as the role that prepositions play in mathematics. The chapter on diversity and equity contains interesting material that is essential if we want teachers to consider how to teach students who come from very different cultural or social backgrounds. However, the main research quoted relates to middle-class versus working-class students and also Papua New Guinean students. Increased attention to research relevant to the mix of cultures that many Australian teachers face in their schools would be helpful. In addition, key cultural language differences could have been presented in the chapter on language.

There was no specific information in either *Mathematics for Children* or *Teaching Primary Mathematics* on equity, diversity, or individual needs. In these books language is incorporated into the content chapters, with an emphasis on the specific terms relevant to teaching a topic.

Use of Examples of Children's Work

Neither *Teaching Primary Mathematics* nor *Teaching Mathematics in Primary Schools* have used many examples of children's work. In contrast, the children's work in *Mathematics for Children* is a predominant feature of the book and makes it visually appealing. Shading is also used extensively to highlight information, although so much text is shaded-often whole pages-that the impact of the shading is often lost. The many shaded sections, containing activity, work sample, teachers' comments, mathematical content and processes, posing key questions and extending the investigation, at times distracted attention from the main points, rather than consolidating them. The information accompanying the work samples often includes important ideas that do not seem to be evident in the main commentary. Although the use of examples of children's work provided insights into children's thinking, it also constrained the sequencing, flow and interpretation of this text.

Conclusion

Let me consider first the early childhood perspective. Does the syllabus-related content of these books assist teachers to cater for children in the first three years of school? With the exception of number, the answer is no, and there is an apparent need for a book written for teachers of children in Years K-2, rather than simply by extension from existing chapters in these books. On the other hand, the generic information, such as, "What is mathematics?" and "How do children learn it?", as well as the effective teaching section, would be relevant to all teachers.

Mathematics for Children is not an easy book to read because of its extremely detailed analysis of the activities and work samples. However, it would be an extremely valuable asset for pre-service teacher education programs as a source of examples of challenging investigations, combined with examples of children's work. This book has the most obvious research base of the three, and gives a comprehensive reference list for most chapters. It might better have been prepared as two companion books, one to provide information, based on research, about children's learning of each concept, cross referenced to an accompanying volume of the investigations for teachers to use in their teaching.

By contrast, *Teaching Primary Mathematics* includes few investigations and is quite prescriptive in its approach to teaching. For these reasons it will probably be very attractive to those student teachers who lack confidence in teaching mathematics. The book has many strengths but my impression is that this third edition now needs to be extensively rewritten so that it reflects recent trends in the teaching of mathematics.

The most recent book, *Teaching Mathematics in Primary Schools*, is a very accessible text for pre-service teachers. Information is packaged in brief sections and the writing style is in active voice with short simple sentences. There are few references to break the flow of the text but a reference list is provided at the end of each chapter. The book would be suitable as an entry-level text, as it provides some information about a range of mathematical topics. There is insufficient detail, however, to support the teaching of concepts or to provide a rich research base to highlight the complexity of the concepts.

There is no one method of teaching primary mathematics. Taken together, hence the desire to "triangulate" these three approaches, the different perspectives of these books will shape teachers' constructions of mathematics teaching and learning. The books' diversity of approaches ensures rich, multi-faceted constructs created from the interleaving of research, teaching, and reflection.

References

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