chapter 1

Introduction: Towards an Inclusive Philosophy and Practice for Early Childhood Numeracy Education

This chapter explains:

- the meaning of numeracy and its relationship to mathematics
- that an inclusive philosophy and practice for early childhood numeracy education entails:
  - a sociocultural perspective on teaching and learning
  - goals and expectations common to traditional early childhood philosophy and sociocultural perspectives.

DEFINING NUMERACY AND ITS RELATIONSHIP TO MATHEMATICS

Mathematics is a discipline or knowledge domain, an abstract system of representation with meanings that are absolute. **Numeracy** is a social and cultural perspective for discovering and thinking about mathematical knowledge and applying it to fulfil the purposes of our everyday lives. The distinctions between numeracy and mathematics are discussed further in Chapter 3.

When we think of mathematics we usually think of it as a formal abstract system involving rules and requirements for accuracy and precision. However, we also apply mathematical concepts in situations arising from our everyday activities, such as preparing a meal and arranging furniture, or in sport and leisure activities such as swimming, netball or dance. A numeracy perspective appreciates and values informal contexts such as these for their application of mathematical concepts or processes.

This book's interpretations of the meaning of numeracy are based on the Australian Association of Mathematics Teachers' (AAMT, 1998) current definition of numeracy:

> To be numerate is to use mathematics effectively to meet the general demands of life at home, in paid work, and for participation in community and civic life.
>
> In school education, numeracy is a fundamental component of learning, discourse and critique across all areas of the curriculum. It involves the disposition to use, in context, a combination of:
>
> - underpinning mathematical concepts and skills from across the discipline (numerical, spatial, graphical, statistical and algebraic);
> - mathematical thinking and strategies;
> - general thinking skills; and
> - grounded appreciation of context. (p. 2)

The concept of numeracy allows for a focus on:

- **context** *and purpose*, and on the usefulness of a particular approach in solving problems in everyday life
- *flexible, negotiable and meaningful applications* of mathematical concepts—unconventional tools, materials or processes can be applied to achieve a desired outcome, for example using a hand-span, a stride or a stick to measure distance
- *the process* of applying mathematical concepts or operations—what is being done—rather than on an external assessment agenda
- *appreciating* the mathematical dimensions of everyday leisure or work experiences
- *using available knowledge*, skills, intuition, creativity, experience and resources or tools in order to fulfil a particular purpose
- *developing confidence alongside competence* so that the mathematical process is satisfying and fulfilling.

In these respects, *numeracy* is a viable concept for inclusion in early childhood education programs catering for children from birth to age eight. This book demonstrates how this is feasible, both theoretically and in practice.

The Australian Association of Mathematics Teachers (1997) has identified ways of being or becoming numerate. There are four broad *numeracy senses* incorporating concepts of number, space, measurement, and probability, defined as follows:

- *number sense* is an ability to use numbers, and an appreciation of number and number relationships
- *data sense* is the ability to use statistical and measurement information
- *spatial sense* is the ability to use spatial, visual and location information
- *formula sense* is the use of formulae, graphs, symbols, signs (AAMT, 1997).

What is 'mathematical' in people's everyday experiences can be identified using these senses (see, for example, Macmillan, 2001, 2002). In school mathematics curriculum documents, the Working (or Thinking) Mathematically segment corresponds most closely to the principles of numeracy implicit in these four *numeracy senses*. (See e.g. Board of Studies, NSW, 2006.)

Throughout this book, transcribed interactions of children playing are used to illustrate how the mathematical concepts of number, space, measurement and probability are present in play, although the children themselves are usually not aware of it. The observation of bridge construction play below demonstrates that numeracy senses are present and functioning in a play context.

The observation occurred in the outdoor area of a preschool. Danna (D) was building independently with big wooden blocks (approximately 60 centimetres in size) (Figure 1.1). The teacher (T) has just stopped to observe.

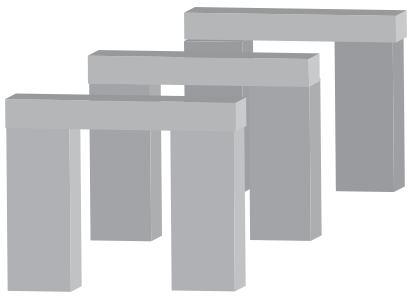

Figure 1.1 A three-dimensional view of D's bridge construction.

THE OBSERVATION	NUMERACY SENSES
1 [D stood three blocks vertically beside each other.	*Spatial sense:* position concepts in the vertical placement of blocks parallel to each other.
2 Opposite them she placed another three blocks in the same position.	*Number sense:* number concepts of equivalence and comparison of quantities of blocks.
3 She then placed three blocks on top of the horizontal blocks and selected a large sheet from the blanket box, returning to her construction. She placed the sheet over the construction, covering the rear and front of the construction.	*Spatial sense:* positioning blocks in the horizontal and vertical placements. *Spatial sense:* concepts of position—'on top', 'beside', 'inside'. *Data, spatial senses:* the blocks are positioned so that there is a route between them, big enough for a child to sit in.
4 D crawled inside the construction, sat down.]	*Spatial sense*: 3D perspective; estimating the distance separating the two rows of blocks.
5 D: Look T, I made a house. 6 T: That's fantastic. 7 T: Can I come and sit in there with you, D? 8 D: No, you won't fit, T.	*Spatial, data senses:* 3D concepts are applied to construct a structure, formed by placing a roof on the two parallel rows of blocks, discriminating relationships of weight and force; child improvises the original construction, creates another representation and reconceptualises it as a 'house'.

The child's ability to choose how to proceed and to use the resources of play demonstrates that the learner is completely in control. The teacher is an interested bystander until such time as she is invited to participate (5). The teacher responds by appreciating the value of the construction (6) and by asking to share in the play (7). Mutually constructed meanings could then emerge from this shared participation. This is an example of mathematical concepts being situated in, and emerging spontaneously from, the social and **perceptual** context of construction play (1, 2, 3, 4, 5, 8).

TOWARDS AN INCLUSIVE PHILOSOPHY AND PRACTICE FOR EARLY NUMERACY EDUCATION

That numeracy has a place in early childhood education from birth to eight years can be argued from an inclusive philosophical position that encompasses:

- sociocultural perspectives that recognise and incorporate ecological, constructivist and developmental theories
- the valuing of the social dimensions of a learning environment and the relationship between social context, participation and learning (negotiable, flexible, expressive modes of interaction, production and performance)
- the belief that all children have a natural disposition to learn that begins at birth and continues throughout life (cultivating curiosity, choice and control, and offering challenges through providing and designing imaginative, meaningful and purposeful contexts for teaching and learning)
- the notion of 'shared contexts for teaching and learning'—role of the teacher as mediator, collaborator and facilitator.

These components are discussed below.

Sociocultural perspectives aligning with early childhood education theories

Sociocultural perspectives are investigative frameworks for analysing and examining what is going on between people as they find ways of relating to each other, and making sense of the things people do together—that is, what is going on socially and culturally. The main sociocultural perspective for this book is Lave and Wenger's (1991) concept of *situated learning*. It is one of many perspectives that can be used for analysing the social and cultural meanings and relationships of an educating community.

The concept of *situated learning* is that learning takes place within social situations through language and participation. It arose from Lave and Wenger's (1991) interest in bringing together theories of learning from educational psychology and ways of investigating issues of social justice in

teaching and learning contexts. Situated learning has some connection with the ecological theory of Bronfenbrenner (1979) and its focus on the various layers of children's social worlds. It recognises the contributions made by constructivist principles, and the role of cognition in learning and development. However, it shifts away from the idea of ability as a fixed construct internal to the individual, who has little capacity to change it, to focus on the social environment or context, which is not fixed but dynamic and fluid. It perceives the learner as having control in that social context—to be self-motivating and self-regulatory. Competence is perceived as accessible and achievable for all learners.

In mathematics education, the change of focus away from the internal mechanisms and structures of the mind and towards an interest in the role of language and other means of social support began in the 1980s. However, the idea of numeracy, and its sociocultural orientation, has emerged more recently as a focus of mathematics curriculums. In the early childhood education literature, support for sociocultural perspectives is growing (see, for example, Anning, Cullen & Fleer, 2004a; Göncü, 1999), and they are beginning to influence government policies and structures (Fleer & Raban, 2005).

Understanding and examining the social dimensions of the learning environment

Lave and Wenger (1991) examined other scholars' studies of adults learning in informal education contexts—apprentices learning to become master butchers, tailors, midwives and so on. They found certain elements to be common in all these settings, and the degree to which the apprentice could emerge as an autonomous, competent and confident craftsperson was determined by a range of factors. These included:

- access to the resources and meanings of the practice
- experiencing engagement in the activities
- negotiability in how the required activities could be carried out
- an emphasis on flexibility regarding process rather than rigid attention to particular outcomes.

That is, when high degrees of choice and control were possible in a supportive, responsive and collaborative **culture**, apprentices acquired responsible self-regulative strategies, met challenges confidently, and learned how to manage the human and technological resources of the practice competently.

Situated learning focuses on the relationships between identity and belonging and the ways in which social and cultural contexts include or exclude the learner as a participant. That is, it asks questions about who has access to full participation and who doesn't, how equitably resources are distributed and if they are made accessible to all, and to what degree all children have access

to feedback and support from peers and others, such as the teacher or carer. It seeks to explain and understand:

- the whole person who is learning
- the integral and inseparable aspect of engagement and activity
- the relations of power and knowledge.

The first two points reflect the focuses of most mainstream early childhood philosophies. The third point has been a focus of research examining issues of social justice, such as gender, race or colonial governance (Dahlberg, Moss & Pence, 1999). Analyses of power and knowledge are increasingly applied to various aspects of early childhood curriculum (MacNaughton, Rolfe & Siraj-Blatchford, 2001; Siraj-Blatchford, 2004) and to critique theories and practice based on ideas of developmental stage and what is age-appropriate (Grieshaber & Cannella, 2001).

A sociocultural perspective necessitates a focus on language as a cultural entity and dynamic. Differences in terminology between the developmental literature and sociocultural literature can be daunting at first. For example, the early childhood term 'the environment' has some correspondence with 'social context', and the term 'experience' with 'activity'. The sociocultural term 'activity' includes a focus on language and learning—on what can be determined about the nature of the teaching and learning from the verbal and non-verbal actions and interactions being carried out. The concept of activity acknowledges that:

- educators' understanding of the design, plan, purpose and structure of an activity will inform analyses of the teaching–learning process
- the possibilities and potential of the activity's social, perceptual, emotional, intellectual and even spiritual elements will determine, to a great extent, the nature of engagement and the quality of the experience.

Guberman (1999, p. 223) confirmed this view when she noted that it was important for mathematical activities to provide opportunities for change:

> for children to participate meaningfully as they move from limited knowledge and involvement towards greater understanding and participation; and for activities to change as they are transformed by children who, through their constructive activity, acquire new understanding and encounter new challenges.

In essence, then, the concept of *situated learning* invites **analysis** and understanding of how power relations and knowledge generate inclusive or exclusive, equitable or inequitable social relations. It offers explanations of how these evolve in relation to capacities to perform in ways modelled by the practice.

Its basic principles include addressing:

- the needs, interests, desires and strengths of the learner
- the integral nature of engagement in activity, whereby the learner responds to the many dimensions of the context and makes sense of what is happening according to what s/he brings to the activity
- the complexity of these relations of power and knowledge—things to be regulated and things to know and discover.

Each component defines the others and 'cannot be considered in isolation' (Lave & Wenger, 1991, p. 35). Combined, they create possibilities for the development of a sense of belonging through engagement, respect and recognition, and for clear and gradually increasing access to full participation and community membership through growing understanding. Shared moral obligation and responsibility permit growing possibilities for self-regulation and self-agency (Chapter 6). Control of resources and organisation of tasks integral to the practice contribute to the developing sense of legitimate participation and identity (Chapter 5).

Children's natural propensities for learning

A numeracy focus in education acknowledges the potential of everyday experiences to expand numeracy, which is understood to evolve and grow from birth and throughout life. Babies, toddlers and preschool children may not be aware that they are exploring and coming to know mathematical meanings as they play, talk and carry out their daily routines, but they respond to their natural curiosity from the moment of birth. Their basic human needs are intimately connected to natural urges to know and learn. Most of the observation material used in this text to demonstrate how young children are becoming numerate in informal environments has been recorded from the conversations of four- and five-year-old children. This choice was made because their verbal interactions offer rich scope for identifying the mathematical skills and concepts. Similar observational focuses can be applied to appreciate the developing numeracy of infants and toddlers. The teaching strategies are relevant to all age groups, as they rely on close observation and attention to the details of actions and interactions so that appropriate collaborative responses and stimulating learning contexts can be provided.

The teaching and learning of numeracy is a collaborative process.

That is to say, mathematics is part of the cultural world of infants and toddlers as much as for preschoolers and children in the early years of school. As babies and toddlers, children begin to discriminate and perceive differences and similarities in objects and symbols: 'Actions and understandings

are tightly interwoven in that an individual can only act in relation to the surrounding world, based on his or her understanding of said surrounding world' (Marton & Booth, 1997, cited in Bjorkland, 2008, p. 85). Moreover, 'toddlers today are considered relatively competent social beings with skills and capacities, ready to encounter and master their surrounding world' (Bjorkland, 2008, p. 82). When toddlers are still developing the language for expressing what they perceive, they express understanding through action (Bjorkland, 2007): 'a change in actions implies that a change in understandings has occurred. Therefore, ... a person's actions can be interpreted as his or her understanding and learning' (Bjorkland, 2008, p. 85). Specific guides for interpreting such actions and interactions are provided throughout the book, but particularly in Chapters 2, 4 and 7.

Shared contexts for the teaching and learning of numeracy

A *shared context* for teaching and learning presupposes a collaborative relationship between teacher and learner. The *social context* or situation allows learners to be supported through engagement and challenge in pleasurable and meaningful activities (Guberman, 1999). The teacher adopts the role of mediator, and facilitates connections between the known and the new. There is sufficient flexibility in the social context and in the design of the activity for learners to find a match or fit between what they know already and what they are interested in or curious about. Processes of negotiation, through participation in action and interaction, allow learners 'themselves to transform activities in ways that support their own involvement and learning' (Guberman, 1999, p. 223). For example, when young children play or invent a game based on an adult version (of Tic Tac Toe, for example), the rules are re-negotiated and transformed to fit their own purposes.

A focus on the social nature of learning and development acknowledges the evolving character of children's intellectual engagements. Learning environments 'must be understood as flexible, emergent constructions that reflect both cultural achievements and values and the interpretive, sense-making processes of participants' (Guberman, 1999, p. 223). Young children are often unaware that they are engaging in mathematical thinking and developing mathematical understandings, so the teacher's role is to identify when these are occurring in order to facilitate the process—when it is advantageous for the learner for the teacher to do so. Observation, identification and interpretation of mathematical concepts, skills and strategies are part of the collaborative process. The teacher perceives what is mathematical and enhances the construction of meaning in ways that allow the child to maintain control over the process and outcome.

TOWARDS QUALITY TEACHING IN EARLY CHILDHOOD NUMERACY EDUCATION

There are historically, culturally and systemically based tensions, issues and dilemmas concerning the notion of 'teaching' and 'learning' in the before-school sector of early childhood education. The main areas relevant to our present focuses concern:

- the notion of non-intervention, and protecting children's capacities to be independent, curious and self-regulatory
- perceptions that a focus on teaching and learning involves a domain-specific curriculum based on teacher-directed instruction and assessment practices
- fears about a 'push-down' curriculum that shifts the focus from a child-centred curriculum to an outcomes- or objectives-driven curriculum.

Neveretheless, there are respected leaders in the field who believe that early childhood education is changing (Anning, Cullen & Fleer, 2004b). In Australia, the Commonwealth Government's *National Agenda for Early Childhood* has set up the *Early Years Learning Framework* initiative for children from birth to age eight (Department of Education, Employment and Industrial Relations, 2008)—although it is up to the states to address the content aspects of the framework. In the United Kingdom, Iram Siraj-Blatchford is forthright in her recommendations that the field of early childhood education adopts a concept of 'learner-centred' **pedagogy** rather than 'child-centred' pedagogy, and that 'it should be considered a legitimate aspect of early childhood professional practice on the grounds of learning theory, exemplary practice, and social justice' (Siraj-Blatchford, 2004, p. 145). She argues that there have been erroneous assumptions regarding interpretations of Piaget's constructivist principles, and that:

> adult–child and peer relations influence every aspect of development and that affective and personality development are intimately related to intellectual and moral development. Perhaps more importantly, Piaget argued that reciprocity in peer relations provides the foundations for perspective taking and for decentering. This suggests that collaborative play is exceptionally important for children. (Siraj-Blatchford, 2004, p. 142)

Teacher–learner and peer–peer collaboration is fundamental to the notion of shared contexts for the teaching and learning of numeracy. There is a focus on what children are doing in the here and now and co-constructing meaning from that context (Anning, 2004). The learner's contributions are perceived as being as significant as the teacher's knowledge. One form of knowledge is

not privileged over another; rather, a community of practice evolves in which 'multiple perspectives are shared and contribute to the meaning making' (Cullen, 2004, p. 79).

The Australian Association of Mathematics Teachers (2006) has compiled a comprehensive list of *Standards for Excellence in Teaching Mathematics*, summarised in Table 1.1. Listed beside each standard are similar principles from the National Childcare Accreditation Council's (2001) handbook. There is correspondence in the areas of respect for the social and cultural backgrounds of children, community responsibility, the learning environment and sustaining curiosity, logical thinking and creativity, but it is clear that the professional knowledge of mathematics for teachers and planning for the learning of mathematics are not addressed in the NCAC document. This book attempts to bridge that gap.

Table 1.1 Mathematics teaching standards and their relationships with NCAC guidelines.

STANDARDS FOR EXCELLENCE IN TEACHING MATHEMATICS (AAMT, 2006)	GUIDELINES FOR EARLY CHILDHOOD PRACTITIONERS (NCAC, 2001)
Domain 1: Professional Knowledge 1.1 *Knowledge of the students:* their social and cultural contexts, the mathematics they know and use, their preferred ways of learning, how confident they feel about learning mathematics.	*Principle 2.1:* Staff respect … the social and cultural background of all children and accommodate the individual needs of each child.
1.2 *Knowledge of mathematics:* … sound, coherent knowledge of mathematics appropriate to the student level they teach, and which is situated in their knowledge and understanding of the broader mathematics curriculum.	
1.3 *Knowledge of students' learning of mathematics:* rich knowledge of how students learn mathematics, knowledge of learning sequences, representations, models and language; promote enjoyment of learning and positive attitudes; utilise information and communication technologies; encourage parent involvement; are effective role models.	
Domain 2: Professional Attributes 2.1 *Personal attributes:* enthusiasm, conviction that all students can learn mathematics; commitment to maximising students' opportunities to learn mathematics; aim for autonomous and self-directed learners who enjoy mathematics; they exhibit care and respect for their students.	*Principle 2.3:* Staff treat children equitably.

STANDARDS FOR EXCELLENCE IN TEACHING MATHEMATICS (AAMT, 2006)	GUIDELINES FOR EARLY CHILDHOOD PRACTITIONERS (NCAC, 2001)
2.2 *Personal professional development:* commitment to the continual improvement of their teaching practice; undertake sustained, purposeful professional growth; develop informed views about relevant current trends (e.g. resources, technologies, curriculum changes).	*Principle 10.4:* Management provides and facilitates regular professional development opportunities for all staff.
2.3 *Community responsibilities:* contribute actively to the community; positively advocate mathematics in the wider community; interact effectively with parents; involve students in activities beyond the classroom; **collaborate** with colleagues; support and mentor others.	*Principle 3.2:* Family members are encouraged to participate in the centre's planning, programs and operations. *Principle 4.1:* Staff communicate effectively with each other and function well as a team.
Domain 3: Professional Practice 3.1 *The learning environment:* address the psychological and emotional learning needs of students; respond to the diversity of students' needs and talents; empower students to become independent learners; create an inclusive, caring atmosphere of trust and belonging, active engagement with mathematics, foster communication skills, and encourage cooperative, collaborative efforts.	*Principle 2.2:* Staff respect the diverse abilities … of all children. *Principle 1.1:* Staff create a happy, engaging atmosphere and interact with children in a warm and friendly way. *Principle 5.3:* Programs cater for the needs, interests and abilities of all children in ways that assist children to be successful learners. *Principle 10.4:* Staffing policies and practices facilitate continuity of care for each child.
3.2 *Planning for learning:* plan for coherently organised learning experiences that have the flexibility to allow for spontaneous, self-directed learning; provide for applying mathematics across key learning areas and beyond the school setting.	
3.3 *Teaching in action:* arouse curiosity, challenge students' thinking, engage them actively in learning; act as facilitators of learning, negotiate mathematical meaning, and model mathematical thinking and reasoning; promote creative thinking, mathematical risk-taking, strategic intervention and assistance.	*Principle 6.1:* Programs encourage children to make choices and take on new challenges. *Principle 6.5:* Programs foster curiosity, logical inquiry and mathematical thinking. *Principle 6.6:* Programs foster creative and aesthetic development.
3.4 Assessment: regularly assess and report student outcomes, both cognitive and affective; use a range of fair, inclusive and appropriate assessment strategies; maintain ongoing informative records to map student progress and plan future learning experiences; provide constructive, purposeful and timely feedback to student, parents and school authorities.	*Principle 5.4:* Programs are evaluated regularly. *Principle 5.2:* Records of children's learning and well-being are maintained by the centre and are used to plan programs that are appropriate for each child.

AIMS, CONTENT AND STRUCTURE OF THE BOOK

This introductory chapter provides only a brief overview of the book's aims and content. Each chapter provides an outline of its aims, a theoretical explanation, practical examples and illustrations, and a summary. The ideas being discussed are complex, and understanding how the various dimensions of teaching and learning relate to each other is a challenge. Diagrams, tabular summaries and appendices are provided in order to assist in grasping both the detail and the big picture—or sociological—view. The book has emerged from my own research in preschool education and practice in the early years of school, and in tertiary education with early childhood practitioners and undergraduates.

More than one theoretical orientation is needed to understand how to promote numeracy in early childhood educating contexts. Both constructivist principles and sociocultural perspectives are involved. Success in grasping the fundamentals of numeracy learning and teaching in early childhood education can be achieved by careful reading, responding to the suggested readings, and study. Learning to be a numeracy educator involves dedicated hard work, testing and checking ideas, and discussing challenges and successes with peers, colleagues and teachers. It involves reflection in order to validate new perceptions and to keep track of those dilemmas and challenges still to be explored. It is a gradual process—an understanding of the whole picture is not likely to happen until you have arrived at the end of the book. At the same time, careful study and steady completion of the study activities will generate a sense of confidence and competence. As the poet T.S. Eliot wrote:

> We shall not cease from exploration
> And the end of all our exploring
> Will be to arrive where we started
> And know the place for the first time.
>
> 'Little Gidding' (*Four Quartets*, 1943)

The book's aims are listed below and linked to each chapter. The first half of the book focuses on understanding the learning process, and the second half focuses mainly on the teaching process, although, of course, these processes are essentially inseparable and interdependent. Two case study chapters, Chapters 6 and 13, provide a synthesis of the main ideas of the preceding chapters.

Table 1.2 Chapter breakdown.

AIMS AND CONTENT	CHAPTER
Towards an inclusive philosophy and practice for early childhood numeracy education ■ defining numeracy and its relationship to mathematics ■ towards quality teaching in early childhood numeracy education	1
To understand the learning process the learner needs ■ to make sense of the mathematics □ to have access to the mathematical concepts and activities: the mathematical meanings and activities; investigating through play; motivations; participation; and identity □ to have access to the abstraction processes required for formal thinking: distinctions and relationships between mathematics and numeracy	2
■ to be able to think about the mathematical meanings: the facilitators of formal learning; metacognition: the role of reflection	3
■ to model, test and check mathematical knowledge □ the role of language in learning: modelling as a responsive control strategy □ to communicate what they think they know and may be unsure about: communication roles and strategies; children using language to fulfil learning potential—types of texts □ to have access to support, guidance and feedback	4
■ to be able to think about the mathematical meanings: the facilitators of formal learning; metacognition: the role of reflection	3
■ to model, test and check mathematical knowledge □ the role of language in learning: modelling as a responsive control strategy □ to communicate what they think they know and may be unsure about: communication roles and strategies; children using language to fulfil learning potential—types of texts □ to have access to support, guidance and feedback	4
■ to assert needs and wants—accessing the community's resources □ to express learning potential through performing and producing: rules, roles and responsibilities; technology as a perceptual tool and abstract tool □ to participate in a well-managed community: organising the human resources, the physical setting and its technological resources, the role of reflective practice	5
■ *to be positioned advantageously:* **agency**: its meanings and relations ■ *to acquire a numerate identity:* to experience the social and cultural outcomes of acceptance, belonging and agency	6

Table 1.2 (*continued*)

AIMS AND CONTENT	CHAPTER
To understand the teaching process ■ the content □ pedagogical issues relating to mathematics and early childhood education □ understanding mathematical principles, concepts and skills	7
■ the role of language in the teaching–learning process □ using the language and register of mathematics □ sharing the interactive space in the mediator role □ sharing the interactive space in the instructor and evaluator roles	8
■ teacher language and the social context—its meanings and relations □ responsive teaching strategies □ restrictive teaching practices	9
■ assessing children's mathematical learning potential □ assessment practices in early childhood education □ observation and planning for individual learning □ the peer culture—its meanings and relations □ the mathematics education culture—its meanings and relations □ **problem-solving** processes, planning and assessment approaches	10
To understand the planning process ■ the conceptualisation process and activity design □ shared contexts for numeracy learning □ constructivism as a rationale for planning in mathematics education ■ relating pedagogical goals to best practice □ designing meaningful, purposeful activities □ models of planning: concept-based, activity-based, integrated curriculum	11
To cater for individual learning potential and cultural diversity ■ understanding cultures, diversity and individual needs: pedagogical issues ■ making numeracy accessible for Indigenous preschoolers ■ becoming a critically reflective practitioner	12
To understand the social and cultural context ■ the relationship between participation and identity ■ the sociocultural outcomes of agency, acceptance and belonging	13

CHAPTER SUMMARY

Definitions of numeracy and mathematics

Numeracy is distinct from *mathematics* with its abstract system of absolute meanings and requirements for precision and accuracy, because numeracy is person centred rather than system driven. Its acquisition allows for flexibility, choice, creativity and ingenuity in terms of tools, applications, processes and outcomes. Mathematical ideas and understanding arise spontaneously

from within a context that is motivated by individual needs and purposes, performances and productions. In these respects, numeracy can be perceived as reflecting child-centred philosophies and practices of early childhood education.

Sociocultural perspectives

Sociocultural perspectives provide frameworks for analysing and **evaluating** the social and cultural context in which teaching and learning of any or all knowledge takes place. A sociocultural perspective is being used here because it is as relevant to contexts that are predominantly informal, as in preschools and children's services, as it is to those that are predominantly formal, as in schools.

Need for an inclusive philosophy

An inclusive philosophy is needed for early numeracy education. There are goals in various education departments in Australia and around the world to create guidelines for teaching and learning for children from birth to age eight that interweave the many jurisdictions involved in children's services and school curriculums. Although children in this age group share many common characteristics, providing them with greater continuity involves bringing together two systems, cultures, and practices, and presents a considerable challenge (Department of Education and Early Childhood Development, 2008). Children's learning in non-school settings is play based and therefore investigative and exploratory. In schools, exploratory opportunities are certainly provided, but children's learning is sequenced, structured and formalised through various modes of instruction and assessment. The role of the teacher in early childhood before-school settings differs, at least in emphasis, from the role of the teacher teaching mathematics in school settings, because in schools 'teaching takes place around pre-determined curriculum standards and goals' (p. 50).

This book demonstrates that it is possible to create an inclusive philosophy and practice for early childhood numeracy education. The professional expertise required for planning to teach, implement and assess mathematical concepts, skills and process is addressed.

Need for quality teaching

Quality teaching is essential in early childhood numeracy education. Teaching for numeracy in early childhood education involves being able to interpret through observation the actions and interactions of children as they engage in play or other meaningful activities. In order to collaborate, stimulate, challenge and support the learner, the teacher must understand what is going on mathematically as those actions and interactions take place—to determine

when and how to provide stimulating materials that invite the child to explore and be challenged, and when and how to provide support: when is an interaction going to present too much challenge, distraction or interruption, and when is it going to facilitate new learning? Teacher interactions are perceived as necessary, for learning through play 'cannot be left to chance' (Wood, 2004); rather:

> the role of the practitioner is crucial in:
> - planning and resourcing challenging learning environments;
> - supporting children's learning through planned play activity;
> - extending and supporting children's spontaneous play;
> - extending and developing children's language and communication in their play;
> - assessing children's learning through play;
> - ensuring continuity and progression (Wood, 2004, p. 20).

These strategies are reflected and detailed in the AAMT's (2002) *Standards for Excellence in Teaching Mathematics in Australian Schools* and are elaborated on and discussed in Chapter 5 and Chapters 7 to 12 of this book.

FURTHER READING

For the current Policy on Numeracy in Australian Schools from the Australian Association of Mathematics Teachers (AAMT):
www.aamt.edu.au/Documentation/Statements/Policy-on-Numeracy-Education-in-Schools-1998

For the current AAMT and Early Childhood Australia's position paper on Early Childhood Mathematics:
www.aamt.edu.au/Documentation/Statements/Position-Paper-on-Early-Childhood-Mathematics-print-friendly

For the Victorian Department of Education's mathematics standards:
http://vels.vcaa.vic.edu.au/essential/discipline/mathematics/index.html

For the South Australian Department of Education and Children's Services' Early Years curriculum:
www.sacsa.sa.edu.au/index_fsrc.asp?t=Home

For the Tasmanian Department of Education's Mathematics–Numeracy curriculum:
www.education.tas.gov.au/curriculum/standards/maths

For the Western Australian Department of Education's Mathematics/Working Mathematically/Early Childhood Curriculum:
http://k-10syllabus.det.wa.edu.au/content/learning-areas/mathematics/scope-sequence/working-mathematically-ec

For the Queensland Department of Education's Numeracy Framework:
http://education.qld.gov.au/curriculum/area/literacy/docs/numeracy.pdf

For the New South Wales Department of Education's Mathematics Syllabus (including Foundation Statements):
http://k6.boardofstudies.nsw.edu.au/go/mathematics

For the Northern Territory Department of Education's Mathematics Learning Area (categorised according to the numeracy senses):
www.det.nt.gov.au/education/teaching_and_learning/curriculum/ntcf/docs/learning_areas_maths.pdf

For the Australian national benchmarks for Year 3 numeracy, using number, measurement and data senses:
http://cms.curriculum.edu.au/numbench/bench_yr3b.htm

Growth points for number, space and measurement from the Early Numeracy Research Project used in Victoria for the early years of school:
www.education.vic.gov.au/studentlearning/teachingresources/maths/enrp/enrplaf.htm

STUDY ACTIVITIES

1 Study the following quote about interacting mathematically with toddlers engaged in everyday activities. Seek an opportunity to interact with a toddler and discover how you could 'problematise' the experience for them in a way that encourages awareness but respects their interpretations of the experience. Record the gist of the conversation and discuss with a colleague or peer what you learnt from the experience and to what extent it helped you to make sense of the quote.

> When toddlers are given the opportunity to express themselves in their own way and encountering for example an adult's way of understanding a situation, toddlers are competent to form their understanding with the support of the adult. The adult's role is to help the toddler become aware of similarities, differences and reasonableness by bringing out variety and problematizing meaning. 'Talking maths' is thereby important when teaching maths to the youngest children. (Bjorkland, 2008, p. 95)

2 Think of an activity you have carried out in the last twenty-four hours, at home, work or leisure, and determine and explain which of the numeracy senses were involved.

3 Write your own explanation of the distinction between numeracy and mathematics. Describe your initial feelings about the idea of numeracy in early childhood education after reading this introductory chapter and in the light of your present or future role as an educator of early numeracy.

4 Browse your local, state or national websites for outlines of current mathematics curriculum frameworks (such as those listed above in Further Reading) and choose one that you think will be useful to you as a reference document.
5 Retrieve a source of the cognitive and language developmental domains and study its indicators of development from birth to age eight. Find similarities and differences with the mathematics curriculum document you sourced in the previous activity.
6 Which indicators of the other developmental domains are related to a sociocultural perspective on early numeracy education? List four or five points of evidence to support your case.

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