

# Literacy & Numeracy

a review of the literature

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# Literacy and numeracy that counts from birth to five years: a review of the literature

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## Abstract

Quality early educational experiences have a lasting effect on children's achievements. An overall analysis of the international and national literature on the effect of early learning experiences on later learning can be clustered into three major outcome areas: increased participation rates in education, socially adjusted behaviours in school and in later life, and higher qualitative educational outcomes. Family-related and community-related outcomes have also been shown to influence children's subsequent achievement. Those features which influenced the learning outcomes for children included: family attributes and processes, community factors, and centre or school, family and community partnerships. In addition, low family socioeconomic status, attending schools in poor communities, or having a first language other than the mainstream language of the community were shown to be linked to low attainment.

Although all children learn, they learn better with the support of others. Three ways of supporting children's learning have been identified: telling, showing and modelling, and talking and doing it together. However, it is the reciprocity between all three dimensions that makes the richest learning possible.

Everyday experiences build rich embedded understandings which work well in a certain situation (or horizontal level), but which require translation to move to an abstract level (or vertical, conceptual level). Children will have many conversations that require the use of mathematical and literacy terms and concepts within everyday settings, but very young children will not necessarily transfer these ideas to different contexts to solve problems or make meaning or communicate. Reciprocity between contexts and concepts is necessary, and teachers can create pathways for children to move between them.

It is particularly important to make explicit the rules and principles of literacy, numeracy and 'doing school' for Indigenous children and children growing up in economically disadvantaged communities. Moving from contexts to concepts occurs when the link between the every day to the abstract is made explicit.

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## Introduction

This report presents a review of the literature from Australia and other countries relating to:

- children's early learning experiences and the effect of these experiences on later learning
- approaches to development and learning that improve later acquisition of literacy and numeracy
- current pedagogy, child development theory and philosophy in the education and care sectors
- current examples of good practice in promoting early childhood learning
- other recent advances in understanding developmental needs in early childhood.

The scope of this document means only a brief analysis is possible. Readers who wish to gain a deeper understanding should consult the selective bibliography.

## Children's early learning experiences and the effect of these experiences on later learning

There is overwhelming evidence that attributes quality early childhood experiences to children's subsequent achievement in schooling and later life (see Raban 2000; Bowman 2001). An analysis of the literature from Australia and other countries points to three major outcomes: increased participation rates in education, socially adjusted behaviours in school and in later life, and higher educational outcomes. These are summarised below.

Increased participation rates in education, including:

- increased benefits with longer times in early childhood programs (Kolb 1989; Reynolds 1995; McCain & Mustard 1999; Smith et al. 2000)
- a lack of year repetitions and reduced interventions (Campbell & Ramey 1994; Barnett 1995)
- increased secondary school completion rates (Roderick 1994)
- reduced resourcing needs for special education (Wasik et al. 1990)
- improved outcomes for girls (Caughy et al. 1994).

Positive social behaviours in school and in later life, including:

- positive socialisation outcomes (Johnson & Walker 1991)
- more settled behaviours (Rowe & Rowe 1997)
- aspirations for education and employment, motivation and commitment to schooling (Rutter 1985; Sylva 1994a, 1994b)
- prevention of chronic delinquency (Yoshikawa 1995) or crime and anti-social behaviour (Commonwealth of Australia 1999).

Higher educational outcomes, including:

- promoting short-term cognitive development and preparing children to succeed in school (Boocock 1995; Lunenburg & Irby 1999; Schweinhart & Weikart 1999)
- narrowing the achievement gaps faced by disadvantaged children (Smith et al. 2000; Centre for Community Child Health 2000)
- making a significant difference to the lives of disadvantaged children (Barnett 1995, 1997)
- reducing, but not removing, the effect of socioeconomic status (SES) backgrounds (Smith et al. 2000).

Of significance is the longstanding research from the United States (USA) which has systematically examined how high-quality early childhood programs, using the High/Scope educational approach, contribute to the life outcomes of participants born in poverty (eg Berrueta-Clements et al. 1984; Schweinhart et al. 1986, 1993, 1997; Seefeldt et al. 1997; Raver & Zigler 1997; Schweinhart and Weikart 1998, 1999; Abbott-Shim et al. 2000). The findings indicated that children were better prepared for school, had higher achievement-test scores in middle and high school; were likely to graduate from high school; as young adults earned more money, were more likely to own a home and a second car, and were less likely to be on welfare; and were arrested for half as many crimes (Schweinhart & Weikart 1999, p. 76) and ‘children who experienced High/Scope had significantly higher achievement test scores than other students did’ (Schweinhart & Weikart 1999, p. 78).

In the United Kingdom (UK), The Effective Provision of Preschool Education (EPPE) (Melhuish 2000; Siraj-Blatchford & Taggart 2000; Sylva & McSherry 2000; Sylva & Sammons 2000) was commissioned in 1997 to specifically examine the effect of preschool education on subsequent achievement for children in England and Wales. The EPPE study is a five-year longitudinal research project designed to assess the attainment and development of children aged three to seven years. Specifically, the study examined the effects of preschool education on children’s cognitive attainment and social and behavioural development on entry to school, and after two years. The findings demonstrate that differences in educational outcomes for children are linked to staff qualifications, with trained early years teachers providing the highest educational outcomes for children (Sylva et al. 2001). They were better able to sustain conversations with children and were more knowledgeable about child development.

In New Zealand, the National Institute of Child Health and Development, which followed a representative sample of 1085 children from birth until three years old, found strong links between quality child-care programs and cognitive outcomes, particularly for school readiness and language” (McCartney 1999, p. 7, as cited in Smith et al. 2000, p. 49).

In Australia, de Lemos (1999, p. 14) investigated the outcomes of children attending preschool and found:

*children in the full-time pre-primary program scored at a significantly higher level than children in the part-time preschool program ... the difference in performance between these groups increased from June to November, suggesting that children in a full-time pre-primary program were gaining more from the full-time program than was the case for children in the part-time program.*

In contrast, the EPPE (UK) has indicated that there does not seem to be that much difference between the outcomes of children going to full- or part-time preschool.

Family-related and community-related outcomes also influence children’s subsequent achievement.

In a best evidence synthesis of international research, Biddulph et al. (2003) found that family attributes and processes, community factors, and centre/school, family and community partnerships were the key levers for high quality outcomes for a diverse range of children. The evidence is summarised below.

The significant family attributes that were associated with achievement in children were as follows:

- culture and ethnicity, with dominant cultural groups achieving at the highest levels
- language, where children whose first language is the language of instruction recording higher achievement
- quality of family ties (not structure or change in structure) and the resources available to families were both linked to higher achievement.
- low SES is linked to low achievement.

The family processes that can affect educational outcomes are as follows:

- Higher levels of educational expectations have the most positive effects on achievement.
- Attendance at schools in higher SES neighbourhoods has a positive effect on achievement.
- Dysfunctional family processes can affect outcomes.
- TV viewing for fewer than three to four hours daily relates to higher achievement when compared with children who view TV for longer periods of time.
- Rich home environments, which include positive contact and interaction with extended family, including meaningful mathematics experiences and varied language encounters (oral and written), are linked to higher achievement.

The community factors that increase educational achievement are:

- social networks which provide opportunities to develop cultural identity and a sense of belonging
- access to local community resources, such as libraries, doctors and social support agencies, together with schooling.

The Centre or school, family and community partnerships that enhance children's achievement are:

- integrated programs
- use of school-like activities by families within the home or community context
- collaboration between home and school.

In Australia, the Department of Education, Training and Youth Affairs (DETYA – now the Department of Education, Science and Training, DEST) identified that educational environments should be inclusive of culturally appropriate materials, programs which build upon children's home and community experiences and writing programs which are connected with familiar experiences in home language and Standard Australian English (SAE) (DETYA 2000b, p. 54):

*Surrounding kids with supportive people and a supportive context, lots of Aboriginal role models, heaps of culture. The kids should say, we are proud of who we are every single day.*

DETYA (2000c, p. 16) has also demonstrated that cultural recognition, acknowledgement and support, the development of requisite skills, and adequate levels of participation are all factors that influence children's success in education:

*Success will not be achieved without recognition of the cultural factors which may impact on the success; nor will it occur without the consent, approval and willing participation of those involved.*

DETYA (2000c, p. 6) has also shown that Indigenous students, and others who lack experience of the dominant 'schooled' discourse, need teachers who are explicit in making the links across home culture and school culture.

In this regard there are 3 ways of supporting children's learning: telling, showing and modelling, and working together (DETYA, 2000c: .23).

The international research provides strong evidence that the best possible outcomes for children are achieved when they experience quality early childhood education alongside of positive family/community experiences. The latter is significant, as major reviews of childhood and family outcomes in recent years have all demonstrated that there is overwhelming evidence for investing early for improved health and wellbeing of young children (see Shore 1997; Ochlitree & Moore 2002; Commonwealth of Australia 2003).

Like governments across the world (Hannon 1995), the Australian Government (Report HRSCEET 1993; DETYA 1998) has been expressing concerns about levels of literacy and numeracy achievement among school students. Those from rural and remote regions, Indigenous students, boys, children from culturally and linguistically diverse backgrounds and those from low socioeconomic areas have been identified as underachieving in national surveys conducted in Years 3 and 5 by the Australian Council for Educational Research (ACER) (Masters 1997). Consequently literacy and numeracy continues to attract much attention within educational research and especially in the early years (Young 1995; Hill et al. 1998; Young-Loveridge et al. 1998; Anning and Edwards 1999; Makin et al. 1999; Barratt-Pugh & Rohl 2000; Ginsburg 2000; Makin & Jones Diaz 2002; Perry & Dockett 2002; Raban & Coates 2004). This is because there is a growing recognition that literacy learning is taking place during the years before formal schooling begins. Indeed, many researchers point out that the early years have major significance for later school success. In the recent review of literature prepared for the UK government, David et al. (2003, p. 10) argue:

No time is too soon to begin, with studies showing that right from birth (in fact, even before birth) children are already competent learners.

## Approaches to development and learning that improve later literacy and numeracy acquisition

### Literacy

Traditionally, literacy has been defined as reading and writing. In recent times this definition has been widened to include speaking, listening and viewing. There is a further call for literacy to be redefined to recognise the new literacy skills required by the use of information technology (Arthur & Makin 2001) such as visual and other non-linear ICT literacies (Makin 2004). Research into literacy learning is examined in this section through a systematic study of early literacy, literacy and oral language, and literacy environments. We then consider the unique



characteristics of rural and remote families, boys, Indigenous children, literacy at home and the role of parents. Finally, we examine home, community and school literacy alongside the many languages and literacies that are possible across groups and contexts.

### **Early literacy**

Literacy begins well before school, perhaps even from birth (eg Sulzby 1985, 1994; Sulzby & Teale 1991; Australian Language and Literacy Council 1995; Reading Excellence Act 1999), and what young children learn about literacy in the preschool years is vital for later success (Hannon 1996). As Makin and Spedding (2003, p. 39) explain:

*Literacy in the first three years of life is as much about relationships as knowledge and understandings. Early literacy interactions combine social interaction and a growth in empathy with development in thinking and learning about the world.*

Goodman (1986) has termed this period as the ‘roots of literacy’. Findings from a study by Neuman and Roskos (1997) report that long before formal instruction begins, young children use writing and reading behaviours as part of their daily lives if they are encouraged. As Raban (2003) suggests, an important phase of early literacy learning for young children is participation in authentic writing and reading practices that take place within family and community contexts. Research replicated in four countries shows that later success depends in large part on these early experiences and understandings (David et al. 2000).

### **Literacy and oral language**

There are strong connections between a young child’s early language experience and later literacy development (Anderson & Freebody 1981; Snow 1991). In an ongoing study carried out by a research team from Harvard Graduate School of Education (Dickinson & Tabors 2001, 2002) findings point to the preschool period as one that makes crucial contributions in preparing children for their later literacy achievements. This extensive study conducted over several years specifically focusing on the home environment (Tabors et al. 2001, p. 330), concluded that the activities in the home made a considerable contribution to a child’s ultimate literacy success:

*Everyday activities of all sorts, accompanied by interesting talk with lots of new vocabulary words, can play an important part in children’s language and literacy development.*

Another finding was the need for vocabulary-rich talk within the contexts of play and everyday experiences.

Other studies (Hart & Risley 1995; Purcell-Gates 1995) also concluded that a strong relationship existed between children’s early language skills and later reading abilities. Levels of language and literacy skills that children have before school and on entering the school environment are strong predictors of achievement many years later (Cunningham & Stanovich 1997). According to Fox (2001, p. 13):

*The foundations of learning to read are set down from the moment a child first hears the sounds of people talking, the tunes of songs, and the rhythms and repetitions of rhymes and stories).*

However, Watson (2001) states that the relationship between oral language and literacy is bidirectional. Indeed, Raban and Coates (2004) point out that waiting for oral language



development before thinking about acknowledging literacy experiences may not be helpful, as their research described a reciprocal relationship with oral language and literacy supporting the development of both abilities.

Long before a child utters their first word, parents and children begin to communicate. Their first communications take on the form of gestures initiated by the adults (Karmiloff & Karmiloff-Smith 2001). Parents take a leading role in a child's language development mainly by talking to young children about the here and now, by being selective about the words they use, by encouraging children to take turns in a conversation, by altering the way they say things such as slowing down or in the usage of short, simple sentences. Although the development of literacy skills is different from the development of language, it is interrelated, as shown by the work of Reese (1995).

### **Literacy environments**

Young children's environments do affect their literacy development. Environments need to be language rich, that is, with interesting conversation taking place using many words, and with stories and explanations given. Children of parents who directed more speech to them had larger vocabularies (Hart & Risley 1995) and faster vocabulary growth over time (Huttenlocher et al. 1991). A major UK study by Siraj-Blatchford et al. (2002) reported that positive outcomes for young children are linked to adult-child interactions that involve 'sustained and shared' talking time, involved open-ended questioning and ongoing feedback during activities. As Clay (2001) points out, every child brings into their first school classroom their own repertoire of literacy learning, which has been significantly shaped by the social and cultural environment into which the child was born (Bruner 1986). The environment, therefore, has a vital impact on all aspects of a child's literacy development.

A review of the results of longitudinal studies of the home environments of young children by Snow et al. (1998) concluded that differences in home literacy environments relate directly to differences in achievements during the latter years of schooling. However, much attention is now being paid to the ways in which schools can modify their responses to children's differing literacy experiences, by building on the strengths children bring with them into the classroom (eg Carrington 2002), accommodating the richness and variety of children's home and community experiences. This research also demonstrates that the educational practices (eg focus on verbal communication, creation of abstract learning contexts and alternating attention management) that are found in schools and centres tends to support the home practices of European heritage children and are less likely to support the cultural regularities found in other culturally and linguistically diverse communities.

### **Literacy at home and the role of parents**

For many children literacy is an integral part of their everyday life at home and in the community. As pointed out by Rickleman and Henk (1991), parents play a critical role in the development of their children's life-long attitudes towards reading. Through normal family activities, children 'develop ideas and values about literacy practices and activities and their personal and cultural identity' (McNaughton 1995, p. 17). In learning to be literate children participate in particular cultural and social events and experiences (Barratt-Pugh 2000). But as Anstey and Bull (1996, p. 158) point out, 'there is no one set of literacy practices common to all communities'. Indeed, parents' views of what literacy is and how it develops affect their structuring of everyday activities for children (Reese & Gallimore 2000).

Parents' reading to their children has warranted a great deal of attention. Mem Fox (2001) and Paul Jennings (2003), both well-respected Australian children's authors, have stressed the significance of sharing books and reading aloud to children, a finding confirmed by the research of Halsall and Green (1995). Swinson (1985) looked at increased book sharing with preschool aged children and found that by increasing the level of daily home reading from around 15 per cent to 100 per cent in a one-year program, gains were measured in both oral vocabulary and verbal comprehension. In a follow-up study after entry to school, gains were also noted on word matching and letter identification when compared to children in a control group.

Hannon and James (1990) found parents of preschool children, across a wide range of families, are also active in promoting their children's literacy development. This finding was echoed in a study of families from a lower socioeconomic context in one geographical area of Melbourne where families were found to be providing rich and meaningful literacy environments (Fleer et al. 2004). Hill et al. (1998) along with Landerholm and Karr (2000) also found that children are involved in a range of home and community literacy experiences. Through these interactions the child is being engaged in various and extensive language and literacy experiences.

Weinberger et al. (1990) at Sheffield University have shown that to maximise the effect on children's literacy development it is important for parents to provide experiences within the ORIM framework they outline:

- opportunities for learning
- recognition of the child's achievements
- interaction around literacy activities
- models of literacy.

A framework such as this enables a variety of literacy experiences to become more available for consideration. For instance, Rodriguez (1999) found that Dominican preschool children in New York City were finding print materials an interesting part of their world and were observed to engage with literacy while watching television and singing.

### **Home, community and school**

Family literacy practices vary and some practices may have particular consequences for later school success (Mandel Morrow 2004). The closer the match between home and community literacy practices and school literacy practices, the more likely that the child will be successful in school literacy learning (eg Heath 1983; Cairney 1994; Gregory 1994; Hill et al. 1998; Makin & Jones Diaz 2002; Paulson & Kelly 2004). However, home literacy practices need to be more clearly understood so that full advantage can be taken of the understandings children bring with them into school (Burgess et al. 2002). As Serpell and Sonnenschein (2002) show, a significant proportion of the variance in children's literacy development was predicted by indices of intimate family culture, leaving little or no additional variance due to family income or ethnicity. Wolter (2000) emphasises the adoption of strategies for viewing families neutrally and avoiding assumptions and judgements.

Teachers and parents have very different views of literacy and how literacy development should be undertaken (Heath 1983; Taylor 1983; Taylor & Dorsey-Gaines 1988; Hannon et al. 1991; Baker & Sonnenschein 1996). Staff in early childhood settings generally have little cultural knowledge about children's home literacy practices and do not incorporate them into their programs (Makin et al. 2000; Fleer et al. 2004). As Campbell and Jones Diaz (1995, p. 70) state 'any educational context must be attuned to the home-language context and to the

accommodating of children's knowledge and experiences'. This will be especially so when you consider that Makin et al. (1995) propose that literacy is most appropriately established initially in a child's home language.

### **Boys and literacy**

Literacy practices are both shaped and reshaped by gender subjectivities (Gilbert 1989; Davies 1989, 1993; Cherland 1994). Maynard (2002) examined student writing in one school setting. She found that there were 'no apparent gender differences in the early development of writing skills' (Maynard 2002, p. 73), but girls in Years 2 to 4 seemed to be more focused and more responsive to teachers' guidance. The same thing was apparent in Years 5 to 6. However, teachers asserted that boys' writing was conceptually better than girls' by this time. Maynard (2002, p. 76) concluded that 'girls' strengths in writing were seen as being related to hard work, while boys' strengths were related to their "natural ability"'. Another argument presented was that girls are more likely to write for their teachers while boys are more likely to write for themselves. The implication drawn by Blackburn (2003, p. 276) from reading Maynard's work is that 'boys' lower achievement in literacy may have more to do with the fact that they define their audiences on their own terms rather than on assessors' terms'.

Brozo (2002) identifies four points to consider in facilitating boys' engagement in reading:

- reading material must be tied to boys' interests
- boys' interests must be honoured when selecting texts
- 'Books with positive male archetypes are important' (Brozo 2002, p. 157)
- adults must model engaged reading.

He makes the case that boys are in the greatest need of help with their literacy achievements, stressing the importance of engaging boys in active literacy experiences, and that they need to be exposed to literary images they can identify with and look up to.

Millard (1997) argues that many boys do shy away from literacy activities in their need to establish a masculine identity – the feeling being that reading is a 'feminine' activity. Millard conducted a study focusing on middle schools in Great Britain. From the findings she proposed that there are distinct gender differences in literacy attitudes and practices at school and in the home. One issue raised is the self-segregation among girls and boys due to their different perceptions of reading and writing. Linked to this are 'the concerns about bridging the gap between experiences of reading at home and at school, and between the narratives of popular culture and the traditional class "reader"' (Askew discussing Millard's work, 1998, p. 104). Millard proposes the use of non-literary texts to engage boys and to broaden the definition of literacy within schools.

While Millard (1997) and Askew (1998) report school-based data, Makin and Spedding (2001) show gender differences in literacy behaviours by study participants from the first months of life and that these are wider when children reach three years. The most obvious gender difference at the three ages reported in this study (8–12 months, 18–22 months, 32–36 months) were reported to demonstrate both a larger number and wider range of early literacy behaviours. If this finding is replicated in further studies, then it indicates that gender differences in literacy start very early in a child's life.

### **Rural and remote families**

Ryan (2001) reports on the findings of a major inquiry into rural and remote education in Australia by the Federal Commissioner for Human Rights (MCEETYA 2001). The Inquiry's central finding was that the right to education of many Australian children was violated on the basis of one or more of five criteria:

- schooling available without discrimination
- accessible
- affordable
- acceptable culturally to children and their families
- adaptable to different student needs and circumstances.

Rural and remote children are among the most disadvantaged compared to their urban peers, with Indigenous students the most disadvantaged. This Inquiry stressed the need to make educational innovations locally appropriate and 'owned' by the communities, and noted the importance of support for children and families during the preschool years.

### **Indigenous education in the early years**

Williams-Kennedy (2004, p. 84) clarifies the nature of Indigenous cultural learning which is 'built on collaboration in on-going activities, and the purpose of the daily activities and reasons for learning are obvious to the children'. Indeed, all children learn best when they 'contribute to real-life family activities where the purpose and significance of such activities is clearly understood'. Many Indigenous children 'are expected to learn through observation, participation in daily extended family activities and non-verbal systems of communication' (Williams-Kennedy 2004, p. 87). What is common for all young children is that early 'literacy development is essentially a collaborative social process rather than an individual activity' (Williams-Kennedy 2004, p. 89). For young children during their early years, all forms of communication need to be learned, to be 'read' or 'made sense of'. For all cultures this will be body language, prosody, hand movements and head nods, and the like – each being interpreted through the matrix of context, audience and purpose.

Gaining understandings of their world through these real-life experiences is a valued beginning to 'reading' meanings, of which meaning from printed text is only one form. Acknowledging the complexity of young children's successful learning in these culturally defined ways provides a stronger base from which to support their increasing repertoire of resources.

Research into the nature of Indigenous children's literacy in prior-to-school settings (see Flear & Williams-Kennedy 2002; Williams-Kennedy 2004) suggests educators recognise that literacy for many Indigenous families also involves 'ability to communicate appropriately within kinship systems, as well as being able to read and interpret local symbols of nature, in order to sustain and maintain family and culture' (Williams-Kennedy p. 80). In particular, this research advocates for a broader view of literacy, in which multiple literacies feature, including:

- speaking
- listening
- reading natural and human made symbols
- recording language in lore
- stories
- songs
- dance

- rituals and traditions
- observing body and sign language.

In addition, this research also strongly supported the importance of accepting Aboriginal English as a recognised language in its own right (see Box 1).

Box 1: Literacy and numeracy in the community  
(Fleer & Williams-Kennedy 2002)

*Family is on a picnic in the bush a few kilometres from Alice Springs. Janette (mother) has Tahlia (four years old) on her hip and is walking around the area, then settles next to Tahlia's grandmother. Some conversations are heard in Language.*

*Janette: My mum speaks Language to Tahlia all the time. She is now starting to talk back. She teaches others too. She shows Leanne's two children (non-Indigenous children). When we go outback, we teach animal names and things.*

*Janette: When Tahlia grows up she will need English and Language. If she is like me, then she will need both.*

*Grandma has a crow-bar in her hand and is digging a hole in the ground. Digging occurs for 40 minutes. (Very little discussion is heard.)*

*Janette: Grandma has a teacher role; parents are more of the disciplinarian.*

*You see it in town. Grandparents take over. She was always the one to teach them to do things. Same with the country and the Language. That role is still there – another thing we take for granted.*

*Grandmother continues to dig whilst the family members move about. The children sit and watch for most of that time. Tahlia moves the dirt Grandma takes out of the hole to one side. During this time, the children sit and watch the activity, occasionally moving around the bush.*

*Janette: There – she is explaining to them what is good and not good (bush food).*

*Janette walks with the children over to a nearby tree and picks up a Bush Coconut. She places it on the ground and cracks it open with a rock. Discussions occur in Language. The inside of the Bush Coconut is shown to the children. The children watch and listen.*

*Janette: Non-Indigenous people think that we just go on a bush trip; they think we just go out and have a picnic; they don't know that we teach them things.*

*Janette: We let the kids go out by themselves; exploring; it's giving them a chance to do it; they then come back and show us that they found these (gestures with hands); they explore and learn things too, instead of us just putting it into their heads; they enjoy sharing with their friends; they talk about their knowledge.*

*Janette: They have got to learn both ways – **2 way learning is making them one person!** In our Indigenous preschool (Yiparinya) they get both.*



### **Many languages, many literacies**

Evidence suggests that children can easily learn more than one language from birth and in many countries this is normal language behaviour. In Australia, however, there is a strong movement towards 'one literacy'. This equates with English literacy and is heavily focused towards standardisation and doing away with difference, complexity and diversity (Lo Bianca & Freebody 2001). However, there is an increasing number of people who hold an alternative view which recognises the importance of a sociocultural view of literacy that is multicultural and multilingual. Ezell and Gonzales (2000) argue that there are many different paths to proficiency in SAE and that the home lives of children and the early preschool experiences that children have provide a strong foundation for literacy development.

There are positive effects of bilingualism (Skutnabb-Kangas 1981; Hakuta 1986; Hakuta & Pease-Alvarez 1992). Positive effects include increased self esteem, positive attitudes to learning, positive identity, cognitive flexibility, increased problem-solving, increased literacy and greater metalinguistic awareness. At least one in four children is likely to understand and maybe speak a home language other than English with many families and children at home or preschool speaking dialects of English such as Aboriginal English.

It is critically important that children have the opportunity to continue developing their home language (and early literacy skills) as a strong foundation in the first language provides the basis for later learning of the second language (Barratt-Pugh & Rohl 1994; Siraj-Blatchford & Clarke 2000; Kenner et al. 2004). Similarly, for those whose first language is English, there is considerable evidence that learning of a second language can enhance English literacy skills. For example, the Review of the Commonwealth LOTE Programme (Erebus Consulting Partners 2002) cited studies (Thomas et al. 1993; Bialystok 1997) showing that bilingual children understood the symbolic representation of print better than monolingual children, and that those who participated in intensive foreign language programs scored as well or better than all comparison groups on achievement tests, and remained high academic achievers throughout their schooling.

As Lennox (1995) points out, there is no one theory that can best describe children's literacy learning. A variety of theories are needed to take account of the complexities of children from diverse cultural and linguistic backgrounds growing up in a range of social and cultural contexts. Australian communities reflect a wide variety of multiple literacies with over 248 community languages, including 48 Aboriginal languages (Australian Bureau of Statistics 2000). Literacy as a social practice is more accurately described as multiple literacies within people's local, social and cultural contexts, all of which interact in complex ways.

### **Numeracy**

The term 'numeracy' has been much contested (eg Anning & Edwards 1999; DETYA 2000c; Perry & Dockett 2002), and approaches to numeracy have been interpreted widely across Australia. The Australian Department of Education, Training and Youth Affairs (DETYA 2000c, p. 4) in citing Willis (1998a, p. 38) states:

*Reflecting on varied definitions, Willis (1998) synthesised major perspectives as having one of three foci: 1) on mathematics itself, with numeracy used more or less synonymously with mathematics; 2) on the contexts in which people are expected to function where numeracy is seen to be quite context specific; and 3) on the*

*processes needed to choose and use mathematics, where numeracy is described in terms of strategic mathematical processes and the capacity to bridge the gap between mathematics and the real world. She considers that 'to develop numeracy as practical knowledge would seem to require a blending of these three interpretations [mathematical, contextual, strategic].*

Doig et al. (2002, p. 13) in their review of the early childhood literature for effective numeracy strategies have shown by implication that very little evidenced-based research exists in Australia. Their findings suggest that: 'what constitutes numeracy in the pre-school and how it should be presented to children remains to be answered'. Perry and Dockett (2002, p. 65) pointed out in their review that not only do young children have great potential for learning mathematics (see Cobb & Bauerefeld 1995; Becker & Selter 1996; Bobis et al. 1999; Tang & Ginsburg 1999) but also that children know a vast range of 'mathematical concepts by the time they start primary school' (see also Wright 2002). Perry and Dockett (2002) cite evidence of:

- arithmetical operations (Boulton-Lewis et al. 1996)
- patterning and tessellations, and notions of fairness and fractions (Paley 1981).

Willis (2002, p. 120) has also stated that there is evidence of very young children's capacity in mathematics:

*During the past two decades, evidence has been accumulating that babies just a few weeks old have a sense of numerosity (see Dehaene 1997, Butterworth 1999, Devlin 2000). They can make distinctions between arrays of one, two and three distinct items, although of course they cannot name the distinction).*

Aubrey et al. (2003), in their review of mathematics in the home, noted that:

- mothers and toddlers use number names in the context of nursery rhymes stories and songs; sequential complements with routines (one, two, three and ready steady go); recitation of number strings with and without actions; repetition and clarification of cardinality; counting for numerosity, counting for turn-taking (count with me) and incidental number use (eg how old are you?) (Durkin et al. 1986)
- families used mathematics for incidental tasks (accomplishment of an activity) and pedagogical tasks (teaching or practising mathematical concepts) – with the latter mothers or carers took on the role of playmate and equal participant, extending the child's knowledge (Tizard & Hughes 1984; Walkerdine 1988; Aubrey et al. 2003)
- parent mediation of number sequences and one-to-one correspondence counting through a form of apprenticeship in the context of domestic routines or play was evident – more counting mediation was noted in preschool settings than in the home context (Young 1995).

Perry and Dockett (2002) found in their review of mathematics in the prior-to-school settings that:

- mathematics instruction occurs incidentally in prior-to-school settings (Young-Loveridge et al. 1998)
- 42 per cent of all play experiences observed in preschools featured mathematical experiences (Ginsburg 2000)
- block play supports mathematics education (Rogers 1999, 2000)
- water, sand and dramatic play support mathematics learning (Perry & Conroy 1994)



- effective learning of mathematical concepts during play occurs when the educators ‘adopt the role of provocateur’ (Edwards et al. 1993; Griffiths 1994; van Oers 1996; Perry & Dockett 1998; Yackel 1998)
- effective learning occurs when ‘children and their educators become more aware of the fact that they are engaging in numeracy activities and that they are encouraged to undertake them with the possibility that they might learn some numeracy ideas’ (Perry & Dockett 2002, p. 66).

Guberman (1999) argues that although there is evidence of children’s prior-to-school mathematics experience and competence, supportive parent–child interactions are needed if mathematical experience is to be turned into valued mathematical knowledge. Graham et al. (1997) in their study of four preschool teachers in two child-care settings found that although teachers expressed the view that mathematics was important and that they organised mathematical learning opportunities, very little mathematics was presented directly or indirectly to children. Anning and Edwards (1999, p. 118) have shown in their research that children frequently engage in mathematical conversations with adults, but they do not necessarily understand the mathematics involved in the same way that adults do.

Guberman (1999) suggests that the type of activities and their frequency vary across cultures (Ginsburg et al. 1981) and across ethnic groups (Guberman 1999) and as a result mathematical knowledge and skills develop differently in prior-to-school settings (Saxe 1991; Nunes et al. 1993; Abreu 1995). Willis (2002, p. 12) has found in her analysis of the literature that:

*Across many cultures, rhymes, stories and games for young children promote ... (the) capacity to recognise and distinguish between small numbers of items ‘at a glance’ and to ‘name the distinction’.*

She also reports (Willis 2002, p. 123) that in rural communities different pathways to numeracy learning are also evident:

*I have been told by graziers’ and farmers’ children that they learnt to tally stock by recognising and counting groups before learning one to one counting in school.*

Willis (2002, p. 124) in drawing upon Gilmore’s (1934, pp. 153–4) documentation of how she learned to recognise ‘twoness, threeness, and so on’ as a result of being shown the ‘black method’ from Indigenous elders, states:

*To me it seemed easy to miscount by ones – easy to miss a single sheep – impossible to miss three, four or five, though I was surest with three. As a matter of fact I thought it a waste of time to say one, two, three, four when I could say three, six, nine and so on.*

According to Willis (2002) evidence points to the fact that traditional beliefs about learning to count for enabling children to represent quantity has placed too much emphasis ‘on one to one counting as the only way to decide “how many”’ and Willis (2002) suggest that this approach ‘may actually delay children’s development of a sense of the size of numbers and their flexibility in dealing with them’ (Willis 2002, p. 123). In essence, Willis questions the single mathematical pathway that has been built and mainstreamed. This is also supported elsewhere (see Aubrey 1997). While learning to count is still important, the pathways for learning quantity may require teacher programs which support a diverse range of strategies (see Willis 2001, p. 5) for building

numeracy outcomes for children – still arriving at the overall outcome, but in ways which engage more immediately with learner’s experiences – as shown in Figure 1.

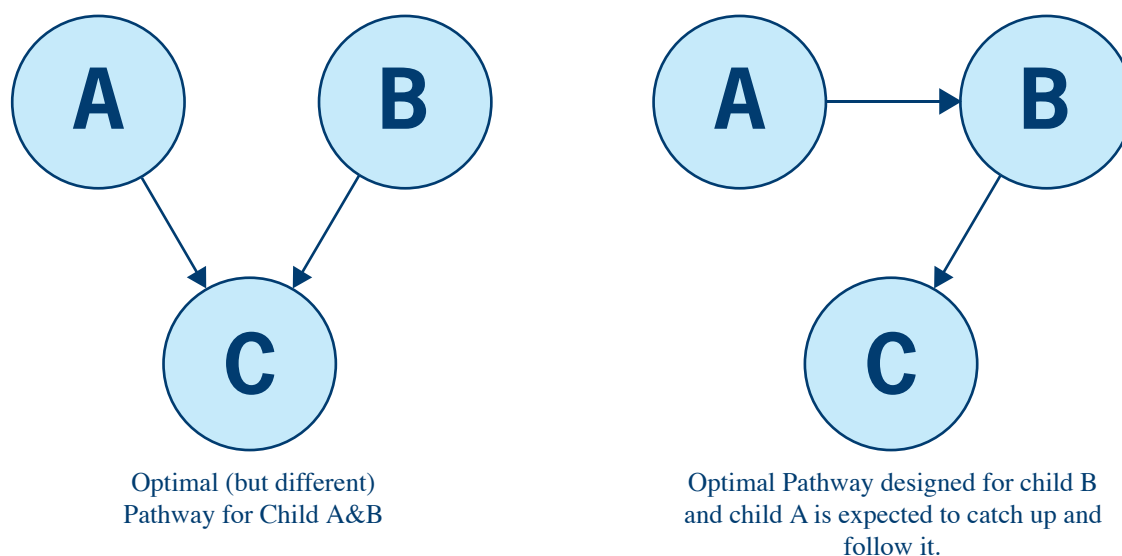


Fig 1

Various possible and optimal pathways for learning numeracy (from Willis 2002, p5)

This research ‘does not treat the curriculum as neutral or “innocent”’ (Willis 2001, p. 4) but rather suggests that children are different and schools and teachers need to understand, map and determine how programs can be built in ways that cater for diverse or different pathways for numeracy (Willis 2001).

Perry and Dockett (2002) argue that mathematical knowledge and skills are desirable outcomes (Mannigel 1992; Copley 2000; National Council of Teachers of Mathematics 2000) and should be integrated into meaningful contexts for learners. They suggest the following innovations as examples of curriculums which feature relevance, activity and social context:

- Early Mathematical Experiences (Schools Council 1978)
- Te Whaariki – New Zealand inclusive early childhood curriculum (Ministry of Education, New Zealand 1996)
- Flying Start and Essential Connections (Department of Education, Tasmania, 1997, 2004)
- Preschool Curriculum Guidelines (Queensland School Curriculum Council 1998)
- Singapore Preschool Syllabus (Sharpe 1998)
- Foundation Areas of Learning (Department of Education and Children’s Services, South Australia 1996).

Other programs available to help teachers assess young children’s numeracy skills and understandings include:

- Count Me In Too (CMIT) (Bobis & Gould 1998a, 1999b, 2000; New South Wales Department of Education and Training 2000)
- Mathematics Recovery (Wright 2000; Wright et al. 1996, 2002)
- Learning Framework in Number (LFIN) (NSW Department of Education and Training 2000; Wright et al. 2000).

In a comprehensive study of children and their families from lower socioeconomic backgrounds, Fleer et al. (2004) found that families provided rich and purposeful mathematical and literacy environments (both areas featured in their study). These environments were much richer than those expected by the teachers who worked with the children. Through photos taken of the children in the home, and the parents' subsequent discussion of these at the family workshop, the diversity of constructions of numeracy being enacted was shown. Some examples of the range of literacy and numeracy activities included: doing puzzles, drawing, reading the newspapers together, reading the television guide, going to the library for books and videos, computer games (those designed to 'teach', 'educational' CDs, and others), 'reading' and telling stories to others (including teddies and dolls), looking at picture books, board games, and singing or saying rhymes.

Examples of the range of numeracy experiences included cooking, setting the table, counting objects (such as fruit, fingers, toy cars and houses in a street), making collections, sorting and classifying toys and people, lining up objects, ordering objects, recognising numerals on the letter boxes while out on a walk, playing tenpin bowling, drafting patterns for dolls' clothes, playing hopscotch, reading speed limits (and commenting on speed being travelled!), talking about shapes (such as moon, stars and trees), building with blocks and saving and counting pocket money.

Many of the parents related that through being involved in the project they had become much more aware of the scope of literacy and numeracy experiences they engaged in on a day-to-day basis, for example:

*There is much more to this literacy and numeracy than you realise, you know, from day one. (L1)*

*... every time I tuned in he was actually learning, everything was literacy and numeracy. (L2)*

*... we read to them, we write, but you don't realise you do it (develop literacy and numeracy with their children). It is just embedded. (J)*

The data demonstrated that families had well-formed views on what was literacy and numeracy, and also knew how to promote learning in these areas through authentic experiences.

Guberman (1999, p. 204) has shown in his extensive review of behaviourist, constructivist and socioculturally framed studies that within supportive environments children participate meaningfully when there:

- is flexibility that allows the transformation of activities in ways that encourage children's participation from novice to expert status
- are moment-to-moment changes of instructional interactions, as when parents adjust their assistance in response to children's ongoing difficulties
- are age-related and socially organised changes that occur as activities are modified for children by others, as when adults assign children of different ages to distinct settings and tasks
- are changes in activities that are brought about by children through their own participation, as when children interpret and transform games in varied ways.

Sometimes, changes are accomplished through negotiation as children interact with more knowledgeable partners, sometimes through the arrangement of appropriate activities for children by adults and social institutions, and sometimes through peer interaction as children bring prior knowledge to their joint participation (Guberman (1999, pp. 204–205).

Research undertaken into the use of calculators and other technologies for supporting early years mathematics has shown positive outcomes for children (eg Clarke 1992; Groves & Cheesman 1992, 1995; Clements et al. 1993; Power 1996; Stacey & Groves 1996; Becker 2000; Cordes & Miller 2000; Pianfetti 2001). This would suggest that their use can also be considered for the birth to five years ages. Plowman and Stephen (2003), in their general review of international research into the use of Information and Communication Technologies (ICT) for preschools, provide evidence that in the context of a play-based environment, and with better software and pedagogical models for the broad range of technologies now available to children, important educational outcomes are possible. This perspective is also supported by Yelland (1999) and the Alliance for Childhood Report (Cordes & Miller 2000).

Overall there is a limited research base on which to draw for making conclusive statements and setting directions for pedagogy and practice in preschool mathematics. While further research is urgently needed, we know from the reviews of the literature that context and interactions are significant and school mathematics is being influenced by research that examines numeracy in prior-to-school contexts.

## Supporting young children's growth into literacy and numeracy

### **Literacy and numeracy with babies 0–3 years**

Babies are skilful from birth, and Murray and Andrews (2000) state they are attracted to people from that moment onwards. They know how to attract attention, they understand quickly and recognise routines, they respond positively to cuddles, familiar voices and other enjoyable activities. Makin and Whitehead (2004) note from their observations just how capable young babies are at making sense of their surroundings, mediated by the people who care for them daily. Babies understand that what they experience has meaning for them, what they hear, see, feel, taste and smell. Some of these experiences are positive and babies seek to enjoy them over and over again. They learn readily how they can attract attention and make this happen.

Given the distinctly symbolic nature of literacy and numeracy, a first step towards these abstract accomplishments, as Whitehead (1996) has pointed out, is to understand that one thing can stand for something else. This is at the very essence of language, which along with walking, are the major achievements of the first year of life. Children learn to talk because they are surrounded by it, even before birth. They learn that certain words go with certain behaviours in a regular pattern and that they can use noises and eventually first words to create meanings and make themselves understood.

Eimas et al. (1971) show how very young babies pay particular attention to adults who talk to them and with them. Indeed, as Pinker (1995) points out this is an essential ingredient for healthy early development. As Trevarthen (1995) has demonstrated, infants engage in eye contact, gurgle and move their mouth in synchrony with the words and sounds they hear. Such playful interactions have been referred to by Trevarthen and Aitken (2001) as 'protoconversations' that gradually offer the young child opportunities for anticipating and predicting, and they form the basis for social and cognitive advances in the first year of life.

When talking with babies, an activity that parents find irresistible according to Gopnik et al. (1999), adults typically gaze at the baby in a highly focused manner, they also coo and gurgle, and they speak with a greater range of tone and prosody, emphasising and exaggerating words and meanings for the baby to engage with. This form of language has been termed ‘motherese’ by Snow and Ferguson (1997). Adults and other children make faces with babies and use their hands to demonstrate their meanings. Babies wiggle their arms and legs in excitement and do this when their name is called or they hear a familiar voice.

Many babies are being held while the adult is doing something else, for instance, looking up a TV program in the newspaper or looking for a number in the phone book. Sometimes they might be looking in a catalogue for information or checking a bill or a statement. Clark’s research (1976) illustrates how babies will notice these activities and will want to engage with them. They will want to hold the pen and make marks of their own. They can see that these behaviours around them are not random – they are rich with purpose and meaning for those engaged with them. Babies are inquisitive and curious, and they want to be able to join in all the shared activities within the household. For instance, Cushla at eight months old was fascinated by the calendar in her grandmother’s kitchen (Butler 1979, p. 26):

*on being held close she would make a strenuous effort to focus on the large black numbers underneath the coloured picture. She would then appear to ‘scan’ them, the whole procedure occupying several minutes.*

Telling and reading stories together during a quiet time after a meal or nap are a good beginning for engaging babies with the language and values of their culture. Turning off the television or radio, making close physical contact and talking about what is going on around the house, or what has taken place or is planned for another time will be rewarding and enrich children’s later vocabulary (Evans et al. 2000). Introducing toys, books and other objects will give a joint focus that will create the hallmark for sharing and developing further opportunities for language development. McArthur (1995) has shown how playing with language, using songs that become familiar, rhymes and rhythms with movements associated become opportunities for giving babies a sense of the patterning of language.

Whitehead (2002) has shown that looking at books and other texts together, even if only talking about the pictures and pointing to objects that are familiar, will be an early start to later literacy development. Stahl (2003) found an especially salient activity, when the adult tracks the print with a finger, giving an opportunity for the baby to explore concepts like directionality. Using the same story book over and over again will also give babies a sense of security and familiarity, as well as contributing to later vocabulary development (Evans et al. 2000). Counting fingers and toes at bath time and nappy changing, telling the time from a clock, counting packages while out shopping, talking about things being too heavy or food being too warm and the like will all prime the baby for later numeracy conversations.

Some of the key messages for practice suggested by David et al. (2003) are that babies need (and seem to enjoy):

- responsive and encouraging interactions
- turn-taking patterns of interaction
- motherese, rhyming games, singing and word play
- not too much background noise (eg from television).



Research has also shown that babies also need (and seem to enjoy) being central to all the activities happening in their community. Some babies are held most of the day by their primary caregiver and see and feel all the activities going on around them. The adult and the baby communicate through many different types of non-verbal communication. These babies are embedded in the day-to-day activities of their communities and talk is situated around what is happening immediately in their environment (eg Rogoff et al. 1998; Schieffelin & Ochs 1998; Woodhead et al. 1998). In other communities where babies are not held all day, but rather have special spaces created for them, a lot of conversations are created, often about things that are not directly observable (see Rogoff 1990, 2003). The latter is more pervasive in families who have had parents with more than 12 years of Western schooling (Chavajay & Rogoff 1999, 2002; Correa-Chavez et al. in press; Mejia-Arauz et al. in press). In both contexts, babies need responsive, turn-taking interaction, and benefit from motherese. What is important is building upon the various strengths that the different child-rearing practices generate (see Box 2).

#### Box 2: Literacy in the home

*Example One:* Sitting on the veranda of a house, a caregiver gathers his five-month-old infant onto his lap, faces the baby out to the community, and as members of the community walk past he names them and points out their relationship to the infant. The adult then takes a sturdy book with bright images and numbers on the pages and points to the pictures and names them, turning each page with the help of the infant. A toddler notices the activity and joins in; but this time it is the toddler who points to the pictures as the adult or the toddler name them. A preschooler leans over the back of the adult, and points to each object on the page counting as she goes. The adult then points to the number and reads it to all the children. The preschooler discusses her birthday when they reach the number five.

*Example Two:* In a study designed to map family constructions of literacy and numeracy (Fleer et al. 2004) a range of everyday examples of literacy were recorded. Below are examples of literacy contexts that were actively supported by families:

#### **Intergenerational learning:**

I don't know at what age (I read) 'The Very Hungry Caterpillar'. You can get it at the library. My mother sent down from Queensland a book we as children loved, and then she put in a little message, 'You loved this book. I hope your children will, too.' It was 'Are You My Mother?' (L1)

#### **Writing letters to family:**

This is H writing a letter. We are over from South Australia, so we try and keep the kids in touch with family and friends. She tells me what she wants to write in her letter. I write it for her. She copies it. I teach her to keep it in line, sound out her letter. (C2)

#### **Reading the paper together:**

... we read the paper, he likes to recognise letters. He has only started in the last year really.  
... Of course, reading books, with dad and me too ... (E)

#### **Writing together:**

... the first time a child writes her name is really special. She wrote it backwards, so I kept it. Her brother is in prep, and she likes to look at his take home book. (L1)

## Current examples of good practice in promoting early childhood learning

Variations in beliefs about what constitutes ‘good’, ‘best’ or ‘effective’ practice have been noted in Australia (see Fleer & Williams-Kennedy 2000), New Zealand (see Duncan 1997; Smith 1997, 1999; Smith & Barraclough 1997; Farquhar 1999a, 1999b), in the USA (Scarr et al. 1994) and in the UK (Dahlberg et al. 1999). Although there are many interesting programs designed to support young children’s learning around Australia, few have been systematically researched. Nevertheless, comprehensive studies from other countries collectively demonstrate examples of pedagogical practices which support early childhood learning – many of which are relevant to Australia.

In the United Kingdom Siraj-Blatchford et al. (2002), in their extensive study of effective pedagogy in the early years (14 case studies of excellent and good centres and the reception classes as determined in previous research), found that effective centres:

- focused on cognitive interactions which lead to sustained conversations
- had teachers with sound pedagogy and subject matter knowledge
- located teacher questioning within guided play contexts
- had discipline and behaviour policies based on talking through conflict
- had home acknowledgement and involvement in learning activities.

Barnett (1995, 1997) examined the outcomes of programs, concentrating upon intelligence quotient (IQ), achievement in reading and maths, school progress and placement, and socialisation, and found positive gains for children who attended a Perry Preschool Program (teacher and child planned and initiated activities and worked together). Similarly, the National Research Council in the USA found in its review that quality programs feature:

- integrated programs (cognitive, social–emotional and physical)
- responsive interpersonal relationships with teachers
- class size and adult-staff ratios are correlated with greater program effects
- well-planned, high-quality programs in which curriculum aims are specified and integrated across domains
- staff who are qualified, reflective, responsive and attend professional development.

The National Research Council also found that children living in circumstances that place them at risk are much more likely to succeed in school if they attend well-planned, high-quality early childhood programs.

In New Zealand, quality indicators for long-term outcomes for children have also been reported. Smith et al. (2000) have identified:

- quantity of teacher–child interaction
- secure attachments
- joint attention episodes (eg adult and infant attend to infant’s gaze and interest)
- the inclusive curriculum Te Whariki (which emphasises child initiation, exploration, meaningful activities, and teacher scaffolding)
- positive and harmonious peer interaction
- sensitive and clear communication with families.



This is consistent with a best evidence synthesis on quality teaching for diverse students in schooling by Alton-Lee (2003), which found that:

- quality teaching is focused on student achievement (including social outcomes) and facilitates high standards for student outcomes for heterogeneous groups of students
- pedagogical practices enable class and other learning groupings to work as caring, inclusive, and cohesive learning communities
- effective links are created between school and other cultural contexts in which students are socialised, to facilitate learning
- quality teaching is responsive to student learning processes
- opportunities for learning are effective and sufficient
- multiple task contexts support learning cycles
- curriculum goals, resources including ICT usage, task design, teaching and school practices are effectively aligned
- pedagogy scaffolds and provides appropriate feedback on students' task engagement
- pedagogy promotes learning orientations, student self-regulation, metacognitive strategies and thoughtful student discourse
- teachers and students engage constructively in goal-oriented assessment
- students have secure attachments
- joint attention episodes (eg adult and infant attend to infant's gaze and interest).

Quality issues, including structural quality (eg staff–child ratios) and process quality (eg interaction with teachers) have been highlighted in the literature as significant variables when considering quality early childhood practice (Russell 1985; Smith et al. 1989; Scarr et al. 1994; Cassidy et al. 1995; McGurk et al. 1995; Kagan & Neumann 1996; Smith 1996, 1999; Danziger & Waldfogel 2000; McNaughton 2000). Overall, these findings have shown that the salary or qualifications of the staff member and the adult–child ratio both significantly influence the quality of the program.

Although it is not possible to delve into the details of the range of factors that promote early childhood learning, the areas that have consistently been mentioned in the literature are:

- predominance of cognitive interactions between children and adults that promote thinking through talking
- low staff–child ratios and group sizes with consistent relationships
- university qualified early childhood teaching staff who are responsive and reflective and understand subject knowledge
- teacher and child planned and initiated activities
- predominance of scaffolding and co-construction pedagogy
- pedagogy which promotes learning orientations, student self-regulation, metacognitive strategies and thoughtful student discourse
- genuine, sensitive and effective centre–home links.

### Box 3: Numeracy in the home (Fleer et al. 2004)

In a study designed to map family constructions of literacy and numeracy, a range of everyday examples of numeracy were recorded. Below are examples of numeracy contexts that were actively supported by families:

#### **Money:**

He's counting his money from his money box (referring to photo). I let him spend his money, teach him about his money. (He must learn that) he can't have everything, and I teach him to save his money, collect and count out the pocket money ... (C1)

She likes to take her purse (when we go to the shops) and pay for it herself. She gets cross with me if I give her the right amount of money. (She says 'I didn't get the change!' Otherwise she feels she's getting ripped off. It's a big learning curve. (R)

She is counting her pocket money to see if she has enough to buy what she wants to buy. (L1)

#### **One-to-one correspondence:**

Out of the two photos – he took it that as far as he was concerned, he was allowed to take the photos – there's the family dog. But that's how we started him counting, one dog, one cat, by two and a half he was able to count to ten! (L2)

Setting the table ... S knew it was one more, who is missing, so we only need four. He has learnt to subtract ... He realises there are only two of them (children), so he will only get two cups out'. (L4)

Well the number thing, we go walking every day and they got into the habit of counting the numbers on the house and sometimes it would take us half an hour extra because we were counting. (K)

#### **Cooking – measurement**

I lost my measurement cup. I had to use a half cup. C said, 'Mum, it only says one cup, one cup ...' (L3)

#### **In the car:**

Like you were saying (referring to another parent) with the sign boards. And she reads then. 'Are you doing 80?' 'You need two hands on the wheel!' They start to know and tell you things. (V)

My daughter has an uncanny sense of direction. She will say we are nearly at Nannie's. We went to the snow, and she had been to Healesville Sanctuary and she recognised that. It actually blows me away sometimes, like if I go a different way she says, 'That's not right!' (K)

#### **Calculators:**

With the calculator, she is learning to add up ... So they pull it out, her and her older brother. He has taught her 7 plus 7 is 14. She is learning it herself by being with her brother. He will read to her. (C2)

Good practices in observing and planning have been published by Early Childhood Australia (see Fleer & Richardson 2004c) and the Australian Government (see DEST 2002d). Both documents draw upon sociocultural theory, and both have generated new cultural tools for observing children in early childhood settings. Rather than documenting learning by children as a static, individual and independent performance, the new tools document learning within the context of modelled, shared or independent activities within a community of learners. Previous approaches have not included the adult within the observations. However, the sociocultural approach outlined in both publications actively encourages the documentation of how the adult models practice (eg calculating ingredients when cooking with children), co-construct with children (eg jointly writing the children's names on their group recipe), and note the contexts in which children are successful learners (eg small group of children helping each other to write letters on their posters to advertise their produce at a country fair). The last reveals levels of independent competence being exhibited by individuals within the context of a meaningful and intellectually collaborative activity.

## Other recent advances in understanding development needs in early childhood

### Implications of research for the promotion of early literacy

Makin (2004) proposes three approaches to overcoming gaps in early literacy development. Firstly, that literacy support be offered to parents who are developing their child's literacy foundations. Secondly, that effective two-way communication systems be established to link early childhood settings to the families that they service. Thirdly, that gaps between home and community literacy and school literacy practices be narrowed. (For a more comprehensive list of useful strategies to improve home/school partnerships see Makin et al. 1995, p. 112–15).

McNaughton (1995) identified three ways to support literacy development in everyday activities:

- 1 collaborative participation – give and take with a more knowledgeable other
- 2 directed performance – modeling and imitating
- 3 item conveyancing – query and response feedback sequences.

Arthur and Makin (2001), as a direct result of a study of 79 preschools and long day-care centres in New South Wales, developed key principles of high quality literacy programs for young children. These principles include: communicating with families about literacy, building on children's home experiences, planning to support individual literacy needs, integrating literacy experiences across the curriculum, and adult-child interactions that scaffold literacy understandings.

There is a consensus among researchers from a variety of disciplines that play is highly significant in the development of young children (Hall & Robinson 2000). As Sylva (1993) has shown, guided play provides an excellent method to learn about and use literacy in purposeful and meaningful ways (Raban 2003). Neuman et al. (2000) conclude that by incorporating literacy into play children are helped to develop and extend understandings about the functions and purposes of texts.

To learn literacy, children need opportunities to see and hear, to experiment, to interact and share, and to practise and refine what they know and can do (ECLIPSE 1997). Fox (2001) argues that

sharing and constant feedback of children's initiated literacy is also considered vital to literacy development. Other studies show that young children are naturally equipped to learn language (Wood 1998); however, there are differing views as to how children become literate. What is without doubt is the importance of providing young children with a variety of meaningful, high-quality, interactive experiences during their preschool years.

An evidence-based approach to the study of early literacy has improved our understanding of how literacy develops during the preschool years, and which aspects are central to high quality initiatives and programs. Some of the studies that have added to our knowledge have focused on aspects such as:

- consistency between home and school values and experiences (Freebody & Ludwig 1995; Cairney & Rudge 1997; Makin 2004)
- understanding the function and purposes of literacy and its form (Teale & Sulzby 1986; Hall 1987; David et al. 2000)
- frequent, interactive reading (Sulzby 1985; Bus 2001)
- understanding narrative and story (Meek 1982; Fox 1993)
- de-contextualised talk (Snow 1991)
- developing oral language (Norton 1996; Dickinson & Tabors 2001)
- phonological and metalinguistic awareness (Goswami & Bryant 1990; Byrne & Fielding-Barnsley 1995; Burgess & Lonigan 1998).

However, as reported by the Centre for Community Child Health and The Smith Family (2004, p. 27):

*Currently, no single early literacy program lays claim to being the universal remedy to the challenge of long-term literacy success.*

## Implications of research for the promotion of early numeracy

There is a small but growing body of research which supports the view that most children, by the time they reach five years, will have developed some sense of number, patterning, and notions of fairness and fractions. Research also suggests that children will have many conversations that require the use of mathematical terms within everyday settings, but that very young children will not necessarily transfer these ideas to different contexts to solve problems. Similarly, a range of pedagogical pathways in mathematics are needed to take account of the broad range of early years experiences children have in their prior-to-school years.

Overall, the research in schools suggests (rather than provides evidence of) that children have the capacity to engage in important elements of mathematics as distilled by Bird (1991, p. 170) and shown below (Table 1):

Table 1 Children’s engagement in mathematics

Mathematics	Young children
Activities such as the making of conjectures; structuring; and deciding on rules are essential.	Young children engage naturally in these processes.
Involves one in developing mathematical ideas; questioning; exploring; initiating ideas, methods and symbols oneself; and attempting to control apparently chaotic or muddled data.	Young children are naturally eager and curious and are able to invent and sustain activities themselves.
A major concern is to be consistent.	Young children are intrigued by inconsistencies and attempt to sort them out.
Is neither bounded nor confined to the material world.	Young children can go beyond the immediate and familiar, showing imagination and an ability to make their own generalisations from particulars.
Is a challenging intellectual activity.	Young children often take tasks upon themselves which we would be wary of setting, then show determination in tackling them.
What is correct depends on the context – different decisions and assumptions can lead to different results.	Young children can appreciate that more than one answer can be right at once; questions can be ambiguous and need interpretation.
Is not rigidly compartmentalised.	Young children can become involved in a wide range of skills and ideas within the same short space of time; they can forge a rich variety of connections and view items from different angles.
Is not a mindless activity; for example, there are sensible reasons for the introduction of notations and terminology.	Young children can work with a purpose; for example, they are capable of seeing a need for new terms and symbols and for modifying usage of familiar ones.
One can push forward one’s own thinking – one does not have to keep to set methods.	When not constrained by continually having to work out and provide ‘what the teacher wants’ within a closed context, young children are often willing to have a go and make suggestions.

As a result of extensive research by Willis (2001, 2002) into mathematics, Willis (unpublished) has developed a set of diagnostic questions which draw to teachers’ attention important aspects of young children’s thinking which underpin their mathematical development.

Does the child:

- show awareness of ‘sameness’ and ‘difference’ and use this in classifying things?
- recognise repetition and use it to copy, continue and make patterns?
- distinguish numerals from other symbols and notice how they are used?
- recognise ‘at a glance’ how many are in small collections?
- know the basic features and uses of counting numbers?
- think of sharing as involving equal groups or amounts?
- notice, talk and use shape?
- attempt to represent obvious spatial features of things?
- understand and use simple everyday words for position and direction?
- notice and talk about the size of things?
- pay attention to length, to weight and to capacity when comparing things?
- show awareness of time?

Although only limited research has been directed to the prior-to-school period in studying mathematics, sufficient evidence does exist to guide practitioners and families in supporting children’s mathematical learning.

## Current pedagogy, child development theory and philosophy in the education and care sectors

The average age of Australian teachers is 48 years (Senate 1996). As such, most Australian teachers are highly experienced with a depth of practical knowledge about teaching young children. However, this also means that most teachers completed their tertiary education qualifications 25 years ago, when theoretical emphases were grounded in interpretations of Piaget’s theory of development. This legacy must be taken into account when examining contemporary early childhood theory and practice within Australia.

The dominant pedagogy supporting early childhood education practice in Australia is informed by Developmentally Appropriate Practice (DAP) (Bredekamp 1987; Bredekamp & Copple 1997), and grounded in Piaget’s stage-based theory on child development, within the context of an active hands-on pedagogy. As a result, child-centred ideology enacted through individual observations and planning within Frobelian children’s gardens (eg blocks, puzzles, construction kits, collage trolleys, child-sized home corner or dramatic area, child-sized tables and chairs, trestles and planks, slides, jumping mattresses) is what is seen in many early childhood centres within Australia.

However, since the mid 1990s DAP has been re-examined by scholars in the USA (see Clyde 1995; Cross 1995) and in Australia (Clyde 1995; Cross 1995; Flear 1995). Australian researchers in early childhood education have asked whose development is being privileged (McNaughton 1995b), considering the cultural variations which make this world view problematic (Flear 1995; Flear & Williams-Kennedy 2002; Williams-Kennedy 2004) and have questioned previously accepted stage-based research as being the dominant perspective underpinning the theoretical and practical directions in early childhood education (Clyde 1995). As a result of this work, the status quo of early childhood practice and theory has been challenged (Flear 2000a, 2000b, 2003a, 2003b).

Edwards (2003a, 2003b) has shown that there is a growing realisation among early childhood teachers that DAP and the work of Piaget have not fully supported them in dealing with the



complexities of teaching in the 21st century, particularly when catering for the diversity of children who attend their settings. Edwards (2003b) found that many teachers expressed ideas which illustrate a working knowledge of sociocultural theory, but used the dominant discourse or conceptual tools available to them (DAP; Piaget) to talk about curriculums. Edwards also interviewed teachers who used the principles of Reggio Emilia to inform their work with young children. In Australia, there is a small but growing number of scholars and practitioners who have visited Reggio Emilia Italy and have brought back new ideas, principles and future directions to support early childhood practice (see Millikan 2003). Edwards found that those teachers in her sample who subscribed to the beliefs and principles of Reggio Emilia had at their disposal a broader set of conceptual tools for articulating their beliefs about curriculum.

As noted by Edwards (2003a), sociocultural theory has led the charge in debunking DAP as the dominant theoretical informant in Australia. This is in line with a general worldwide trend in education (Daniels 2001, p. 1):

*There is a growing interest in what has become known as ‘sociocultural theory’ and its near relative ‘activity theory’. Both traditions are historically linked to the work of L.S. Vygotsky and both attempt to provide an account of learning and development as mediated processes.*

Sociocultural theory and activity theory have both provided researchers and practitioners with ‘methodological tools for investigating the processes by which social, cultural and historical factors shape human functioning’ (Daniels 2001, p. 1). In the context of these theoretical perspectives, development is not seen as unfolding, but rather it is actively shaped by the social, cultural and political contexts in which humans reside. Rogoff (2003) has recently used the phrase ‘the cultural nature of development’ to name this perspective or as suggested by Daniels (2001, p. 14), development should be seen within the context of mediation:

*‘mediation’ which opens the way for the development of a non-deterministic account in which mediators serve as the means by which the individual acts upon and is acted upon by social, cultural and historical factors’.*

The legacy of Vygotsky’s work has seen a burgeoning body of theoretical writing and new opportunities for pedagogical research in early childhood education. As Daniels (2001, p. 2) suggests:

*These developments in social theory are creating new and important possibilities for practices of teaching and learning in schools and beyond. They provide us with theoretical constructs, insights and understandings which we can use to develop our own thinking about the practices of education.*

Centuries of debate have been concerned with how young children think and learn, but exciting new developments are beginning to take account of Vygotsky’s perspectives (Wood 1998). He valued the role of supporting dialogue in the learning process and argued that ‘the capacity to learn through instruction is itself a fundamental feature of human intelligence’ (Wood 1998, p. 26). Through these social experiences with more knowledgeable others, the child is able to develop understandings and cognitive transformations that spur further learning. In this sense the learning process is essentially social, but what is learned is cultural in nature (Vygotsky 1978, p. 162):



*Any function in the child's cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people ... and then within the child.*

The process by which the social becomes the psychological is called 'internalisation'. This is not the transfer of an external activity to a pre-existing internal 'plane of consciousness'; it is the process through which this plane is formed. This transformation of form is an essential part of the developmental process. As Vygotsky continues to elaborate, learning 'presupposes a specific social nature and a process by which children grow into the intellectual life of those around them.' (Vygotsky 1978 p. 88) Rogoff (1990, p. 192) further explains that it is a shared thinking process whereby the child is supported by someone more experienced. Her summation (Rogoff 1990, p. 35) of the Vygotskian view stresses that:

*individual development of higher mental processes cannot be understood without considering the social roots of both the tools for thinking that children are learning to use and the social interactions that guide children in their use.*

Tharp and Gallimore (1988) point out that, long before they enter school, children are learning higher order cognitive and linguistic skills. Their 'teaching' takes place in the everyday interactions of domestic life. In this informal socialisation, neither communication nor cognition is the subject of direct instruction. The pleasures of social interaction seem sufficient to lure the child into the language and cognition of the more competent care-giver.

While infants and toddlers may lack knowledge and experience, they do not lack the ability to reason. Indeed, as David et al. (2003) report, babies are seen to enter the world primed to learn curiously and competently from the sociocultural environment surrounding them. As Raban (2001, p. 33) has pointed out, 'learning is promoted and regulated by both the biology and the ecology of the child and in this sense learning drives development rather than the reverse'.

Through all of these more recent understandings, it is clear that development can no longer be viewed as the unfolding of pre-programmed patterns, but rather as shaped and spurred by experiences and these continuously transform the intellectual life of the child. Brandsford et al. (1999) and others (Chugani et al. 1987; Bruer 1997, 1999a, 1999b; Chugani 1998) illustrate how physical changes give rise to structural changes in the brain and the complexities of the synaptic linkages necessary for later learning. Not all children follow the same developmental pathways (Clay 1998; Hill et al. 1998). Yet a set of principles is emerging, identified by Raban (2001), that can support the learning and development of all children:

- build on what the child already knows and understands
- take account of the transformations that take place as a result of learning through experience
- keep a clear distinction between developing concepts and the contexts within which those concepts will be embedded.

By working from what children already know and understand, account is taken of their differing learning trajectories. The interactions between current understandings and new information will drive the transformations in socially and culturally relevant ways for each child. These relevant ways and the myriad of contexts within which authentic literacy and numeracy experiences occur during every day of children's lives lead them to enduring conceptual developments that will prepare them well for the more formal demands of schooling. According to Raban (2001, p. 33), 'learning is promoted by social and cultural norms that value this search for understanding'.

Pioneering work reported by Wood et al. (1976) observed the role of parental support in a shared task with wooden blocks. With the youngest children, the parent was principally concerned with luring the child into the task, either by demonstrating it or providing tempting material, with the parent typically intervening and being ignored. With children one year older, the parents were seen to act as verbal prodders and suggesters, even correctors. With children another year older than this, parents acted as confirmers and checkers. These researchers reported that well-executed support begins by luring the child into the actions that produce recognisable-for-them solutions. Once this is achieved, the parent can interpret discrepancies to the child. Finally, the parent stands in a confirmatory role until the child is checked out to 'fly on their own'.

In Australia, early research into mediation processes by early childhood teachers in science and technology education, for instance, drew upon Vygotsky's theory on the social formation of mind and Bruner's work on scaffolding (see Flear 1991, 1992). This research examined the role of the adult in children's learning and focused on documenting scaffolded interactions over time in child care, preschool and the early years of school. This research foregrounded the role of the adult in children's cognition and demonstrated the importance of mediated interactions for early childhood teachers. Research in New Zealand by Jordan (1999, 2001, 2003, 2004) has built upon this original research and demonstrated the rather crude nature of the scaffolding metaphor to explain the variety of interactions that occur in early childhood centres between children and staff and among children. Jordan has used the term 'co-construction' to capture the way children and adults actively mediate learning in a collaborative manner. This research has been important for demonstrating the complexity of interaction and the range of mediation possible, thus signalling to early childhood researchers and teachers the need for further pedagogical research in childhood education. Robbins (2004) has also used sociocultural theory to frame her research and to examine data that she has gathered in extended interview contexts with individual children. This research, which is ongoing, has made explicit the shortcomings of existing early childhood research into the social formation of mind.

Patterson and Fleet (2003, p. 14) have argued that 'many people (are) ... searching for more authentic ways to record children's learning'. However, the challenge of introducing new conceptual tools has been noted by Flear and Richardson (2003, 2004a, 2004b) and Flear and Robbins (2003a, 2003b). They investigated how early childhood teachers incorporate sociocultural theory into their belief system and use it to inform how they frame their observations of children and develop their educational programs. Flear and Richardson (2003, 2004a, 2004b) documented over two years the complexity of moving from the domains of learning and development to a sociocultural approach to observing children in early childhood settings. Realising new theory into practice took over 12 months, and many teachers expressed concern that what they were doing did not necessarily fit the dominant approach in early childhood education, and therefore they believed they ran the risk of their centres not being re-accredited because of not meeting standard quality assurance processes (Flear and Richardson 2004a, 2004b). Raban et al. (2003) studied teacher beliefs and examined pedagogical practices, producing a self-assessment instrument designed to help teachers locate themselves along a theoretical, pedagogical and philosophical continuum. This ongoing research is significant as it provides a robust tool for teachers and researchers to make explicit existing approaches to early childhood education in Australia. Subsequent research will be critical for professional development.

Flear and Robbins (2003a, 2003b, 2004) noted how the dominant approaches to early childhood education severely limited what Year 4 students studying for their Bachelor of Early Childhood Education degree could do in the field. They found that the teachers in the centres assessed the

students in the field in relation to how well they pedagogically reproduced existing practice. That is, to what degree were the student teachers copying the experienced teachers. Their study showed that it was very difficult for the student teachers to use sociocultural theory to inform their work, as the artefacts they produced (programs, observations) looked too different to the dominant approach and therefore pressure was placed on the students to change if they wished to pass their professional experience program. Although teachers welcomed the new approach to talking about practice, they were uncomfortable with the new artefacts the students produced. As Vygotsky (1978, p. 28) suggests 'Just as a mould gives shape to a substance, words can shape an activity into a structure'. The new theory produced new artefacts and ways of thinking about early childhood education which were too different to the dominant discourse and world view. As Bakhurst (1995, p. 160) suggests (cited in Daniels 2001, p. 21):

*the artefact bears a certain significance which it possesses, not by virtue of its physical nature, but because it has been produced for a certain use and incorporated into a system of human ends and purposes. The object thus confronts us as an embodiment of meaning, placed and sustained in it by 'aimed-oriented' human activity.*

These findings by Flear and Robbins (2003a, 2003b, 2004) from Australia are consistent with early childhood research using sociocultural theory undertaken in English speaking countries such as the UK (eg Edwards 1999, 2000, 2001, 2002a, 2002b; Anning 2004; Siraj-Blatchford 2004; Wood 2004), New Zealand (Nuttall 2004; Cullen 2004) and the USA (Lubeck 1996, 1998).

Alongside of these theoretical discussions and ongoing research have been postmodern critiques of early childhood education. Postmodern perspectives have become increasingly influential, sparking much debate in the field and encouraging early childhood educators to question existing and taken-for-granted practices. In particular, critiques from developmental psychology about the universal nature of development resulted in a critique of the foundations of early childhood education (Dahlberg et al. 1999; Penn 2001), generating focused conferences and papers on the reconceptualisation of early childhood education.

Similarly, the mounting evidence from three decades of cross-cultural studies on young children and their families (Rogoff 1990, 1998; Woodhead et al. 1998; Göncü 1999) has provided further evidence of the shortcomings of the theoretical foundations of early childhood education. The ethnocentric nature of theories of play (Flear 1996; Dockett & Flear 1999), the domination of a universal framework for the development of all individuals in our culturally and linguistically diverse communities (Dahlberg et al. 1999; Siraj-Blatchford & Clarke 2000; Flear & Williams-Kennedy 2002; Williams-Kennedy 2004), and an entrenched Western belief in the individual over the sociocultural collective (Rogoff 1998) have all been foregrounded.

Early childhood education in Australia is changing. While the dominant discourses surrounding the domains of learning and DAP have enshrined in quality assurance processes a particular world view (see Flear & Kennedy 2000), sufficient disquiet exists for teachers to consider new theoretical perspectives. The principles of Reggio Emilia and the introduction of sociocultural theory have both generated change. Early childhood education in Australia is undergoing a paradigm shift (Edwards 2004). How these new theories and principles are applied to practice within an Australian context is yet to be determined.

## Conclusion

### Developing early literacy and numeracy

Literacy and numeracy are primarily about access to cultural knowledge and involve a variety of symbolic thinking activities. However, literacy and numeracy experiences for young children should not be restricted to an emphasis on books and print and counting alone. Before children start to gain conventional literacy and numeracy, the fundamental symbolic skills begin to develop. The understanding that symbols represent or refer to something else develops in the toddler period. The use of symbols that include words, gestures, marks on paper and objects modelled for instance, makes it possible to represent experiences, feelings and ideas. The development of literacy and numeracy is dependent on understanding the way symbols work and using them efficiently and effectively.

Symbolic representation is at the core of language development and symbolic learning occurs whenever children create or utilise an object, symbol or role to represent an idea, feeling or process. Children purposefully learn and make sense of the complex semiotic signs and symbols of their culture (Hill 1997). In addition, the connection between symbolic thinking and early literacy and numeracy is well grounded within sociocultural theories of child development (Vygotsky 1962, 1966; Bruner & Sherwood 1981; Bruner 1893; Schrader 1990). Vygotsky (1978, as cited in Rogoff 1990, p. 35) concluded that competence with using symbols in one area should predict skill in other symbolic areas such as literacy and numeracy:

*For Vygotsky, children's cognitive development must be understood not only as taking place with social support in interaction with others, but also as involving the development of skills with sociohistorically developed tools that mediate intellectual activity.*

From birth, early literacy and numeracy development occurs in early social experiences and relationships, including sounds and babble, adult–baby games and interactions, listening to and enjoying songs, rhymes and taking turns. Children's early experiences include listening, talking, scribbling, drawing, painting, recognising oral language, enjoying pretend and dramatic play, dressing up, experimenting with various print and other visual media, counting, weighing, sharing and the like. Early literacy and numeracy development does not simply happen; rather, it is a social process, embedded in children's relationships with parents, grandparents, extended family members, siblings, teachers, caregivers, friends and the wider community.

### Requirements for children to develop their maximum potential for literacy and numeracy

To ensure that children are able to develop their literacy and numeracy skills to their maximum potential, children need:

- carers who interact with them frequently
- opportunities to interact with appropriate resources
- experiences of routines that are rich with meaning
- engagement with their world through talk and non-verbal communication.

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