
Numeracy and New Zealand early childhood education

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Abstract

The notion of numeracy in early childhood education is undoubtedly seen as a valid and important aspect of all young children's learning. This is supported by the Literacy and Numeracy Strategy which stresses the important nature of early experience as a catalyst for high levels of success in future numeracy. However, it seems that our youngest citizens are not being deliberately exposed to numeracy experiences in early childhood settings. Although there is evidence that children tested at school entry have skills and knowledge above the first stages of the numeracy framework, early childhood teachers could be making a greater difference to children's future success in numeracy if these resources were made available, and their use encouraged, in early childhood education and care settings

The New Zealand Numeracy Development Project [NDP] (Ministry of Education [MoE] 2001) was developed as part of the *Literacy and Numeracy Strategy* (MoE, 2000) to meet the identified needs of New Zealand children in an apparent lack of numeracy skills and general number sense, by increasing the professional capability of teachers. The basis of NDP is a framework of skills and knowledge that children are facilitated through to increase their numeracy capability (see Appendix). The evaluations of the NDP in 2002, 2003 and 2004, have increasingly shown that children are actually achieving the first stages of these frameworks before entering school. Early childhood teachers could be supporting children to reach further levels of skill and competence in numeracy if the resources and materials of the NDP, (accompanied by appropriate professional development) were made available.

Curriculum in early childhood education

The development of the *New Zealand Curriculum Framework [NZCF]*, (MoE, 1993) sparked the notion of a national curriculum for early childhood education in reaction to a possible downward curriculum push from the compulsory sector into early childhood. Early childhood academics argued at the time that “*Te Whāriki* was developed as much to protect the interests of children before school as it was to promote and define a curriculum for early childhood education.” (Carr & May, 1996). These authors stated that the early childhood sector could gain strength to resist the predicted downward curriculum push, and status, by ensuring clear links to the *NZCF*. There were implications for both the primary and early childhood sectors in this development as the implementation of a curriculum framework for early childhood would have significant effects on the gathering of assessment information at school entry.

Once a draft curriculum document had been developed, a nation-wide consultation process was undertaken. Many early childhood teachers at the time were skeptical of the idea of a document outlining the complete curriculum for the sector (May, 2001) and much of the discussion during the consultation phase was centred on ensuring that the diversity of the early childhood sector would remain ‘un-spoilt’. However, once those that were involved had engaged with the draft document, they were able to see the possibilities for child-centred holistic education and the value to children in having such a curriculum framework. The notion that this document had the potential to provide a framework against which to measure the quality of education and care being offered in early childhood settings was a positive move to many in the sector.

Along with the traditional areas of play evident within most early childhood settings (sand, water, visual art, music, books, blocks, etc.), the notion of the seven essential learning areas from the *NZCF* as the basis of learning experiences for children, became more widely utilised. Teachers, educators and parents involved in early childhood settings began to consider traditional ‘school subjects’ as a basis for child-centred curriculum (May, 2001). This idea of the school curriculum subjects as important in early childhood settings has been debated widely and continues to do so. It must be noted,

however, that the philosophy behind the *Te Whāriki* (MoE, 1996) principle of holistic development in which curriculum areas and subjects of learning are integrated, has remained the driving force in early childhood education.

The numeracy examples provided in *Te Whāriki* (MoE, 1996) are linked to goals and learning outcomes and discuss ways in which adults can provide experiences for children to hear and see numbers, counting, numerical patterns, using mathematical tools for the intended purpose, the language of measurement, and many other ideas for mathematical play. Each 'age group' - infant, toddler and young child, has ideas discussed for implementing experiences, which clearly build upon the previous stage. These examples provide early childhood teachers with ideas on which to base their teaching with children who have an interest in mathematical exploration. As the *Numeracy Development Project* book four: *Teaching Number Knowledge* states:

Although the groundwork is laid in mathematics, other curriculum areas also provide opportunities for numeracy learning. In addition, the home, early childhood settings, and the community assist in the development of numeracy.

(MoE, 2003, p.8).

The literacy and numeracy strategy

The *Literacy and Numeracy Strategy* (MoE, 2000) and subsequent Government policy has led the way in terms of new initiatives in the compulsory sector as well as making references to early childhood education.

The strategy provides a common set of evidence based principles to underpin policies and practice. Three key themes have been used in organising the framework. They are:

- Raising expectations for learners' progress and achievement;

- Lifting professional capability throughout the system so that everyone plays a part in ensuring that the interaction between teacher and learner is as effective as possible; and
- Developing community capability-encouraging and supporting family, whānau and others to help learners.

(MoE, 2000, para 3).

What do the three themes of the *Literacy and Numeracy Strategy* mean for early childhood teachers?

If teachers are to *raise expectations for learners' achievements* then it is vital that children are viewed as competent and confident learners from infancy. This image of the child is in direct contrast to some previously held views of children as 'empty vessels' waiting for teachers to fill them up with knowledge. Early childhood professionals must be able to see the potential in supporting children's interests as a catalyst for complex learning and plan appropriate extension of children's ideas and thoughts without identified learning intentions in mind.

Lifting professional capability suggests that teachers have the right to gain appropriate content knowledge on which to base their interactions and teaching with children. It is also one of the many and varied roles of the professionally capable teacher to be able to provide support and advice to parents and whānau in order to *develop community capability*. Many early childhood settings have parent education programmes in place in order to do just this. *Feed the mind* (MoE, 1999) has also served to meet this focus through television and radio commercials and printed leaflets, including a specific early childhood set.

Another aspect of developing professional capability is described within the *Numeracy Story* (MoE, 2001a) which briefly highlights the importance of early childhood numeracy experiences for young children. "While much of the work on numeracy is directed at the first years of schooling, the foundations for numeracy are laid in early childhood." (p.1). It reiterates that the early childhood curriculum includes emphasis on early mathematics

including: counting skills, prediction and estimation, pattern making, recognizing and using symbols, measurement ideas, spatial awareness and the language of probability, and that these foci are important and appropriate for the youngest children in our society.

What the *Numeracy Story* (MoE, 2001a) fails to acknowledge is that the very early stages of the *New Zealand Number Framework Knowledge and Strategy Stages* (MoE, 2001), (see Appendix), are often achieved in early childhood prior to children entering the primary school sector. This early knowledge and strategy development is evident within the evaluation documents of the *Early Numeracy Project* (MoE, 2001) (see Table 1).

Table 1: Results of testing skill and knowledge, for the operational domains of addition and subtraction, year 0-1 students (5 year olds).

ENP Results	2001	2002	2003
Number of Children Tested	4491	5491	10101
Strategy Stage			
0- Emergent	5%	6%	3%
1- One to One	16%	14%	8%
2- Materials	40%	45%	47%
3- Imaging	18%	17%	22%
4- Advanced Counting	16%	17%	18%
5- Early Additive	4%	1%	2%

Note: 2001 Results from Ministry of Education (2002, p. 77)
 2002 Results from Ministry of Education (2003, p. 79)
 2003 Results from Ministry of Education (2004, p. 72)

This data shows that almost half of the five year old children, usually tested within six weeks of starting school, had gained basic addition and subtraction strategies, or more, (and by implication the prior knowledge necessary for this development), before starting school. These basic skills are first seen in the *Number Frameworks* at stage 2. This

provides evidence that children younger than five years of age have the knowledge and skills necessary to develop further complex numeracy skills once they enter the primary school sector. Of the children who had attained higher than stage 2 (42% in 2003) the assumption can be made that they would have had rich early childhood mathematical experiences in the home or early childhood setting to be able to achieve these levels.

If we look at the resources available in the *NDP* (MoE, 2001) there is an abundance of games, ideas, and resources for teaching numeral recognition, forward number word sequence and simple addition. If the majority of children in primary schools engaging in *NDP* are already at stage 2 and higher (over 80% in 2003), why is there such a strong focus on stages 0-1? Perhaps teachers of new entrant children should be starting their numeracy focus at stage 2 and not in the emergent stages. The framework resources for these early stages should be made available to early childhood centres, teachers, and parents in order to develop beginning school competence in the emergent stages and further strengthen the links between early childhood and school.

Teacher subject content knowledge

Mathematics as a singular entity or topic has not historically been an area where teachers in early childhood settings have strong content knowledge or focused their professional development (Davies, 2003). Over the past five years or so, this has changed considerably and it is now quite common to find workshops, seminars, and literature around the topic of early childhood mathematics but not necessarily a strong emphasis on numeracy. (e.g. Babbington & Lomas, 2004; Davies, 2003; Haynes, 2001; Hedges, 2003).

One of the reasons for the lack of availability of *NDP* could be that early childhood pedagogy and philosophy is one of an holistic, socio-cultural, child- centred approach and any methods or resources that could be considered formal, didactic teaching are resisted (MoE, 1996). However, teachers cannot teach that which they have no knowledge of themselves, nor can they build upon the knowledge and skills of children without subject content knowledge. It would be beneficial to the knowledge, skills, and attitudes of those

children who have an identified interest in numeracy for all teachers to have an understanding of the early knowledge and strategy stages of *NDP*. They would then be able to increase the opportunities for learning, of those interested children, regardless of their age or stage. Davies (2003) in her recent research of teacher content knowledge in mathematics in early childhood agrees;

The question must be raised as to how confident early childhood educators are in developing number knowledge and skills in children...teachers were unaware of the vital importance of early number skills as a foundation for future mathematical thinking. (p.34)

It is the responsibility of early childhood teachers to ensure that there are equitable opportunities for children to have experiences that are rich in numeracy content. These can include activities such as a numeral rich environment, counting songs including both forwards and backwards number sequences, books and puzzles that have numbers within them, measuring experiences, (using both non-standard and standard units) and teachers that are knowledgeable about and motivated, excited and interested in mathematics within an early childhood holistic context.

Holistic numeracy teaching

The holistic nature of early childhood education must also again be stressed. Within early childhood settings it is evident that many essential areas of learning are occurring at any one time in a play-based curriculum (Babbington, 2002). Consideration must be made for each individual child's level, pace, and interest, in a play-based programme, and that each child is being empowered by the teachers to reach their full potential. For numeracy, this means that if a child is interested in a particular item, object, topic or theme at the moment, then every opportunity is undertaken by the teachers to incorporate mathematical concepts within the child's choice of play resources. For example; if a child is strongly interested in outdoor gross motor play at the present time, then teachers should be able to plan and implement learning areas and experiences into the outdoor area that

include numeracy content. The Communication strand of *Te Whāriki* (MoE, 1996) is one example of an holistic numeracy focus:

Communication, Goal 3. Children experience an environment where they experience the stories and symbols of their own and other cultures...Children develop:

...familiarity with numbers and their use by exploring and observing the use of numbers in activities that have meaning and purpose for the children.

(p.78).

It is vital for early childhood teachers to gain knowledge of numeracy experiences, activities and theory in order to increase children's competence through a rich mathematical environment. Teachers must be numerate if they are to assist children. Professional development focusing on the development of knowledge, and supported by the resources, knowledge and opportunities of *NDP*, should be available to, and encouraged, within the early childhood sector. This must be seen as viable, exciting and appropriate teaching and learning, with the proviso that numeracy should not be taught in a formal, didactic manner. Child-centred numeracy experiences can occur every day, and should do so. Children deserve the right to access the very best that can be offered in order to reach their full potential in the early childhood years, and for life. As the *NDP* states; "To be numerate is to have the ability and inclination to use mathematics effectively - at home, at work and in the community." (MoE, 2003. p. 18).

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Appendix

The New Zealand Number Framework Knowledge and Strategy Stages Levels 0-6

<p>Stage 0: Emergent</p> <p>The student is unable to consistently count a given number of objects because they lack knowledge of counting sequences and/or one-to-one correspondence.</p>
<p>Stage 1: One-to-one Counting</p> <p>The student is able to count a set of objects or form sets of objects but cannot solve problems that involve joining and separating sets.</p>
<p>Stage 2: Counting from One on Materials</p> <p>The student is able to count a set of objects or form sets of objects to solve simple addition and subtraction problems. The student solves problems by counting all the objects.</p>
<p>Stage 3: Counting from One by imaging</p> <p>The student is able to visualize sets of objects to solve simple addition and subtraction problems. The student solves problems by counting all the objects.</p>
<p>Stage 4: Advanced Counting</p> <p>The student uses counting on or counting back to solve simple addition or subtraction tasks.</p>
<p>Stage 5: Early additive Part-Whole</p> <p>The student uses a limited range of mental strategies to estimate answers and solve addition or subtraction problems. These strategies involve deriving the answer from known basic facts, (eg. doubles, fives, making tens).</p>
<p>Stage 6: Advanced Additive/Early Multiplicative Part-Whole</p> <p>The student can estimate answers and solve addition and subtraction tasks involving whole numbers mentally by choosing appropriately from a broad range of advanced mental strategies (eg. place value positioning, rounding and compensating or reversibility).</p> <p>The student uses a combination of known facts and a limited range of mental strategies to derive answers to multiplication and division problems, (eg. doubling, rounding or reversibility).</p>

(Ministry of Education, 2001. pp. 6-7).