PLAYING WITH MATHEMATICS: IMPLICATIONS FROM THE EARLY YEARS LEARNING FRAMEWORK AND THE AUSTRALIAN CURRICULUM

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After an introduction to the current conceptions of play in early childhood settings, we consider what The Early Years Learning Framework and the Australian Curriculum say about play and mathematics learning in the home and preschool, and the early years of school. We analyse similarities and differences in the two documents with regard to their philosophies about play as pedagogy for the learning of mathematics. We use the construct of a Numeracy Matrix to illustrate how playing with mathematics can be utilised to provide curriculum and pedagogical continuity between preschool and school.

Introduction

The current context of early childhood education in Australia is one of social, political, and educational change. At a time of unprecedented political focus on early childhood education and growing awareness of the importance of high quality early childhood education for children, their families and communities, two national curriculum documents that will shape the nature of early childhood education for some time to come have been introduced.

Early childhood education in Australia has recently embraced *Belonging, Being and Becoming: The Early Years Learning Framework for Australia* [EYLF] (Department of Education, Employment and Workforce Relations [DEEWR], 2009). The EYLF advocates play-based learning, supported by quality teaching, as the basis for promoting children's learning and development. At the same time, a national school curriculum, the Australian Curriculum, is being developed and implemented (Australian Curriculum, Assessment and Reporting Authority (ACARA, 2010). This curriculum is organised across distinct subject areas, and has a focus on curriculum content, rather than pedagogy.

Both documents emphasise the importance of children's learning and note some specific outcomes for learning in the early childhood years. However, each document reflects a different focus on that learning. The EYLF, in keeping with the consideration of young children aged birth to five years, reflects a holistic approach to learning and development, embedded within play-based environments and includes broad learning outcomes. The Australian Curriculum is focused much more on specific learning outcomes, associated with discrete subject areas and definite years of schooling. Partly,

this relates to the purpose and intention of each document: the EYLF is a curriculum framework, with emphasis on pedagogy, principles, and practice; the Australian curriculum is much more focused on the curriculum content.

Clearly, the documents serve different purposes and reflect the different nature of the educational settings for which they are designed. However, educators across early childhood settings and schools are required to work with both documents, and the associated expectations, in order to promote continuity of learning and positive educational outcomes for all children. This paper explores one means of facilitating such continuity in the area of mathematics, through pedagogy based on contemporary conceptualisations of play. It provides a summary of current conceptualisations of play and links these to learning through the construct of a Numeracy Matrix. This matrix and the data reported in the paper are drawn from the *Early Years Numeracy Pilot Project,* conducted with a total of 130 preschool and school teachers in South Australia (Perry, Dockett, & Harley, 2007; Perry, Dockett, Harley, & Hentschke, 2006) as they explored ways to enhance the mathematical opportunities and experiences for their students.

Play-based pedagogy

Early childhood education has a long tradition of play-based pedagogy. Play has been regarded as both a vehicle for learning and as an opportunity for children to demonstrate their knowledge, skills, and understandings (Johnson, 1990). Traditional approaches to play have emphasised the child-initiated and directed nature of play, relegating adults to the roles of stage managers and onlookers (Bennett, Wood, & Rogers, 1997). Recent reconceptualisations of play have moved away from these notions, referring instead to the social nature of play and the opportunities afforded through play for children to engage with important others in many of the routines and interactions important within their social and cultural contexts (Rogoff, 2003). Rather than casting play and learning as opposite elements of children's lives—where play is something that is child-initiated and learning is adult-initiated (Pramling-Samuelsson & Asplund Carlsson, 2008)—recent critiques of play note the importance of adult and child interaction within play, particularly in situations of sustained shared thinking (Siraj-Blatchford, 2009) and scaffolding (Arthur, Beecher, Death, Dockett, & Farmer, 2008). Current play-based pedagogy recognises the complexity, as well as the potential of play to contribute to learning. It also acknowledges that not all play is either productive or likely to lead to positive learning outcomes. Along with this, it emphasises active roles for participating adults as they co-construct meaning through strategies such as inviting children to elaborate on their ideas and play, clarifying ideas, offering alternative views, speculating and modelling thinking (Siraj-Blatchford, 2009).

Young children's play often includes a great deal of mathematics (Greenes, Ginsburg, & Balfanz, 2004; Seo, 2003). Sometimes, this is identified and extended by educators; at other times educators' own understandings of mathematics may limit the identification and response to mathematics within play (Sarama & Clements, 2009). The potential of play to facilitate children's mathematical thinking depends largely on educators' ability to "seize on the teaching opportunities in an adequate way" (van Oers, 1996, p. 71). This ability requires mathematical knowledge; understanding of the nature of children's play, particularly the characteristics of play that promote mathematical

learning and thinking; and awareness of the role of educators in promoting both play and mathematical understanding.

What about mathematics?

Preschool educators tend, at least in Australia, to reject the divided, content-based approach to mathematics curriculum that is often used in schools (Australian Association of Mathematics Teachers and Early Childhood Australia, 2006). There is, however, general agreement that all children in their early childhood years are capable of accessing powerful mathematical ideas that are both relevant to their current lives and form a critical foundation for their future mathematical learning, and that children should be given the opportunity to access these ideas through high-quality child-centred activities in their homes, communities, and preschool settings (Lee & Ginsburg, 2007; Hunting et al., 2008; Perry & Dockett, 2008).

Recognising young children's competence may mean that educators introduce a range of curriculum content and promote children's learning around a set of agreed learning outcomes. Both the EYLF and the Australian Curriculum adopt such an approach. However, there is tension between the two documents around both the nature of mathematics curriculum for young children and appropriate pedagogies to deliver this. Part of this tension involves resistance to 'push down' academic curricula from preschool educators, who argue strongly for early childhood curriculum that is play-based and child-centred, rather than curriculum that is subject driven. Also contributing to the tension are moves for greater accountability for teachers and schools, and growing emphasis on national and international testing. While children in Australia do not engage in national testing until Year 3, there is certainly anecdotal evidence that teachers in the first year of school, and even preschool, feel pressure to start preparing children early for such assessments and that this influences their pedagogy. In this context, how can educators work together, utilising the curriculum documents that are prescribed for their settings, to build on children's existing understandings and promote positive learning outcomes for all children?

Connecting curricula

The EYLF outlines five broad learning outcomes, each with several key components. While it is possible to align these outcomes with broad curriculum areas, it is argued that they represent integrated, rather than subject specific, learning outcomes. These outcomes are:

1. Children have a strong sense of identity.
2. Children are connected with and contribute to their world.
3. Children have a strong sense of wellbeing.
4. Children are confident and involved learners.
5. Children are effective communicators.

There is potential for mathematics to be an integral part of each of these outcomes. However, the last two are particularly relevant for addressing mathematics learning.

Material developed to support the implementation of the EYLF includes reference to a recent survey of Australian early childhood educators which concluded that young children were capable of working with mathematical ideas that could be attributed to the areas of number, algebra, geometry, measurement, data analysis, and probability

(Hunting et al., 2008). While these terms are not used in the support material, the importance of mathematical thinking for young children is reflected in the inclusion of a range of these same areas within the EYLF, which refers to the importance of sharing and clarifying thinking and ideas, developing understanding of measurement and number, experimenting with ways of expressing ideas, recognizing patterns and relationships, and using symbols to represent meaning. The Australian Curriculum for the Foundation Year of school also reflects these areas, although it formalises them into the content strands of number and algebra, measurement and geometry, and statistics and probability. These strands include a number of powerful mathematical ideas identified in mathematics teaching and research (see, for example, Greenes et al., 2004; National Council of Teachers of Mathematics [NCTM], 2000; Perry & Dockett, 2008).

Continuity in pedagogy

In a quest for pedagogical continuity across preschool (represented by the *Early Years Learning Framework for Australia*) and early school (represented by the *Australian Curriculum—Mathematics*) settings, the construct of a Numeracy Matrix linking the two curriculum documents has been explored. The current version of the numeracy matrix (DEEWR, 2010) provides direct links between the learning outcomes from the EYLF and these powerful mathematical ideas, many of which match closely the strands of the Australian Curriculum. The links are made through 'pedagogical inquiry questions' that ask educators in both settings what they might do to promote both the learning outcomes and the powerful mathematical ideas. These 'pedagogical inquiry questions' are about pedagogical approaches designed to lead educators to reflect on their pedagogical practice based on knowledge of their children's learning and the mathematics that they are endeavouring to develop in these children. Hence, the Numeracy Matrix provides a guide to the mathematics that might be developed by preschool educators—which is not highlighted in the EYLF—and a guide to the pedagogies which might be developed by early years of school educators—which are not highlighted in the Australian Curriculum.

Tables 1 and 2 illustrate the nature of the numeracy matrix and its potential to link the EYLF and the Australian Curriculum through pedagogical inquiry questions.

Table 1. Numeracy Matrix Cell—Example 1.

	Australian Curriculum—*Mathematics* Number and algebra
Early Years Learning Framework Children are confident and involved learners	What opportunities do we provide for each child to accept new challenges, make new discoveries and celebrate effort and achievement? What do we do to encourage children to use symbols and different representations of their mathematics?

Table 2. Numeracy Matrix Cell—Example 2.

	Australian Curriculum—*Mathematics* Statistics and Probability
Early Years Learning Framework Children are effective communicators	How do we encourage children to collect, analyse and represent data? How do we encourage children to begin to recognise, discuss and challenge unfair attitudes and actions?

The Numeracy Matrix can be used to link approaches taken in the preschool settings and the early years of school by having the early childhood educators in both of these sectors ask the pedagogical inquiry questions. While the answers may be quite different in each of the sectors, the asking of similar questions can provide opportunities for continuity across the transition to school, something which is known to benefit children in the early years of school and later (Wood & Bennett, 1999).

Using the Numeracy Matrix to promote pedagogical continuity

As part of the South Australian Early Years Numeracy Pilot Project, early childhood educators from both preschools and schools have developed a collection of work samples that illustrate each of the cells of the Numeracy Matrix. These work samples show how the same pedagogical inquiry questions can be used in both preschools and schools to help children develop their mathematical ideas through play.

For example, consider the Numeracy Matrix cell details in Table 1. Figures 1 and 2 below provide examples from children in the first year of school who were answering the question "How many legs do 10 chickens have?" in the context of farmyard play.

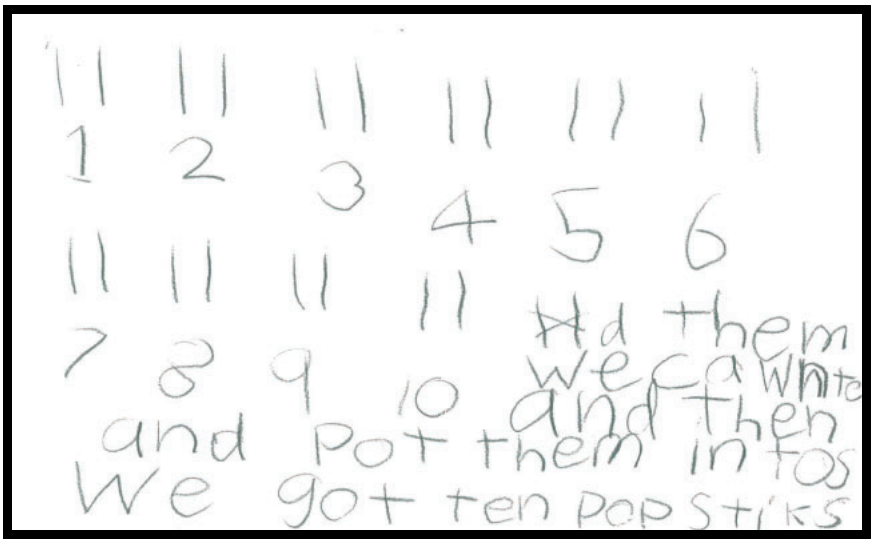

Figure 1. Tracey's justification of her solution to the challenge and use of symbols.

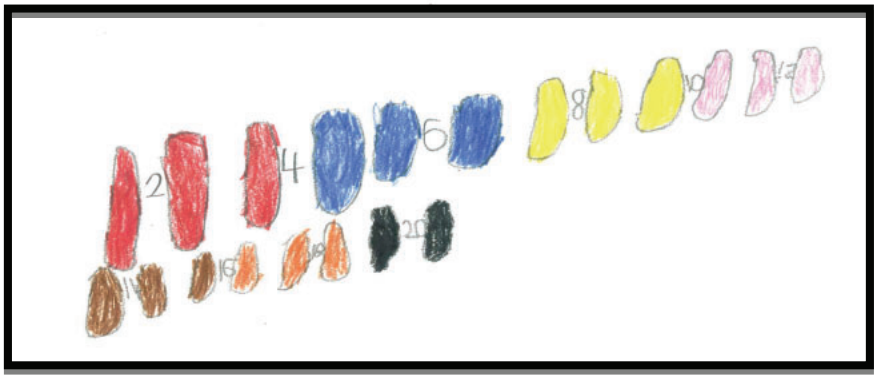

Figure 2. Emily's response to the challenge and use of patterning.

There are many ways in which young children might be challenged in number and algebra to demonstrate their use of symbols and show that they are confident and involved learners. Blair (Figure 3) is a 4-year old preschooler, and his preschool educator wrote the learning story.

Blair was sitting playing at the play dough table and I went to have a chat with him about making a number game. Blair said to me, 'I know a really big number—a million.' I asked Blair if he knew how to write one million in numerals and as he didn't I showed him. After briefly looking at the numbers I had written down (1,000,000) Blair said, 'Now I get it, a million is six zeros. A thousand is a one and three zeros. A hundred, one and two zeros. If you took three zeros away (from a million) it would be a thousand.' I asked Blair what the number would be if I replaced the one with a six and he told me it would be six million. Blair then said that he knew an even bigger number, a fillion! I said that there was not a number called a fillion but there was a billion (with nine zeros) and a trillion (with twelve zeros). He was very impressed by the number of zeros in these numbers.
Following our conversation Blair decided to paint a picture. He painted numbers from zero to fourteen on his paper. I asked Blair why he had stopped at number fourteen and he said that fourteen was his favourite number, he just likes the four.

Blair is able to initiate, explore, listen, and respond. He is curious and can classify and order, having a wonderful understanding of numeracy concepts. He uses language to express his thoughts and understands the function of print.

Figure 3. Blair knows a big number.

Conclusion

Clearly, the Australian Curriculum and the EYLF differ in the ways that curriculum is organised and delivered. Partly, this is related to the different philosophies and approaches underpinning the different documents and sectors. Early childhood educators who work across the sectors, including those involved in transition programs, need to be aware of these differences and the ways in which they can be navigated. While the children will not be aware of the pedagogical continuity provided by the Numeracy Matrix, it does provide educators in the preschool and school settings with a common language and format that can be used to discuss the children's learning and the educators' pedagogy. Educators who have used the Numeracy Matrix have been able to

provide such guidance through the linking of the learning outcomes from the EYLF and the content strands in the Australian Curriculum—Mathematics.

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