Introduction

In the writing of this book, the editors wanted to create a text that would inform and guide students and practitioners of early childhood science. Using current research, both that of the authors and through review of the research literature, the book provides information that is relevant and responsive to its intended audience. Each chapter helps to develop content knowledge of areas of science and instructs on how to guide children's learning in that area. Many different approaches to science learning are taken, with an understanding that science is inter-related with most other curriculum areas and, in particular, with an understanding that young children tend to learn in an holistic way. There is a growing recognition of the importance of science explorations in children's lives as they try to make sense of the world around them. Cognitively, it is very important to have input into children's developing science understandings and to be able to guide their concept development. The book is designed to complement the Australian Early Years Learning Framework (EYLF) with references in each chapter to the alignment of content with the philosophy and anticipated outcomes of the guidelines. Internationally, the 'early years' comprise a period recognised as that time between birth and eight years of age, and this book provides resources for practitioners working in this age range. In recognition of the general acceptance in the early years' community of 'learning through play', this book highlights varied types of learning and learning environments: naturalistic, informal and formal.

Chapter summaries

Chapter 1 provides the reader with an overview of Australia's first national curriculum framework for early childhood educators – the Early Years Learning Framework: Belonging, Being and Becoming (Department of Education, Employment and Workplace Relations (DEEWR), 2009). The relevance of the EYLF in relation to teaching science in the early years is explained, concluding with the identification of science outcomes for children within the framework. The voices of early childhood educators and early childhood teacher educators are highlighted to illustrate how those working in the field are engaging with the framework. Chapter 2 discusses the many theories of learning that have an impact on how educators deal with young children. There are accepted theories about how children (and, indeed, adults) learn science and the factors that affect learning in young children. This chapter describes those theories of children's development and the range of influences that can affect science learning. The following chapter, Chapter 3, discusses the importance of play as a developmental tool. Play is of great use in early childhood, and is of value to professionals. The chapter addresses theoretical aspects of play and how play supports child development. It discusses play in the pre-school to Grade 2 school curriculum and the role of the professional in play pedagogies.

Introduction

Chapter 4 links practice to theory with a discussion of the range of teaching approaches used with young children to enhance their learning. It outlines the interactivity of the approach used by the educator as well as the settings. Whether through the processes of science, such as the development of observation, or through the skillful questioning of the educator, the approach used should enhance children's learning.

In Chapter 5, the discussion revolves around the pedagogical practices associated with teaching science in early childhood settings. Educators are being challenged as to why, what and how they should teach science. Through the use of two case studies, this chapter explores pedagogical practices associated with the teaching and learning of science for young children using play as a medium, and relates the findings to the five outcomes of the EYLF (DEEWR, 2009). Chapter 6 focuses on the ways in which educators promote science learning in play based contexts, in settings both within and outside learning centres. Cases of interactions between children and educators are provided to highlight the ways in which language can enhance learning. These cases encompass the inside, natural and built environments, and show how educators can use unplanned events to scaffold learning immediately as well as to inform their planning for teacher-led explorations to follow up on these occurrences.

Chapter 7 provides insight into the informal learning of science in settings outside of centres and schools, such as home and community. Sociocultural theory is used to examine some of the multiple and complex ways in which science skills and concepts are being developed within the everyday practices of families, and how families' funds of knowledge provide a rich and meaningful basis for children's future learning in science. Moving onto Chapter 8, the issues of sustainability of our environment is brought into early childhood learning. The chapter discusses the ability of young children to feel empathy for their natural environment and the living things within it.

Chapter 9 describes how our systems of education and care are based on the premise that all children have the right to equal opportunities to experience life and learning. How the early childhood practitioner actually puts this into practice in a science context is the focus of the chapter.

Chapter 10 and Chapter 11 deal with the pragmatics of planning, observing, assessing and documenting children's learning, using a range of resources and accepted practices. Links are made to the EYLF (DEEWR, 2009).

The final chapter of the book, Chapter 12, looks at the continuing requirement for educators to be lifelong learners through effective reflection on their own practices. Given the dearth of professional learning in science available to educators, the chapter promotes practices that allow for growth of the individual educator while acknowledging that reflective practice is a learned and practised skill.

What does science look like in the early childhood years?

If you walked into an early years' learning centre, what would you see in terms of science education? Would you find structured activities with a whole-class focus, children undertaking teacher-led investigations, or children exploring their natural and human-built environments in their own time and in their own way? All of these approaches are used at some time or another in different centres. There is no single way that children are taught science in the early years; a multitude of approaches and different ways are used to provide children with science knowledge and understanding. What is acknowledged as crucial is the role of the educator and the social environment in promoting that learning.

Children learn as they grow, and they adopt their own explanations for the ways in which they understand the world. This is often termed 'everyday science', referring to the ways children interpret their environments, based on their own everyday experiences. Hedegaard and Chaiklin (2005) reported that if an educator is able to 'interlace' everyday concepts with scientific concepts in play based contexts, then a child's thinking and practice will be transformed. Science learning can occur incidentally, as the child is involved or engaged in other activities. Incidental learning is considered to be unintentional or unplanned learning that results from other activities. It occurs in the home environment and early childhood centres as children undertake their normal play activities. Incidental science understandings can arise through observation of others or specific things (like watching how a caterpillar moves), through problem solving (working out how to balance on a tree stump) and through social interactions in which discussions with others may present new information. Incidental learning can also occur through the mistakes that children make when they are forced to adapt or accept an alternative way of doing or understanding something.

Children love to explore the world around them. As they feel confident in their surroundings and with those with whom they interact, they investigate further and further. They demonstrate a sense of wonder about the little things around them and delight in the natural aspects of the world – for example, finding tiny snail eggs, which most of us would not even notice in our busy lives.

Young children's development

From birth, children develop at an astonishing rate. During this time they are developing simultaneously across the five recognised domains: physical, social, emotional, linguistic and cognitive. The physical domain is characterised by rapid development of both gross motor skills (rolling, crawling, walking) and fine motor skills (eye–hand coordination, grasping, cutting, drawing). Living in a social world, as children interact with others, they develop an understanding of how to communicate, make friends,

share, take turns and maintain relationships. Through play, they practise what they know by working in groups, exercising self-control and learning what approaches work or do not work. As they learn how to interact socially, the aspects of self-esteem and self-confidence start to develop. Children learn to express and manage their emotions such as happiness, sadness, fear, courage, anger and contrition. Social and emotional development tend to occur simultaneously as the social environment may have an impact on the child's emotional stability.

Language development is important for the development of many of the other domains. Children learn to communicate, expressing their desires and understandings, and learn to use language to guide the environment around them. Intonation, words, concepts, vocabulary, awareness of language and verbal thinking are practised through play and interactions within their environments.

From birth, children make meaning about their environment and their interactions within that world. This is referred to as their cognitive development. They learn through play, activities and relations with others. From these experiences, young children develop their understandings and skills in a wide range of areas, such as language, mathematics, science and art. As a child attempts to solve problems in play situations, she or he learns to persist in tasks and thinks more creatively. Child psychologist Jean Piaget identified four stages of cognitive development (Johnston & Nahmad-Williams, 2009). The first and earliest stage, called the 'sensori-motor stage', is characterised by the development of early ideas in response to experiences in the environment and to stimuli. Children from birth to age 2 years (approximately) exhibit this stage. As they move from this stage to the next, the 'preoperational stage', children begin to develop their mental imagery and reasoning skills, using symbols, memory and imagination. This thinking can be non-logical and uncoordinated. Language also starts to develop more fully.

The next stage, which occurs at around 7 years of age, is termed the 'concrete operations stage', at which time children recognise the conservation of properties such as mass, liquid, number, length, area and volume. Thought becomes more logical and children are increasingly able to manipulate symbols related to concrete things.

Characteristics of children in the developmental domains 0–3, 3–5 and 5–8 years

In terms of science, the developmental domains characterise what the child is capable of. For example, from birth to about 3 years of age, children are able to focus their attention on particular features of their own world, and in their explorations and play they seek meaning for their experiences. They demonstrate an interest in

why things occur and start to use others as sources of information and learning. This often emerges as children repeat their investigations over and over again, becoming absorbed in their discoveries of new knowledge. Children's language begins to reflect their enquiries with questions starting with 'why, how, who, when, where, what?'

In the 3–5-year-old category, children show a great deal of curiosity and interest in objects and living things. They start to demonstrate an understanding of cause and effect and realise that things can change. They are able to articulate their own understandings and ask questions of others. They investigate material by using their senses appropriately and begin to identify features of living things and objects they observe. They demonstrate the ability to notice similarities and patterns in objects and events around them.

In the domain 5–8 years, children develop dispositions for learning. They become adventurous in their thinking and begin to reflect on their thinking processes. They develop further skills in problem solving, inquiry, experimentation, researching and investigating. Increasingly, they are able to transfer information from one context to another, or adapt what they have learnt and start to develop their own explanations for the observations they make, based on the evidence they have collected. Finally, they are able to connect with people, places, technologies and materials to provide independent resources for their own learning.

References

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Chapter 1

Science in the national Early Years Learning Framework

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Learning objectives

At the end of this chapter, you will:

- have explored the EYLF
- recognise how the framework sits historically with international research and understandings
- be able to describe the principles and outcomes within the EYLF, with reference to pedagogy, play and embedded values
- recognise how the EYLF provides for teaching and learning in science in early childhood settings
- describe ways that educators can enhance science learning through attending to the EYLF.

Overview

This chapter provides an overview of Australia's first national curriculum framework for early childhood educators – Belonging, Being and Becoming: the Early Years Learning Framework (EYLF) (DEEWR, 2009). It traces the development of the framework, situating it alongside existing national and international frameworks and curriculum documents. It discusses the rationale for the new structure, the underpinning philosophies and the implications these have for educators' practices and children's learning. The Belonging, Being and Becoming motifs are explained in light of teaching and learning in the early years, along with the eight practice elements, five principle elements and five designated learning outcomes. The relevance of these in relation to teaching science in the early years is made clear, concluding with the identification of the science outcomes for children within the framework. This chapter firmly establishes the purpose of the national framework and its ramifications for the teaching of science in the early years. Throughout the chapter, the voices of early childhood educators and early childhood teacher educators are highlighted to illustrate how those working in the field are engaging with the framework.

Evolution of the framework

In 2009, Australia saw the development of its first national framework to guide early childhood curriculum and practice when working with children aged birth to 5 years in a range of early childhood settings. This was a direct result of the Council of Australian Governments' (COAG, 2008) reform agenda in the areas of early childhood education and care. With the election of the Rudd government in 2007, the 'productivity agenda' surfaced, underpinned by a firm commitment to increasing investment in social and human capital as a way to strengthen the Australian economy. Education was seen as a key component of this agenda, with early childhood education and care receiving attention with the commitment to improvement of program quality. The COAG vision for 2010, that 'all children have the best start in life to create a better future for themselves and for the nation', saw state and territory governments collaborate on a National Quality Agenda for Early Childhood Education and Care. The new framework, the EYLF, was a key element of this quality agenda as it 'form[ed] the foundation for ensuring that children in all early childhood education and care settings experience quality teaching and learning' (DEEWR, 2009, p. 5). It was aligned with the National Quality Standard (Quality Area 1) with the expectation that staff working in programs for young children would engage with the framework in designing and implementing their programs, thereby ensuring that children's learning from birth to 5 years of age and through the transition to school was extended and enriched (DEEWR, 2009).

The international context

A search of the international literature (VCAA, 2008) found a proliferation of curriculum frameworks and learning documents employed in the early childhood years. While these frameworks vary in the age range catered for and differ in the definition of the term 'curriculum' and its intentions, there are common themes that have implications for practice. These include:

- recognition of the early years, especially the first three years of life, as important for laying the foundation for later learning
- the link between quality programs and later economic benefits
- acknowledgement that changes in family lifestyles require changes in the provisions offered
- working in partnerships, leading to 'a shared sense of responsibility and shared commitment to children and their education' (VCAA, 2008, p. 24).

Within these frameworks children are positioned as competent and capable citizens. The social nature of learning is acknowledged, children are valued for who they are and what they bring to the learning situation, and play is recognised as the context through which a young child learns. Overarching elements that underpin quality programs take a strength-based approach towards documenting, assessing and planning for children, providing continuity of service provision in well-resourced programs, ensuring practice is informed by research evidence, and that literacy and numeracy are embedded into learning documents.

Principles that can be drawn from an analysis of the frameworks (VCAA, 2008) that determine what is provided for children and how this is provided include:

- acknowledging that children have rights (UN Declaration of the Rights of the Child, 1959)
- valuing the richness and uniqueness that each child brings to learning situations (cultural diversity, different understandings of literacy)
- understanding the impact that environments and relationships have on shaping the learning that takes place within them.

These principles have been carried into Australia's framework.

The Australian context

Most Australian states already had in place their own frameworks and curriculum documents prior to the development of the national framework. However, these differed as to the age range described and the language used within the documents. For example, in Tasmania and New South Wales, the provision was for children from birth to 5 years of age, whereas in Western Australia, Queensland, the Australian

Capital Territory and Northern Territory children aged 3 to 5 years were the focus, and Tasmania used a common language and common organisers across all children aged from birth to 16 years (VCAA, 2008). Therefore, with the introduction of the new framework, decisions regarding how each state or territory would engage with the new document were left up to the jurisdiction of that state or territory. For example, it is acceptable that the EYLF be used to supplement or complement existing frameworks, or that it completely replace current documents. In Victoria, the only Australian state not already having a framework in place, the EYLF was used as a foundation upon which the Victorian government developed the Victorian Early Years Learning and Development Framework ([VEYLDF] DEECD, 2009). While this document echoed the features of the EYLF, it broadened the scope to encompass the age range birth to 8 years, thereby incorporating the transition to school process and the Victorian Essential Learning Standards (up to Grade 2), the Preparatory (first year at school) to Year 10 curriculum for Victorian schools (VCAA, 2007).

The structure of the framework and implications for teaching and learning in early childhood settings

There are different layers in the framework, from the main concepts of Belonging, Being and Becoming to the Principles, Practices and Learning Outcomes and what these mean for young children's learning. Belonging, Being and Becoming are interwoven concepts or motifs that are strongly represented throughout the framework and act as a reflection of a child's life. Belonging relates to feeling part of the group, family or community, Being is about living in the 'now' and understanding how you are positioned, accepted and valued, and Becoming refers to change and how children grow, develop and adapt to new situations. The Principles, Practices and Learning Outcomes are considered as 'inter-related elements' and valued as 'fundamental to early childhood pedagogy and curriculum decision-making' (DEEWR, 2009, p. 9). Put simply, the *principles* relate to educators' beliefs about young children's learning and how best this learning can be supported. These, in turn, will inform educators' *practices* – 'the doing'. The *learning outcomes* connect with the skills, knowledge or dispositions that can be encouraged and supported in early childhood settings in collaboration with others.

The five **Principles,** informed by research and contemporary theories of teaching and learning, are designed to strengthen and support early childhood educators' practices, ensuring that their work with young children demonstrates:

- secure, respectful and reciprocal relationships
- partnerships with families
- high expectations and equity

- respect for diversity
- ongoing learning and reflective practice.

The **Practice** element of the framework recognises that early childhood educators' practices are informed by a wide range of strategies to support children's learning. The focus is on the teaching and learning context, the interactions and the assessment for learning, planning and reflection on practice. Recognising that there is interconnectedness in children's learning between their health, physical and mental wellbeing, children's individual capabilities are acknowledged and built upon, and relevant learning opportunities are offered in fitting and responsive ways. Purposeful teaching is incorporated and attention paid to the learning environment to ensure it has a welcoming atmosphere with which children can identify and in which they feel secure and supported. Indeed, practice is considered effective when the cultural and social contexts of children and their families' lives are valued, when transitions are planned for and continuity of learning is provided that has individual children's learning monitored, reflected upon and evaluated.

The **Learning Outcomes** are broad in scope to cater for the complexity of each child's learning journey. These are designed to assist early childhood educators in respect to planning for children's learning outcomes and represent the interrelatedness and complexity of children's learning. These learning outcomes are that children:

- have a strong sense of identity
- are connected with and contribute to their world
- have a strong sense of wellbeing
- are confident and involved learners
- are effective communicators.

Descriptors accompanying each learning outcome provide more guidance as to the knowledge, skills, dispositions or learning processes that will demonstrate attainment of the outcome. However, the learning outcomes, while providing the content and processes, do not clearly articulate how these can be identified and achieved (Krieg, 2011).

Valuing different views

The framework was developed with the intention of not only supporting good practice, which was already happening within the field, but also to create a space in which dialogue could take place in relation to early childhood pedagogy, curriculum and discourses (Sumsion et al., 2009). It was designed to be flexible so it could be interpreted in ways that were relevant to the culture or context of the setting and broad enough in scope to be respectful of the many theories and discourses held by those working