Chapter 4
Theoretical and Conceptual Insights – The Young Learner in Science

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Abstract In this chapter a brief discussion of the concepts outlined in the first section of the book are revisited and brought together to give new insights into concept formation for the very young learner: Critiquing the historical legacy of science education research in relation to a set of 'taken for granted' assumptions; foregrounding the everyday concepts that young children hold, rather than being seen as getting in the way of scientific learning; framing science learning as a dialectical relations between scientific concepts and everyday; and conceptualizing science knowledge as dynamic. In drawing together these four principles, this chapter theorises a new set of assumptions for shaping the development of a cultural-historical view of learning in science for young children.

Keywords Historical legacy • Dialectical relations • Science knowledge as dynamic

4.1 Introduction

In this first section of the book we have examined the theoretical foundations for learning science in early childhood. In particular, we looked at the empirical and theoretical literature in order to gain understandings about how others have conceptualized children's learning in science. Because we were interested in a cultural-historical framework for preschool children's conceptual thinking in science, we specifically examined this literature, noting that only a small pool of material was available to us. However, in extending our analysis through drawing upon the collected works of Vygotsky, we were able to give a new kind of reading for science learning.

4.2 Principles for Science Learning

In this section of the book we sought to move away from the traditional empirical studies that have generally argued that everyday concepts get in the way of scientific concepts, and have instead been guided by Vygotsky's (1987) work on the dialectical relations between everyday concepts and scientific concepts. Here we argued

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strongly that children need everyday experiences of science in order to name and work with new meanings of their environment – that is, everyday experiences and concepts do not get in the way, but rather provide the rich tapestry from which scientific understandings can form. We argued that through a consciousness of concepts, on the part of both the teacher and the children, new meanings of the environment could be made. That is, the children's environments do not change, but rather how they think about their environment does as a result of science teaching. From this perspective it can be argued that a new way of thinking about science learning in early childhood education is needed.

We also examined a different reading of preschool science education. We focused on imagination, creativity and emotions in science. When we use cultural-historical theory for framing our understanding of teaching and learning, where the dialectal relations between everyday concepts and scientific concepts are the focus of our attention, and imagination and creativity are considered alongside of how the learner feels, a whole new orientation to early childhood science education emerges. We noted this as being important for both re-theorising our conceptions of early childhood science education, but also we can now see that a new set of principles to guide our day-to-day work in preschool centre is needed.

As such, we present the following principles to inform a new conception of early childhood science education:

Principle 1: *We must recognize and scrutinise the historical legacy of science education research because this frames what we see and think, contributing to a set of 'taken for granted' assumptions that may no longer be helpful*

Principle 2: *A cultural-historical reading of science education means that we see everyday concepts of children as central and not as getting in the way of scientific learning*

Principle 3: *The dialectical relations of learning science means we must develop both scientific concepts and everyday concepts if conceptual development is to occur – this is different to conceptual change*

Principle 4: *Science knowledge is not static, therefore why would we assume one explanation of the material and natural world is the 'right' one.*

These four principles can be drawn together to theorise a new set of assumptions for shaping the development of a cultural-historical view of learning in science for young children (see Chap. 13). An overview of the key assumptions and theoretical drivers for informing a cultural-historical view of early childhood science education are shown in Table 4.1.

In this first section of the book we also studied how imagination, creativity and emotions shaped and was shaped by science education. In particular we put forward a wholeness perspective, where five characteristics featured:

1. *Collective investigations and narratives*
2. *Affective imagination*
3. *Being in and out of imaginary situations – flickering*
4. *Duality of emotions and thinking*
5. *Emotional filtering*

A wholeness approach to science teaching in preschools foregrounds these characteristics, suggesting that the child, the concept and the social and material world cannot be separated from each other. They each give meaning to science teaching, and collectively ensure they make learning meaningful for the young learner. In Table 4.2 we bring together these characteristics and argue that for young children preschool science needs to encompass affective imagination as a central dimension in teaching and learning.

The principles and concepts outlined in Tables 4.1 and 4.2 begin to capture the complexity of what matters in the teaching of science to very young children. In the next section we progress these key assumptions and theoretical drivers further. There we examine the empirical literature on early childhood science learning across a range of countries. We specifically explore these studies from the theoretical framework introduced in this first section. What we seek to do is find out how children learn science in play-based settings across cultures.

Table 4.1 Key assumptions and theoretical drivers for informing a cultural-historical view of early childhood science education

	Everyday concepts	Scientific concepts	The dialectical relations between everyday and scientific concepts
1. *The historical legacy of science education research:* Problematising the dualism between Children's Science and scientific concepts.	Everyday concepts are important in conceptual development, they do not get in the way of children's learning.	Scientific concepts are formed as a result of a child's 'extraordinary efforts' in his/her own thought processes and not through assimilation or memorization.	Conceptual development is immeasurably more complex and positive than the idea of cognitive conflict.
2. *The dialectical relations of learning science:* Everyday concepts can only be understood in relation to scientific concepts. Scientific concepts can only understood in relation to everyday concepts.	Everyday concepts build broadly and intuitively, capturing the dynamic flux, ebb and flow of a child's interactions with their material and social world.	Scientific concepts allow for a consciousness of everyday experience, giving meaning to everyday experiences, supporting the naming and explanation of lived reality.	Scientific concepts and everyday concepts are closely connected processes that influence each other. They are two types of concepts which in the actual course of development shift back and forth many times.
3. *A cultural-historical reading of science education:* Conceptual development is the relations between everyday and scientific concepts	Everyday concepts provide the foundational real world experiences that are needed for giving meaning to scientific concepts.	Scientific concepts allow a child to be able to think and act independently of the concrete situation.	Scientific concepts and everyday concepts develop in different ways.

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Table 4.1 (continued)

	Everyday concepts	Scientific concepts	The dialectical relations between everyday and scientific concepts
4. *Science knowledge is not static:* Everyday and scientific concepts are not static they change over time and across communities.	Everyday concepts form in relation to the specific cultural communities, shaping what a child experiences and pays attention to in their everyday life.	Scientific concepts are culturally developed; they grow from particular time periods and societal needs for explanation of everyday events. There is nothing inherent in the word of a concept that gives insights into its meaning. It must be learned through the particular cultural community from which the concept arises.	Neither everyday concepts nor scientific concepts are static. What children pay attention to in their everyday lives has changed since ontogenesis. Similarly, the meanings and explanations of scientific terms have also changed, marked as scientific periods within history, such as we see in Western science of Aristotelian science, Newtonian science and contemporary science (e.g., Einstein).

Table 4.2 Affective imagination in early childhood science education

Concept	Emotionality in scientific learning
Collective scientific investigations	*Children collectively* develop a consciousness of scientific and technological *concepts and emotionality* by working together with other children to solve the problem.
	A *scientific narrative forms* as children collectively work together to solve scientific and technological problems
	In a scientific narrative, children empathise and want to help the characters to solve the collective scientific and technological problem.
Emotional imagination	Through role play of scientific narratives and learning, the *children collectively* begin to anticipate the results of each others' actions in the play, begin to anticipate their own actions, including image-bearing dramatization, verbal descriptions, prop use and transformation, and importantly, the scientific solutions created through the support of the teacher.
Flickering	Children *flicker* between concrete and imaginary worlds.
	It is the border of the imaginary world and the concrete world that creates a dialectical relation and emotional tension that promotes scientific conceptual development.
Imagination, thinking and emotions in play	Children give new meanings to objects and actions to everyday situations when learning science – creating a new scientific sense of the situation.

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Table 4.2 (continued)

Concept	Emotionality in scientific learning
Dual role of emotions in thinking	Children feeling happy enacting or exploring a science narrative with others, but also feeling excited or curious by learning new things and solving scientific and technological problems in order to scientifically help the characters in the narrative.
Emotional anticipation	In scientific investigations, children's feeling state becomes connected with the learning as they anticipate *finding a solution*. Through consciously considering feeling states in science, emotions become intellectualized, generalized, and anticipatory, while cognitive processes acquire an affective dimension, performing a special role in meaning discrimination and meaning formation (e.g., gut feeling this is going to work).
Emotional filtering	*Emotional filtering* is "where kindergarten teachers attribute emotional significance to events" (Iakovela, 2003, p. 93).
	Teachers help children in knowing what is noteworthy to pay attention to in science learning. What should they notice or look for?

References

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