Chapter 11
The Nature of Scientific Educational Encounters

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Abstract In this chapter the nature of the educational encounter is presented. The educational encounter is conceptualized primarily as an interaction between an adult (e.g., a preschool teacher, acting as a more experienced peer) and a child. How the encounter plays out in a concrete sense is critical for understanding what opportunities children are given and what kind of support they receive during their learning of science. A cultural-historical perspective on learning and development shows that communicative support is fundamental to a child's development and this perspective is different from an exploratory-based notion of children's development where they develop by their own accord as they explore the world. While an exploratory view could explain some learning, it is insufficient to explain more abstract forms of knowledge such as typical scientific knowledge. The chapter also discusses how not all encounters between two (or more) people can be viewed as an educational encounter. The idea of a scientific encounter with distinctive features is introduced in this chapter.

Keywords Interactions • Mediation • Discovery learning • Sustained shared thinking • Deictic referencing • Intersubjectivity

11.1 Introduction

In this section of the book we will summarise and discuss several important features of the educational activities that we have analysed in previous chapters. The overarching theme for this chapter is the nature of the educational encounter, primarily between an adult (e.g., a preschool teacher, acting as a more experienced peer) and a child. We will argue that how this encounter plays out in a concrete sense is critical to what children are given the opportunity and support in developing. Taking a cultural-historical perspective on learning and development, communicative support is considered fundamental to a child's development (Mercer & Littleton, 2007). This is a rather different perspective than an exploratory-based notion of children's development, that is, the idea that children develop by their own accord as they explore the world. While an exploratory view

M. Fleer, N. Pramling, *A Cultural-Historical Study of Children Learning Science*,
Cultural Studies of Science Education 11, DOI 10.1007/978-94-017-9370-4_11

could explain some learning, it is insufficient to explain more abstract forms of knowledge such as typical scientific knowledge. In addition, it should be clear what we refer to as an 'educational encounter'. Following Pramling Samuelsson and Pramling's (2011) definition, not any encounter between two (or more) people is an educational one, but a scientific encounter has certain distinctive features. What features these are will shortly be explained and illustrated.

The features we will point out and discuss in this chapter are the following: the distinctive features of scientific 'educational encounters' (Pramling Samuelsson & Pramling, 2011), including 'sustained shared thinking' (Siraj-Blatchford, 2007); deictic referencing and the linguistic informing of experience; how to avoid the pitfalls of 'illusory intersubjectivity' (Ivarsson, 2003); the difference between exploratory (Piaget, 1970) and teacher mediated learning (Wells, 1999); how the variety in understanding among a group of children can be used as an asset and pedagogical principle in developing children's knowledge (Pramling, 1994, 1996); and the distinction and relational management of everyday and scientific concepts (Vygotsky, 1987).

We specifically introduce these general pedagogical concepts in order to discuss in the latter part of the chapter, discovery learning in science.

11.2 Educational Encounters

In a recent volume on children's learning in early childhood education settings (primarily Swedish and Norwegian preschools), Pramling Samuelsson and Pramling (2011) summarise the features of what they refer to as an 'educational encounter'. It is decisive to realize that what is here referred to as an 'education' is not the same as 'learning'. The latter concept is far more general, and obviously children and others learn a great deal without being enrolled or engaged in any activity that would be referred to as an education. Hence, when Pramling Samuelsson and Pramling write about educational encounters, they have certain institutional arrangements in mind. The defining features of such arrangements are an interest in and an ambition to build upon the children's perspectives, trying to establish and maintaining temporarily sufficient intersubjectivity (Rommetveit, 1974), through recontextualising and meta-communication establish an education from a series of events, teachers introducing and scaffolding children to appropriate 'the tools of the domain' (e.g., distinctions and categories), and coordinating the children's perspectives and the perspective of the domain. In connection to these educational features, we will now discuss early childhood science education.

11.2.1 Establishing Intersubjectivity or Sustained Shared Thinking

A popular concept coming out of the large-scale EPPE project in the UK (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2010), is 'sustained shared thinking'. Siraj-Blatchford (2007) explains this notion in the following terms:

> The EPPE Qualitative analysis revealed a general pattern of high cognitive outcomes associated with sustained adult-child verbal interaction along with a paucity of such interactions in those ECE settings achieving less. 'Sustained shared thinking' (Siraj-Blatchford et al., 2003) thus came to be defined as: '…an effective pedagogic interaction, where two or more individuals "work together" in an intellectual way to solve a problem, clarify a concept, evaluate activities, or extend a narrative'. (p. 17f.)

In relation to this concept, Siraj-Blatchford (2007) also makes a point about pedagogy and early childhood education that is highly relevant to our present discussion. She writes that: "As I have argued elsewhere (Siraj-Blatchford, 1999) any adequate definition of pedagogy for early childhood education must include the indirect scaffolding provided by adults in e.g., providing the stimulating learning environments for socio-dramatic play." While what she points out as a distinguishing mark of such a practice may be necessary, is it also sufficient? An 'education' as opposed to the more general concept of 'learning' in Pramling Samuelsson and Pramling's (2011) understanding also includes a more competent communicative partner who introduces and scaffolds the appropriation of some important cultural tools (e.g., categories, distinctions) and who also supports the child in recontextualising (van Oers, 1998) activities into a coherent whole; the latter is according to Mercer (2008) what constitutes an education from a number of events. Hence, it is worth keeping in mind when we speak about 'early childhood education' and when we speak of the more general notion of 'children's learning'. Since the discussion of the present chapter is on educational models (early childhood education), this is important to consider.

If we return to the concept of 'sustained shared thinking', a perhaps more familiar term for this phenomenon is 'intersubjectivity'. However, the latter term has been understood in many different ways in different traditions of thinking. Importantly, scholars building on the work of the later Wittgenstein have emphasized that intersubjectivity does not mean that two or more interlocutors have identical concepts. Rather, intersubjectivity is a temporarily shared focus of attention making it possible for interlocutors to go on with a shared activity (Rommetveit, 1974), as distinct from pursuing diverse and parallel one another, lines of inquiry. An illustration of the latter can be found in a study by Ivarsson (2003) on computer-assisted learning. Investigating the notion of 'recursion', children and their teacher were able to interact around a computer program using deictic references such as pointing and using words such as 'there', 'that', etc. However, while these references signified conceptual distinctions for the teacher, there was no indication in the children coming to such an understanding. Rather, they manipulated buttons without a 'deeper' conceptual understanding. Ivarsson (ibid.) labels the activity as illustrating 'illusory intersubjectivity', that is, children and teacher in one sense refer to the same objects but conceptually these are distinct matters for the communicative partners. Another illustration of the difficulty of establishing 'temporarily sufficient intersubjectivity' (Rommetveit, 1974) can be found in Säljö, Riesbeck, and Wyndhamn's (2001) study of group work on elementary geometry (the triangle as a geometric object and how to calculate its area) in Swedish primary school. One of the points made by their analysis is that

the children and their teachers were not coordinated in their communication. Significantly, the children used the Swedish word 'trekant' (literally: 'three-angle') while their teachers used the geometrical term 'triangel' ('triangle'). This may seem like synonymous terms. However, these illustrate the important difference between what Vygotsky (1987) referred to as 'everyday concepts' and 'scientific concepts'. While 'three-angle' is functional for the children in solving the task of cutting out this shape from a paper, it does not relate systematically to other concepts, like the geometrical concept 'triangle' does, allowing them to calculate its area. Hence, the lesson goes on, but the intersubjectivity is, in Ivarsson's terms, 'illusory'. Säljö and colleagues reason that what they have analysed in their study (group work) is a common form of organising learning in classrooms. They further suggest that this form of education which is sometimes referred to as 'pupil active' or 'pupil steered' is very much a heritage from Piagetian theory. According to this perspective, the child's understanding will be a result of his or her independent manipulation and observation of the world (ibid.). However, as they conclude on the basis of their empirical study:

> From a Piagetian perspective, we could say that an intended accommodation does not appear. The pupil does not change his/her mental structure so that new information can be attached. The pupil does not understand the world in a new way. To see and to do are no guarantee for understanding. […] The teachers are notably insensitive to this fact and only reluctantly take part in the pupils' conversations. In the passages we have registered, the teachers have difficulties to achieve and sustain a mutual perspective with the pupils on problems. (p. 236, our translation)

In contrast to such a perspective on children's learning, Säljö et al. (2001) clarify how their findings can be interpreted from a sociocultural (cultural-historical) perspective:

> From Vygotskian points of view, we could instead say that the pupil appropriates new knowledge first through reworking and working through different interpretations of the practical work. Cooperation in the form of a 'negotiation' with the teacher or another peer […] paves the way for new insights. This requires coordination or in other words a shared perspective and an adequate language with which to speak about what the physical material shall illustrate. A clear discourse must be established. (p. 236f., our translation)

Säljö et al. (2001) draw a number of conclusions. First, that so-called pupil-active or pupil-lead activities, while in some sense may be necessary, are not sufficient in order to develop the children's understanding. Second, in order to make use of the practical work and concrete observations the lessons revolve around, at least two additional features are necessary: (a) the coordination of perspectives (between the teacher and the pupils), so that they can agree in what way and in what terms to speak about the object of inquiry and (b) the teacher introducing and scaffolding the pupils in using a certain language (a discourse, in this particular case, a geometrical discourse). Even when the activity is guided by practical manipulation of concrete objects, the participation of the teacher far beyond providing sufficient material is necessary in order to support children developing the more abstract forms of knowledge Vygotsky (1987) refers to as 'scientific concepts'. Obviously this last point is inherently intertwined with curricula. If the intent is for the children to 'get a feel for',

in this case, geometrical shapes, then the conclusions here drawn from a Vygotskian perspective would not be relevant. However, in the present case, the Swedish curriculum prescribes an intention with the children's knowledge development of a 'scientific' (in the Vygotskian sense) kind. The role, if any (cf. Siraj-Blatchford, 2007), of a teacher in early childhood education is contingent upon the framing provided and promoted by guiding documents such as a curriculum.

11.2.2 Mediated Learning

While the concept of 'scaffolding' was not used by Vygotsky himself, it has been a frequently employed concept within cultural-historical theory since it was introduced in a seminal paper by Wood, Bruner, and Ross in 1976. In their study, Wood et al. (1976) analysed adult-child conversation and interaction when engaged in carrying out a problem-solving task. Through their analysis, they were able to show how adult and child changed the division of labour in solving the task, that is, who did what and how this changed during the course of the activity. That a 'more experienced peer' (Rogoff, 1990, 2003) provide some support, structuring resources (Lave & Wenger, 1991), or in Wood et al.'s terms, scaffolding, and that this support changes as the child come to take over increasingly more responsibility for the different steps of the problem-solving activity are important to understand children's learning in interaction and communication with others.

In the course of theorizing, the concept of scaffolding has been critically scrutinized. In a review of this critique, Stone (1998) summarizes the most important critique as revolving around the following issues: that this model of interaction may be culturally specific, that it emphasizes the micro-level of analysis rather than macro-level issues of child development, focuses adult-child interaction rather than child-child interaction, that this kind of interaction may not be frequent in children's lives, and that discussions about scaffolding has been less specific about the mechanisms. However, it could be argued that the focus the concept of scaffolding places on the micro-level of analysis is necessary for understanding how children are assisted in learning, and that how this interaction plays out in a concrete sense is a legitimate interest for research on learning and development. Whether or not focus is on adult-child interaction rather than child-child interaction is a matter of what kind of situations are studied, rather than a feature of the concept as such. In fact, as Stone also points out, there is also research on child-child interaction in this vein. In principle, any more experienced peer could scaffold another child's development. As for the argument that scaffolding may not be frequent in children's lives, this cannot be seen as a critique of the usefulness and value of the concept for studying certain educational activities. Finally, the argument that researchers have not always been specific about the mechanisms of scaffolding, this may be the case but it is not true of the original conception as reported in Wood et al.'s (1976) study, where they do clarify in detail what this assistance consists of in the activity they follow. In fact, clarifying what scaffolding means in a more concrete sense in various activities is

of considerable interest to research on children's learning and development. Like any concept in science, the value of scaffolding needs to be decided on the basis of what one intends to say something about. If wanting to investigate more specifically what the changing division of labour between, for example, a teacher and a child consist, then this concept may indeed be useful, as it has been in many studies.

However, over time, the term 'scaffolding' has spread to discussions about education in, for example, policy documents, which are not theoretically grounded and elaborated. This has perhaps made the concept somewhat vague. However, the same argument could be made concerning other theoretical terms such as 'mediation' that is often used simply as 'teacher mediation' rather than the more theoretically crucial notion of 'semiotic mediation' (Vygotsky, 1987; Wells, 2007; Wertsch, 2007) and has been positioned in the general literature as being integral to understanding a Vygotskian perspective. And, of course, the very term 'learning' which is conceptualized in a particular way within cultural-historical theory – as the appropriation of cultural tools and practices (Rogoff, 1995; Tomasello, 1999; Wertsch, 1998) – is used in many different ways for various purposes. "Given its attractiveness," Mercer (1995) writes,

> it is not surprising that the term 'scaffolding' is now commonly used in educational research and by teachers discussing their own practice. However, I have some reservations about its being casually incorporated into the professional jargon of education, and applied loosely to various kinds of support teachers provide. The essence of the concept of scaffolding as used by Bruner is the sensitive, supportive intervention of a teacher in the progress of a learner who is actively involved in some specific task, but who is not quite able to manage the task alone. Any other kinds of help provided by teachers are better described as 'help'. (p. 74)

Mercer further writes that the reasons for him questioning the usefulness of 'scaffolding' for conceptualizing school practices are, for example, teacher-child ratios as fundamentally different from the dyadic relationships originally referred to by the concept. He argues that "A theory of the guided construction of knowledge in schools cannot be built upon comparisons with teaching and learning in other settings. To be useful, the concept of 'scaffolding' must be reinterpreted to fit the classroom" (ibid., p. 74). "Education", he argues, "is not about the physical manipulation of objects" (p. 74). Rather, "A great deal of it is learning how to use language – to represent ideas, to interpret experiences, to formulate problems and to solve them" (p. 74f.). Connecting to this discussion, in a later account, Wells (1999) suggests, that "one of the chief functions of the use of language in the classroom is to induct students into modes of discourse that provide them with frames of reference with which to 'recontextualize' their experience, and that it is this task that gives educational scaffolding its particular character" (p. 127; cf. Mercer, 2000).

In a study similar to Nilholm and Säljö's (1996) study of Swedish mother-child dyadic problem solving (cf. also Wertsch, 1979), Sun and Rao (2012) compared the scaffolding of Chinese mothers and teachers, respectively, in dyadic problem-solving activities with kindergarten children (approximately 5 years old). In their study, Nilholm and Säjö studied problem-solving dyads with mothers and their 6-year-old child. The problem was to tie a knot (a clove hitch) using a schematic

picture as a resource. The mothers differed in terms of education and profession (industrial workers, nurses and teachers). Briefly, Nilholm and Säljö found many similarities between the groups but one difference was that "the teacher mothers were more inclined to involve the child as a performer and to organize the cooperation in such a way that the child had to engage in the semiotic activity of relating the picture to the tying of the rope" (p. 325). The researchers explain this difference in terms of the participant mothers' definition of the task and what it means to learn in such a situation. Sun and Rao studied how an adult and child solved four different tasks: supermarket (buying a combination of fruit with a certain amount of money, do a jigsaw puzzle, an arithmetic task, and a map problem). The interactions between the adult and the child were videotaped and analysed in terms of how the activity developed. It was found that "teachers gave higher-level cognitive support and emotional feedback than did mothers" (p. 246). The mothers differed in that those "with more education provided more optimal scaffolding than those with less education" (ibid.). The teachers did not tend to adjust their scaffolding to the two groups of children, that is, those children with more respectively less educated mothers. Both teachers as well as the mothers adjusted how they scaffolded the child's problem solving in response to the characteristics of the task. One important finding of the study was that "professional training in early childhood education is important for equipping adults with effective scaffolding skills" (p. 260). More specifically, "teachers showed a higher level of scaffolding manners, less negative feedback, and transferred more responsibility to children than mothers" (ibid.). Another important finding of these studies is that they show in a rather concrete sense how children are given different developmental opportunities due to the varying participation of adults in joint activities. Scaffold a child to solve a problem does not merely refer to making sure the problem is solved in the present situation. Rather, the concept entails that the child will successfully take more active part in carrying out this form of problem solving, and similar ones, in subsequent situations. Hence, the premise is that through participating in activities where another regulates one's activities, the child will come to develop self-regulative capacities (see Wertsch, 1979, for an elaboration on this Vygotskian idea).

As we have already mentioned, the concept of scaffolding has received some critique, for example, by scholars such as Mercer (1995) arguing that the concept originally referred to a situation of one-to-one interaction (Wood et al., 1976) and that it therefore is perhaps not useful for understanding learning in classrooms where one teacher rarely interacts with one child at a time for a sustained time. While this is certainly true, the basic idea of the metaphor of scaffolding as changing division of labour between interlocutors points at an important feature of learning in many situations, including learning in educational settings. The concept of scaffolding as used in this theoretical tradition does not simply mean 'support' of any kind, but a gradual change in division of labour between participants. It thus, among other things, serves to highlight the important contributions made by others, such as a teacher, to the child's learning, which is important to understand learning in educational institutions such as preschool and school. It is important to remember that 'scaffolding' is a metaphor. Like all metaphors it mediates our perception and

cognition, that is, it 'informs' and directs our attention. It is useful since it provides a means of conceptualizing the important role of a more experienced peer, such as an early years teacher, in the child's development. Since phenomena such as 'learning' and 'understanding' are not directly available to inspection, we need metaphors to talk about these. However, it is an important theoretical discussion to keep alive, what metaphors to use when studying and conceptualizing children's learning and development. We also discuss this point in Chap. 9.

11.2.3 Using Children's Different Understanding as a Resource and Pedagogical Principle

In any group of children there will be a variation in ways of understanding a phenomenon or a theme that is being investigated and talked about. In a series of studies, Ingrid Pramling (1990, 1994, 1996) has shown how this basic empirical fact can be used as a pedagogical principle in developing children's understanding. One example is the making of children's song sheets in order to remember which songs to sing at an upcoming cultural event, the celebration of Lucia (13th December each year). Lucia is the bringer of light in a dark time of the year and she is celebrated through a so-called Lucia-procession where children with electric or live candles in their hair walk into a dark room singing traditional songs for the occasion, usually before the invited parents. This is a common cultural practice in Swedish preschools and schools. While children making song sheets for this event may seem an odd example within the framework of the present book, what concern us here are mainly two things. First that the children are given the task of representing an event on paper (an issue we study in detail in Chapter 10). Second, this way of working, as we will now describe, illustrates how the variety among a group of children's understanding can be used as an educational principle and asset in furthering their development.

The reason for the teacher encouraging the children to represent the song repertoire on paper is that the children can have difficulties remembering what songs to sing and in which order. As described by Pramling Samuelsson and Asplund Carlsson (2003), the teacher first gives the children the task of dividing their paper (through drawing) into twelve frames. The reason for this number is simply that the children will be singing 12 songs on the upcoming occasion. As a consequence of this task, the children get to solve a mathematical problem. However, the teacher's main objective is to allow the children to reflect on writing (graphical representation). The children and teacher then sing the first song together. Having done so, the children are encouraged to write and/or draw a symbol for the first song in the first frame. The teacher asks them to think about what the song is about and how it can be drawn or written in a way that they can remember what song it is. In order to remember in what order to sing the songs, the teacher also suggests the children to think about how they can know in what order the songs come. In response to this

question, the children variously use numbers and letters. This sequence is then repeated with the other songs they are going to sing. Even if the resulting song sheets are unique for each child, this difference is made explicit and discussed among the children and teacher, that is, the children's solution to the problems of remembering what songs to sing and in what order, are made into a topic of discussion. The purpose of this activity is to make the children aware of the fact that problems can be solved in different ways and not everyone does the same. To learn that not everyone understands the same way as oneself does is a very important lesson in life. In addition, to discuss to what extent a representation is intelligible also to another child could be the next step in their development, thus introducing the insight that in order to serve as an external memory (Middleton & Edwards, 1990; Säljö, 2005) also for someone else, either some kind of depiction or conventional sign would perhaps be necessary. In Chapter 10 of this book, we could observe how the relationship between idiosyncratic representations and more conventional ones came up for negotiation in the talk between children and their teacher.

11.2.4 Discovering by Oneself or Mediated Through Communication

If we return to the discussion referred to above to Säljö et al. (2001) study between different concepts of learning, what they referred to as a Piagetian notion based on exploration and discovery and a Vygotskian notion based on mediated activity, we can further emphasise and illustrate this important difference in how to account for children's development. The Piagetian notion of development has been very influential for how educational experiences are organized in many parts of the world. In a description of the manifestation of this view, Säljö writes (on school, but basically the same argument could have been made about early childhood education settings such as preschool):

> When entering a classroom today in many European countries, but also in many other places around the world, the chances are great that you will enter an environment that is heavily inspired by Piagetian notions of teaching (see e.g., Bergqvist, 1990, for an insight into Swedish teaching and Edwards & Mercer, 1987, for British conditions). Curricula and similar official documents formulated in the 60s, 70s, 80s and 90s in many countries are also influenced by Piagetian ideas about cognitive development. The discourse – the metaphorics – here established is about how children should be allowed to be 'active', 'discover things on their own', 'work laboratively' and 'be guided by their own curiosity', they were to 'understand' and not merely 'learn by rote'. Adult intervention in children's activities and traditional teaching were seen as disturbing elements that counteract children's 'spontaneous' activities and 'independent' development. Verbal instructions – as traditional teaching was presumed to premise – were put against what was described as 'concrete' and 'self-guided activity' where the child on his or her own 'explored' the world. (Säljö, 2000, p. 58, our translation)

In an important text, written at the end of his career, Piaget himself made clear how the participation of a teacher was not seen as facilitating the child's development, rather the opposite. In the text, "Piaget's Theory", published in 1970, he wrote that "each time one prematurely teaches a child something he could have discovered for himself, that child is kept from inventing it and consequently from understanding it completely" (Piaget, 1970, p. 715). Commenting on this quote, Säljö (2000, p. 58f.) writes that this "can be seen as something of the first premise of 'child-centered' pedagogy – the child should guide his or her own development" (our translation).

While the child can certainly discover many features of his or her surrounding world through physical manipulation and observation, as suggested by Piaget, many other forms of knowledge cannot really be acquired in this way. To give an example from science education; the child can discover that objects dropped tend to fall to the ground, although some objects instead rise to the skies. However, it is difficult to see how the child through these acts of manipulation and observation could arrive at *the scientific explanation of why* this happens in one or the other way. The latter is a discursive form of knowledge that is not really there to be seen, discovered, by the child him- or herself. Rather mediation, that is, the linguistic informing of the child's experiences by a more competent partner (Pramling Samuelsson & Pramling, 2011) seems necessary for the development of this latter kind of knowledge. This claim is not specific for young children's learning, even if that is our concern in the present book. In fact this very difference and the importance of such discursive mediation can be illustrated by an empirical study of science class with older children:

Säljö and Bergqvist (1997) studied science education in the form of a physics laboratory with secondary school students (aged 13–14). The purpose of the activities followed was for the students to "acquire, by means of what is referred to as concrete experimentation, models of understanding the properties and behavior of light" (p. 393). During the laboration, the students are working on a so-called optical bench (consisting of a bench with a light source, an object such as a pen or a prism, and a screen). The following is one snippet of the ensuing conversation among some of the students and their teacher:

Anita:	It's no fun Anders [the teacher]. Nothing's happening! Nothing's happening here. Either we're stupid or it's…
ANDERS:	What are you doing then?
Eva:	Nothing.
Inga:	Nothing.
ANDERS:	I see. You're doing nothing. Well, then nothing will happen.
Eva:	Oh yes! We're doing lots of things. Yes, indeed, we're doing lots of things but still nothing's happening.
Inga:	We're finding masses of these things to do and…
Eva:	We do not know what it's for! (Säljö & Bergqvist, 1997, p. 395f.)

It is not clear to the students, even though they conduct the laboration right, what they are expected to see and why this is relevant. As Säljö and Bergqvist extensively argue, what the students are expected to see is not really there to be seen. The laboration is

only illustrative if seen in terms of certain institutional concepts of physics that the teacher sees through but the students do not. For example, that there is a shadow on the screen behind a pen does not for the students become an instance of some properties of light (that it cannot go through such solid objects). Being able to see the laboration as illustrative of the properties of light requires certain sociocultural experiences that are typically appropriated through participation in schooling. However, if the students are expected to discover these by themselves, they are not supported properly in becoming members of that scientific knowledge. In other terms, the discrepancy between the expectation and the outcome as evident in the students' response makes clear the important difference between what in the language of theory of science would be referred to as 'induction' and what in cultural-historical theory is referred to as 'mediated action'. In a similar vein, Fleer (2009) has shown how without teacher and children being coordinated in perspectives – sharing semiotic mediation – they will engage in parallel, disjoint activities.

11.3 Children's Interest and How to Nurture It

One purpose of introducing children to elementary science may be to make children interested in or, if they already are so, build upon their interest in nature and how its processes may be understood. In the pedagogical literature there has been a long-lasting interest in what kinds of questions teachers pose to children (e.g., Cazden, 2001; Siraj-Blatchford & Manni, 2008; Wells, 1999; Wood, 1998). However, whether children themselves raise questions, and if so, what kinds of questions, and how these questions are responded to, have not been given the same attention. A recent study has investigated precisely these matters in the context of early childhood science education. In an empirical study of children's questions, Thulin (2010) analysed data from a sustained theme work on 'soil' in a Swedish preschool. A group of 12 children and their 3 teachers were followed with a video camera. Investigating the entire transcript of these learning events taking place over a 2-month period, she asked: (1) What do the children ask questions about? and (2) Can any developmental trend be discerned in the children's questions during the course of the theme? Hence, the first research question concerns what is thematised in the questions the children ask and the second research question concerns whether children's questions change over time. Summarising the findings in relation to the first research question, Thulin reports that the children's questions can be categorized under three headings: Questions about the content/the topic (soil, what it is, processes of decomposition etc.), Questions about the tools (e.g., magnifying glass), and Questions outside the theme (e.g., asking where an absent child is). The two first categories also have several sub-heading that we will not discuss here. In addition to categorizing the children's questions, Thulin (2010) also makes a simple quantification of these. Of the in total 206 questions asked by the children during the theme, the number of questions within each category is: 173 (Questions about the content/topic), 22 (Questions about the tools), and 11 (Questions outside the theme). One conclusion from this is that the

children do ask questions and that these thus warrant analysis in, and consideration to, their science learning. A second conclusion is that the children are obviously greatly interested in the topic, the theme, since the great majority of their questions are directed towards finding something out within this. A question for education is of course how this interest in these young children could be nurtured and cultivated throughout their education.

Analysing the quantitative data on the questions posed by the children, two other important and interesting findings are reported. First, the number of questions asked by the children increases throughout the duration of the theme. On the first occasion, the children ask merely six questions. On each of the two final occasions, the children ask 48 questions. Hence, the children ask far more questions at the end than at the beginning of the theme work. This may be somewhat contrary to common sense, assuming that the less one knows the more questions one may ask. However, this result indicates the opposite. That is, in order to be able to ask (relevant) questions, the children need to gain some experience of a domain before they can ask questions to learn more. Second, not only the number of questions asked by the children changes but also the kinds of questions they ask. As already mentioned, the most common kind of question was questions about the content/the topic. However, this is also the kind of question that increases during the course of the theme. On the first occasion, four questions have this focus, while on the last occasion all 48 questions asked by the children are of this kind. Hence, not only are the children focused on, interested in finding out about, the topic, they also become more so the more experiences they gain of this topic. While the findings to the two research questions are certainly encouraging to educators, and stand in rather sharp contrast to frequently expressed fears of children not being interested in science learning in their later schooling, there is a third issue that should be considered: How do the teachers respond to the children's questions? This issue was not analysed within the framework of Thulin's study. However, in her work she hints at the teacher often responding to the children's questions by posing a new question or simply repeating the child's questions. This may be due to the teachers nurturing an ideal for early education as supposed to be guided by children exploring and themselves finding out things, or it may be due to the teachers, as generalists, not being knowledgeable enough in this particular domain to answer the children's questions. For research, studying systematically how teachers do respond to children's questions is pressing. As we have argued in this book how children's experiences are responded to by, for example, a teacher is decisive for what developmental challenges, opportunities, and support they encounter.

As was shown in this chapter, an encounter is an educational encounter under specific conditions. Similarly, a scientific encounter needs a context, as was shown in Chap. 2, which supports children to notice and use the science that is afforded through their social and material environment. Only then, is the encounter scientific.

References

Bergqvist, K. (1990). *Doing schoolwork: Task premises and joint activity in the comprehensive classroom* (Linköping studies in arts and science, 55). Linköping, Sweden: Linköping University.

Cazden, C. B. (2001). *Classroom discourse: The language of teaching and learning*. Portsmouth, NH: Heinemann.

Edwards, D., & Mercer, N. (1987). *Common knowledge: The development of understanding in the classroom*. London: Methuen.

Fleer, M. (2009). Supporting scientific conceptual consciousness or learning in 'a roundabout way' in play-based contexts. *International Journal of Science Education, 31*(8), 1069–1089.

Ivarsson, J. (2003). Kids in Zen: Computer-supported learning environments and illusory intersubjectivity. *Education, Communication & Information, 3*(3), 383–402.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Mercer, N. (1995). *The guided construction of knowledge: Talk amongst teachers and learners*. Clevedon, UK: Multilingual Matters.

Mercer, N. (2000). *Words and minds: How we use language to think together*. London: Routledge.

Mercer, N. (2008). Talk and the development of reasoning and understanding. *Human Development, 51*(1), 90–100.

Mercer, N., & Littleton, K. (2007). *Dialogue and the development of children's thinking: A sociocultural approach*. London: Routledge.

Middleton, D., & Edwards, D. (Eds.). (1990). *Collective remembering*. London: Sage.

Nilholm, C., & Säljö, R. (1996). Co-action, situated definitions and sociocultural experience: An empirical study of problem-solving in mother-child interaction. *Learning and Instruction, 6*(4), 325–344.

Piaget, J. (1970). Piaget's theory. In P. H. Mussen (Ed.), *Carmichael's manual of child psychology* (3rd ed., Vol. 1, pp. 703–732). New York: Wiley.

Pramling, I. (1990). *Learning to learn: A study of Swedish preschool children*. New York: Springer.

Pramling, I. (1994). *Kunnandets grunder: Prövning av en fenomenografisk ansats till att utveckla barns sätt att uppfatta sin omvärld* [The foundations of knowing: Outlining a phenomenographic approach for developing children's ways of understanding their world] (Göteborg studies in educational sciences, 94). Göteborg, Sweden: Acta Universitatis Gothoburgensis.

Pramling, I. (1996). Understanding and empowering the child as a learner. In D. R. Olson & N. Torrance (Eds.), *The handbook of education and human development: New models of learning, teaching and schooling* (pp. 565–592). Cambridge, MA: Blackwell.

Pramling Samuelsson, I., & Asplund Carlsson, M. (2003). *Det lekande lärande barnet i en utvecklingspedagogisk teori* [The playing-learning child in a developmental pedagogy theory]. Stockholm: Liber.

Pramling Samuelsson, I., & Pramling, N. (2011). Didactics in early childhood education: Reflections on the volume. In N. Pramling & I. Pramling Samuelsson (Eds.), *Educational encounters: Nordic studies in early childhood didactics* (pp. 243–256). Dordrecht, The Netherlands: Springer.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.

Rogoff, B. (1995). Observing sociocultural activity on three planes: Participatory appropriation, guided participation and apprenticeship. In J. V. Wertsch, P. Del Rio, & A. Alvarez (Eds.), *Sociocultural studies of mind* (pp. 139–164). Cambridge, MA: Cambridge University Press.

Rogoff, B. (2003). *The cultural nature of human development*. Oxford, UK: Oxford University Press.

Rommetveit, R. (1974). *On message structure: A framework for the study of language and communication*. London: Wiley.

Säljö, R. (2000). *Lärande i praktiken: Ett sociokulturellt perspektiv* [Learning in practice: A sociocultural perspective]. Stockholm: Prisma.

Säljö, R. (2005). *Lärande och kulturella redskap: Om lärprocesser och det kollektiva minnet* [Learning and cultural tools: On processes of learning and collective memory]. Stockholm: Norstedts.

Säljö, R., & Bergqvist, K. (1997). Seeing the light: Discourse and practice in the optics lab. In L. B. Resnick, R. Säljö, C. Pontecorvo, & B. Burge (Eds.), *Discourse, tools, and reasoning: Essays on situated cognition* (pp. 385–405). Berlin, Germany: Springer.

Säljö, R., Riesbeck, E., & Wyndhamn, J. (2001). Samtal, samarbete och samsyn: En studie av koordination av perspektiv i klassrumskommunikation [Conversation, collaboration and intersubjectivity: A study of coordination of perspectives in classroom communication]. In O. Dysthe (Ed.), *Dialog, samspel og læring* [Dialogue, interaction and learning] (pp. 219–240). Oslo, Norway: Abstrakt.

Siraj-Blatchford, I. (1999). Early childhood pedagogy: Practices, principles and research. In P. Mortimer (Ed.), *Understanding pedagogy and its impact on learning* (pp. 20–45). London: Paul Chapman.

Siraj-Blatchford, I. (2007). Creativity, communication and collaboration: The identification of pedagogic progression in sustained shared thinking. *Asia-Pacific Journal of Research in Early Childhood Education, 1*(2), 3–23.

Siraj-Blatchford, I., & Manni, L. (2008). 'Would you like to tidy up now?' An analysis of adult questioning in the English Foundation Stage. *Early Years, 28*(1), 5–22.

Stone, C. A. (1998). The metaphor of scaffolding: Its utility for the field of learning disabilities. *Journal of Learning Disabilities, 31*(4), 344–364.

Sun, J., & Rao, N. (2012). Scaffolding preschool children's problem solving: A comparison between Chinese mothers and teachers across multiple tasks. *Journal of Early Childhood Research, 10*(3), 246–266.

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (Eds.). (2010). *Early childhood matters: Evidence from the effective pre-school and primary education project*. London: Routledge.

Thulin, S. (2010). Barns frågor under en naturvetenskaplig aktivitet i förskolan [Children's questions during a science activity in preschool]. *Nordisk Barnehageforskning, 3*(1), 27–40.

Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.

van Oers, B. (1998). From context to contextualizing. *Learning and Instruction, 8*(6), 473–488.

Vygotsky, L. S. (1987). *The collected works of L. S. Vygotsky, Volume 1: Problems of general psychology, including the volume* Thinking and Speech (R. W. Rieber & A. S. Carton, Eds., N. Minick, Trans.). New York: Plenum.

Wells, G. (1999). *Dialogic inquiry: Towards a sociocultural practice and theory of education*. New York: Cambridge University Press.

Wells, G. (2007). Semiotic mediation, dialogue and the construction of knowledge. *Human Development, 50*(5), 244–274.

Wertsch, J. V. (1979). From social interaction to higher psychological processes: A clarification and application of Vygotsky's theory. *Human Development, 22*, 1–22.

Wertsch, J. V. (1998). *Mind as action*. New York: Oxford University Press.

Wertsch, J. V. (2007). Mediation. In H. Daniels, M. Cole, & J. V. Wertsch (Eds.), *The Cambridge companion to Vygotsky* (pp. 178–192). New York: Cambridge University Press.

Wood, D. (1998). *How children think and learn* (2nd ed.). Oxford, UK: Blackwell.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100.