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Objectives
At the end of this section, you will be able to:
- recognise a range of teaching approaches
- demonstrate the need to scaffold a child’s explorations and how this can be achieved
- be able to use effective questioning for focusing and enhancing children’s learning
- be able to describe ways that educators can enhance learning through targeted exploration
- recognise the skills, processes and knowledges that can be acquired by very young children.
Overview
This chapter links theory with practice by discussing the range of teaching approaches that can be used with young children to enhance their learning. It discusses the interactivity of the approach the educator uses with the child and the settings. Whether it is through the processes of science, such as the development of observation, or through the skilful questioning of the educator, the approach used should enhance children’s learning.

From theory to practice
Considering the range of learning theories presented in the earlier chapters of this book, how does a practitioner make sense of the multitude of theoretical perspectives available and translate these into a practice that aids children’s learning? One way is to consider the strong messages coming from all theories: children construct their own understanding, learning is enhanced through social interaction and the practitioner is pivotal to children’s learning.

Considering the teaching approaches
Working with the belief that children construct their own knowledge, we need to consider what else the constructivist theory is alerting us to with regard to children’s learning. One idea is that children build their learning on their previous experiences and, for an educator to enhance learning, a knowledge of what these previous experiences and understandings are is required to make the appropriate links for children. In addition, children’s pre-conceptions or naïve beliefs can form useful prior knowledge upon which an educator can build. However, in some cases children’s alternative conceptions can prove difficult to shift and may hinder their learning.

The most important factor influencing learning is what the learner already knows.Ascertain this and teach the child accordingly (Ausubel, 1968).
There are several ways in which an educator can elicit prior understandings:
- Through questioning – using student-centred questions such as ‘what do you think?’ Alternatively, listening to students’ questions can provide the educator with an idea of what the children already know.
- Using children’s drawings – children will often draw what they understand and by asking children to describe their artwork, their prior understandings can become clearer.
- Interview about instances – educators make use of stimulus material to ask children specific questions about a scientific idea or understanding.
- Concept puppets – using a puppet as the mediator, the educator can ask students for their ideas and understandings.
Effective questioning as part of the scaffolding practice

There are many recognised ways to provide support for a child undertaking his or her own investigation. Effective questioning, asking the right question at the right time, is a skill that is not all that well developed in many educators. It takes practice to ask an open-ended question that requires the child to think along a particular path. Using questions effectively can draw a child's attention to a particular focus, or open up his or her mind to other possibilities. Simplistically, the question stems, who, why, how, if, where, what if, what do you think, linked to a science idea, can provide the stimulus for conversations, further investigations or deeper thinking. Questions that promote hypothetical, tentative and exploratory student talk are productive, open-ended and usually centered on the child in some way (Department of Education & Training, 2003).

There are many ways to use effective questions in early years’ settings:

- As a stimulus for an exploration – this is particularly strong if the question was generated by the child.
- Using a question to stimulate a prediction before children undertake an activity or exploration. 'What do you think will happen?'
- Finding out what the child knows. 'Why do you think the bubble floated?'
- To promote reasoning. 'Why does the snail have those long stalks on its head?'
- Productive questions encourage children's investigation and discussion:
  - Attention-focusing questions: 'Have you noticed ... ?'
  - Measuring and counting questions: 'How many ... ?'; 'How long ... ?'
  - Comparison questions: 'How are these different or the same?'
  - Action questions: 'What happens when ... ?'
  - Problem-posing questions: 'How can you make ... ?'; 'Can you find a way to ... ?'
- Person-centred questions focus on the children's ideas, and hence tend to reveal a child's alternative conceptions and why these are held. 'What do you think ... ?' 'What can you see ... ?' are typical starting stems.
- Questions can be used to promote thinking and action. Such questions might focus on finding out children's ideas (prior knowledge) or be used to develop their ideas:
  - Questions that focus on identifying a child's prior knowledge are person-centred and specific: 'How do you think the sound of the siren travels from over there to your ear?'
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- Questions designed to develop ideas encourage children to think of ways they could test their ideas: 'If you think that the piece of wood is too large to float, how could you test that to see if it is true?'

- Questions can also be used to develop processing skills and such questions can be categorised as:
  - Observing: 'What do you see ... ?'
  - Hypothesising: 'Why do you think that happened?'
  - Predicting: 'What do you think will happen if ... ?'
  - Investigating: 'What would you want to do to find out?'
  - Interpreting and drawing conclusions: 'What did you find out?'
  - Communicating: 'How can you show this to others so they can understand?'
    'What else will you need to use (materials)?'

(adapted from Department of Education & Training, Victoria, 2003)

Interview about instances
This is a simple technique (White & Gunstone, 1992) that relies on an educator presenting a picture or artefact to a child and asking a number of focused questions to draw out the child's understanding. It is a non-threatening way to determine quite specific information about a child's conceptual understanding of a particular science theme or phenomenon.

To encourage answers that relate to the concepts being probed, an educator should:

- Begin with a focus question that requires application of the concept to be investigated, without forcing the child into an explicit definition. This indirect approach is usually quite productive because it allows the child to discuss her or his understanding. It can also help the instructor to gain an idea of how the child might apply the implicit concept.

- Not force the child into a specific response to each artefact. If the child does not have an understanding of the concept that allows her or him to talk about a specific instance, do not force the child to choose. This lack of understanding is an important piece of the child's 'conceptual framework'.

- Allow 'wait time' of at least 3 to 5 seconds before trying to interpret the question or ask another.

Variations
- Prediction interviews – these require children to predict a possible outcome of a situation. This type of interview indicates whether a child can apply his or her own meaning to the situation.
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- Sorting interviews – children are presented with pictures and asked to sort them according to a particular instruction. As the child sorts, he or she is asked to talk about what they are doing.

- Problem-solving interviews – similar to the sorting interview, the child is presented with a problem and with the physical means to solve the problem. The child is asked to think aloud while attempting to solve the problem. Understanding the child’s conceptual framework remains the overarching goal in conducting the interview.

This technique is used when using children’s drawings to highlight their prior knowledge and understandings. Either as the child is producing the drawing or artwork, or after the product is finished, the educator asks the child to describe what is happening in the artwork and may focus specifically on one aspect of it.

Photograph 4.1: A simple piece of artwork can illustrate a child’s attempt to understand shape, form and/or colour.

Observing children’s prior knowledge in science using concept puppets
One way of observing children’s prior understandings in science is to use puppetry to question them about certain aspects of life and living in our world. Children love
playing with puppets. Recent research (www.millgatehouse.co.uk) over the past few years has shown just how useful puppets can be in gaining information of children’s science understandings. Puppets can be used to:

- Ask the children questions, thereby gauging their understanding or naïve concepts in science.
- Help children plan an investigation – the puppet becomes the ‘learned other’.
- Answer some questions – it is less intimidating than adults.
- Ask the teacher for some ideas on how to decide what to do.

‘The Puppets Project’ (www.puppetsproject.com) in its research found that nearly all of the children (4–8-year-olds) were highly engaged and motivated when puppets were used. They listened, became involved in the discussion and engaged in conversation. Many children who did not normally speak became more willing to share their ideas. Children give full explanations of their understandings so that the puppet would understand better. Children’s science talk involved reasoning and children talked readily about scientific problems. Higher-order thinking (such as explanation and justification) was promoted and improved. This allowed educators to observe and document a range of science skills that may be difficult to see in other science explorations.

Naylor et al. (2007) reported that ‘The puppets appear to be effective in providing an interactive narrative which sets a context for learning and provides a purpose for children’s talk and follow-up activity. It is notable that the increase in argument and talk involving reasoning is in relation to explicitly scientific problems, rather than in relation to the socio-scientific issues which are frequently used by researchers to promote argument in science lessons’ (p. 296). Their research found that educators using puppets were more likely to ask questions involving reasoning rather than just ‘recall’ questions. In addition, as puppets are a normal part of a pre-school setting, the use of puppets required few extra resources and little disruption to normal practices. Very little additional preparation time was required to set up a discussion around a science topic of interest to the children. According to Naylor et al. (2007) ‘[puppets] therefore appear to offer a valuable extension to the teaching/learning strategies typically used ... in science and a potentially valuable mechanism for facilitating change in professional practice’ (p. 296).

Like any resource, puppets should not be over-used. However, research and the educator’s own experience would indicate that children react positively to puppets and apart from their other uses at pre-school for imaginative play, can be used to expand and enhance children’s understandings in many areas of science, as well as provide an educator with many opportunities to document science learning.
Practical example – using puppets for science

Think about a character when you are using a puppet:
- It should suit your personality and teaching style.
- Introduce your puppet to the children.
- Show a range of emotions and have a life outside the 'lesson' (avoid stereotyping).
- The puppet should make eye contact with individual children as it speaks to them.
- Avoid having the puppet make lengthy speeches.

Discuss with children some ground rules (not too many) so that everyone has the opportunity to talk. Remember that most of us can at times have overlapping conversations. The idea is that all children feel that their ideas are equally valuable; all children who want to share ideas can do so. When ready, your puppet can be used as a stimulus for talk. For example, have your puppet present a science problem to the children. Some examples of how to do this are:
- being muddled and asking the children for ideas
- presenting a range of ideas children have been overheard discussing
- disagreeing with the educator’s ideas
- using puppets to help children solve a problem.

Approaches to teaching

In helping children to construct their own knowledge, the teacher may facilitate a child’s science experience through a range of approaches such as: process skills approach, guided discovery learning, inquiry learning, interactive, problem-based learning and project approach.

A process skills approach

A process skills approach indicates that the teacher will help the child develop science skills. In essence, while building science knowledge, we also want children to develop the skills and processes to be able to confidently undertake their own investigations. Examples of some of these skills include:
- Communicating – children realise the importance of communicating and learn to communicate their explorations to their peers and other interested adults.
- Developing science language – as children explore, the educator introduces scientific language to slowly replace everyday science language.
• Asking questions - children begin to develop the skill of asking focused questions that allow them to proceed further with their own explorations.

• Making sense of phenomena - using peer support or a knowledgeable adult, children discuss and make sense of what they are observing.

• Predicting - based on prior experiences, children attempt to make a prediction about what they think is likely to happen.

• Modelling - children are able to represent their understanding by constructing a model (such as a drawing).

• Conducting investigations - children are able to conduct their own simple investigations. This will require teacher scaffolding and some structure but even young children have been shown to be able to distinguish between observations and inferences, of asking investigable questions, planning experiments and arguing from evidence given sufficient support.

• Planning - young children are capable of planning a science experience and can move through a set of logical steps.

• Testing - children will test things to check their beliefs or predictions. For example, many children believe that a paperclip will float, because it is small, and they will then test it to find out what happens.

• Observing - this is an extremely important skill that educators can enhance in young children. Close and accurate observation is crucial in following through with an investigation.

• Reasoning - children may have trouble recognising evidence or proof and will need significant scaffolding to help them reason.

• Drawing conclusions - again, children will need help from the educator to understand the process of coming to a conclusion after completing their own investigation.

In assisting children to learn the skills of science, the educator is emphasising the nature of science and how scientists work. However, this is only one small part of learning in science and should always be complemented with other approaches.

**The guided discovery approach and scaffolded learning**

Originally, the discovery approach was adopted by pre-school centres (and primary schools) as the most natural way for a child to investigate things of interest. Children attempt to make sense of their world through their own play explorations and if a constructivist approach to learning is accepted, children build their own understandings from their own experiences. However, children are limited in how far the discovery can aid understanding. Interaction with peers and adults provide additional stimulus to extend understanding further. Eshach (2006) commented that “… assuming children are able to understand complex concepts and are able, to some extent,
to connect theory and evidence, educators should, in our view, expose children to situations in which those abilities may find fertile ground to grow’ (p. 17). Being a co-investigator with the child or asking effective questions that encourage further explorations provides children with the opportunity to extend their own investigations while they experience the science of their own world.

In undertaking their own investigation, or even through everyday play, children are often exposed to science experiences. This is termed ‘incidental science’ or part of an emergent curriculum (this is a curriculum arising from children’s own investigations – Dockett and Fleer, 2002, p. 199). Without further scaffolding at the point and time of interest, the opportunity to enhance the child’s learning may be missed. For this reason, it is crucial that early childhood educators have a basic understanding of science in the world. Teachers who are attuned may recognise the science in spontaneous events and can make use of these to develop deeper understandings in children. In light of the literature on emergent curriculum in which teachers need to respond to the child’s questions and learning needs ‘on the spot’, it is evident that some early childhood educators would not be prepared if their own background knowledge of science is insufficient (Campbell & Jobling, 2009). Dockett and Fleer (2002) described the role of adults as ‘one of focussed observation and responding to the play that occurs in ways that extend and enhance learning’ (p. 198).

**Interactive approach and inquiry learning**

The interactive approach to learning recognises that children have legitimate questions of their own to which they would like to find answers. In an interactive approach, the children’s question(s) lead the explorations and the teacher’s role is to provide resources and guide/scaffold the explorations. The teacher supports the development of the children’s ideas, asks focused questions, suggests alternative ways of thinking and helps develop children’s responses. The extent of support offered by the teacher is dependent upon the complexity of the investigation, the age of the children and the available resources, which may include teacher knowledge. An interactive approach relies strongly on the ability of the educator to be flexible, to be able to help children with knowledge or where to locate it and to be able to take a ‘helper’ position with regard to children’s learning.

An inquiry approach is the most current approach to learning science and relates to children undertaking investigations to answer their own questions. It is said to follow a number of phases: engagement, exploration, explanation, elaboration and evaluation.

With very young children, the engagement phase arises from the children’s own interest in a particular item or phenomenon. For scaffolded learning, the teacher can use this engagement phase to determine the child’s prior understandings. The exploration phase is one that comes most naturally to children; however, as early childhood educators and teachers, we can also introduce children to other explorations (or
teacher-instigated experiences) through providing additional materials and further scaffolding of the exploration. Through the guided exploration, encouraging children to ask their own questions, focusing their observations or asking specific questions, early childhood educators can help children develop their own scientifically enhanced explanations. Through providing other activities, children can be extended to transfer their new knowledge to different contexts (elaboration). Finally, again through scaffolding, children can be encouraged to share their understandings with others and present their learning through discussion, role play, drawings or other communication mechanisms. While these may seem to be higher-order processes, we should never underestimate the capabilities of young children. With appropriate help, young children are quite capable of following through on an inquiry approach, particularly in the 5–8-year age group.

**Problem-based learning**

In problem-based learning, the educator provides a problem to children, usually in small groups, and gives them time to try to solve it. It is a child-centred approach. With young children, the educator works with the children to help find out facts, generate ideas and assist the learning. Children may challenge each others’ ideas and the educator helps to resolve issues. The process continues as new information is added to existing facts and more thinking occurs. Solving the problem is not the most important aspect: the learning process through child-directed inquiry is. Effective problems are those that engage children’s interest and motivate them to probe for deeper understanding of science concepts. Educators take a small role during problem-based learning – they stimulate learning by asking effective questions and offering support. With more practice, children become more able to direct their own learning and identify what they need to find out to solve their problem. There are usually five steps in a problem-based approach:

- The problem is presented to the group by the educator, who may use stimulus pictures to help children remember what to focus on.
- Children talk about what they already know.
- Children brainstorm their ideas and identify the broad problem.
- Children identify what else they need to learn in order to prove or disprove their ideas.
- Children share their findings with others.

Educators can generate ideas for problem-based learning from such a wide range of resources: stories, television, children’s games, news articles. Problem-based learning can enrich children’s normal learning experiences by providing them with challenge and stimulation not normally available in their learning setting. The problem-based
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learning situation should align with the educator’s desired learning outcomes or with the theme existing in the centre.

**Targeted exploration**

Children explore the world around them at all times, trying to make sense of their own experiences. When we are aware of children’s interest in a particular science area, it might be the time for a targeted exploration. We need to be aware of what children can achieve by themselves, and what might be realistic in terms of broadening their range of experiences and opportunities. A topic might be introduced in response to a child’s question or through a related story or event. For example, when there is any major environmental disaster captured in the national news, children want to know more. The teacher may be able to set up a tornado in a plastic bottle to show the movement of tornadoes, or show how clouds are formed in bottles. Simple activities or demonstrations in which children can participate can provide additional experiences from which they build their understandings.

I have mentioned that children need scaffolding to be able to shift them from their initial naïve beliefs to more scientifically appropriate ideas. Asking questions is one way to focus children’s observations and open up their eyes and minds to further possibilities. For example, a child may be watching a snail move and comment on how slow it is – a simple, focused observation would be to ask the child to see whether the snail moves faster over other surfaces. Another example occurs when a child comments on how soap bubbles move through the air; the teacher can ask whether the bubbles have different shapes.

**Children talking**

Recent research has indicated the power and value of children’s talk with adults and peers (Eshach, 2006; Sfard, 2000). It is during these discussions or share-time that a child may tend to adjust her or his thinking, or the talk process may help the child clarify his or her own ideas. The discussions reveal to a child that often there can be more than one idea or answer. It lets children know that it is alright to have a different response. In shared talking, children contribute to the discussion and extend their own thinking when challenged with alternative ideas. However, when engaging children in talk, an adult needs to allow time for children to ‘gather’ their thoughts and then to try to put them into words that the adult can understand. Sometimes a child has never had to order their thoughts in such a way as to make them understandable to others. Patience is needed.

Group discussions add another dimension. Not every child will feel comfortable contributing in a group situation, but it can be the opportunity to introduce new vocabulary to the children and draw out the more timid children by having them repeat the new words. This will provide them with a successful interchange and make the next discussion less fearful. The quantity and quality of adult–child shared
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talking supports children’s learning and appears to be directly related to improved cognitive outcomes for children. As indicated by Koralek & Colker (2003), talking with children about what they were doing, not only ‘involved the children in a conversation, but also offered them the relevant vocabulary and modelled ways of thinking about and talking about their experiences’ (p. 6).

Child-instigated versus teacher-instigated activities

There is a general belief that children’s explorations should be child-instigated. As indicated previously, however, a vast number of explorations would not be attempted if everything was left to the child. In particular, some children (just as with some adults) work within their level of comfort and rarely challenge themselves. The natural breadth of young children’s experience is limited, and exposure to new things is always of interest to the enquiring minds of children. So why would an effective early childhood educator wish to restrict the child’s experiences by not introducing activities that would normally be outside the child’s scope?

Children exploring

From the first moment they enter the world, children start to explore. You can see it when a child learns to move a hand or arm deliberately. Each movement is practised over and over, and each time there is wonder in the child’s eyes at the discovery he or she has made. Dropping items onto the floor from a height is an investigation that produces several observations – the object often leaves the sight of the child, a sound follows the dropping, the object can re-appear. Slightly older children discover that they can ‘hide’ and re-appear, thereby establishing a constancy about the people and the objects in the immediate environment.

When children explore, they are usually following their own interests or that of one of their peer group. They use their senses, usually all of them (sight, sound, touch, taste and hearing), to work out what it is they have encountered. Their curiosity encourages investigation to solve problems or to make connections between what is known and what is unknown. Through their explorations, children play with objects, materials and ideas to extend or develop new understandings.

As the child explores, she or he asks questions for further exploration or to seek ideas from others (peer group or adult). The early childhood educator assists this through their scaffolding and through providing additional resources and experiences. As the early childhood educator observes the child’s explorations, the use of shared conversations and focused questions can provide a direction or alternative direction for the child’s enquiry.

One thing is certain, children need sustained periods of time for their explorations and their investigations. They need to be able to think about what they have seen or experienced. They need time to try it all again and to solve the problems that arise. Opportunities need to be provided for them to involve others in their explorations or
to work alone, with minimal interference. Scaffolding should never be deemed to be interference if undertaken professionally with consideration for the child’s cognitive development.

**Conclusion**

This chapter discussed the teaching approaches used to guide the early childhood educator in how to approach children’s learning in science. It presented practical strategies for helping children to learn in science: scaffolding, effective questioning, child/teacher-instigated science explorations. Finally, it referred to the underlying beliefs that are at the heart of children’s learning: that children construct knowledge from their own experiences, that educators are able to scaffold that learning and that social situations enhance learning opportunities.
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References


