Deakin Research Online

This is the published version:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30046810

Reproduced with the kind permission of the copyright owner.

Copyright: 2012, Cambridge University Press
Objectives
At the end of this chapter, you will be able to:

- describe and document children’s learning in science with reference to the EYLF
- describe ways children’s explorations can demonstrate and enhance their understanding
- describe different strategies for observing, monitoring and documenting science understanding.
Science in Early Childhood

Overview
Early childhood educators are required to determine what children know and understand. Evidence may be based on how children explore and interact within their environment, or specific competency tests. Data relating to science is usually obtained through a process of observation, anecdotal note taking, journal entries, checklists and folios of each child’s work. At times the determination of science knowledge, understanding and children’s development may be easier said than done. Consequently, this chapter outlines steps associated with the development of learning in science. These steps are outlined in the EYLF (DEEWR, 2009a), with an indication of some associated strategies that are appropriate for each developmental level. These guidelines provide a comprehensive framework to determine children’s learning as well as enhancing the teacher’s planning for future learning.

Children’s learning
The EYLF (DEEWR, 2009a) advocates that children learn through play and that play based learning is ‘a context for learning through which children organise and make sense of their social worlds, as they engage actively with people, objects and representations’ (p. 3). Within play based learning, the role of the educator is crucial for developing a child’s understanding of the world around them and the science within it.

The EYLF proposes that educators can enhance children’s learning by:
• adopting holistic approaches
• being responsive to children’s questions
• planning and implementing learning through play
• intentional teaching
• creating environments that have a positive impact on learning
• valuing the social and cultural contexts of children and families
• providing continuity of experiences and enabling success
• assessing and monitoring children’s learning.
(adapted from the EYLF, DEEWR, 2009a, p. 14)

In the previous chapter, Beverley Jane discussed how an educator can plan for learning through play, both intentional and focused play. In particular, she indicated a number of questions educators should ask themselves as part of the planning process. These questions focused on children’s prior knowledge, motivation, what children wanted or needed to learn and what was the best approach to take. She also presented evidence about particular teaching approaches that could be used, depending on the educator’s purpose. Her comments related to the use of both incidental learning through play to intentional learning, through to children’s curriculum-based explorations.
Background research on children’s learning
With the introduction of the EYLF, the focus in early childhood centres has shifted from incidental learning through play to delivering a planned curriculum with play as the vehicle to achieve this. This intentional, discipline-based teaching can change the pedagogical focus of early childhood educators. In the past, early childhood educators have used exploratory play, including incidental learning, as the means for enhancing children’s learning. However, within the current contemporary framework, educators will need to re-think what constitutes a ‘learning experience’ and also reflect on practices they can implement to support the new approach. Goodfellow (2009) indicated that ‘the goal is to enrich children’s learning experiences through purposeful actions by educators in collaboration with children and families’ (p. 2). Providing an attractive and interesting environment is not sufficient to stimulate deep learning and sustained engagement (DEEWR 2009b). Furthermore, Arthur (2010) supported the idea of strong guidance by the educator when she stated that ‘intentional teaching reflects a socio-cultural approach to learning which emphasises the value of an experienced learner building a scaffold so that the child moves to higher levels of understanding’ (p. 10). However, some early childhood educators are not comfortable with the philosophy or practice of ‘guided learning’, teacher-led practices or intentionally planning for discipline-based learning outcomes to occur through children’s autonomous actions during play (Campbell & Jobling, 2009; Edwards & Loveridge, 2011). According to the EYLF, ‘Curriculum decision making is informed by the context, setting and cultural diversity of the families and the community’ (DEEWR, 2009a). The quality of the child’s experience is enhanced when early childhood educators know about the concepts and look for opportunities during play to foster understanding in children (Cullen, 2007). Siraj-Blatchford (2004) also commented that ‘Effective pedagogy is both “teaching” and the provision of instructive learning and play environments and routines’ (p. 6).

Educators employ a range of verbal scaffolding strategies that aim to effectively help children to extend their knowledge, understanding and skills (Dockett and Fleer, 2002). They include: direct guidance, explanation, cues and questions, demonstration and modelling, goal and problem identification, planning, keeping on track and evaluating actions.

Children learning science in early childhood centres
Earlier chapters (Chapter 2, Chapter 6) have discussed how children learn science and the importance of science in children’s lives. It is equally important that an educator plans for science experiences (see Chapter 10) and is able to monitor children’s understanding and progress. Monitoring of children’s learning can occur through a
process of observation, anecdotal note taking, journal entries, checklists, collections of children's work and, occasionally, specific competency tests.

Chittendon and Jones (1998) stated:

Interest in science assessments brings the opportunity to explore methods that require a central role for early childhood science teachers... For teachers, recognizing the science in children's development as authors and writers, in part because of the teachers' own limitations of content knowledge. In addition, the boundaries of the child's development as a 'scientist' are less clear. Children's ways of figuring out how the world works are not constrained by science lessons but cut across the curriculum areas. (p. 1)

These points argue for greater involvement of teachers in the documentation and analysis of children's science learning, both for professional development and for the design of appropriate assessments.

**Observing children’s learning in science**

As indicated previously in this and earlier chapters, it is now accepted that children learn through the construction of meaning, usually through social situations. Therefore, as we observe children in play, we need to consider all factors as contributing to the learning. For example, as we watch children playing with small animals from the garden, we need to be aware of their interactions with each other, as well as their interactions with the animals and the way they behave individually. As educators, we would be watching what they do, but also listening to what they say to each other. We might be aware of the need to come into the discussion with a focusing question or some other form of scaffolding to assist their learning. The observation of a child learning needs to take all these factors into consideration. As indicated by Fleer and Robbins (2004), these observations are:

- vibrant, reflective and complex. The focus shifts from what the individual in isolation can or cannot do, to the dynamic interplay of pairs or groups of children, or children and adults, noting the scaffolding, supporting, extending, leading and following ... Without this, we may run the risk of not only missing vital aspects that are helpful in understanding how both individuals and groups of children are learning and developing, but we might possibly ‘get it wrong’ in our interpretations … (p. 25)

The EYLF places emphasis on holistic learning, taking into account children's identity, wellbeing, confidence as learners, communication skills and connectedness to their world (DEEWR, 2009a). Effective observation will therefore lead to effective planning and further support of a child's individual learning pathway. The educator needs to form sensitive and attached relationships with the child to ensure that observation is carried out on multi-sensory levels. This is particularly relevant for young children. Gandini and Golhaber (2001) observed that the educator's role is 'to construct a shared understanding of children's ways of interacting with the environment, of
Chapter 11 Observing, assessing and documenting learning

entering into relationships with other adults and other children and of constructing their knowledge' (p. 125).

Observation is one of the primary means of collecting information or evidence of a child’s learning. But for an educator, busy with 20 or more children, how can this observation remain in their minds? How can the recording of this learning consider all factors and be kept for future reference? This is the single most difficult aspect of monitoring children's learning. There are a number of possibilities of recording. The educator could, at that time and instant, write up comprehensive anecdotal notes of what has happened to indicate learning. The educator could take a digital image of the learning and later in the day, write notes to accompany the image, using the image to stimulate recall. Finally, the educator could write up brief key words for use as memory stimulants of the learning incident for further elaboration at a later time.

CASE STUDY 11.1

An educator (let's call her Rebecca) in a small rural pre-school came up with a recording strategy that worked for her. With 20 lively 4-5-year-old children, she was aware that her time for recording was limited. Rebecca developed a simple grid of squares (4 x 5) on one A4 sheet of paper. In each grid, she inserted a child's name. She copied enough single grid sheets for each week of the term and placed them in an open binder on her desk. When she observed learning she would record it in brief points in that child's grid and in the others' if it was shared learning. At the end of each week, during her planning time, she wrote out more comprehensive notes around each of the learning incidents and placed these in the child's portfolio. Sometimes, she took photographs as well. At the end of each week, she was aware of which children had demonstrated learning that she had been able to 'capture' and those children she had missed. Rebecca then made a concerted effort to observe the other children in the following week and to determine whether she needed to spend more time with them, scaffolding their learning.

Observation of learning is related to finding out what children do know and what they can do. It is not about what they cannot do. So in observing children, an educator should be focusing on a child's strengths and taking in the entire learning incident. The recording should include what children do and say, as well as the interactions between children. It should also include the context in terms of the tools or artefacts the children are using at the time and how they are using them. As part of the documentation process, the educator might involve parents to gain some background to the child's prior understandings. Recording parents' comments, as well as the educator's comments, can provide a more comprehensive account of a child's learning. The documentation needs to be in-time and accurate, as indicated in the discussion below.
Documentation of science learning

Anecdotal note taking is a term used in a range of contexts but essentially means the notes that educators record about a specific instance of a child’s learning. To be of value, the notes should be recorded as soon as possible after the observation and should contain a number of specific elements. These were noted previously, but include the context of the learning, what the child says or does and with what, and how other children interact and any interaction with the educator. Anecdotal notes are subjective, based largely on observations but also on how well the educator knows the child. It is for this reason that other documentation or evidence is collected. This could be in the form of photographs, children’s work or children’s words (recorded).

Photograph 11.1: Learning about the body – a child’s drawing at 42 months of age

In the above artwork, the child depicts her awareness of body parts – the hair, eyes, pupils, mouth, head, arms and legs. She also is starting to form letters and recognise her name.

Six months later, the child has already advanced in her depiction of body parts, indicating an increased awareness of her whole body. She now draws the trunk, belly button (umbilicus), fingers and feet in addition to what was included previously. By collecting this artwork at the time, educators were able to see the changing understandings of this child. This linked with the EYLF ‘Children are confident and involved learners, who create and use representation to organise, record and communicate (mathematical) ideas and concepts’ (DEEWR, 2009a, p. 27).
Chapter 11 Observing, assessing and documenting learning

One current strategy for observing and documenting a child’s learning and progress is through the use of a learning story (Arthur et al., 2005). Learning stories were first described by Podmore & Carr (1999) as a narrative or storied approach to assessment that describes a child’s learning process, and is a way of documenting that learning. Goodsir and Rowell (2010) indicated that the elements of a good learning story include the child’s interests and achievements; strengths, knowledge and feelings; interactions with peers and adults; and the influence of family, heritage, culture and community. A learning story generally starts with the child’s initiative or with how she or he has responded to a learning opportunity offered. The educator takes a photograph of what is happening and adds comment after discussion with the child. The learning story can take place all at one time (see <http://earlylearningstories.info> – Rosie’s drip) or can cover a longer period as a child comes back to further explore an activity or task. More photographs can be added as well as a narrative of descriptive details. Towards the end, the educator analyses the learning through a ‘what does it mean?’ approach, describing why these events are significant. From here the educator would add a page indicating what adults can do to assist this learning further. Often, parents are given a page as well where they can add any significant historical, cultural or contextual elements or perspectives.

Example of a learning story

Daniella was playing quietly in the corner of the garden on a path. We noticed a small group of children were starting to form around her, so we went to investigate. We found that they were watching Daniella drip water onto the path. We photographed the incident. As Daniella
dripped water, using a small cup and bucket, she was watching which way it went. 'See,' she said to the others, 'it always goes that way.'

One of the others wanted to try, so Daniella handed over her water. 'I can do it too;' he exclaimed proudly, before handing the water back to Daniella. Daniella wanted to know why the water always went the same way. Rather than respond to the question, I asked her whether she had tried other parts of the path. She had not, but was eager to investigate. She moved further along the path, about two metres. This time when she dripped the water, it did not go in quite the same direction, it seemed to go more sideways. This fascinated her and she proceeded to try other parts of the path, still with a small group following her and watching what happened. Several more photographs were taken. After a while, she appeared to give up. I went up to Daniella and asked her why she had stopped. She smiled at me and said, 'I know what happens. The water is always going downhill.' With that she wandered off to try other adventures in the garden.

What does this mean?
Daniella was able to undertake an investigation of her own interest. With scaffolding, she persisted with her investigation. She was prepared to share her knowledge with others and was generous in allowing another child to try things for himself. After multiple observations, Daniella was able to come up with a scientific reason to her observations. She demonstrated good problem-solving skills as well as persistence and motivation.

Further learning
As Daniella has demonstrated an ability to persist in her own investigations, we will ensure that we provide her with other challenges of a similar nature and help her achieve some success as she learns to solve problems and can draw conclusions from evidence.

Using portfolios as documentation of learning
A portfolio is a collection of children's work that highlights their learning. It contains work samples, records of forms of systematic observation, anecdotal notes, photographs (annotated), learning stories, video snippets, checklists, journal entries and parents' contributions. A child's portfolio can be digital, with an electronic file, however, due to the philosophy that the portfolio is for the child and parent as well, most pre-schools provide portfolios in hard copy and in accessible places so they can be easily retrieved. In particular, children's learning can be enhanced if the child has the opportunity to extract a piece of work or a learning story and offer further elaborations. Children delight in sharing their portfolios with each other and illustrating their learning to others.

A portfolio must have an explicit purpose to guide the decisions about what to include as part of the portfolio. As such, a portfolio should contain a statement indicating its purpose. The portfolio should make sense of children's work and learning artefacts, and how this work relates to the broader context of the child's progressive learning. Material in the portfolio should be ordered chronologically and by category (discipline area) as well as category of development.
An example of a portfolio entry

David, aged 4, drew two caterpillars on the same sheet of paper (Photograph 11.3). One drawing had the segments of the body and multiple legs. The other caterpillar showed hairs on the body and different dots. Both drawings indicated that there was a head end (the direction the caterpillar was moving). In terms of science understandings, the educator could determine that David had observed the animals closely and had noted differences between them. David had noticed that one had a clearly defined segmented body and both had multiple legs. They were different colours. David could determine that there was a head end to each caterpillar and his drawings depicted that the legs started after the defined head.

Photograph 11.3

Another example for a portfolio might be a systematic observation of a child at play outside. Systematic observations should be objective, stating only what is actually seen or heard and should not include the educator’s opinion. They should be unobtrusive, in that the educator does not enter into the play or learning scenario. Finally, systematic observation should be carefully recorded to include all details. For example, an educator may set up a discovery table with a range of rocks from different origins and with different features, and then may sit at a distance recording how children interact with the display. This systematic recorded observation can then provide the educator with information about the content of intentional teaching relating to rocks.

Another form of systematic assessment includes an individual or group interview. Often in science explorations, this involves the educator setting up some materials related to specific science understandings. As the children investigate the materials, the educator records what the children are doing and asks questions, recording the children’s responses for later analysis.
Analysing children’s understanding in science

While observation and documentation are important, it is the analysis undertaken by the educator that adds meaning to the observation. What learning is the child demonstrating? For accurate measurement of a child’s learning, the educator her/himself needs to have a good understanding of science. This is problematic as many educators have come through schooling with little emphasis or interest in science in general (Campbell & Jobling, 2009). However, with a focus on the very basics of science, an educator can quickly learn the important concepts relevant to a young child’s understanding. There are a number of ways to consider children’s learning. If we consider the individual child, we can discuss learning in terms of skills, content and attitudes.

When it comes to the demonstration of skills, educators need to consider what are the appropriate skills that young children are able to demonstrate. These include: observation, reasoning, describing, measuring, investigating, testing fairly, categorising, communicating and problem solving. (Many of these were more fully described in Chapter 4.)

In any given observation of children’s learning, particularly in outside settings, educators need to look for the science so that the science learning is not missed due to a concentration on, for example, social learning. When children jump in a puddle, they are investigating what will happen. They are undertaking science. When children pile blocks higher and higher, they are investigating what will happen. Often they will repeat the investigation again and again, just to make sure that their information is correct. They have just learnt to undertake multiple experiments to confirm findings. They have demonstrated persistence, engagement and motivation.

For content knowledge, educators can focus on general broad statements of knowledge, such as ‘Jenna understands about the living things in her environment’, or at the level of specific information, such as ‘Jenna knows that snails have shells and that these shells have distinct patterns’. Of these two statements, the second is much clearer about what Jenna knows and allows the educator to build on Jenna’s understanding in the future. In science, these statements of specific information are called ‘concepts’. For science, there are many such statements or concepts that help educators articulate a child’s understanding at a quite defined level. Examples of these include:

- Sight, hearing, touch, taste and smell are very important senses we use to interpret our world.
- Objects float if the upthrust force from the water can balance their weight.
- Our ears are used to detect and hear sound.
- Light travels in straight lines.

Children’s attitudes or dispositions to science should also be recorded.
Chapter 11 Observing, assessing and documenting learning

Example of intentional teaching in science and the science assessment

Lesson topic – Plants

Concept – Plants are living organisms that require water and energy to grow and develop

Prior knowledge of 3.5 to 4.5 year old children:

Child 1: ‘The plants are alive just like me and you, all of us. And one day is gonna be the day that we die. Just like the old trees at my house did.’

Child 2: ‘They’re living because they need water and energy and breathe and move a little bit.’

Child 3: ‘They need the sun but need a rest from it and a big drink otherwise they can die.’

Child 4: ‘Yeah well the plants can’t run with us in the sun, but they are alive. They don’t move, ya know. Only if the wind is strong.’
Child 5: 'Because they always drink water and get wet in the rain. That's the same for a tree and for the kids playing.'

From what the children are saying, we can make some judgements about what the children already know. Child 1 has developed a definition for 'alive' and can provide examples of 'dead' things. Child 2 can expand the definition by incorporating some of the characteristics of living things: water, energy, respiration, movement. Child 3 indicates that the sun provides something for the plant but can extend that thought to the consequences of too much sun and not enough water. Child 4 picks up on the inconsistency with the characteristics of living things – that plants are living things even though they cannot move freely. Child 5 cannot add a great deal in terms of content but is using his reasoning skills in determining that some features of living things are common for plants and children.

The children already know quite a lot about what makes a plant a living thing. Children are then given the opportunity to explore the diversity of living things in the outside environment. They are supplied with a digital camera and the teacher follows them to guide the children's learning and confirm the characteristics of living and non-living things. She also discusses categorising and differentiating between living things such as plants and animals.

**Learning that children acquired**

The children were able to learn about science concepts as they explored their own environment. They scaffolded each other's learning and at times deeply discussed whether or not certain things were living, or whether to photograph certain things or not. This generally happened when the children were observing things such as wood chips and cut flowers. Photo subjects that the children captured included:

- a wide variety of trees, bushes, flowers and plants
- other caregivers
- children from the other group
- sticks, bark chips, dirt and mulch
- a bird.

Child 1: 'Of course Catherine (kindergarten teacher) and the children are living things (laughs out loud).'

Child 2: 'I know that this tree is alive but I don't know why it can't move from one place to another if it is a living thing. All other living things like people and animals can move from walking or crawling and sliding and stuff like that. The tree never changes spot.'

Child 3: 'This is the best one of living things because it has many in one picture. There's a bird, tree, grass and people at the bottom.'

Child 4: 'We don't need a photo of the bark and soft fall because it doesn't need water or sun anymore. When it was with the tree it needed that but now it's dead.'

**Science learning demonstrated**

The children confirmed their previous understandings of living things. Again, one child could not resolve the issue of the lack of movement of the tree when he was convinced that it
Chapter 11 Observing, assessing and documenting learning

was a characteristic of other living things. Perhaps this was a time when the educator could have stepped in with a few focusing questions so that the child would have realised that there is movement in plants, but it occurs in one spot. Child 3 recognised the diversity of living things while Child 4 was able to identify non-living things in the environment.

Children require time and multiple opportunities to grasp a single topic or theory. They need to make sense of the world through practice and experience. Taking photographs enabled them to raise questions and to make decisions around living things. To further this activity, the children could display their photographs for others to see, or the photographs could be annotated and included in their portfolios. The educator could facilitate the key concepts that a plant is a living organism by writing the text from the discussion. When displayed in a room the children are able to look at it throughout the day and are subconsciously encouraged to think about the science of plants.

Acknowledgement: Meagan Beer, early childhood educator

Conclusion

Children play, explore, make friends and have fun, and the entire time they are learning. The role of the educator is to monitor that learning, to make sense of children’s investigations and to plan for extended opportunities for further learning. This chapter discussed how the educator can monitor the learning, using a range of strategies for recording the developing understandings of children in science. It mentioned that the educator can use child-instigated learning experiences or can set up teacher-led explorations. However, it also noted the concern that to assess science learning, the educator must be able to recognise the science in everyday situations. The examples that were provided demonstrated the multiple opportunities educators have for science learning in the pre-school setting.

References


Science in Early Childhood


