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Chapter 12

Professional learning - reflective practice in science education

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Objectives

The aim of this chapter is to:

- provide understanding regarding the value of reflective practice
- provide strategies to enhance professional learning
- stress the importance of professional learning when planning science learning experiences.
Overview
Research has shown that educators need to engage in critical reflection so that they examine the judgements, interpretations, assumptions and expectations they have of themselves, children and learning (Hanson, 2011). This is particularly important in science education, where often the educator is learning the science curriculum alongside the children. Without reflection on their decisions and actions, modifications cannot made appropriately and learning experiences are less developed. This chapter discusses educators’ professional learning, with particular reference to science in early childhood settings.

Introduction to reflective practice
Research into the early years of childhood over the past decade has highlighted the significance of wellbeing in early learning (Perry, 2006; Laevers, 2005). Incorporated into the EYLF (DEEWR, 2009) is a requirement that educators undertake ongoing reflective practice to ensure that all children in early childhood settings receive quality teaching and learning.

Reflective practice is a form of ongoing learning that involves engaging with questions of philosophy, ethics and practice. Its intention is to gather information and gain insights that support, inform and enrich decision-making about children’s learning. (DEEWR, 2009, p. 13)

Kolb (1984) was one of the early users and advocates of a process he called ‘reflective observation’. He linked concrete experience with abstract conceptualisation and active experimentation. This is specifically related to taking a learning experience and interrogating it through the following perspectives.

![Gibbs' (1998) 'reflective cycle' process included six steps through which a reflective practitioner cycled in reviewing her or his own professional practice.](image)

According to Raban et al. (2005) ‘reflective learning is an essential element of teaching and learning, regardless of the discipline or professional orientation of the individual practitioner’ (p. 3). Raban and colleagues (2010) also commented that
reflective practice provides maximum benefit for ‘learning about and developing professional practices’ (p. 11) if it is sustained over time and embedded in all aspects of the early childhood setting. They suggested that the tools of reflective practice are self-assessment, professional portfolios and mentoring by a learned ‘other’. In a process of self-assessment, educators ask themselves a number of questions: Why do we act as we do? Why do we see the world as we do? Why do we think as we do?

In the early childhood setting, such questions are translated more specifically to broad questions around practice:

- How often are the learning environments evaluated?
- In what ways are warm, caring attachments formed with children?
- How are materials and resources chosen?
- How are families involved?
- How are transitions addressed?
- How is the concept of ‘learning through play’ addressed and explained to families?
- To what extent does your personal philosophy impact on your interaction and teaching and learning of children? (adapted from Raban et al., 2010, p. 30)

Questions can be broad, as indicated above, or can be related to individual occurrences within the daily activity of the early learning centre. Focused questions could be: How could I improve that learning opportunity? What resources could enhance or extend the learning?

Johnston and Nahmad-Williams (2009) considered that individual reflective practice can relate to an overview of experience (as indicated above), to a single critical incident (anything that makes the educator pause and wonder why something happened) and/or a specific aspect of practice.

**Task 1**

**Reflection of a critical incident in your life**

Reflect on a critical incident that has had an impact on your life. It may be something related to your choice of career or something else in your life that made you stop and take stock. What was it about the incident that made it significant? What other factors were involved?

**Task 2**

**Reflection of a specific aspect of your practice**

Choose an aspect of your work with young children that you would like to improve – it could be related to developing better relationships, improving communications with parents, or how you develop and plan your curriculum. Write a checklist of good practice (what you should do) and share it with a colleague. What additional suggestions did they make? Reflect on what you would do, or change, to be able to tick each item on your checklist.
Reflective tools – professional portfolios and reflective journals

A professional portfolio is a collection of materials and resources that together highlight an educator's journey over time. It may include pieces of writing about a child or a reflective account of an incident. Often, a professional portfolio is geared towards professional standards of practice and the portfolio may be organised in such a way as to include evidence of competence against those standards.

Another tool that supports an educator's reflective practice is the use of a reflective journal. Using a reflective journal, educators can systematically examine their practice and plan for future professional learning. If an educator wants a very powerful, enriched practice, then working with a mentor (who might be one of their own colleagues or the director at their early childhood centre) offers an opportunity for the educator to critically appraise their own practice in a collaborative way (Moran & Dallat, 1995). A reflective journal then serves three purposes: as a tool for evaluating current practice aimed at identifying assumptions that underpin practice, assisting in determining future professional learning at the level of individual need, and mapping out an educator's professional learning journey.

Barriers to reflective practice

The idea of reflective practice is not new, with most educators in agreement with the statement 'We never stop learning; we never know it all. The day you think you do, is the day to give up teaching' (Johnston and Nahmad-Williams, 2009, p. 369). However, reflection, and particularly critical reflection, is not an easy thing for many people to do.

Maloney and Campbell-Evans (2002) indicated that issues can arise during reflective practice, such as: the introduction of deep reflective skills; the assessment of reflective writing; potential over-use of the reflective journal and the debate around openness versus structure. In general, most people are not socialised to be reflective thinkers, and demonstrate poor skills in this area. Reflection is a skill characterised by 'the interrogation of material in conscious awareness by means of searching questions' (Bourner, 2003, p. 271), whereas poor reflection results in descriptive accounts.

Other constraints such as personal motivation and/or time will impact on reflective practice. Maloney and Campbell-Evans (2002) noted that personal commitment and a dedication to reflection are key issues. There is often a fear of the unknown – with fear of failure and of judgement by peers contributing factors in the consideration of reflective practice (Richert, 1990).

The lack of time is probably one of the most significant barriers to effective critical reflection. Gil-Garcia and Cintron (2002) suggested that people need to find time to enable the reflective process to occur. Mentor educators should allow time
to instigate challenging discussion, allowing for considerations of deeper thinking (Walkington, 2005).

However, these barriers to reflective practice are not insurmountable. With some effort, they can be overcome. Finding a specific time for reflection is crucial and may need to be timetabled into an educator’s diary. Finding the right colleague for a collaborative reflective session may require some discretion. An honest approach, however, and deeper discussion, may result if the colleague is a ‘trusted’ other.

For an early childhood educator, who always seems ‘time poor’, setting up a reflective process is important for professional learning, for the appropriate development of all key elements of the learning environment and for the long-term planning of children’s development. With these key points as elemental to an educator’s role, there is a strong argument to be made that reflective practice is part of the educator’s continuing role.

Reflective practice in science education

Reflective practice is particularly important in science education, where often the educator is learning the science curriculum alongside the children. Without reflection upon their decisions and actions educators cannot make appropriate modifications and their learning experiences are less highly developed than is possible with reflective practice.

There is a body of evidence suggesting that science is not often ‘taught’ in early childhood settings; however, this is not to indicate that science experiences do not occur, particularly through play (Campbell & Jobling, 2010). Many early childhood educators undertook their training when the idea of ‘teaching’ very young children was not considered the responsibility of early childhood centres. Some early childhood educators would have undertaken little or no training in science other than ‘nature study’ or ‘integrated studies’ into which science was incorporated. Undergraduate courses in early childhood offered by universities now include science education in some form – sometimes as stand-alone programs, linked with another area of learning or integrated. Until recently, early childhood centres tended to be staffed by people with a range of qualifications, and educational disciplines were not necessarily included in preparation courses (Campbell & Jobling, 2010).

If children are trying to make sense of their world through their own play explorations and if a social constructivist approach to learning is the accepted theoretical framework, then children are building their own understandings from their own discovery experiences. Children are limited, however, in how far the discovery experience can aid understanding. Interaction with peers and adults provides additional stimulus to extend their understanding. Biddulph and Osborne (1984) have previously indicated that for children to make sense of the world, they need input from science educators and science education. As a co-investigator with the child (a feature
of what is termed 'emergent curriculum' by Dockett and Fleer, 2002, p. 199) the science of our world is experienced together. In addition, asking effective questions that encourage further exploration can provide children with the opportunity to extend their own investigations. 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 children's deeper understandings.

This then raises a dilemma for the educator. Research has shown that there are few professional learning opportunities for educators in the area of early childhood science (Campbell & Jobling, 2009). It therefore becomes even more critical that educators make opportunities to reflect on their practice, particularly when science experiences are being undertaken by children. As mentioned elsewhere in this book, even a child who is building blocks and watching them fall is undertaking a science investigation. Science explorations form a large part of early childhood, but are often misconstrued as, for example, art, construction or 'just playing'.

**CASE STUDY 12.1**

Case studies in early childhood science education

Pre-school educators at four centres were asked for information about their qualifications and those of other staff, and about science experiences within their early childhood setting and the opportunities they had for professional development in science education.

### Settings and staff qualifications

<table>
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<tr>
<th>CASE STUDY</th>
<th>STAFF</th>
<th>TYPE OF PROFESSIONAL SCIENCE LEARNING WANTED</th>
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| Case study 1 | Director: Experienced, 33 years, Bachelor of Early Childhood Studies  
Assistant: not qualified.  
Teacher: Diploma of Teaching (Early Childhood) | Hands-on activities, workshops with ideas that can be incorporated into existing programs |
| Case study 2 | Director: Experienced, 25 years, Bachelor of Early Childhood Education  
Assistant: Diploma of Children's Services  
Teacher: Bachelor of Early Childhood Education | Ideas on how to integrate science more successfully |
| Case study 3 | Director: Experienced, more than 20 years, Bachelor of Education (Early Childhood), Diploma of Teaching (Early Childhood)  
Teacher: Diploma of Teaching (Early Childhood)  
2 Assistants: not qualified | Professional development about magnets, electricity and 'tools' such as ramps, levers, pulleys etc. |
The research revealed that, although early childhood educators indicated that they provided children with a large number of varied experiences, they were often unsure of the science content or the science understanding. This limited their ability to develop the activities further. Early childhood educators also indicated that while they had access to some science professional development, more would be welcome. The types of professional development they felt would be most beneficial were ‘hands-on’ play experiences.

While we can describe the science we see occurring in early childhood centres, it is difficult to communicate what is actually happening. The learning experiences are rich in context and language; however, we cannot comment on how the children’s science concepts or skills develop over time through repeated or challenging experiences. It is quite clear that early childhood teachers incorporate science into the experiences of the children, but some admit to not being able to extend the children due their own lack of knowledge.

Improving the basic science knowledge of the early science educators is very important (Campbell & Jobling, 2009).

Recent research by Edwards and Loveridge (2011) indicated that better use of a teaching team approach can more effectively support children’s science learning and that of other team members. While lack of science knowledge is still problematic, team teaching can minimise the effects of lack of knowledge of any one educator and provide opportunities for educators to enhance their own practice through reflection as a group.

A guide to undertaking reflective practice in early childhood science education

For an educator to reflect on her or his science education practice requires reflection of a critical event and/or a specific aspect of an event. When considering a critical event, the educator needs to hone in on several questions that broadly fall under three areas: science knowledge, pedagogy and understanding students.
CASE STUDY 12.2

A science educator's interpretation and ways of undertaking critical reflection.

We can quickly check how a science exploration went, by using these areas to guide reflection. Ideally, there should be some way for you to record particular high and low points, and whether it was successful or not in terms of managing children or running an activity that really engaged the whole group.

Science knowledge

- Did you need to refer to notes/texts for information, or to check that everything had been covered?
- Were you able to give extra examples or applications when needed?
- Did you suggest useful extension activities or challenging questions to more able children?
- Were there any questions you were dreading?
- If there are areas you want to check on or recap, do you know where to look?
- Were you confident that your enthusiasm was noticeable to children?

Pedagogy

- Were your instructions followed by useful questions for students to ask themselves during the activity?
- Did you use a range of activities to cater for individual's learning?
- Did the responses show that children across ability ranges made progress?

Understanding children

- Were activities helped or hindered by your actions and how you phrased your questions?
- For both positive and negative actions, did you follow sound strategies?
- When children responded to your prompts/questions, did you show that you recognised this?
- Did you act and react fairly to all children?
- Do you need to follow up any of your actions?

I hope that you can see how this ‘quick and easy’ approach to regular reflection could help. Many of us do this subconsciously, perhaps intuitively. I find it useful to look back over my ‘scores’ every fortnight or so, and in fact I’ve now allocated time to do that. Doing it a few days afterwards means I’ve got a better perspective, and I can see how a series of experiences went rather than just one. That way I can tell exactly which issues were transient – we all have them, after all – and which I need to work on.

Adapted from ‘Ian’s blog’. <http://teachingofscience.wordpress.com/2011/06/05/reflective-practice-better-and-faster>.

It is important to remember that a singular approach will not suit everybody. Educators need to develop their own way of undertaking reflective practice that fits their needs within their context. Joyce and Showers (1995) emphasised that professional learning occurs within a framework of cultural change, and argued the need
for social support as educators practice strategies that are new to their repertoire or implement the difficult areas of a curriculum change. Mitchell and Cubey (2005) found that when professional learning was effective, educators engaged in critical reflection and more readily shifted their views and understandings. Furthermore, Doll (2008) suggested that ‘effective staff learning and development needs to address the various needs of educators at various stages in their careers if it’s to lead to the best possible educational outcomes for students’ (p. 45).

**What happens in practice?**

Often, educators find themselves in time-poor situations that do not allow for instant recording of ideas. It may be several days before an educator can stop and think about either a critical event in science or a specific aspect of their science practice that they wish to reflect upon. There needs to be some way the educator can trigger recall. Digital photography is one such solution. Just as an educator might collect photographs to record student learning, they might also photograph incidents or experiences to interrogate at a more convenient time. At the time designated for reflection, the photograph can be used to stimulate recall of an event. Another strategy educators might use is to write a few important notes on a sticky note, which can be placed temporarily into a notebook or file. Similarly, the educator can return to recorded events of children’s experiences and search out the incidental science learning, which may have been missed. If the science was not missed, the educator can reflect on ways that the experience may have been enhanced.

In a recent study, Edwards and Loveridge (2011) commented on how some educators used a collective reflective practice. In coming together regularly, they would bring their own ‘critical incident’ to the table and it would be debated by the group. Individual pedagogical practices would be highlighted, but also individual and collective reflection would take place.

**CASE STUDY 12.3**

Read the following information regarding a science experience the educator had set up for the children. The experiment followed a child-instigated discussion about jelly.

**Food science**

Cooking allows the investigation of many science concepts. Making jelly relates to the concept of ‘dissolving’. Crystals become so small that they are suspended in solution and cannot be seen. However, they have not disappeared, as some children believe.

The educator asked a question to determine what children may already know.

How do you think jelly is made?
Science in Early Childhood

Nathan: ‘I don’t know but I really like eating jelly when it’s wobbly.’
Ben: ‘Do you know Aeroplane jelly? ‘Cause you just use that packet and then have a bit of time doing some other things and later you pull it out of the fridge and it is finished and ready for eating.’
Kayla: ‘The water has to be hot so you need a bit of help from a big person and then you add the coloured sugar. Then ya gotta wait for it to go hard in the fridge.’
Caitlin: ‘I’m not sure because I always need my mum to help and I just do the mixing with it.’

Making jelly – Frog in a pond

Materials: jelly crystals, hot water, large bowl, spoons, chocolate frogs, jelly rings (these are lollies available in the sweets section of supermarket), individual plastic cups.

Method: Make the first layer of jelly with the children by mixing the water and jelly crystals together and stirring until dissolved. Pour a small amount of jelly into each individual plastic cup. Place cups in the fridge and allow to set. Make the second layer of jelly; pour into a large bowl and place into the fridge to set. Once both layers are set, take the large bowl of jelly out of the fridge and gently stir the jelly to create a new texture. Do not over stir as it will become too runny. Spoon out a little of the second layer of jelly into the individual cups of jelly. Place a jelly ring around each chocolate frog and then place the frog into the ‘pond’ of jelly in each individual cup.

Discuss the science concepts as they arise and probe children’s thinking throughout the experiment. For example, ‘Why is the first layer of jelly firmer than the top layer?’, ‘How did the crystals dissolve, become a liquid and then firm up?’ and so on.

Tips:
• Take care with hot water around children.
• Use less water in the first layer to create a thicker jelly base (alternatively, use more water in the second layer of jelly).

Learning that children acquired

All children developed a greater understanding of dissolving materials through this experience. One child commented: ‘The sugary jelly is all down the bottom away from the water, is it done now?’ to which another child replied, ‘We have to stir and stir until it disappears into the hot water ‘cause the other one we just did you couldn’t see any of the jelly crystals’. Later in the day two children interacted with their parent and tried to explain what ‘frogs in a pond’ were. This was an interesting conversation as I was able to listen to the changes that children had observed in the food preparation, which included heating the water, mixing the crystals and water, stirring the top layer of jelly, ‘dressing the frog’ and putting it all together. This demonstrated that the children had learnt about the physical changes involved in food preparation.

Acknowledgement: Meagan Beer, early childhood educator
Reflection
Comment on the first question the educator asked (How do you think jelly is made?). Did the question result in the educator gaining an understanding of children's prior knowledge? Is there another question that could have been asked to provide further or better insight into what children already knew?

How could this activity be improved? How could you collect further information about what children had learned? How could you record this learning?

In reading about this activity, were you challenged in your own understanding of what dissolving actually is and where it fits into science?

Conclusion
Reflective practice is an important component of an educator's practice and is critical in the area of early childhood, where change is continuous. Continuing professional learning is a global trend aiming to ensure that educators are highly skilled and up-to-date (Pickering, Daly & Pachler, 2007). However, effective professional learning is both complex and difficult. Professional development learning has traditionally occurred through the medium of workshops and conferences that focus on particular elements of practice, activities and ideas, and skills and content knowledge. While this short-term 'skills and knowledge' approach can be valuable and efficient in disseminating information and ideas, it has been shown to be quite ineffective in challenging and supporting more fundamental aspects of pedagogy and beliefs (Owen et al., 1987; Carrick 1989; Hoban 1992). The ineffectiveness of the approach is related to the lack of connection with centre priorities or the direct needs and concerns of children, and the lack of long-term and systematic planning (Campbell et al., 2007). There is thus almost universal agreement among education researchers that long-term professional learning, sensitive to the needs of educators and their contexts, is necessary to support significant educator development.

This chapter discussed some strategies educators could use to enhance their professional learning and focused strongly on the use of reflective practice. Reflective practice is seen as an educator asking in-depth questions about their own practice and using a more systematic approach to practice. This can be achieved by the use of professional portfolios, a reflective journal, mentee/mentor reflection sessions and collaboration with others. Reflective practices provide an educator with the means to grow and develop.

With the relative dearth of professional development in science education in early childhood education, reflective practice offers educators the opportunity to expand their own understandings, while enabling the young children in their care to undertake meaningful science explorations.
References


