The Journal of Emergent Science

Millgate House Education

Issue 3 Spring/Summer 2012

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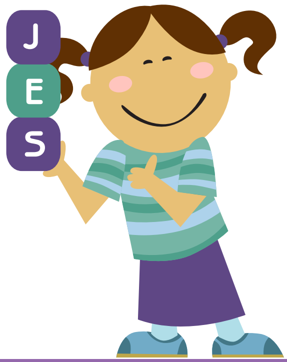
Issue 3 Spring/Summer 2012



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Cover Photo Courtesy of:
Millgate House Education Ltd

Publisher:
Emergent Science Network
c/o ASE, College Lane,
Hatfield, Herts, AL10 9AA, UK

Edition Sponsor:
Millgate House Education Ltd

ISSN: 2046-4754

The Journal of Emergent Science (JES) is published by the Emergent Science Network and is supported by the Association for Science Education (ASE).

This edition has been kindly sponsored by Millgate House Education Ltd., Sandbach, Cheshire.

For further details, please see page 41)

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Editorial
Welcome to the third edition of the Journal of Emergent Science (JES)

Brenda Keogh ▪ Stuart Naylor

As well as the major articles, the second edition included two extended abstracts from presentations delivered in Lyon at the European Science Education Research Association (ESERA) Conference in 2011. Three more extended abstracts are included in this issue. As extended abstracts, they do not contain the full sets of data or more detailed information as is required of full academic papers. Should you wish to obtain additional details for any of these research projects, you are advised to contact the authors directly or find an extended version of the paper on the ESERA website, www.esera2011.fr/

The first extended abstract, by Maria Kallery, examines the potential influence of older learners on young children's learning. It suggests that older learners can have a positive influence on young children's learning when they work together on science activities. If this is the case, then it has implications for planning and organising learning in mixed age settings. For example, which age groupings might work best in which settings? Do all mixed age groupings have the same effect? How much do other factors, such as children's social interaction skills, confidence in expressing ideas, or previous experiences, impact on the younger children's learning? If, as is often claimed, teaching someone something also improves learning for the one who does the teaching, what might be the impact on the older children's learning? We wonder whether the researchers have any evidence about this?

The second abstract, by Coral Campbell, reviews published research in early childhood science education in Australia and concludes that there are relatively few research papers published about early childhood science education. Exploring the nature of current research in early childhood science seems especially important. How is science education defined for young children? Does it include aspects such as outdoor learning, problem solving, talking, thinking, creativity and observation (see Jane Johnston's paper on *Observation* in this edition)? How much do we need to look at more generic research into these areas and identify the implications for engaging very young children in science? *JES* aims to focus specifically on research in emergent science education. Do we know what issues are distinctive and important in early years settings, and in what ways can *JES* help to identify them through the papers that it publishes? What would be top of your list?

The third abstract, by Cristina Mariani *et al*, focuses on how story can be used as a cognitive tool, both for developing the concept of quality in young children and as a methodological framework for analysing practice and guiding teachers. A fascinating element of this paper, which appears not to be explored in depth, is the use of characters to bring the stories alive and to get the children to empathise with the story. This is of particular interest to us as it resonates with our own research into the use of puppets to engage children in science. The puppets have exceptional power to draw children into solving science problems (Simon, Naylor, Keogh, Maloney & Downing, 2008). We wonder about the impact of the three characters in this research. How much difference might they have made to the way the children and the teachers engaged in the stories? What do you think? What would have happened if the stories had been used on their own? In our research into the use of puppets, we found that young children were highly engaged when the puppets were used to introduce problems and tell the children stories. They enhanced all the lessons where they were used by drawing the children into the problems being posed and creating authentic situations with which the children could engage. They treated the puppets as friends who needed support. Interestingly, the puppets that were the least knowledgeable and most confused had the greatest impact. Children worked hard to support these puppets and help to find answers for them. We had several instances where children did more work than usual, or talked when they would not otherwise have communicated, because they were 'helping the puppet to learn'. Puppets that took on the role of expert had less effect. This was possibly because it was like having another teacher in the room. Children's comments appeared to confirm this. Puppets appeared to have more impact than stuffed toys, but our evidence for is fairly limited. We used people puppets and animals. Whilst older learners preferred the people puppets, younger children were equally positive about both types of puppets. The only negative response we had was from two high achieving five-year-old boys who could not relate to one of the puppets that was very 'girly'. Other puppets were not a problem. The puppets only needed to be used for a very short period at the beginning of the lesson to have a noticeable impact on the whole lesson. It was also important to use the puppet to share ideas at the end of the lesson. The impact on the teacher was also notable. In every instance, there was an improvement in the way that they used questions. Teachers posed more open-ended and challenging questions, and they used more accessible language. When interviewed, many of the children noted that the teacher was easier to understand when using the puppet. More information about the project is available through the PUPPETS Project website www.puppetsproject.com or via the research and projects sections of www.millgatehouse.co.uk

Amongst the major articles in this edition, the paper by Phyllis Katz, *Using photobooks to encourage young children's science identities*, uses a case study approach to document how one child has used photobooks to reflect on his own scientific learning. The photographic record of his science activities provides an evidence base for review and reflection, and helps him to create a picture of himself as a learner in science. Presumably, with modern technology and video capability on smartphones, photobooks could easily be extended into video diaries. If photobooks can be a valuable way to capture some of the children's experiences for them to review later, to what extent can children take control of this approach themselves? How would they respond if they have regular access to cameras and video cameras from an early age that they can use to capture self-selected experiences, and what might be the impact of using these records to review their own science learning? Although this was a study over time, it should be possible to use photographs to talk with children about individual activities to explore the value of this approach. To make it manageable in normal settings, teachers would need to be selective in how the approach is used. Which children would you talk to and when? Ideally, teachers across the whole setting would need to commit to the approach so that a sequence of photographs would be gathered over time. However, it would be a very interesting way to review learning towards the end of each year. We wonder, if children are involved in taking or selecting their own photographs, whether they would learn how to select the best things to record or the most useful photographs to keep to help them share their ideas.

In *The development and support of observational skills in children aged under 4 years*, Jane Johnston explores how observation can be supported in young children whilst playing with a range of toys. She finds that observation in the older children was more social and functional than with younger children, and highlights the importance of social interaction and social construction of ideas. Is there a connection between this paper and the extended abstract by Kallery on mixed aged groups? To what extent could younger children develop their observational skills working with slightly older peers as well as/or instead of adults? What are the most effective ways for adults to support observation? The paper recognises the significance of adult support, but the research cited (Kallery & Psillos, 2002) suggests that opportunities provided for observation by children can be limited and dominated by the teacher. If children need different support at different ages, how can adults develop the understanding that they need? Are there generic strategies that adults can develop through their professional learning? Professional learning is explored further in the final paper.

For the final paper, we return to Australia, in which Coral Campbell focuses on Identifying some issues in professional learning in early childhood science. She interviews teachers at four pre-school centres in order to ascertain their professional background and recent professional learning and identify future professional development needs. One conclusion she reaches is that early childhood educators rarely have a strong background in science and would benefit from more professional development, especially contextualised support with a strong theoretical base that goes beyond activity-driven workshops. If early childhood educators tend not to work from a strong science base, should pre-service or in-service professional learning help to foster an approach of finding out together with children and confidence in the process of finding out answers? Whilst this may not completely overcome the limitations of a lack of science background, it can highlight the value of an inquiry-based approach and reflect how young children's science ideas develop. In our work in teacher professional development we have found that strong subject knowledge can sometimes provide a barrier to teachers engaging with young children learning science. There can be a reluctance to recognise the limitations of their own knowledge and a desire to pass on what they know, regardless of its suitability for the audience. We have seen too many courses that attempt to top up subject knowledge but leave the recipients feeling less secure and with a smattering of science that does not necessarily serve the teachers well. This does not mean that we should not get early years teachers to think about science ideas – the best teachers will always be the ones that can combine good science with good pedagogy. However, we strongly believe that they should engage with science in a way that leaves them feeling more confident to explore science questions, their own and children's, and to recognise their own learning. As we wrote in an article some time ago, accepting that you don't know, being curious and having the capacity for surprise, provides precisely the kind of role model that young children need to work scientifically themselves (Keogh & Naylor, 2003).

We hope you enjoy this issue of *JES*. We are sure that the Editorial Board would welcome your views on the papers or the questions we have raised, and to hear about your experiences. We look forward to seeing how future issues of *JES* help to explore and celebrate emergent science.

References

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Contributing to The Journal of Emergent Science

The Journal of Emergent Science (*JES*) focuses on science (including health, technology and engineering) for young children from birth to 8 years of age. The key features of the journal are that it:

- is child-centred;
- focuses on scientific development of children from birth to 8 years of age, considering the transitions from one stage to the next;
- contains easily accessible yet rigorous support for the development of professional skills;
- focuses on effective early years science practice and leadership;
- considers the implications of research into emergent science practice and provision;
- contains exemplars of good learning and development firmly based in good practice; and
- supports analysis and evaluation of professional practice.

The Editorial Board of the journal is composed of Association for Science Education (ASE) members, including teachers and academics with national and international experience. Other reviewers drawn from a wider group of experienced international academics are also involved in the process. Contributors should bear in mind that the readership is both national UK and international and also that they should consider the implications of their research on practice and provision in the early years.

The Editorial Board

Submitting to *JES*

Please send all submissions to: janehanrott@ase.org.uk in an electronic form.

Articles submitted to *JES* should not be under consideration by any other journal, or have been published elsewhere, although previously published research may be submitted, having been rewritten to facilitate access by professionals in the early years and with clear implications of the research on policy, practice and provision.

Contributions can be of two main types; full length papers of up to 5,000 words in length and shorter reports of work in progress or completed research of up to 2,500 words. In addition, the journal will review books and resources on early years science.

Guidelines on written style

Contributions should be written in a clear, straightforward style, accessible to professionals and avoiding acronyms and technical jargon wherever possible and with no footnotes. The contributions should be presented as a word document (not a pdf) in Helvetica point 12 preferably with double spacing.

- The first page should include the name(s) of author(s), postal and e-mail address for contact.
- Page 2 should comprise of a 150-word abstract and up to five keywords.
- Names and affiliations should not be included on any page other than page 1 to facilitate anonymous refereeing.
- Tables, figures and artwork should be included in the text but should be clearly captioned/labelled/numbered.
- Illustrations should be clear, high-definition jpeg in format.
- UK and not USA spelling is used; i.e. colour not color, behaviour not behavior, programme not program, centre not center, analyse not analyze, etc.
- Single 'quotes' are used for quotations.
- Abbreviations and acronyms should be avoided. Where acronyms are used they should be spelled out the first time they are introduced in text or references. Thereafter, the acronym can be used if appropriate.
- Children's ages should be used and not only grades or years of schooling, to promote international understanding.

- References should be cited in the text first alphabetically, then by date, thus: (Vygotsky, 1962) and listed in alphabetical order in the reference section at the end of the paper. Authors should follow APA style (Author-date). If there are three, four or five authors the first name and *et al*. can be used. In the reference list, all references should be set out in alphabetical order.
- Web addresses should be checked at time of submission.

Guidance on referencing:

Book

Piaget, J. (1929) *The Child's Conception of the World*. New York: Harcourt

Vygotsky, L. (1962) *Thought and Language*. Cambridge, MA: MIT Press

Chapter in book

Piaget, J. (1976) 'Mastery Play'. In Bruner, J., Jolly, A., and Sylva, K. (Eds) *Play – Its role in Development and Evolution*. Middlesex: Penguin, 166–171

Journal article

Reiss, M. & Tunnicliffe, S.D. (2002) 'An International Study of Young People's Drawings of What is Inside Themselves', *Journal of Biological Education*, **36**, (2), 58–64

Reviewing procedures

Manuscripts are sent for blind peer-review to two members of the Editorial Board and/or guest reviewers. The review process generally requires three months. The receipt of submitted manuscripts will be acknowledged. Papers will then be passed onto one of the Editors, from whom a decision and reviewers' comments will be received when the peer-review has been completed.

Books for review should be addressed to Jane Hanrott, ASE, College Lane, Hatfield, Herts., AL10 9AA and should include full price and availability details.

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The Development and Support of observational skills in children aged under 4 years

■ Jane Johnston

Abstract
This research explored the skill of observation and how it can be supported in children under 4 years of age whilst playing with a range of toys. The children's play was initially categorised according to affective, social, functional and exploratory observations and social interactions were analysed for impact on observation. Further analysis focused on children's responses to aural and moving/operated toys and types of play.

Observation in the youngest children was found to be aural, tactile and solitary, whilst in older children it was more social and functional. A few functional responses may have led to scientific exploration if supported by the adults through scaffolding and modelling. The research indicates the importance of social interaction in play to encourage more scientific play and observations, with adult support being greater in children under 2 years of age and peer support being greater in children between 2 and 4 years of age.

Keywords
Early years, science, observation, play

Background, framework, and purpose
Observation as an early scientific skill
Observation is an important generic skill for early years children, identified in many theories of education (e.g. Pestalozzi, 1894; Piaget, 1929). Early years curricula have incorporated observation as an important skill (e.g. MoE, 1996; DCSF, 2008). It is also an essential process skill in early scientific development (Covill & Pattie, 2002; de Bóo, 2006). Observation is integral to the development of curiosity and motivation by helping children to remember their investigations and solve investigative problems (Grambo, 1994).

Children begin to observe from birth, using all their senses in order to make sense of the world around them. Observation supports development in every area of child development (see, for example, Berk, 2003). Most knowledge about scientific observation comes from older primary- and secondary-aged children, although evidence of the nature of scientific observation in children aged 4 to 11 years has been documented (Johnston, 2009a). This has indicated that observation in young children is tactile, involving the senses of touch and hearing as much as sight, but that, as children develop, they move from broad observations to more specific observations. Later development involves close scrutiny of objects and events and exploration to help understanding of how the world works. As children develop, they begin to focus on specifics in their observation and develop their scientific process skills (Harlen & Symington, 1985; Johnston, 2005). Early scientific observations are influenced by personal and taught ideas (Driver, 1983; Duschl, 2000; Tompkins & Tunnicliffe, 2007) as well as interests (Tunnicliffe & Litson, 2002). Children have been found to bring their previous knowledge to their observations, making fewer theoretical inferences compared with older children (Johnston, 2009a; Duschl, 2000; National Research Council of the National Academies, 2007). Duschl's (2000) research indicates that it is often children's intuitive ideas that take precedence over scientific theory, this also being seen in younger children (Johnston, 2005).

Research into early years observation tends to focus on generic rather than specific scientific observation. Moreover, research has indicated that students training to be early years professionals see observation as a skill that they use in their work with children, rather than an important skill used by children (Johnston, 2007). This is despite recognition of observation as a generic skill for young children (Riley, 2003). There is increasing evidence about young children's scientific ideas (e.g. Reiss & Tunnicliffe, 2002; Fleer, 2007; National Research Council of the National Academies, 2007). However, scientific skills are less well researched, although the link between observation and understandings is established (Driver, 1983; Duschl, 2000; Tomkins & Tunnicliffe, 2007). Johnson and Tunnicliffe (2000), in looking at children's understandings of the features of plants during a visit to a garden, and Kameza and Konstantinos (2006), in researching children's ideas about astronomy, found that metacognition and social construction were more important than direct observation in developing scientific understandings (see Shayer & Adey, 2002 for more about early metacognition and social construction). This endorses findings of early years research about the power of social interaction and co-construction in developing understandings of the world (Siraj-Blatchford *et al*, 2002).

How professionals support early scientific development
Although the importance of observation is recognised (see above), it has been found, in one study, to form only 5% of classroom activities and, where it was present, was not active observation conducted by children, but passive observation made by the teacher (Kallery & Psillos, 2002). A review of research indicates that observation tends not to be used to initiate activities and motivate children to want

to make inquiries (National Research Council of the National Academies, 2007). Many studies have shown that practical observational experiences are more appropriate for younger children (BERA, 2003; Howe & Davies, 2005). However, the development of good scientific observational skills needs to be supported by focused and structured teaching (Harlen, 2000; Johnston, 2005; de Bóo, 2006). This is in order to develop thinking and linguistic skills (de Bóo, 2006) and creative thinking (Johnston, 2009b). Pedagogical factors affecting the quality of observational development are similar throughout early years and primary education (Harlen, 2000; Johnston, 2005) and include:

- Time to observe and discuss observations, including the creation of conceptual conflicts (Hand, 1988), through debate and argument (Naylor *et al*, 2004) and *'sustained shared thinking'* (Siraj-Blatchford, 2009).
- The careful use of observational aids (Harlen, 2000). Care is needed when giving observational aids, as children may focus on their use rather than the scientific phenomenon they are observing (Johnston, 2005). This does not mean that observational aids should not be used but rather that children need to be familiar with them before they can be used effectively for specific observations.
- Encouragement and support from teachers, including questioning (Vygotsky & Cole, 1978) and co-construction of understandings (Siraj-Blatchford *et al*, 2002).
- Focus on patterns, sequences of events and interpretations.
- Using children's natural interests in the world around them, including motivating scientific phenomena or objects to help children to make close observations (Ashbrook, 2007). Motivating experiences help to captivate and utilise children's *'compelling urges, in the social, the intellectual and the personal realms'* (Bary *et al*, 2008).
- Recording observations. Indeed, rapid sketching of detail has been found to improve observational skills by focusing on important features, which are then remembered (Grambo, 1994).
- The opportunities for explorations where children use their senses, noticing details, sorting, grouping and classifying or sequencing (Johnston, 2005).
- Natural contexts involving the observation of natural phenomena, particularly observations involving animals (Tompkins & Tunnicliffe, 2007).

Without support, observations are likely to be limited, unsophisticated, creative and imaginative general observations (Tunnicliffe & Litson, 2002). With support, children move to unsophisticated particular observations, rather than improve their skills in both types of observation. Whilst young children can make very sophisticated and detailed observations, they can get distracted easily and may need support to refocus (Keogh & Naylor, 2003).

There has been increased understanding of the pedagogies that support early scientific learning (Harlen, 2000; Kallery & Psillos, 2002; BERA, 2003; Howe & Davies, 2005; Johnston, 2005; National Research Council of the National Academies, 2007; Fleer, 2007). A common theme in all these studies is social interaction, especially where it involves practical exploration that builds upon previous knowledge (Vygotsky, 1962; Piaget, 1929). Active social participation in scientific development appears to be most effective with children learning alongside peers and teachers (Bruner, 1991; Stone, 1993; Johnston, 2009a). This involves a complex social interaction, with children learning through social interaction on three *'inseparable, mutually constituting planes'*: personal, interpersonal and community/ contextual (Rogoff, 1995 p.139). These planes have been found to be useful in analysing early scientific development (Fleer, 2002; Robbins, 2005).

This research aims to extend knowledge of early observation by answering the following questions:

- What does the skill of observation look like in children under 4 years of age?
- How can the skill of observation be supported through social interaction and co-construction?

Methods

The research participants were two groups of children aged between 15 months and 4 years of age engaged in a play activity with a range of unfamiliar toys. In Group 1, there were six children aged 15 months to 2 years, two early years professionals and the researcher. In Group 2, there were nine children aged 2 to 4 years of age with four professionals and the researcher. All children attended a private day nursery in a rural location in England. All children at the nursery whose parents had given permission were included in the research.

For each group of children, a collection of new and unfamiliar toys was placed on the floor for them to freely play with. The toys included:

- Moving toys, such as a battery-operated hen that danced while singing, wind-up toys and pull-back cars/ helicopter;
- Aural toys that made sounds, such as a rattle, a battery-operated chick that cheeped, a megaphone that children could speak through in alien/ robot/ spacemen voices and a jack-in-the-box;
- Operated toys involving some operation by the child, such as a ball and hammer set, a wooden frog that made a frog noise when a stick was pulled across its back, a helicopter (whose propellers moved when pushed), a honey bee who 'buzzed' down a pole and colour-change ducks (which changed colour when warm);
- Soft toys, such as a large dog, a sheep rug (that could be worn); and
- Other toys, such as a large multi-faceted mirror, a magnetic elephant with body parts that could be removed and replaced and a wooden person (with moveable limbs).

The free play activity was observed for 10 minutes whilst the children played independently. The professionals interacted with the children, as appropriate, by playing with a toy, pointing out what the toys did and asking questions about the toy, such as, *"Why do you think that happens?'* The play session was videoed and, although the camera was in full view of the children, only one child took any notice of it during the play and it did not appear to have any effect on the children. The research design draws upon interpretative studies in science education (Lemke, 2001). The video of the interactions was transcribed and analytical induction (Erickson, 1998) was used to identify the types of initial observations made by the children, as well as the number and types of observations made in the different parts of the activity.

Four categories of observation were planned:

- Observations containing an affective element, where children show interest through body language, giggles and exclamations, such as '*Whee!*';
- Observations containing functional comments or behaviour that focuses on how the toys work;
- Observations involving a social element, where children communicate and interact with their peers in the play; and
- Observations that lead to scientific exploration of the toys.

The children's play was also analysed using four categories of play; aural play or play stimulated by sound; moving/ operated play, stimulated by moving toys; Ludic or fantasy play (Piaget, 1976); and symbolic or epistemic play, that is, play using knowledge of the world.

Further analysis looked at the effect that personal, adult participatory and peer participatory interaction had on the scientific skill of observation (Rogoff, 1995). Robbins (2005) and Fleer (2002) both drew upon these analytical techniques in analysing different aspects of interaction in early years science contexts. In this research, the individual, peer and adult/ teacher interaction has been analysed in an attempt to understand the skill of observation from both child and adult perspective and the part played by different types of interaction.

Results

Similar to research conducted with older children (Johnston, 2009a), the initial observations were grouped into four categories: affective, social, functional and scientific explanation.

The children showed clear social and affective responses to the toys, but they did not engage in real scientific exploration. While there was some.professional-directed focus on changes in colour to the colour-change ducks, this category was dropped from Tables 1a and 1b as it was not seen in the younger children involved in this research.

Most responses from the children under 4 years of age were non-verbal. Affective responses took the form of dancing and squealing (see Tables 1a and 1b), although a few children used gestures or rubbed their face or heads when unhappy or distressed.

Their play and observation was solitary (playing alone) and needed greater adult modelling of play or participation in play. Indeed, the youngest children had no verbal social interaction with peers and limited other social interaction, as can be seen from the interaction below between two of the youngest children in Group 1:

- Boy 1 crouches by the hammering box and picks upthe hammer and puts in mouth.
- Another child comes up to the box and picks it up.
- Boy 1 tries to hammer (unsuccessfully, as his motor skills are undeveloped), but continues to play alongside the other child.
- The second child takes the box away and Boy 1 picks up the moveable man, drops it and follows the child with the box (with the hammer still in his hand). He drops the hammer and picks it up again.

As shown in Table 1b, children in Group 2 occasionally made a verbal response, such as one child who played quietly and independently with the helicopter throughout the whole time observed and then forcefully said '*No!*' when he left it and another child picked it up. Social responses in Group 1 were initiated by the professionals (See Table 1a), who interacted with the toys, '*Stroke the doggy, stroke the doggy*', and

Table 1a: Affective, social and functional responses to toys in children in Group 1 (aged 15 months to 2 years of age). *(Number in brackets denotes number of children responding in this way if more than 1)*

Affective	Social	Functional
❍ Dances (2) ❍ Dances with chicken (2) ❍ Backs away ❍ Rubs head ❍ Waves arms ❍ Cries	❍ *(All are with the professional unless indicated)* ❍ Strokes dog ❍ Looks at rattle ❍ Counts ducks ❍ Takes Jack-in-the-Box to professional ❍ Hands ducks to professional one-by-one ❍ Gives dog to professional ❍ Brings chicken to professional ❍ Professional discusses mirror ❍ Professional suggests putting ducks in water ❍ Child tries to take a duck from another ❍ Professional encourages child to share ducks ❍ Takes chicken to professional ❍ Professional focuses on colour-change ducks when put in water ❍ Professional encourages children to squeeze water out of duck	❍ Looks closely at elephant ❍ Looks closely at the way a 'clatterpillar' (from the setting's toy collection) moves

Table 1b: Affective, social and functional responses to toys in children in Group 2 (aged 3 to 4 years).
(Number in brackets denotes number of children responding in this way if more than 1)

Affective	Social	Functional
❍ Dances with chicken (2) ❍ Squeals with delight (2) ❍ Claps hands and giggles and wiggles bottom to sound of chick ❍ Dances and claps hands and wiggles bottom ❍ Shows signs of distress when cannot have toy ❍ Says 'No' when someone takes toy ❍ Muttering and not looking pleased ❍ Laughs and dances to chicken	❍ Shows 3 toys to professional without playing with them ❍ Shows megaphone to a peer ❍ Takes dog to peer ❍ Follows another child around, asking for chicken ❍ Holds up chicken so another child cannot reach it ❍ Dances with others ❍ Plays together with dog and sheep ❍ Takes toys to the professional ❍ Plays 'builders' with other child (for brief moment) ❍ Follows other children around	❍ Looks closely at rattle (3) while turning moving parts (1) ❍ Looks closely at moveable person (3) ❍ Looks closely at rattle (2) ❍ Looks closely at megaphone (2) ❍ Looks closely at butterfly (watching it without touching) ❍ Looks closely at kangaroo (observing it moving down a ramp) ❍ Looks closely at ball (rolling it down a ramp and watching the professional catching it) ❍ Looks at the Jack-in-the-Box (professional asks, *'How can you wind it up?'*)

gave encouragement to share toys and guidance on the functionality of the toy, *'Push the button'* (to show the child how to turn on the dancing chicken toy).

Case Study 1 shows the social interaction involving one girl in Group 1. In this interaction, the child initiated some interaction by taking toys to the professional and the professional responded by focusing attention on how one toy worked (demonstrating how the Jack-in-the-Box works), asking questions and engaging in Ludic or fantasy play (Piaget, 1976) and co-construction that linked previous experiences with the current play (playing with the ducks and singing *'Four little ducks went swimming one day…'*).

Children in Group 2 initially focused on a broader range of toys and engaged in some social responses with peers (see Case Study 2), showing them how a toy worked and sharing a toy with, or taking a toy to, another child, although most of their play was solitary.

This can be seen in Case Study 3 where a boy appeared aimlessly to pick up one toy after another, and had almost peripheral engagement with others, or engaged in parallel or companionship play (Bruce, 2004). Case Studies 1 and 2 also show evidence of Rogoff's (1995) personal and interpersonal planes. For example, in Case Study 1, Girl 1 engages in interaction with both a professional and another child (interpersonal), although she also plays alone (personal) and, in Case Study 2, Girl 3 plays alone (personal) and engages with Girl 4 (interpersonal). Some adult interaction, in both age groups, involved questions that focused on the function of the toys, such as, *'What colour has yours gone?'* (when looking at colour-change ducks with the youngest children, as in Case Study 1); *'How do you get that one to work?'*, *'Push it in'* (when encouraging a child to turn the dancing chicken on himself: see Table 1b).

The older children needed less adult support to initiate observations, although they appeared to benefit from interaction that focused on specific functions or aspects of the toys. One boy (see Case Study 3) engaged in the most functional responses, by looking very intently at different toys (a rattle, the butterfly, the dancing chicken). Self-initiated functional responses were not particularly characteristic in any of the children observed.

Case Study 1: Showing social interaction involving a child in Group 1

0-5 minutes

- Girl 1 takes the rattle to Professional 2.
- She counts the ducks with Professional 2, with the Professional singing *'Four little ducks went swimming one day….'*
- Girl 1 plays with the Jack-in-the-Box with another girl. Professional 2 demonstrates how it works.
- The researcher introduces the dancing chicken and Girl 2 dances with some ducks in her hand.
- She sits down by the chicken, which moves towards her, and starts to cry.
- Girl 1 goes to Professional 1 with the ducks and gives them to her one by one.
- Girl 2 moves away from the chicken, still with the ducks in her hand, and sits on the cushion with the ducks. She bounces on the cushion in time to the music (still with the ducks in her hand) and stays there for a while.

5-10 minutes

- Girl 2 is still on the cushion with the ducks in her hand. She now has all four ducks. She drops two and picks them back up again.
- Girl 2 stands up and takes the ducks to Professional 2.
- A boy comes to play with the ducks and Professional 2 encourages Girl 2 to share ducks with him and to put them in water and see what happens.
- Girl 2 gives the boy two ducks.
- Girl 2 looks in the mirror.
- She then looks across the room.
- She touches mirror.
- Girl 2 sits down and plays with the Jack-in-the Box (still with two ducks).
- Girl 2 goes to the other side of the room with the ducks and moves back to Professional 2.
- A third Professional brings in a bowl of water and Professional 2 encourages Girl 2 to put the ducks in the water.
- Girl 2 moves to the water bowl and prods the water with a duck. She looks at the ducks in the water and Professional 2 asks what colour her duck has gone: *'It's gone pink'*.
- Girl 2 squeezes water out of the duck over the bowl. She holds it up high above the bowl and squeezes.

Case Study 2: Showing social interaction in children in Group 2

0-5 minutes
- Girl 3 blows into megaphone and shows to Boy 3.
- Girl 3 shows Girl 4 the megaphone.
- Researcher introduces dancing chicken to children and Girl 4 claps her hands and giggles. She then wiggles her bottom to the sound of the music. Girl 4 picks up the chicken and takes it away.
- Girl 3 follows Girl 4 around, but Girl 4 holds the chicken out of reach. Girl 3 shows signs of distress, putting her hands over her face. She turns away and then goes back to Girl 4. Girl 4 points to another toy and does not let go of the chicken.
- Girls 1 and 2 both want the chicken, but Girl 4 holds it up. Girl 3 asks for chicken. Girl 3 follows Girl 4 around but Girl 4 holds up chicken out of reach. The Professional tells Girl 4 to put the chicken down and watch it dance. She does and then Girl 4 dances and Girl 3 jumps up and down, clapping hands and wiggling her bottom.

5-10 minutes
- Girl 4 has chicken and Girl 3 follows.
- Girl 3 puts box on top of chicken, whilst other children watch.
- Girl 3 picks up chicken and dances with it.
- Girl 3 gets on the floor and shuffles behind the chicken.
- Girl 4 lies on the floor and watches Girl 3 and chicken.
- Girl 3 squeals with delight.
- Girl 4 takes dog and puts it on her head. She takes it to the Professional (hanging over her shoulder).
- Girls 3 and 4 are playing out of sight with the dog and chicken.
- Girl 4, still with the dog, picks up a ball and a duck and takes them to the Professional. She wanders away with the dog.
- Girl 4 takes the ball to the researcher and rolls it down the ramp.

All children responded to aural and moving/operated toys, showing interest and motivation through oral exclamations, laughter and by dancing. A few older children also engaged in Ludic (fantasy) play and symbolic play (Piaget, 1976) and the play was analysed again to consider the responses to the aural and moving/operated toys and Ludic and symbolic play (see Table 2).

Case Study 3: Showing social and functional responses in a child in Group 2

0-5 minutes
- Girl 3 shows Boy 2 the megaphone.
- Boy 2 watches others and the researcher when she turns on the dancing chicken. He smiles at the chicken.
- Boy 2 picks up a colour-change duck.
- He moves to watch two girls playing with the chicken.
- Boy 2 picks up the rattle and looks closely, trying to see how it works.
- He helps another child with the hammering (but no real interaction – parallel play)
- Boy 2 uses the megaphone when put down by another child, but gives to another child when asked.
- Boy 2 picks up the hammer.
- Boy 2 plays (half-heartedly) with kangaroo, moving it across the floor.
- He plays with the Jack-in-the-Box.
- He picks up the rattle and looks closely at it again.
- He picks up the moveable man and looks closely at how it works.
- Boy 2 dances briefly to the tune from the chicken.
- He picks up a colour-change duck.

5-10 minutes
- Boy 2 plays with the rattle, again looking at the mechanism.
- Boy 2 plays at hammering.
- He rolls the rattle over the floor.
- He plays with the kangaroo.
- The researcher introduces a butterfly and he watches intently.
- Boy 2 continues hammering.
- He moves a colour-change duck across the floor and flicks it out of the way.
- Boy 2 goes to the other end of the room and wanders around.
- He plays with another child and puts on a builder's hat briefly.
- He watches the other child with a builder's hat.
- Boy 2 comes back to centre of room and watches a boy with the megaphone and then wanders back and forth, muttering to himself and not looking very pleased.
- He laughs and dances to chicken.
- Boy 2 follows the chicken. The Professional asks if he and another boy want to look at the chicken.
- He plays with the chicken.

Table 2: Children's responses to aural and moving toys and types of play (Ludic and symbolic) at different ages. *(Number in brackets denotes number of children responding in this way if more than 1)*

Age	Aural	Moving/Operated	Ludic (fantasy)	Symbolic (epistemic)
15 months to 2 years of age	Chicken (in constant use) Rattle Jack-in-the-Box	Chicken (in constant use) Hammering balls (4) Rolling balls (2) Rattle Jack-in-the-Box		Stroking dog (2) Ducks (*'quack quack'* led by Professional) Stroking sheep Hammering (picks up hammer and acts out hammering)
2 to 4 years of age	Megaphone (in constant use) for 10 minutes Chicken (in constant use) Jack-in-the-Box	Chicken (in constant use) Hammering balls (3) Helicopter (2) Jack-in-the-Box (2) Kangaroo Butterfly	Being a sheep (4) Playing with the dog/ being a dog (4) Being a builder (builder's hat) (2)	Dog (making kennel, sheep dog) (2) Playing with sheep Being a builder

There was overlap between aural and moving/ operated toys, with the toy responded to most often (and receiving the most affective responses) being the dancing chicken, which was both aural and moving. There was also overlap between Ludic (fantasy) play and symbolic play, which involves children using their existing knowledge about toys in their play.

In Case Study 1, Girl 1 (aged between 15 months and 2 years of age) and the Professional played with the ducks, singing a version of the children's counting rhyme *'Four little ducks went swimming one day….'.* In Case Study 2, Girls 3 and 4 (aged between 2 and 4 years) play with the toy dog and the chicken and, in Case Study 3, Boy 2 used the setting's builder's hat briefly, but did not connect it to the hammering toy. Another child engaged in both Ludic and symbolic play, becoming a sheep by wearing the sheep rug and playing with the dog: 'a sheep dog', finding a box as a kennel for it.

Later in the session, he used the megaphone, showing it to the Professional, who encouraged Ludic play with the response *'You sound like a robot. Are you a robot?'*

Discussion of findings

What does the skill of observation look like in children under 4 years of age?

The research reported here indicates that, in younger children, aural toys and movement act as stimuli to encourage observations, as opposed to the more tactile stimuli noted in previous research with children over 4 years of age, and identified in the literature review (Johnston, 2009a). As children develop, they engage in more social and functional observations, as well as a few close visual observations. Functional observations appear to require some knowledge not present in very young children to enable them to make theoretical inferences. Theoretical inferences help children to move to more exploratory observation; that is, observation that moves the children to further inquiry. There were no real exploratory observations, although a few random functional responses bordered on the exploratory in that they had the potential to lead to further inquiry. However, in order for this to occur, adult support, or co-construction, is needed (Siraj-Blatchford *et al*, 2002; Siraj-Blatchford, 2009). In addition, support for metacognitive and self-regulatory development (Whitebread *et al,* 2009) was needed to encourage the potential in functional observations to move towards more exploratory observations and inquiry (Bary *et al*, 2008).

How can the skill of observation be supported through social interaction and co-construction?

The importance of adult support is a common theme in the literature reviewed (Harlen, 2000; Kallery & Psillos, 2002; BERA, 2003; Howe & Davies, 2005; Johnston, 2005; National Research Council of the National Academies, 2007; Fleer, 2007). In the youngest children, constant adult support took the form of oral scaffolding and modelling, with the adult playing alongside the child (Stone, 1993).

This focused the child's attention on some scientific aspects of the toys and supported language development (Vygotsky, 1962). With the older children, the adult support was partial; the professionals watching the children and with interaction occurring when instigated by the children, or when thought to be socially or pedagogically appropriate. However, this approach led to some missed opportunities to support children's scientific understandings, such as in Case Study 3, when the quieter child was not supported in developing his initial functional observations. These missed opportunities may arise because professionals are unaware of the science behind the experience or how to support the children in their conceptual development (Campbell, 2009). In addition, professionals may not know how different social interactions can support this development (discussed earlier, e.g. Rogoff, 1995). Indeed, other research indicates that social constructivist approaches may be more rare than we would like to think in early years science contexts (Campbell, 2009; König, 2009). It appeared that the balance of adult, peer and contextual support was different for different ages, with contextual support being equal in all age groups and adult support being greater in children under 2 years of age and peer support being greater in older children. This balance appears to change again in children over 4 years of age, with children exercising more autonomy and using prior knowledge in their observations (Duschl, 2000; Johnston, 2009a).

Conclusions

The research findings appear to endorse the literature review and indicate the importance of social interaction in play, encouraging more scientific play and observations. This social interaction enables children to negotiate social boundaries (Broadhead, 2004) and develop conceptual understandings through cultural mediation (Bruner, 1991). This confirms ideas concerning effective pedagogy for young children as including interaction between children, their environment and adults (Vygotsky, 1962). Children should be active participants in their own understanding of the world, exercising some autonomy and developing understanding from experiences that build upon their previous knowledge (Piaget, 1929). They should have opportunities to scaffold their own and others' learning and with adult support (Bruner, 1977; Stone, 1993). In this way, the research endorses the view that effective pedagogies lead to understandings and sustained shared thinking (Siraj-Blatchford *et al*, 2002; Siraj-Blatchford, 2009). However, it is unclear if this is a conscious pedagogical approach adopted by professionals working with young children (Campbell, 2009; König, 2009). It may be that this needs to be explored more fully with professionals working with very young children to ensure that they move seamlessly from solitary and *ad hoc* observations, to more socially supported functional and exploratory observations.

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Identifying some issues in professional learning in early childhood science

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Abstract

In a small research project, four case studies were developed around the science education of pre-school centres in Victoria, Australia. A quantitative approach was used as the pre-school teachers were asked for information about their qualifications and those of other staff; science experiences within their early childhood setting and the opportunities they had for science education professional development. As part of the research, educators were questioned about the science they provided and their comfort in teaching science. The interviews revealed that early childhood educators believed that they provided a large number of varied experiences, although often they were unsure of the science content or the science understanding. They felt that this limited their abilities to develop the science activities further. Early childhood educators also indicated that, whilst there was access to some science professional development, more would be welcome. The types of professional development that they felt would be most beneficial were 'hands-on' experiences – a 'quick fix' approach. This article discusses the findings of the research through a socio-cultural framework, noting some of the issues identified during the discussions with the educators.

Keywords

Professional learning, Confidence, Science knowledge

Introduction

Professional development or professional learning is essential for ensuring that teachers in all sectors of education continue to address the learning needs of their students in a society where change is continuous. Continuing professional learning is a global trend, aimed towards ensuring that teachers are highly skilled and up-to-date (Pickering, Daly & Pachler, 2007). However, effective professional learning is both complex and difficult. Professional development of teachers most often occurs through the medium of workshops and conferences that focus on particular elements of practice, classroom 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 teaching practice and beliefs practices (Owen, Johnson, Clarke, Lovitt & Morony, 1987; Carrick, 1989; Hoban, 1992). The ineffectiveness of the approach is related to the lack of connection with school priorities or the direct needs and concerns of participants, and the lack of long-term and systematic planning (Campbell, Chittleborough, Hubber & Tytler, 2007). There is thus almost universal agreement amongst education researchers that long-term professional development, sensitive to the needs of teachers and their contexts, is necessary to support significant teacher development.

Many writers (Hargreaves, 1994; Hall & Hord, 2001) have emphasised that change requires of teachers that they ground new ideas in their own personal experience. Joyce and Showers (1995), drawing on research from a large number of studies, argue strongly for the need to site professional development within the teaching context. They emphasise that professional development occurs within a framework of cultural change, and argue the need for social support as teachers practice strategies that are new to their repertoire, or implement the difficult areas of a curriculum change. Contemporary large-scale reform projects in a number of countries have tended to incorporate these principles (Beeth, Duit, Prenzel, Ostermeier, Tytler & Wickman, 2003).

Other research indicates that professional learning needs to happen in an environment where organisational conditions support teacher improvement and where values of sharing, trust, collaborative inquiry and self-assessment are evident (Campbell, Chittleborough, Hubber & Tytler, Barty & Stacey, 2007). The OECD report (2006) *Starting Strong II* highlights the very low levels of investment in quality early childhood services in Australia. Australia spends less than any other first-world country on pre-school, and our kindergarten teachers are the worst paid and least trained.

Early Childhood Australia's CEO, Pam Cahir, recently spoke about the key features of a high-quality early childhood service system – one *'which meets the needs of children and families now and into the future'.*

Below is an extract from Pam Cahir's presentation:

> *'Qualifications matter. Staff with responsibility for children should have early childhood qualifications. In fact the more staff in a service who have early childhood qualifications the better. Research shows that there are better social and cognitive outcomes when children's care and education is in the hands of early childhood specialists – this too can no longer be contested.'*

Early childhood education in the state of Victoria (Australia) is now a division within the Department of Education and Early Childhood Development (DEECD) and reforms indicate that professional learning will be a major part of this process:

'We will improve the quality of early childhood services by emphasising the importance of learning and increasing the qualifications of staff' (Victorian Government, 2008, pp.16–17). This declaration stems in part from the Commonwealth Government's plan for early childhood: *'…improving the quality of early childhood education and care through…support and training of the early childhood workforce'* (Australian Government, 2008, Box 2.2 p.3).

Although early childhood educators are not registered under the Victorian Institute of Teaching (VIT), the issue of standards and registration for this sector across Australia has been a discussion point for some time (Elliott, 2005). Elliott (*ibid*) suggests that registration can *'…provide a gatekeeping and professional learning function that strengthens professionalism – and quality'.* Under current VIT regulations for registration, teachers are required to undertake a minimum of 50 hours of approved professional learning within a five-year period (VIT, 2008). If early childhood educators are to come under such a registration scheme, it is clear that professional learning content and modes of delivery need to be revamped to provide for the needs of both educators and their organisations.

To be effective, professional learning should meet the needs of the individuals and their organisations. It should draw on the previous understandings of the teachers and should enable teachers to engage in reflection as new ideas are presented to them. Mitchell and Cubey (2005) found that, when professional development was effective, teachers engaged in critical reflection and more readily shifted their views and understandings. The seven principles of highly effective professional learning (Department of Education and Training, 2005) reflect this philosophy. Furthermore, Doll (2008, p.45) suggests 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'.* This theme of personal relevance is also taken up by Yeigh (2008) when suggesting a metacognitive model of professional learning.

Science in early childhood settings

Internationally, there is a large body of evidence that suggests 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, 2008). Many early childhood educators undertook their training when the idea of 'teaching' very young children was not considered the responsibility of Early Childhood (EC) centres. Most early childhood educators would have undertaken little or no training in science other than 'nature study' or 'integrated studies' into which science was incorporated. Current Early Childhood Bachelors' degrees offered by universities now include science education in some form – sometimes stand-alone, or linked with another area of learning, or integrated. However, until recently, early childhood centres tended to be staffed by people with a range of degrees or training qualifications and the educational disciplines were not necessarily a part of the course coverage.

In America, Copley and Padron (1999) commented that the development of confidence in the early childhood professional was critical for enhancing science understanding and modelling positive dispositions to science. This is supported by Watters, Diezmann, Grieshaber and Davis (2001) in Australia, who stated that early childhood educators needed better preparation and background knowledge in science. In a study in New Zealand (Garbett, 2003), researchers found that pre-service early childhood teachers' knowledge and understanding of science was quite poor and, disturbingly, they were unaware of how little they knew. It is a recognised issue throughout the world. The problem of what should be considered professional learning for educators and how best to serve their needs, formed some of the questions in this research.

We recognise that children are trying to make sense of their world through their own play explorations and, if we accept a constructivist approach to learning, we believe that children are building their own understandings from their own experiences. However, children are limited in how far the discovery can aid understanding. Interaction with peers and adults provides additional stimulus to extend understanding further. Biddulph and Osborne (1984) comment that *'It is the task of science education to help children make better sense of their world.'* In experiencing the science of our world, being a co-investigator with the child (a feature of what is termed Emergent Curriculum by Dockett and Fleer, 2002, p.199), or 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.

The research questions addressed in this paper are:

- Are early childhood educators confident with the science experiences they offer to their children?
- What professional learning issues arise in discussion with early childhood educators about science education?

The research project

A survey was sent to seventy-five Early Childhood centres and kindergartens in Victoria, inviting the Director of each to respond to questions encompassing their qualifications and practices and those of their staff. They were also invited to participate in several informal interviews. Twenty-two responses were received. Four centres were chosen for interviews, one in a regional city, one in a rural location, one from an inner city suburb and one from an outer metropolitan area. In addition, eight centres were randomly chosen to represent a 'typical' selection from the remaining questionnaire respondents. Data from these eight centres (where staff were not interviewed) are also presented.

Survey questionnaire - Early Childhood Education (ECE)

1. How many staff work at your centre?
2. Please list their roles and qualifications (if any): Staff 1, Staff 2, Staff 3, Staff 4
3. Do any of your staff have specialist knowledge?
4. Does your centre have a policy relating to the content that is taught?
5. Is science (examples: floating & sinking, observing animals' behaviour, cooking) actively taught at your ECE centre?
6. If yes, could you explain what approach you take?
7. If science is not regularly undertaken, could you please indicate why not?
8. Have you had the opportunity to undertake any professional development in the area of science education in ECE centres? If so, where and what?
9. If science professional development has not been undertaken, could you please indicate the reason?
10. If you were able to undertake science professional development, what would you like to see offered? (e.g. 'hands-on' activities, theory-based, thematic units, workshops)
11. Any other comments you would like to make?

The interview questions at the case study centres were loosely based on the questionnaire questions, but the interview was semi-structured, allowing educators to follow new research pathways as appropriate. Questions relating to professional development featured in the interview. Observational notes were taken during two visits to the centres, but these were not used in this paper on professional learning.

Data

The following tables (1&2) give an indication of the range of qualifications held by staff and the nature of professional learning (professional development) offerings.

Expanded comments

Case Study One

The Director of this Centre listed professional development days conducted by her regional association as well as personal research via the Internet, print resources and personal contacts with expertise. The focus for her incorporation of science at the kindergarten was on *'science activities that can be used in kindergartens with the children – things they can do – simple yet teach them through participation and discovery'*. She described the type of professional learning that she would like as 'hands on' activities and workshops with ideas that can be incorporated into the centre's programs.

Case Study Two

The staff commented that they avail themselves of science education through early childhood conferences and workshops. There was no comment about sourcing additional professional learning opportunities, although the Director felt that she would like to see more science professional development offered, as her personal background was in visual arts and she needed support to integrate science. She apologetically admitted to having little or no formal training in science, commenting *'I don't have a strong background in science at all. It wasn't an area of particular study for me either at school or at university.'*

Case Study Three

The Director of this Centre had attended many professional learning sessions, listing the following as examples:

- Lady Gowrie workshops (each year this organisation runs one-off workshops on a variety of curriculum areas)
- Sue Elliott (Early Childhood Environmental Science Educator)
- Kindergarten Teachers Association of Victoria (KTAV)

Table 1: Case study settings and staff qualifications

Case Study	Setting	Staff
❍ **Case Study One**	❍ 4 year-old group, small community kindergarten, government-supported. Total number of children in the setting=25.	❍ Director: Experienced, 33 years, Bachelor Early Childhood Studies. ❍ Assistant: not qualified. ❍ Teacher: Diploma of Teaching Early Childhood
❍ **Case Study Two**	❍ Regional city, privately sponsored early childhood centre, attached to a large private Prep-12 school. 4 year-old group. Approximately 25 children.	❍ Director: Experienced 25 years, Bachelor of Early Childhood Education. ❍ Assistant: Diploma of Children's Services. ❍ Teacher: Bachelor of Early Childhood Education.
❍ **Case Study Three**	❍ 4 year-old group, outer suburban community kindergarten.	❍ Director: B.Ed (Early Childhood), Diploma of Teaching (Early Childhood). Over 20 years' experience. ❍ Teacher: Diploma of Teaching (Early Childhood). ❍ 2 Assistants: not qualified.
❍ **Case Study Four**	❍ Suburban, council-run long day care and kindergarten centre with 14 staff, two of whom are involved in the Kindergarten Room.	❍ Assistant Director: Bachelor of Education (Early Childhood). ❍ Assistant: Diploma of Children's Services.

Table 2: Survey responses relating to qualifications

	Not qualified	Qualified		
		Diploma (three-year training)	Degree (four-year training	Other (e.g. Cert III – one- to two-year training
Staff Qualifications	**19%**	**26%**	**19%**	**35%**

In addition, some staff had dual qualifications in music and Auslan (signing for the deaf).

Table three is a compilation of information derived from comments made on the survey questionnaires of eight selected centres:

Table 3 is a compilation of information derived from comments made on the survey questionnaires of eight selected centres:

Table 3: Professional learning indicated from questionnaire respondents

Non-interviewed respondents	Type of professional learning already expanded	Type of professional learning wanted/needed
❍ Centre 1	❍ No science professional learning attended because days have been scheduled when teaching.	❍ How to teach science at the 3- and 4-year old level and how to simplify or extend if needed.
❍ Centre 2	❍ No, as Director is able to provide leadership in the area.	❍ Yes to 'hands on' activities, theory-based, thematic units and workshops.
❍ Centre 3	❍ No, but commented that it is an area that could be improved in terms of what it offers. What is available has been around for a long time.	❍ 'Hands on' workshops that involve children and teachers together. ❍ Need for new concepts to be introduced. Re-evaluation of what we think children should know in early childhood in relation to science.
❍ Centre 4	❍ Science workshops at regional conferences, but not recently.	❍ 'Hands-on' theory-based; ideas for experiences
❍ Centre 5	❍ Science workshops at regional conferences – Sue Elliott (but not recently).	❍ Integrated activities. Workshops.
❍ Centre 6	❍ Kindergarten/early childhood conferences and workshops.	❍ 'Hands on' activities, theory- based, thematic units and workshops.
❍ Centre 7	❍ Lady Gowrie Professional and training centre	❍ 'Hands-on' activities, workshops and resource books with lots of pictures.
❍ Centre 8	❍ No, even though an important area – other areas such as program implementation have taken priority. ❍ Comment that science course within recent graduate diploma was excellent. 'Hands-on' ideas that can be used immediately with children.	❍ 'Hands-on' ideas that can be used immediately with children.

Table 4 has been developed from the comments of the educators who were interviewed in the case study centres:

Table 4: Types of professional learning programmes that early childhood educators have attended and their stated needs in the case study centres.

Case Study	Setting	Staff
❍ **Case Study One**	❍ Workshops. ❍ Personal research. ❍ Mentors with expertise.	❍ 'Hands on' activities, workshops with ideas that can be incorporated into existing programmes.
❍ **Case Study Two**	❍ Early childhood workshops and conferences.	❍ Ideas on how to integrate science more successfully.
❍ **Case Study Three**	❍ Workshops – Lady Gowrie, Sue Elliott and Kindergarten Teachers' Association of Victoria.	❍ Professional development about magnets, electricity and 'tools' such as ramps, levers, pulleys, etc.
❍ **Case Study Four**	❍ Workshops – Lady Gowrie, Swinburne University.	❍ To increase personal science knowledge.

She expressed a need to attend professional development about magnets, electricity and 'tools', such as ramps, levers, pulleys, etc., stating that *'I'm a bit wary of teaching and explaining it (the first two) to young children in a way they understand'* (questionnaire).

When asked to comment on the types of professional learning that she would like to see offered, she responded *'all of these!!'* to the list provided ('hands-on' activities, theory-based, thematic units, and workshops), adding *'can never know enough'*. This was followed by the comment that *'science (and maths) are the basis to everything (and **boys** respond very well!)'*.

Case Study Four

The teacher interviewed at this Centre described in her questionnaire that *'science education has been incorporated into different professional in-service/training'*. Two examples given were a Lady Gowrie Program Planning for 5s, and a Swinburne University *Just Discover and Improvise.* She described how professional learning in science had not been a *'professional interest until recently'*.

When asked about professional learning for which she saw a need, she commented *'the more I investigate with my group, the more I would like to increase my knowledge to assist facilitating their learning'*.

Analysis

The number of staff members without qualifications (Tables 1 & 2), or with minimal qualifications (total 55%), and the current focus at both federal and state government levels, indicate that there is a need for a more co-ordinated and focused approach to professional learning in science for early childhood educators. If we return to our initial research question, *Are early childhood educators confident with the science experiences they offer to their children?*, the following observations can be made.

Even those staff who are qualified, and that relates specifically to those interviewed, expressed an inadequacy in being able to provide the best possible science experiences for the children. Some commented on a personal lack of knowledge, some on not knowing how to translate the knowledge, whilst others felt that their own knowledge was not an issue if they were able to provide experiences for the children. For this latter group, having a more extensive repertoire of 'science activities' was most important. In light of the literature on Emergent Curriculum (Dockett & Fleer, 2002, p.199), in which teachers have to respond to the child's questions and learning needs 'on the spot', it appears that some early childhood educators would not be prepared if their own background knowledge of science is insufficient. Dockett and Fleer (2002, p.198) note the unpredictable nature of emergent curricula and describe the role of adults as *'one of focused observation and responding to the play that occurs in ways that extend and enhance learning'*. This can be quite a challenge when confidence in one's own conceptual knowledge and understandings is lacking.

Table 3 highlights the professional learning experiences and requirements of the early childhood educators who completed the questionnaire. Most expressed a need for 'hands-on' workshops, the desire for practical activities and some need for developing educators' background knowledge. It is of concern to us as science educators that a few early childhood educators did not see the importance of improving their own understanding. Whilst we can describe what 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, although 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; however, some admit to not being able to extend the children due to their own lack of knowledge. Improving the basic science knowledge of the early childhood educators is very important.

The information in Table 4, combined with that in Table 1, indicates that, although the case study centres were representative of city, urban, rural and regional centres, the professional learning requirements of the educators were similar.

In considering the second question, *What professional learning issues arise in discussion with early childhood educators about science education?*, four discrete needs were identified: activities rich in science; being able to translate knowledge into the appropriate level explanation for children; deeper understanding of science content, and being able to integrate science with other interests of the children. There are overlaps in these needs. With greater understanding of science concepts comes the ability to 'see' more science in a vast range of children's experiences and often leads the way to be able to explain concepts in simpler terms. Being more familiar with science enables an early childhood educator to integrate more successfully and to develop a greater range of integrated activities rich in science.

As the data show, current professional learning programmes attended by the early childhood educators tend to be one-off workshops focusing on discrete elements of science. In many cases, this is exactly what the teachers want. However, research (see earlier) indicates that this is not the most effective form of professional learning. Professional learning must be embedded in the particular context and relate to each individual's previous experiences. Although only half the respondents indicated that the science learning should be theoretically based, again research tells us that, to respond adequately to children's questions and enquiries, the early childhood educator needs to have a reasonable science understanding her- or himself.

Recommendations

How can we meet the professional development needs of teachers, integrating conceptual knowledge with science activities?

The research suggests an alternative model for professional learning, which recognises the unique situation of most pre-school settings. It is difficult for a 'team' from any one setting to come together at the same time and it is often difficult for even one person to be released to attend a professional learning workshop. What seems to have worked in other settings, which could be translated into early childhood settings, is for early childhood teachers to develop professional learning networks that support each other. What is needed is a programme of workshops that are child-centred and scaffolded by the teacher educators. Early childhood educators would be able to work in a collaborative environment that encouraged exploration and the discussion of ideas.

The suggestion would be for the early childhood educators to meet initially with a science educator to gain deeper understanding of underlying science. At that time, together, they also devise a number of experiences that can be trialled in their own settings. Over the next few weeks, these experiences are trialled and educators note down their successes, any questions and issues. They return for a group meeting once a month (usually for several hours after work) to revisit their trials and discuss another science 'topic'. It is important for teachers to be able to access follow-up support, as suggested by Watters *et al* (2000) and commented on in Case Study One, where the educator had access to a science expert. Such support may be provided by the informal networks suggested above; by the organisations providing professional learning programmes, and could include Web 2.0 interactive resources, such as blog or wiki use. An integrated approach could be taken where educators can develop curricula that have a solid theoretical basis, integrating areas such as science, mathematics, literacy and design, creativity and technology in a play base.

The findings of this small-scale study show that a diverse range of professional learning sessions had been attended and that perceived needs were similarly varied with some common themes emerging. The author has used these findings to suggest a way forward to meet the current and future needs of early childhood educators.

Acknowledgements

The author would like to thank Dr. W. Jobling (Deakin University) for the use of her data in this paper.

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Using Photobooks to encourage young children's science identities

▪ Phyllis Katz

Abstract

Helping children develop their identities as capable young science learners is a key to their lifelong confidence to continue to participate in inquiry about their world. This exploratory case study suggests that organised photographs, selected to reinforce this identity, provide a means to have positive conversations with young children about science activities and even the nature of science. Using the capabilities of photobook technology creation, the child becomes the starring character in a book that can be revisited multiple times. In this case study, using photographs from the first six years of a child's life and interviews at six and eight years of age, the photobook facilitated conversation about the child's view of the nature of science and his participation. It was clearly a source of pleasure to the child. The pleasure component leads to willing repetition.

Keywords

Identity development, Early science,
Photography and early science, Children and science

Introduction

It is how we see ourselves and how others see us – our identity (Gee, 2001) – that may well give us our ability to participate in a particular setting (Wenger, 1998, pp.149–158). It follows that, if we want our children to see themselves and to be seen as successful science learners, then those of us who teach them need to provide ways in which such an identity is developed through experience and conversation. Describing a mathematics learning context, Sfard and Prusak (2005) talk of the collection of narratives or stories that become the identities that define individuals. Photographs facilitate one of the ways to stimulate self-description through conversation. By creating a photographic record of a child's science learning and revisiting that record, the child can come to literally see that s/he is capable of learning science and enjoying it. Modern technology has brought us the ability to make Internet photobooks, which may be shared electronically and are published in single or multiple hard copies. These hard copies are artefacts that may give children pride and attention, which further their interest in science.

The technique described in this paper could well be suited to any subject area. This report focuses on science, since it is my area of interest and experience.
In my search of the literature, I have found material related to the use of photographs in teaching and learning. I have found no reports in any subject area on the specific use of photobooks designed to reinforce a child's image of herself as a continual learner in a subject area.

Science teachers have used photography in various ways. In a 'Head Start' class, Hoisington (2002) used photography during a construction activity. She described how her photographs helped her children to remember and extend their investigations, to reflect upon and articulate their experiences, and to work on analysis and synthesis of data. In a US pre-school, children who took their own photos with disposable cameras were asked to narrate their pictures (Keat *et al*, 2009). These photos of home and the cultural perspectives that they revealed gave the children a sense of power, assisted them in learning English, and helped the teachers understand the children's cultures. In Israel, Eshach (2009) asked students both in high school and a teacher training programme to create and interpret their own photographs. Among the findings was his ability to locate his students' science misunderstandings as they chose their photographs and talked about them. At the college level, Krauss *et al* (2010) in the US found that the way students used photographs in their biology course led to increased student questions and better ownership of the materials. They found evidence that there was better retention and proposed that this was due to the personal connection between the instructor/photographer and the students.

Over the last decade or so, trade books have been published with instructions and suggestions on how to use photography as a means of data collection and display for all school subjects. These books include: *Picture This* (Entz & Galara, 2000), *Teaching with Digital Images* (Bell & Bull (Eds), 2005) and *Picture Science, Using Digital Photography To Teach Young Children* (Neumann-Hinds, 2007). The presence of these books attests to both the accessibility of digital photography and the belief that the use of photography can enhance teaching/learning – especially in encouraging conversation.

The advantages of digital photobooks

Teachers have been making scrapbooks with photographs for a very long time. Since the mid-1990s, it has been possible to make digital photobooks on the Internet. I propose several advantages to photobooks over scrapbooks:

- Photographs are printed on the page and cannot come loose and be lost. They are durable;
- Photobooks can be easily edited until ready to print;

- The photobook product is a 'real' book, enhancing the child's sense of her/his importance;
- The story line can be determined by the teacher or in collaboration with the student(s) and can give voice to the student(s), as these digital natives (young children) are much more facile than the previous generation in making digital choices and even keyboarding; and
- The digital photobook is an endlessly flexible medium. A teacher might choose a topic, a group, each student, a specific class, or a field trip visit to a museum as the theme for the book. Children can help decide upon, take and select photos. Some children might be interested in and capable of photo editing, writing captions or explanations. Most photobook programmes present many choices of colours and patterned backgrounds to appeal to those with an artistic bent.

The greatest disadvantage of the photobook medium is the cost. While photobooks can be less expensive than many toys and shoes, they are more expensive than scrapbooks. It is possible to negotiate bulk rates with some of the photobook production companies; some have educational pricing. This information changes rapidly on the photobook websites, and I suggest exploring and communicating with several before making a decision and uploading photos if you decide to try to use photobooks as described.

The questions addressed in this study were:

- How do organised photographs facilitate conversations about how the child sees him/herself participating in science (science learner identity)?
- How does the child change his/her view of what science is to him/her between the ages of 6 and 8?

Method

The case study

To explore the medium and its potential effect in identity development, I used a case study method. I used photographs of the participant child from the age of birth to 6 years. The photographs were collected and published via an Internet photobook publishing website. We reviewed the resulting book in semi-structured interviews conducted at ages 6 and 8 with the child who was the subject of the photographs.

Participants

Researcher: My own work in science education spans more than three decades, both in the field and as a researcher. I have worked primarily in informal science education, but more recently at a university exploring the use of informal science education in its teacher preparation programme. Over the years, I have produced professional development manuals, curriculum pieces, books, articles for the popular press and peer-reviewed articles published in respected journals.

Child: In the exploratory case study presented here, Gerald (pseudonym) is the child participant, both subject of the photography and interviewee. He comes from a middle class home where he has many books and toys to peruse. He was thoughtful when I first approached him about this research. He wanted to know how anyone reading what he said would know about the pictures he was looking at. I described how I would put samples in a report. We talked about permission – both his and his parents' – and I explained that I would use another name for him so that his privacy was protected. He agreed to be interviewed at the age of 6 and again at 8, so that I would have the opportunity to think about how he was growing and changing and how the photobook could be useful for teachers and parents.

He was happy to do this project, enjoying the attention both in revisiting the book and in the conversations. As further evidence, as we finished the interview when he was 8 years' old, he asked if we would do this again when he was ten. I asked him why he thought that would be a good thing to do. He replied that I could keep following his changes and that could be interesting to the same people who wanted to read about the difference in a two-year span.

Creating the photobook

There were many hundreds of digital photos from which to choose samples of Gerald's explorations from birth through age 6. I looked for pictures that showed him learning common skills, such as how to use eating utensils or how to put puzzle pieces together. I wanted a book that would show him how he built up the skills and habits of mind that result in science and I would try to gain insights into his perspective on the science learning quality of his prior experiences.

I organised the book into 20 pages, the minimum number for a full colour bound book produced by the vendor website for a given price. I chose 37 photos that spanned his years and placed them in the book from youngest to oldest. All the captions were questions. Most questions were open-ended to allow for a wide range of responses (American Association for the Advancement of Science, 1993, p.285; Blosser, 1991; Howe, 2002, p.111).

I grouped the photos into the following science education contexts:

- The indoor and outdoor environments that comprise a child's world;
- The explorations by oneself and in collaboration with others that illustrate the individual and social aspects of science investigations; and
- The general playing/exploring settings of childhood and the explorations that take place in designed informal science institutions – in this example, in a science museum and a butterfly garden.

The interviews

In the 2008 interview, I asked Gerald to describe, in his own words, the activity pictured; I asked him if he thought there was any learning in that activity; I asked him what he thought was science. In 2010, I repeated the semi-structured interview to gain insights from any changes. There were instances in both conversations when Gerald initiated a question relating to my questions, or about the research itself. Because of our continued relationship, I believe that Gerald was comfortable interrupting and sometimes changing the course of the conversation temporarily. For example, at one point he said, *'I have a question. How are they seeing what we are looking at? They don't know what we are looking at'* (2010). He was confused about how the voice-recorded conversation would have meaning to anyone else. I explained to him that I would type up the voice recording and match it to the pictures or describe them when I wrote about him, so that people who might be interested in using this for science education would have evidence. *'Why do you want to give evidence?'* he continued to ask. I responded that, in this case, evidence could help people make decisions about whether photobooks would be useful. Satisfied, we continued to look at photos together and talk about his activity in the photos and how he understood them to be science and himself to be a young science learner. The conversation revealed that Gerald did not yet connect the concept of my developing evidence with his own use of evidence, but he did have a concept associated with the term.

Analysis and results

Gerald was quite clear that he saw himself doing science as he understood it. He provided evidence that his view of what science was had changed between the two years, from facts to a way in which to learn:

- In 2008, we had this conversation when he looked at a photo of himself learning to balance on a curb:

  Me: *Do you think that practice has anything to do with science?*
  Gerald: *Yeah, you practice and learn.*
  Me: *How is practicing science different from practicing blowing up a balloon?*
  Gerald: *Cause it's much more important.*
  Me: *Okay, tell me why. Why do you think science is important?*
  Gerald: *Because if you don't learn it, you don't know a lot of things in science, 'cause a lot of things have science in them. You won't know a lot.*

Table 1 illustrates a sample of the photographs and captions sorted into the categories above:

Table 1: Photograph samples and captions by context categories

Examples of photos and captions		Context sorting	Number of Photographs (N=37 total for each pair)
	❍ Is there any science in eating?	❍ Indoors	❍ 23
	❍ What did you learn about snow? How?	❍ Outdoors	❍ 14
	❍ Could you learn science by playing with trains?	❍ Child exploring on his own	❍ 28
	❍ What do you have to know to place a plant to grow? ❍ How did the grown up help you?	❍ Child exploring with others	❍ 9
	❍ What are you doing here? ❍ What does practice have to do with science?	❍ Playing or exploring in everyday settings	❍ 28
	❍ What science tool did you use here? ❍ How did you use it?	❍ Playing or exploring at a informal science institution (here, a butterfly exhibit at a local botanical garden)	❍ 9

- In 2010, he talked about a photo in which he was building a snowman:

  Gerald: *I am learning that I can actually shape that – that it's not going to collapse or fall through my fingers like water does. I'm learning that I can make it into shapes and put it on top of each other.*

  Me: *And tell me why that is science?*

  Gerald: *Because I am figuring things out.*

To better understand more about how Gerald saw himself as a science learner, I applied the Views of Nature of Science (VNOS) categories as an analysis approach to see how his thinking fitted into this framework. There are a number of lists on VNOS (Crowther *et al*, 2005; Lederman *et al*, 1998; McLelland, 2006). I used the description by Crowther *et al* (2005) of attributes as concise statements that had been described for younger children. In Table 2 on page 26, the VNOS categories are provided on the left and samples of Gerald's relevant comments are in the right column. Some of his comments are negative examples in that they provide evidence of alternate conceptions.

Findings

How do organised photographs facilitate conversations about how the child sees himself participating in science (science learner identity)?

The photos in the book were a way for both Gerald and me to focus on my interest in Gerald's thinking about his participation in early science. The book of photos engaged him. At no point did he become bored or ask to stop during our reading of the twenty pages. The photobook did facilitate conversation. I asked Gerald to think about how play could be science and he did. I was able to listen to his thinking about what science means to him and how he thinks he participates. Teachers can also listen for alternate conceptions that would help them provide experiences toward currently accepted explanations. Our conversations used the photographs as starting points for his descriptions of what was happening, what was different now, and what his theories were.

There is evidence that Gerald sees himself as a capable science learner in at least part of his sense of who he is and how others would see him, by virtue of his being the subject of a book of his science explorations – the definition of identity provided by Gee (2001). When he talks about what he is doing in the photographs, he speaks of *'figuring things out'*. While he has a sense of experimentation by trial and error (as in puzzle solving) by the age of eight, he is still not talking about systematic procedures as one part of science.

I did not find that surprising in the informal settings of home and neighbourhood. Knowing this could help teachers to create lessons that introduce the concepts of replicable methods. This could also lead to discussions about what makes evidence acceptable or good. And, while it did not come up in this research, I wonder if children will become ever more aware of photo editing and whether a picture presents an honest image.

How does the child change his view of what science is to him between the ages of 6 and 8?

Gerald's views on the nature of science are not broad. He saw opportunities for science in both natural and designed materials, like flowers and toy trains. He did not use the word 'evidence' for his trial and error learning about magnetic connectors on the trains, or the use of a spoon as a lever. He assumed that he would figure something out from concentrating on the situation at hand. He recognised that adults assisted his learning and helped build his vocabulary. I saw evidence that Gerald thought of himself as a science learner, because he knew that he was curious and solved problems – not a bad start. He did give me examples of alternate conceptions. He states that new information that scientists find can change ideas, as with the dinosaurs. Early childhood classroom teachers could use this kind of information to create environments where children explore under the heading of science and where vocabulary, like the term 'evidence,' is introduced as children investigate. Teachers can ask children what kinds of evidence are more convincing and how they would keep track of it. Photo files, kept for each child during an academic year, might lead to a book for each child (or a class) that shows the journey of change in what investigations engage the children, how they work together to collect data, how they evaluate the evidence, come to conclusions, make arguments at their level and present their findings. Again, while my own interest is in science, the use of photobooks could be applied to other subject areas.

Conclusion

This case study suggests that personal photographs trigger not only memories, but also a sense of importance for science learner identity. It also suggests that a child can be encouraged to focus on this science identity development in his everyday activities of play and exploration. The power of photographic media, coupled with the increased ease of electronic cameras and printing, might well be used in the classroom with the explicit purpose of helping children think of themselves as capable science learners. Continued research is needed to explore what this initial investigation proposes. It raises questions: How would less privileged children respond? Prior research suggests that they would also enjoy the process and participate in conversation (e.g. Hoisington, 2002 or Keats *et al*, 2009). Would one teacher, working with multiple children, find the same benefits as one-on-one attention? Would this be an opportunity for parent participation? How much can a given child or group of children assume in the responsibility for taking pictures and producing photobooks? Is the cost a serious impediment to classroom use in many circumstances? How does the use of photobooks in this way change children's behaviours as they participate in science lessons?

Acknowledgment

The research in this article was first published as:

Katz, P. (2011) 'A case study of the use of Internet photobook technology to enhance early childhood "scientist" identity', *Journal of Science Education and Technology*, **20**, (5), 525–536. DOI: 10.1007/s10956-011-9301-8

Table 2: Gerald's sample comments as analysed by Nature of Science attributes

Nature of Science Attribute	Sample of Gerald's Comment (Author comments in italics)
❍ Empirical nature of scientific knowledge (observation of the natural world)	❍ When viewing a photograph of himself at the age of about one and a half manipulating a small toy: *What do you think you were learning here?* What you can do with things. *What does that have to do with science?* I don't know. (2008) ❍ When viewing pictures of himself in a high chair with food and a spoon: In these pictures I am learning science by figuring out how to use the spoon to eat my food…how I am supposed to pick up food. *So, you are learning to use a tool?* Yes. *Do you see that as part of being a little scientist, too?* I am [also] figuring out that it makes noise. *You were good at that!* How much noise it makes… (2010)
❍ Observation, inference and theoretical entities in science (claims vs evidence)	❍ When viewing a photograph of a wooden train system: It [the train] goes up and down. *And when does it go faster?* On the way down. (2008) *Did you learn that playing trains?* Yeah. *So you learned science by playing with trains?* Yeah. (2008) I am figuring out how the trains connect, like how the magnets work and if I put it the wrong way, it's not going to connect. (2010)
❍ Scientific theories and laws (specificity)	❍ No evidence.
❍ Creative and imaginative nature of scientific knowledge (human activity)	❍ Viewing a photograph of himself and his grandfather planting annuals in the spring: *What does the plant need?* Water. *Is that all?* Sunshine. *Why does it need sunshine?* Give it light to see. *To see?* They might. (2008)
❍ Theory-laden nature of scientific knowledge (beliefs and prior knowledge)	❍ When viewing a photograph of his gardening activities, *I asked the difference between gardening for fun and learning science.* Well, gardening for the fun of it is you already know how to do it, so you do it. You're not thinking about the science – how do I do this thing? You are not trying to figure out because you already know how to do it. So, you are just doing it for the fun.(2010)
❍ Myth of scientific method	❍ *Is there any special way that you figure things out if you are a scientist?* I don't think so, unless you use a tool or something. It's not really a special way.
❍ Tentative nature of scientific knowledge (subject to change)	❍ When looking at a photograph of his visit to a dinosaur exhibit: *What happened to the dinosaurs?* Well, that was before because now they know. *Do you think there might be something new to find out?* Yes. (2010)
❍ Social-cultural embeddedness of scientific knowledge (within cultural milieu)	❍ When looking at himself playing with me: *Did you learn anything from me?* Yes. *Like what?* Like new words. *What does that have to do with learning science?* That you can help.

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Extended Abstract
Learning science in small groups: The role of age and interactions

▪ Maria Kallery

In this edition of JES, we have included further extended abstracts from some of the presentations delivered in Lyon at the European Science Education Research Association (ESERA) Conference in 2011. As extended abstracts, they do not contain the full data sets or more detailed information required of full academic papers. Should you wish additional details of any of these research projects, you are advised to contact the authors.

Background and purpose

Students' learning by interacting with each other rather than only with their teacher is of much interest to educational researchers and practitioners; it is also a highly evaluated goal (Webb, 1989). To achieve this goal, students need a learning environment that promotes the interactive processes of learning, to which they are preferably exposed from the lower grades of education (Huber & Huber, 2007). At the heart of this view of learning is the situation or the context within which learning takes place. Taking into consideration that learning is a transactive phenomenon existing in situations created by the teacher for students to learn, and that social interactions and skills allow the individuals to benefit from the opportunities to learn from each other, the teacher can create environments in which students can collaborate with peers and adults. Examples of such are the small mixed-ability co-operative groups, the use of which is supported by extensive evidence produced by numerous studies.

Small co-operative groups are used in several countries across all levels of education, not only for supporting and improving students' learning, motivation and attitudes, but also as a method for handling classes with a large number of students. While small-group learning has a long history, only in the last decades have researchers studied the interactions among students that facilitate learning, and the factors that lead to different patterns of interactions. One of the factors is the number of members who participate in a small group. Huber and Huber (2007) suggest that groups should comprise as many members as are still able to interact directly with each other. Another factor that has proved to be important is the age of the members of a small group. Furman and colleagues (1979) maintain that socialisation in mixed-age groups serves children in many ways in which same-age socialisation does not, and note that, in mixed-age groups, accommodations are required between individuals whose developmental level differs.

The following findings are also of importance:
a) children prefer to be taught by children older than themselves (Allan & Feldman, 1976);
b) older children are more effective models than younger children (Peifer, 1971); and
c) reciprocal imitation is more characteristic of children's interactions with older children than with younger children (Thelen & Kirkland, 1976).

Given the above, in the present work we study learning in small mixed-age groups. More specifically, we study the performance in science of the younger children participating in these groups, as well as the development of their communication-collaboration skill in an effort to diagnose if these factors are influenced by the number of older children participating in the groups. The questions leading our research are:

- How do the cognitive achievements in science of the younger children in a group change in relation to the number of older children participating in the group?
- How does the communication-collaboration skill of these children develop over the period of their involvement in science activities?

Design and context of the study

The present study, which was conducted in Greece, was designed to be carried out in real classroom settings. Given that in the Greek educational system the only level in which classes are mostly multi-age is pre-primary, the present study was carried out in classes of children aged 4 to 6. In this level, ages are grouped as follows: 4-5 pre-kindergarteners (PKs) and 5-6 kindergarteners (Ks). Four schools participated in the study. Three of the classes were attended by children aged 4, 5 and 6 years and one by PKs only. In all classes children worked in groups. Traditionally, group work gathers 4 to 6 students (Huber & Huber, 2007). In our study, groups of 5 children were formed. We considered that this is a number that provides good opportunities for interactions between members and for making different combinations of ages in a group.

Considering that each individual child has a probability of interacting with each of the rest of the members of the group, we assumed that, when the number of PKs is smaller than that of the Ks, each of them will have a higher probability of interacting with an older child. Thus, for the purpose of our study, we differentiated the number of Ks participating in the groups of each of the classes, keeping the total number of members at 5 (all groups of a class had the same age composition).

In all classes, the teachers implemented science activities with topics from physics and astronomy (see Kallery, 2009; 2010). Activities were hierarchically sequenced in order to support construction of meaning. Implementation started in October and ended in May. All teachers participating had long experience in teaching science at the pre-primary level.

Data collection and analysis

Data were derived from two sources: a) teachers' recordings made during all the stages of the activities' implementation; and b) the post-instructional assessment of the students.
In order to evaluate how each team member has benefited personally, children's assessment was individual. Assessments started in January, after the children had completed the first cycle of activities, and were carried out monthly until May.
Teachers' recordings included: a) separate evaluation of PKs' and Ks' cognitive achievements in class, for each month from October through May; and b) the development of the communication-collaboration skill for each month.

The analysis of the students' answers to the post-instructional assessment classified them in two categories: 'acceptable' and 'non acceptable'. Acceptable answers were assigned the value '1' and non-acceptable the value '0'. The percentage of the PKs' success for a specific evaluation task was then calculated. From these findings, the average percentage of the performance of these children was estimated.

The analysis of teachers' classroom recordings was done in group sessions comprising the teachers and the researcher (author of the present work). In this analysis, the teachers, based on their recorded information and the experience they gained from their interactions with the children, quantified the children's cognitive achievement assigning percentages for each month.

The final value for the children's performance was found by calculating the average of the children's performance in the classroom and the performance in the individual assessments for each month from January to May. On the same basis, teachers quantified their recordings for the development of the communication-collaboration skill in the children, providing a percentage for each month.

Results

Results for both factors investigated were plotted for each of the classes. A representative graph is shown in Figure 1, where E is the PKs' performance. In this Figure, line B represents classroom data, C the individual assessments and D the average of B and C. The maximum value that the children's performance reached, as well as the point at which it stabilised, is shown.
These graphs also provide information on the length of time in which the younger children of each class reached the maximum of their performance, starting from the time they began to collaborate with the older children in science activities. These findings were plotted and provided the graph in Figure 2. Evidently, the larger the number of older children in a group, the faster the younger ones reached the maximum of their performance.

Similarly, graphs were plotted for the communication-collaboration skill.

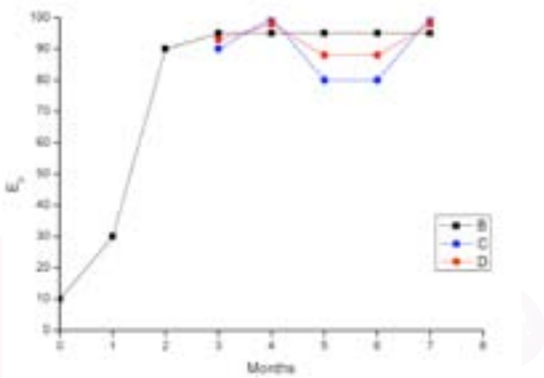

Figure. 1. Performance of the PKs in a class with group composition 1PK and 4 Ks.

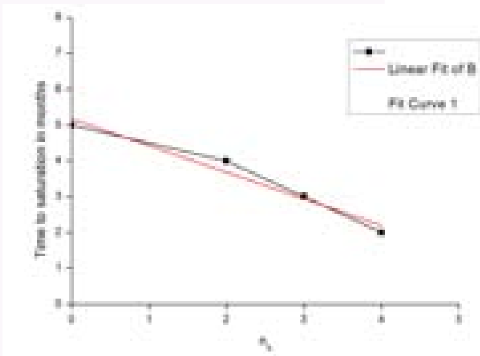

Figure 2. Time in which the younger children of each class reached the maximum of their performance in relation to the number of the older children participating in the groups of each of the classes

Using graph D, the average performance for the months January to May for the PKs of each of the classes, as well as the uncertainty ranges of the average, were calculated. Plotting of these values gave the graph of Figure 3, which represents the performance [E] of the younger children in relation to the number of the older children [n] that participated in the groups of each of the classes.

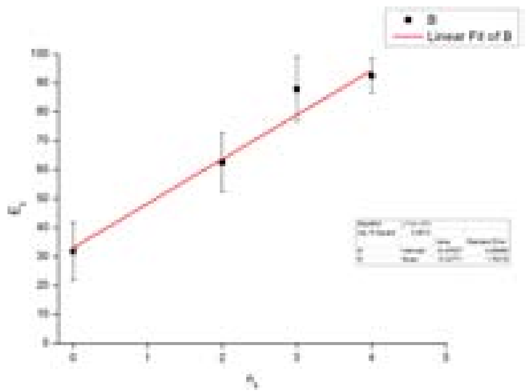

Figure. 3. Performance of PKs in each class in relation to the number of the Ks participating in the groups of each class.

This graph indicates that there appears to be a linear relationship between the maximum of the performance of the younger children and the number of the older children participating in the groups of each of the classes. Based on this relationship, the expected performance of the younger children in a class may be predictable to some extent, depending on the age composition of the small groups in this class.

These predictions appear to be verified in two other groups of 6 members (formed in two of the classes in which the number of children was not a multiple of 5), which had different age compositions (4Ks and 2Pks and 2 Ks and 4Pks) with very small variations (4% and 1% respectively).

Conclusions and implications

This very small study suggests that, in mixed-age small-group learning in science, the age composition of the groups may significantly affect 'cognitive achievement' and 'communication-collaboration', and potentially determine the time in which these factors reach their maximum value. The results can be interpreted on the basis of the findings of other studies reported in the introduction (Allan & Feldman, 1976; Peifer, 1971; Thelen & Kirkland, 1976), which have shown that younger children learn from the older ones, who constitute effective models for them. The present study appears to provide qualitative verification of these interpretations, and also quantifies the role of the age composition of the small science learning groups in a class. Based on the above, the selective composition of groups with a larger number of older children who have more advanced cognitive and communication skills in science can be used to facilitate younger children's learning, as well as their social interactions (Furman, Rahe & Hartup, 1979).

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Extended Abstract
Early childhood science education: Australian publishing trends

▪ Coral Campbell

Introduction

A literature search of both Australian early childhood journals and Australian science education journals provides a compelling picture of science education in Australian early childhood in the recent past and the previous forty years. Whilst a previous review of the literature found that there were concerns over the early childhood educators' confidence in teaching science, particularly physical sciences, current research indicates that this problem is still prevalent. The historical perspective also found that there was a distinctive approach evolving in early childhood science education; however, further research into the place of science in the cognitive domain of early childhood was required. The more recent literature search found that, as an area of investigation, early childhood science is still a neglected research area and there is still much scope for the development of theories in and analysis of early childhood science education. The literature search was undertaken scanning for titles that included science education and early childhood in several Australian early childhood journals and Australian science education journals, although it is acknowledged that some articles may have been sent to international journals.

Background

Over the last forty years, early childhood settings have increased in scope and number as more families with young children (birth to 5 years) return to work. In Australia, pre-school centres were available well over 60 years ago, although these tended to be run by church institutions and were only for a few hours each day. In today's world, however, we have long-day care centres, pre-school centres and kindergartens, all with slightly differing management regimes to suit most families with young children. The importance of early childhood has been brought to the forefront of government policy and practice in more recent years. Research into the early years of childhood in the last decade has highlighted the importance of quality early childhood care. In the first five years of their lives, children have developed most of the brain capacity they need. Catherwood (1999) indicated that considerable brain growth occurs during infancy and that significant learning also occurs in this time.

With early childhood centres becoming responsible for the development of the child, educational aspects were written into frameworks of practice for those centres and their staff. Science education, seen as children investigating and learning about the world around them, is an essential element of a child's development. This paper looks at the way science education has been portrayed in early childhood by reviewing literature in Australian journals in the last ten years and comparing it with an earlier review undertaken by Marilyn Fleer (2001).

Methodology – literature review

A literature review was undertaken looking at significant journal publications in Australia, teachers' journals and major conference presentations. *The Australian Journal of Early Childhood* (previously the *Australian Pre-school Quarterly)* first published a science education article in 1969. The journal *Research in Science Education* was also established 39 years ago. Other journals included: *Teaching Science* and the *Australian Research in Early Childhood Education*. An electronic search was conducted looking at all contents pages printed in the suggested time period. A key word search proved to be not effective, as often the key words, such as early childhood, pre-school and science education, were not in the titles. Instead, the abstract for each result was read to determine if the published article was indeed about early childhood science education in Australia in the past ten years.

Results

In a previous study of science education in early childhood, Fleer (2001) reviewed forty years of research and came to a number of conclusions. She found that there had been an evolution in thinking over the time, which led to important information for early childhood educators. Firstly, there were grave concerns over the science understandings of early childhood educators and the consequence of this for assisting young children with science ideas. She highlighted the disjunction between science education in general and the developing style of science education in pre-school settings. Finally, Fleer indicated that there needed to be significant theorising and analysis of early childhood science education practices.

In the more recent review, looking over the last ten years, again a number of observations have been made. Firstly, at a practical level, there are relatively few research articles written about science education in early childhood.
The articles varied in content and purpose as follows. Some related to early childhood educators' science understandings and professional learning, such as Dawn Garbett's article on *Science education in Early childhood Teacher Education: Putting forward a case to enhance student teachers' confidence and competence* (Garbett, 2003). Yet others related to specific case studies of children working in science in pre-school centres,

Table: Number of published articles on early childhood

	Australian Journal of Early Childhood (2000-2008)	Australian Research of Early Childhood Education (2001-2007)*	Teaching Science (2007-2010)**	Research in Science Education (2001-2010)
❍ Total number of papers	❍ 270	❍ 114	❍ 271	❍ 280
❍ Papers on early childhood science education	❍ 6	❍ 3	❍ 4	❍ 14
❍ Percentage of content given to early childhood science education	❍ 2.2%	❍ 2.6%	❍ 1.5%	❍ 5%

*Limited by access to online journal titles.
**The time frame was limited so that the total number of articles accessed was similar to the other selections.

such as *Preschool children's explanations of plant growth and rain formation* (Christidou & Hatzinikita, 2006). There were a few that related to cognitive development of children: for example, *Tracing young children's scientific reasoning* (Tytler & Peterson, 2003). Others were mixed topics, which included gender and research methodology. The journal *Research in Science Education* devoted an entire edition in 2003 to early childhood science. Three of the articles were from New Zealand and the UK and, while they did not necessarily reflect the situation in Australia, the research topics were sufficiently generic to allow transference of primary ideas. This paper does not intend to develop more fully the content of the articles reviewed, as this review is focusing on publishing rather than content trends.

Conclusion & implications

In undertaking this small research project, I was dismayed at the lack of published articles about early childhood science education. This may reflect the fact that, in Australia, early childhood has just recently gained prominence as a government priority area. It has increased status and increased funding. Research in science education in early childhood science could be considered a developing area. The other possible explanation is that, whilst it is still a relatively young research area, the journals may be reluctant to increase the number of articles that they publish in the area of early childhood science education. However, there is the possibility that journal editors are aware of this deficiency and would maximise their output of articles related to science if the research were available. This leads to the thought that science education within pre-schools is not given the importance it deserves and, therefore, research is limited. If this is the reason, then there is a case for more research being necessary and, hopefully, researchers in Australia will meet this challenge by extending their research agendas into early childhood science. We would hope that professionals working in this area (practitioners and researchers) are aware of the value of science, irrespective of whether it is a government priority area or not.

We all know that science education is important – right from the start of life children begin investigating the world around them. We need to ensure that our pre-school educators understand the value of science education for the young child and work towards providing them with comprehensive experiences in science. We need to work with our student teachers and community members to increase their knowledge of what science education is and its relevance for children. Finally we need to ensure that our research is rigorous and our writing is of high quality, so that journal editors select our papers for publication and word about early childhood science education begins to spread within the science education research community.

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Extended Abstract

A didactic path for age 5-8 on the concept of extensive quantity using a story as a cognitive tool

▪ Cristina Mariani ▪ Federico Corni ▪ Enrico Giliberti

Introduction

The research, investigating 'story' as a cognitive tool, is based on the premise that at the basis of scientific reasoning are some cognitive tools that help to deal with four interrelated activities: modelling, performing experiments, formulating hypotheses, and focusing relevant questions (Fuchs, 2009). The figurative-metaphorical thinking characterised by fantasy, metaphor, rhythm and narration, images, telling and emotionality (Egan, 1988) is the main source for the formation of hypotheses, which are required for modelling and experimentation stages. Literature suggests the use of stories and storytelling to promote emotional (Egan, 1989; Campbell, 1996), cognitive (Egan, 1989; Ellis, 2000) and imaginative (Egan, 1989; White, 1981; Klassen, 2007) involvement. Bringing stories into science teaching derives from the evidence that effective learning is achieved if children are both cognitively and emotively involved (Bruner, 1994). Pupils, under the guidance of the teacher who should suggest inquiry questions and help them to evolve their thought, take an active role in building knowledge through formulation of hypotheses or explanations, identification of problem variables, and hypotheses testing (Mariani *et al*, 2010).

In our approach, the story, together with the experimental activity performed by the pupils, also represents the way to help teachers from a methodological point of view. It represents a sort of scaffolding of intellectual steps and practical activities to focus on simple recurring elements (Corni *et al*, in press), which represent the basis to explore and interpret phenomena through modelling (Hestenes,1997; Gilbert & Boulter, 2000), building and using a shared language. The story, according to this approach, acts as a background element, which fosters the ability both on the creative-imaginative and logical-deductive sides.
For this intervention and the story required for the construction of meaning, the concept of extensive quantity is fundamental, because, on one side, it refers to the basic gestalt of substance-like quantity that children (and adults) use spontaneously to represent and describe the reality seen through everyday experience and, on the other, it is a fundamental element for the formal scientific knowledge. In fact, substance-like quantity, intensity or quality, and force/power are the three aspects of the spontaneous 'Force-Dynamic Gestalt '(Fuchs, 2009; Fuchs et al, 2011) to be developed for early science education.
In this paper, we draw a proposal for a didactical path, inspired to a semiotic mediation framework for the mathematics laboratory (Bartolini & Mariotti, 2008), on the concept of quantity in which meanings are constructed through teacher-guided stories, experiments and class discussions.

Problem

The main goal of this didactical path is to ensure that pupils of ages 5–8 achieve a good mastery of the concepts of extensive quantity. How can the concept of quantity be explored starting from an early age? Which cognitive tools can be supplied both to teacher and pupils to help them in recognising and setting in the right place the emerging ideas related with this concept?

From the teaching side, we suggest the use of a didactical path, which represents a methodological framework in which children and teacher can work together.

Outline

A story, useful as a medium to introduce the concepts and their characteristics, helps both the teacher and pupils to follow a schema acting both at a methodological and a cognitive level. The story presents the main characters, which lead the pupils through the episodes; moreover, children can identify themselves with the characters and are involved in the solution of the problems that the characters meet, trying to ensure their help. Together with others, there are some main characters who are the protagonists of all the episodes: Pico, who represents 'The Little Scientist', curious, attentive, ready to be amazed by the facts occurring around him, but also generous and always ready to help his friends when they meet some problems that they are not able to solve; Rupert, a frog, enthusiastic and curious, but always too quick to draw conclusions, often with awful results; and Merlo, a blackbird who, as a bird, can see things happening from above and is a sort of adviser for Pico and Rupert, who often ask for his help.

The three main characters ask for some kind of emotional identification from the children's side, but there are also some features that can be set on a more 'cognitive' (or at least methodological) level; Pico, for instance, always brings with him a sketch book, on which he writes the accurate description of what happens, and suggests that pupils can do the same. He represents the 'scientific method' and is able to formulate the 'good' questions, so children are stimulated to do the same.

Every step of the story ends with a question posed by Pico, who asks for the pupils' help to solve a problematic situation. Children in the class are both audience of and actors in the story being told; in the beginning, they watch the development of the story, but soon are required to help the characters by means of designing and performing experiments in the classroom, which might explain what happens in the story (Mariani *et al*, 2011; Corni *et al*, in press).

The didactical path presents discrete and continuous quantities, transferring, production, conservation and destruction (Rainer *et al*, 2000). On the methodological side, teachers are invited to design the activities following the path of the story, but they are free to modify and plan the activities according to their own specifications and needs. The teacher relies upon the story to set the correct sequence of steps, starting from simple to more complex concepts.

Another goal is to help the teacher to move from the level of the experimental activity and the pupils' verbal description of their actions, to the level of scientific meaning of the same words/actions (Mariani *et al*, in press). This can be achieved by providing the teachers with a series of examples with some possible situations and help them to recognise some 'pivot words' that pupils may use, and have to be recognised as indicative of the relevant concept.

For every situation, some examples of 'pivot words' and possible situated text (sentences that teachers can expect that children will say/write) are given, with the related scientific meaning (Corni *et al*, 2011). The following table shows an example, taken from the quantity path: a group of friends are at the amusement park and they buy some ice creams. First, (1) they compare their ice creams to find out who has more ice cream (idea of comparison); then, (2) they exchange the ice cream balls and find out how much ice cream they have all together; finally, (3) one of the friends leaves the park and the others investigate whether the total amount of ice cream is the same.

During the class discussion, the teacher, with reference to the scientific text, helps the children, starting from their 'pivot words', to construct scientific meanings, taking into account their common language situated text.

Conclusions

We have outlined a didactical path for pupils aged 5-8 to introduce the concept of extensive quantity using a story as medium. We assume that stories can be suitable as emotional, cognitive and imaginative tools. Teachers can make use of stories as a methodological scaffold, useful to design and lead the activities. The teacher has to be trained to recognise children's 'pivot words' in the classroom discussion, leading them to evolve from the situated level of observation to the scientific level of meanings. Some possible experimental research directions could investigate the ability of the teacher to use such a framework, and which skills are required. On the other side, it is possible to analyse pupils' verbal and written production to see how the 'pivot words' are used and recognised.

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Table: Number of published articles on early childhood

Situation/question	Pivot words	Situated text	Scientific text
❍ How we can tell who has more ice cream?	❍ Number of balls, number of ice creams, count, comparison	❍ Counting the balls of ice cream, we can say who has more. The number of balls is the total amount of ice cream. We compare the weight of the ice creams.	❍ A countable substance can be measured by comparison of the number of units
❍ If someone gives one ice cream ball to somebody else, what is the total amount of ice cream?	❍ Number of balls, one more, one less, comparison, the same, altogether, transferring, giving/receiving, adding/subtracting	❍ If I give one ball to you, I will have one less and you will have one more. The ice cream amount that I give you is the same that you receive. To know the amounts, I have to subtract one from my number of balls and you have to add one to yours.	❍ A substance can be transferred, preserving its total amount
❍ If somebody leaves the park, do we still have the same total amount of ice cream?	❍ Number of balls, amount of quantity, transferring, total amount, park boundaries, inside, outside, before, after	❍ The total amount of substance is the same, if we take into account the quantity both in and out of the park.	❍ The amount of substance in a particular system increases or decreases according to the amount of substance passing through the boundary.

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Notes & News

Association in UK offers journal for early learners

The *Journal of Emergent Science (JES)* is a professional research e-journal published by the Emergent Science Network in collaboration with the Association for Science Education (ASE). The journal focuses on science (including health, technology and engineering) for young children from birth to 8 years of age. The key features of the journal are that it:

- Is child-centred;
- Focuses on scientific development of children from birth to 8 years of age, considering the transitions from one stage to the next;
- Contains easily accessible yet rigorous support for the development of professional skills;
- Focuses on effective early years science practice and leadership;
- Considers the implications of research into emergent science practice and provision;
- Contains exemplars of good learning and development firmly based in good practice; and
- Supports analysis and evaluation of professional practice.

Articles in the journal highlight the importance of first learning and experiences in science and attempts to redress the emphasis on secondary science education, especially since science learning starts at birth. The co-editors, Jane Johnston (Bishop Grosseteste University College Lincoln) and Sue Dale Tunnicliffe (Institute of Education, London, NSTA Life member and former International Committee) are researchers and lecturers fascinated by these critical years, where interest and understanding of science is formed, and passionate about focusing on support for professionals who are attempting to use the impact of research to develop their own practice.

The journal will be published twice a year; in spring and autumn. During 2011 it was free; from 2012 onwards it will only be available for a subscription fee of £30 per annum ($50), although all ASE members will continue to receive the journal free of charge as a membership benefit.

The first two editions can be found on the ASE website at www.ase.org.uk. Click on web address for a subscription application.

The Royal Society's Vision for Science and Mathematics Education 5-19

Information on the vision can be found at http://royalsociety.org/education/policy/vision/?f=1

This project has identified and will focus on five specific areas that are seen as essential components of a high-performing school and college science and mathematics education system:

- Teachers (and the wider workforce)
- Leadership and ethos
- Infrastructure
- Skills, curriculum and assessment
- Accountability

Members of the Emergent Science Network have commented on the 'vision' with sadness that the vision implies that science learning begins at 5 years of age. As one member of the network said, '*The sad thing about most academic visions of science education is that they work backwards, whereas children grow forwards in time'.*

Members of the Network feel that the Royal Society has done nothing to encourage Early Years professionals in supporting science investigation and enquiry. Early Years professionals and anyone who observes young children recognise the importance of emergent science experiences as a foundation for life. The early years are the prime time to develop children's enquiring minds and there is compelling research evidence that indicates that the first five years are the most important for development.

The Network feels that the Royal Society is short-sighted in its vision and needs to remember that *each stage builds on the successes of the stage which precedes it, so the place to start with scientific literacy has to be Early Years.*

New from ASE!

The ASE Guide to Research in Science Education

Published in 2012, this completely new book gives easy access to research that has informed classroom practice and provides support for those wishing to conduct their own research.

The writers of this book firstly review robust and reliable research evidence, topic by topic, that informs the development of science teaching and will help teachers make decisions about the learning experience they offer to their students.

The second part of the book focuses on how teachers can set about doing their own research, on topics pertinent to their own classrooms. These chapters provide practical guidance on the stages of a research project and will help teachers ensure that their research is rigorous and reliable, and that it will be valuable to them and to the research community.

This *Guide* is a valuable resource for teachers of science in training and their early careers, and for experienced teachers undertaking Masters courses in science education.

Available from ASE Booksales: www.ase.org.uk
Price: ASE members £21.00
Non-members £27.00

Contents

Part 1: Thematic review of research in science education

- Science education research – a critical appraisal of its contribution to education
- International science education: what's in it for science teachers?
- Teaching and learning about the nature of science
- Pedagogical content knowledge (PCK): a summary review of PCK in the context of science education research
- What do we know about learners' ideas at the primary level?
- What do we know about what students are thinking at secondary level?
- Science teachers' knowledge of science
- The role and value of practical work
- Group work – what does research say about its effect on learning?
- Creativity in teaching science
- Learning out of the classroom
- Scientific enquiry
- The role of dialogue and argumentation
- Modelling as a part of scientific investigation
- Formative assessment and learning
- What research tells us about summative assessment
- Assessment for learning – classroom practices that engage a formative approach
- Teaching science in ICT-rich environment

Part 2: Doing research

- Planning for research
- Writing a literature review
- Deciding paradigms and methodology
- Research methods
- Analysing data
- Synthesis of ideas
- Presenting the research and findings and offering recommendations

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Research into what museums and art galleries offer the early years

Joanne Buddrige is a university student who is researching what museums and art galleries offer the early years. If you are able to help, please fill out the questionnaire below and send it to Joanne at jbuddrige@hotmail.com

What can museums offer early years (aged 0 – 8) children?

A small-scale research and documentary project by Jo Roberts, Lauren Yorston, Hannah Butler & Becky Mitchell

Overview: *The authors have been given the task of making a 15-minute DVD on art galleries and museums and what they can offer children in the early years (in this case, the age bracket is 0 – 8, but information on the 0 – 4 age range would be particularly appreciated). Their argument is probably going to centre around the fact that more hands-on provision should be made with these children in mind. Initially, what they need is quite broad and any information about past, present and future provision for these young children will be very useful.*

Name **Name of art gallery/museum**

Frequency of early years (EY) visitors

1) How often do EY groups visit?
2) Do your EY visitors tend to be from private nurseries, children's centres, nursery/reception or Years 1 or 2?

Provision for EY visitors

1) Do you have a specific programme for EY? If yes:
2) What does your museum have to offer EYs? (e.g. hands-on activities, art making, storytelling etc.)
3) Do you have appropriate facilities for EYs?
4) What feedback have you had from EYs?

Four themes of the Early Years Foundation Stage (EYFS)

In reference to the terms below, could you please explain your understanding of each term and also if or how the EY provision within your museum caters for each element of the foundation stage:

1) A unique child
2) Positive relationships

3) Enabling environment
4) Learning and development

Improvement to EY provision

1) Do you think your provision for EY could be improved?
2) What else would you like to see offered at your museum and collectively at other museums and art galleries?
3) Would you like to see more school EY children visit your museum? Why?
4) What do you think would or could encourage more EY practitioners/teachers to visit and engage with museums?
5) Why do you think some EY staff choose not to take children to museums?

Staff and institute profile

1) How long have you worked here for?
2) What made you want to work here?
3) Have you seen a change in the way the museum is run, laid out and for whom provision is made?
4) Have you seen a change in the people/children who access the museum – if yes, how?
5) Is there a specific on-site education officer who deals with visits?
6) Where would you like to see museums in the next 10 years?

Additional comments

Do you have any other comments?

ASE and you!

Joining the Association for Science Education (ASE) is the first step to developing a scientific teaching and learning approach in your school.

The ASE Primary Science Committee (PSC) is instrumental in producing a range of resources and organising events that support and develop primary science across the UK and internationally.

Our dedicated and influential Committee, an active group of enthusiastic science teachers and teacher educators, help to shape education and policy. They are at the forefront, ensuring that what is changed within the curriculum is based on research into what works in education and, more importantly, how that is manageable in schools.

ASE's flagship primary publication, *Primary Science*, is produced five times a year for teachers of the 3–11 age range. It contains a wealth of news items, articles on topical matters, opinions, interviews with scientists and resource tests and reviews.

Endorsed by the PSC, It is the 'face' of the ASE's primary developments and is particularly focused on impact in the classroom and improving practice for all phases.

Primary Science is the easiest way to find out more about current developments in primary science, from Early Years Foundation Stage to the end of the primary phase, and is delivered free to ASE members. We have worked closely with the Early Years Emergent Science Network to include good practice generated in EYFS across the primary phase. Examples of articles can be found at www.ase.org.uk/journals/primary-science/2011

ASE's PSC regularly produces new publications; recent ventures include the authoritative *ASE Guide to Primary Science Education* (the main guidance for primary schools on teaching science, including information on safety in practical situations and offering tips and advice for activities) and *It's Not Fair – Or Is It?* (a new primary guide to investigative practical work).

The Committee also promotes the Primary Science Quality Mark, www.psqm.org.uk This is a three-stage award, providing an encouraging framework to develop science in your school, from the classroom to the outside community, and gain accreditation for it. One of the benefits of taking part in this scheme is the whole school membership to ASE plus entry to the ASE Annual Conference for one day.

Shaping and organising the primary elements of the ASE's Annual Conference is a key part of the work that PSC undertakes, to ensure that the needs of primary teachers are addressed at each event. Look out for publicity related to next year's Conference taking place at Reading University, as well as local conference events in your area (www.ase.org.uk/conferences).

The Annual Conference itself is the biggest science education event in Europe, where over 3,000 science teachers and science educators gather for workshops, discussions, frontier science lectures, exhibitions and much more... The AstraZeneca Science Teaching Trust (AZSTT) awards for the Primary Teacher of the Year also take place at this event http://www.azteachscience.co.uk/

Spending at least one day at the ASE Annual Conference is a 'must' for you or your science co-ordinator.

To find out more about how you could benefit from joining ASE, please visit www.ase.org.uk **or telephone 01707 283000.**

The Association for Science Education

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The Association for Science Education

Resource Reviews

An innovative CD and book for developing observational, thinking and discussion skills in the early years, packed with engaging activities.

This is an eye-catching, informative book. It has a very clear format, written with the practitioner in mind. Gaynor Weavers has used her experiences in early years classrooms as the rationale for this book, and acknowledges in her introduction how the publication grew with time to include more than just stimulating activities. Her work has been edited by Brenda Keogh and Stuart Naylor and the final product includes active assessment materials.

The introduction describes a variety of ways in which teachers can use active assessment while promoting talk to reveal children's understanding and advance their learning. It also includes guidance on creating a supportive climate for talk to maximise the benefits provided by the science experiences.

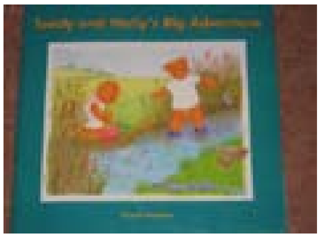
The book has 26 different activities all written up as individual chapters, each with a similar layout that very quickly enables the reader to follow the process of engaging and assessing the children. Each chapter begins with an explanation about the activity, a *Getting Started* text box, which contains resources needed for the task, followed by *How to use it* and then *Key questions*.

The next few pages describe *Looking for evidence of thinking and learning* and include photographs of children to support the explanations. The final section describes how to extend the activities with methods for developing further understanding and recording.

With a wealth of inspirational ideas all contained in one book, this is an excellent resource for anyone starting their career in early years (3-5 year-olds) or Key Stage 1 (5-7 year-olds) teaching.

Kathy Schofield
This is an excerpt from a review previously published in Primary Science 111 (Jan/Feb 2010).

Teddy and Molly's Big Adventure **by Susan Goodwin.**
28 pps paperback. Published by Susan Goodwin, price UK £4.99 (plus £1.50 p&p) from SSP, 36, Belmont Road, Beckenham, Kent, BR3 4HN, UK.
ISBN 978-0-9-564556-0-4
All proceeds to The Sreepur Village, Bangladesh.



My twin four year-old grandsons asked to have this story read to them over and over again at bedtime last time they stayed with me. It tells the tale, in rhyme, of two teddy bears, Molly and Teddy, who wake up one morning on a lovely sunny day. After their breakfast, (*'they finish it up, it will make them strong, SO they can keep playing all day long)'*, they put on their boots and off they go outside. They pass the cows in a field and *'all of a sudden, to Teddy's surprise, he hears little Molly's excited cries'*.

Molly has found a red ribbon. They continue on their walk and find more ribbons, orange, yellow, green, blue, indigo and violet. The weather changes, and they shelter, holding these ribbons. Suddenly, a strong wind blows the bunch of ribbons into the sky where they form the rainbow, with the colours in the order in which the two bears discovered the ribbons.

My grandsons loved predicting the words at the end of each couplet as well as saying the colours and looking, each time I read the rhyme, at the delightful coloured pictures, designed and painted by the author. The layout of the book enables the reader and the listening children to talk about the pictures and share their experiences. The reader can also talk about real rainbows.

Now, we know that is not how the rainbow forms but it is a delightful story and helps the young children learn the names of the colours of the rainbow. I do not consider that the story will impede their future learning of the science of rainbow formation. Indeed, this story will help them to learn the colours of the spectrum and could lead to activities with soap and bubble mixture, for example, to simulate rainbow colours.

Sue Dale Tunnicliffe

Made you look, made you think, made you talk by Gaynor Weavers. 181pps + CD. Published by Millgate House, Sandbach, price £29.00 (£25.00 to ASE members). ISBN 978-0-95562-602-9

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(30 credits) Feb 2013

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