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Issue 4 Winter 2012

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Editorial
Making sense through stories

▪ Derek Bell

To watch young children playing with an object or to see them entranced while listening to a story is fascinating. What is going through their minds? What signals are they picking up, what bits of information are they joining together as they try to make sense of what they are seeing, hearing and feeling? The short answer is: we will never really know, but that does not stop us, as researchers and teachers, trying to find out. Indeed, if it were possible, then our lives might be much simpler as we endeavour to help them learn and understand the world around them.

Understanding the mechanisms that enable young children to build their knowledge and understanding of the endless array of concepts with which they come into contact, as well as to develop the ability to use what they know in new situations, is a long way off. In the meantime, we need to keep watching, observing and recording, very carefully, how they respond to familiar as well as new phenomena. The articles in this issue add to the wealth of material that already exists.

In their article on children's perceptions of volcanoes, Michail Kalogiannakis and Angeliki Violintzi conclude that the concept of volcanoes is accessible to children of pre-school age and that, following the intervention strategies, the representations of volcanoes by children approached the scientific model. They argue that in a country such as Greece this might be expected, where *'volcanoes constitute part of its ground's very morphology'*. Suzanne Gatt and Giselle Theuma, in their article exploring children's understanding of plants and animals, return to a more familiar topic, but one that recognises that young children engage with some things more readily than others; in this case, animals rather than plants. Jane Cooper explores a wider issue, first aid, which, in effect, is a way of applying scientific understanding. Here the young children show that not only can they recognise potential dangers and their effects, but also that they (the children) are able to respond in ways that are appropriate in differing contexts.

Linda McGuigan and Terry Russell literally take a step backwards in order to consider the possibility of identifying emergent science behaviours, which could provide the first steps towards supporting the development of high quality science learning experiences. Based on the holistic assessment framework they developed, McGuigan and Russell first question and then test whether the generic criteria provided any indication of the potential for developing science-based skills. Whilst recognising the complexity of the situation, the authors suggest that their *'retrospective analysis of an attempt at holistic assessment of development in the early years offers encouraging prospects, proving useful in identifying criteria that could be thought of as relevant to the development and nurturing of science-related thinking and behaviour.'*
At first glance, these articles appear to be quite diverse, and in many ways they are, but a further consideration offers some interesting observations. They are all, from their different perspectives, trying to explore young children's thinking in a specific domain. They all recognise that there are many contradictions in trying to interpret exactly how it is that young children are coming to terms with their own ideas and the new experiences with which they are presented. Perhaps most strikingly, they all demonstrate the need for putting the learning into some kind of context and the concept of 'story' is strongly favoured.

The use of a myth, which almost by definition is unscientific, seems counter-intuitive and fraught with danger in creating misconceptions for young children. Yet, as Kalogiannakis and Violintzi argue, *'Myth transposes the phenomena studied onto the realm of fairy tales, which is meaningful and interesting to children'* and *'provide[s] characters and events with which children can identify and through which they can consider their own actions, beliefs, and emotions'.* In a similar way, stories such as *Jack and the Beanstalk*, used as an example by Gatt and Theuma, *'help children to identify relationships between the material world and their own personal world'* and *'can act as a direct stimulus to other learning experiences such as investigations, drama and art'.*

By creating scenarios to provide a context for young children using first aid, Jane Cooper in effect set up stories with which the children readily engaged. The findings indicate that not only did the children retain knowledge, but they were also able to use it at a later date. Although by no means conclusive, this evidence suggests that using such contexts and others, such as crime scene investigations, does have positive effects on children's learning.

The work reported by McGuigan and Russell did not involve the use of stories with children – it was not intended to do so – but it is striking that they invented 'assessment stories', intended to help users [teachers] to pitch their initial assessment activity at an appropriate point for each child. These 'stories' were constructed to describe in narrative form how the criteria might describe children's development. They go on to suggest that they might *'…help practitioners internalise the progression described by the developmental continua and use this knowledge to help make their assessments during their interactions with children.'* It would appear that the 'assessment stories' are being used in a similar fashion to the way in which the myths, stories and scenarios were being used in the other studies; that is, to convey some complex ideas to learners in a manner that will enable them to develop a more holistic view of the overall idea and to put the individual pieces of information into a context with which they, as learners, can identify.

Thus, it seems that adults as well as young children can benefit from the use of stories as they struggle to make sense of something new. As Gatt and Theuma point out, stories in themselves are not enough and further interventions are required, but the stimulus they provide is invaluable. The importance of a narrative and the dialogue that it can generate should not be under-estimated as part of the learning process. Perhaps, returning to the implied challenge in the opening paragraphs of this article, better use could be made of stories in helping us, as teachers and researchers, to understand how young children make sense of their world. Developing the narratives would be a challenge, but a first step might be to encourage greater dialogue between educationalists, cognitive scientists, neuroscientists and, crucially, the children themselves.

Derek Bell is Guest Editor of this issue of *JES*.

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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Identifying emergent science thinking within a holistic approach to early years education

▪ Linda McGuigan ▪ Terry Russell

Abstract
This paper describes an approach to the identification of the antecedents of scientific thinking within the generic assessment of children's capabilities during the Foundation Phase in Wales. The authors were contracted by the Welsh Government to develop an assessment tool to assess children on entry to Foundation Phase. Key requirements were that the assessment should be manageable – that it should fit in with practice and be capable of assessing children in a 36-60 month age range.

The development of the Child Development Assessment Profile (CDAP) as an assessment tool that is consistent with the integrated approach to early years is reviewed, and some of the emergent science capabilities identified via the CDAP are reported. On the basis of this initial evidence, the authors plan to explore with practitioners how emergent science might be recognised and progress in scientific thinking supported within the integrated approaches of the Foundation Phase.

Keywords
Early years, emergent science, assessment, curriculum

Introduction
The Welsh Government has introduced a Foundation Phase Framework for Children's Learning (2008), which is delivered to children between the ages of 3 and 7 years. The Framework emphasises the development of skills and the encouragement of independent, autonomous and reflective learners. It is delivered to children by a variety of providers in Wales, including child carers in the home, private day nurseries and playgroups, Cylchoedd Meithrin (Welsh language nurseries) and schools. It is in the context of this wide-ranging provision that the authors were contracted to develop an All-Wales baseline assessment system, which was capable of providing a one-off assessment of all children at the point of first access to the Foundation Phase. As children first access Foundation Phase between 36 to 60 months, the instrument had to be capable of assessing children at any point within this age range. It was intended that the assessment would be as naturalistic as possible within the Foundation Phase context – that is, in harmony with practice and thus ecologically valid. This single instrument was to replace the eighteen different baseline assessment systems already in use across Wales. In view of the prior existence of so many baseline assessment systems and the expertise that had been built up in implementing them, the authors adopted an inclusive approach, which actively encouraged the contribution of the expertise in local authorities and in the range of Foundation Phase providers. It was anticipated that a collaborative approach could help to ensure the manageability and validity of the materials. The aim was to develop a manageable, practical tool, which fitted with early years policy concern for the whole child and that offered support for the more general, integrated approaches to the planning of activities and recording of capabilities adopted with this age group.

Given our background as science educators, the completion of the detailed CDAP provided an opportunity for the authors to reflect on how this practical tool might offer the possibility of identifying and recording children's behaviours that might in the future be associated with scientific thinking. It is understood that there are some concerns about the quality of science interventions provided for early years children. Kallery *et al* (2009) suggest that the didactical activities that they analysed did not promote scientific understanding. Sylva *et al* (2008) report a need to improve the quality of pedagogical experiences, highlighting the link between high quality experiences and positive outcomes at Key Stage 2 (age 7-11 years). The authors considered the identification of emergent science behaviours as a first step towards supporting the development of high quality science learning experiences. This article represents an early point in the planned activity towards the identification of emergent science behaviours. These behaviours may not have been foregrounded within the more integrated approaches to learning and development characteristic of early years practice. The authors maintain that there remains work to be done in identifying antecedents to later science skills and in enhancing the quality of practice in the form of developing planned evidence-based interventions that aim to support children's development in science understanding.

Method
The empirical element of our work is the two-year research-based design of the CDAP. Consultation with stakeholders, including practitioners, all local authority early years advisers, union personnel and leaders of relevant professional organisations, was an integral part of the developmental process. Early years settings, with the support of local authority advisory staff from across Wales, were involved in cycles of small-scale trialling, a national trial (123 settings and 503 children) and a national pilot (269 settings and 1195 children). The approach to the selection of settings for the trials was deliberately inclusive, with all settings being offered

the possibility to contribute. For the pilot, local authorities (LAs) tended to select the maintained settings, while the pre-school organisations tended to approach the non-maintained settings. All 22 LAs provided a minimum of three settings for the pilot.

Initially, developmental areas were identified from the Foundation Phase curriculum. For each of these areas, developmental continua were constructed, which described the likely progress children might make between 18 months and 84 months. The authors acknowledge that individual children's progress may not be smooth and make no claim for a certain, inevitable, invariant sequence. Russell (2011) adopts the metaphor of migration routes to explain the ways in which developmental trajectories might illustrate the overall direction of progress: *'This is not to assume linear development with every child following the exact conceptual route as all who have gone before. The metaphor of migration routes is a better analogy: swallows generally return to the UK in early April, but precise routes and dates of arrival are not entirely predictable and many may be blown off course'.*

The intention was to identify established developmental milestones associated with norm-referenced information as key points in the developmental assessment of outcomes in early childhood education. It was possible to draw on previous research initially to help formulate the continua (Kagan *et al*, 2005; Evangelou *et al*, 2009). The tentative prototype sequences designed on the basis of relevant literature and Foundation Phase curriculum documents (DCELLS 2008 and DCELLS 2009) had then to be tested empirically by practitioners for validity, reliability and manageability. This was achieved through several iterations in order to arrive at a state that satisfied both the commissioning agency and other stakeholders. The small-scale trials in settings provided opportunities for practitioners to comment upon the suitability of the developmental areas and the appropriateness and position of each individual criterion within each individual developmental area. Those criteria identified as being 'out of place' by practitioners were modified or removed. As part of the evidence-gathering process, illustrative examples of each criterion were recorded in video, still images, written transcripts of observations and children's own models, writing and drawing.

Many practitioners found the criterion-referenced approach very different to the more general way in which they approached their early years provision. A key feature of the assessment process for practitioners and experts was that the Foundation Phase might be characterised as fostering development in an 'across the curriculum manner', rather than emphasising subject-specificity. The criterion-referenced emphasis on individual criteria during the development of the instrument was essential to ensure that each criterion could be operationalised in the day-to-day interactions of children in different settings.

To avoid any tendency to 'assess everything', range-finding devices were invented in the form of 'Assessment Stories', intended to help users to pitch their initial assessment activity at an appropriate point for each child. These 'stories' were constructed to describe in narrative form how the criteria might describe children's development. It was also anticipated that these devices would help practitioners internalise the progression described by the developmental continua and use this knowledge to help make their assessments during their interactions with children. Key to manageability was the fact that practitioners should not need to withdraw children to make their assessments, but that evidence of capability should be collected in the course of their planned provision and associated interactions with children.

The next step was to use the feedback accumulated for each criterion and developmental area to inform the final selection of criteria, and the formulation of a draft instrument that could be exposed to a large-scale trial across Wales. Guidance materials were developed to ensure that each of the selected criteria was accompanied by an elaborated definition and illustrative photographic or textual exemplification material.

A national trial provided quantitative data to check the validity of each individual criterion and the developmental areas. Qualitative data were also collected using interview and by encouraging written comment about the assessment process and the developing materials. Examples of behaviours that, in the practitioners' views, met or did not meet each criterion were also collected. In response to feedback and following further consultation with stakeholders, the CDAP materials underwent further rounds of refinement.
Training materials were developed and a programme of training undertaken to enable local authorities to support practitioners during the national pilot. The analysis of the empirical data focused on establishing age-related progressions across the criteria, the integrity and appropriateness of the areas of development and the practical manageability of the assessment. These data, informed by further consultation with stakeholders, culminated in the final formulation of the CDAP with its supportive illustrative material, the recording system and the training pack.

A second, more theoretical, activity following the completion of the CDAP represents an early, tentative step towards the identification of young children's emergent science capabilities. As described above, this step was undertaken because of the authors' special interest in the development of science-related thinking and because of concerns expressed in the literature about the efficacy of current practices.

The generic capabilities to be supported and assessed in the CDAP were analysed in terms of the science-specific expectations within the science curricula for the following Key Stage (that is, Key Stage 2, 7-11 years). Each criterion was subjected to critical review by researchers for its relevance to later science-relevant thinking and behaviour. While some kind of a case could be argued for a relationship between each and every criterion and later scientific thinking, the criteria were classified into three groups: firstly, those general criteria suggesting no obvious links to science; secondly, those having implicit links with what might be described as attitudes and skills relevant to science; and thirdly, those identified as emergent science, having explicit links with the attitudes and skills that might later be described as science-specific.

Results

The outcome of the empirical research is a practical tool that can be used on entry to the Foundation Phase to establish a baseline and which may be used subsequently for formative purposes during the 36 to 60 month period of development. The authors argue that the materials also provide a theoretical tool that might provide educational researchers with a means to identify emergent science – antecedents of scientific behaviours within a more integrated, global view of Foundation Phase children and their curriculum.

The completed CDAP comprises seven age-related steps covering an age range of 18 - 84 months, within six areas of development. These six areas are: Physical; Personal, Social and Emotional; Sort, Order and Number; Approach to Learning, Thinking and Reasoning; Reading and Writing; and Speaking and Listening. In total, within these areas there are 114 behavioural criteria that describe some of the major steps in development in each area. Each criterion forms part of a progression and is supported by an elaborated definition. Several illustrative examples of how any given assessment criterion might be manifest in children's interactions are offered to help practitioners distinguish between the different qualities of behaviours.

In response to feedback, the number of assessment criteria used to describe development in each area was adjusted during the course of development. No consensus view about the numbers needed was apparent. Ideally, the full complexity of development would be described, but a pragmatic response is to balance valid complexity against what practitioners can cope with administratively.

Figure 1 illustrates the design of the recording device, which is in the form of a wheel, used to record in summary form the evidence of children's capabilities gathered as part of their generic provision. Each of the six areas of development is identified. Within each area of development the individual behavioural criteria are shown as small circles.

The theoretical exercise identified examples of the behaviours from the generic tool relevant to emergent science in several areas of development. As an illustrative example, the emergent science behaviours recorded within a single area, that of Approach to Learning, Thinking and Reasoning, are reported in Figure 1.

One of the priorities of the curriculum innovation within the Foundation Phase in Wales is to foster positive approaches to learning, to support the development of metacognitive skills and children's ownership of their learning, so that learners are enabled to influence actively their own learning and the learning of others. Many of the criteria in this area of development can be thought of as fitting this agenda of a drive towards autonomous thinking and, as a consequence, might be conceptualised as supporting the more general, across-the-board contribution to children's development. This would include characteristics such as the capacity to persist in the face of reasonable challenges. Other criteria in this area may be thought of as offering more than a general underpinning, linking rather more strongly to a particular science-related area. For instance, the capability to explain whether a story is real or make-believe (7c on page 10) might be thought of as having strong links with literacy and creative

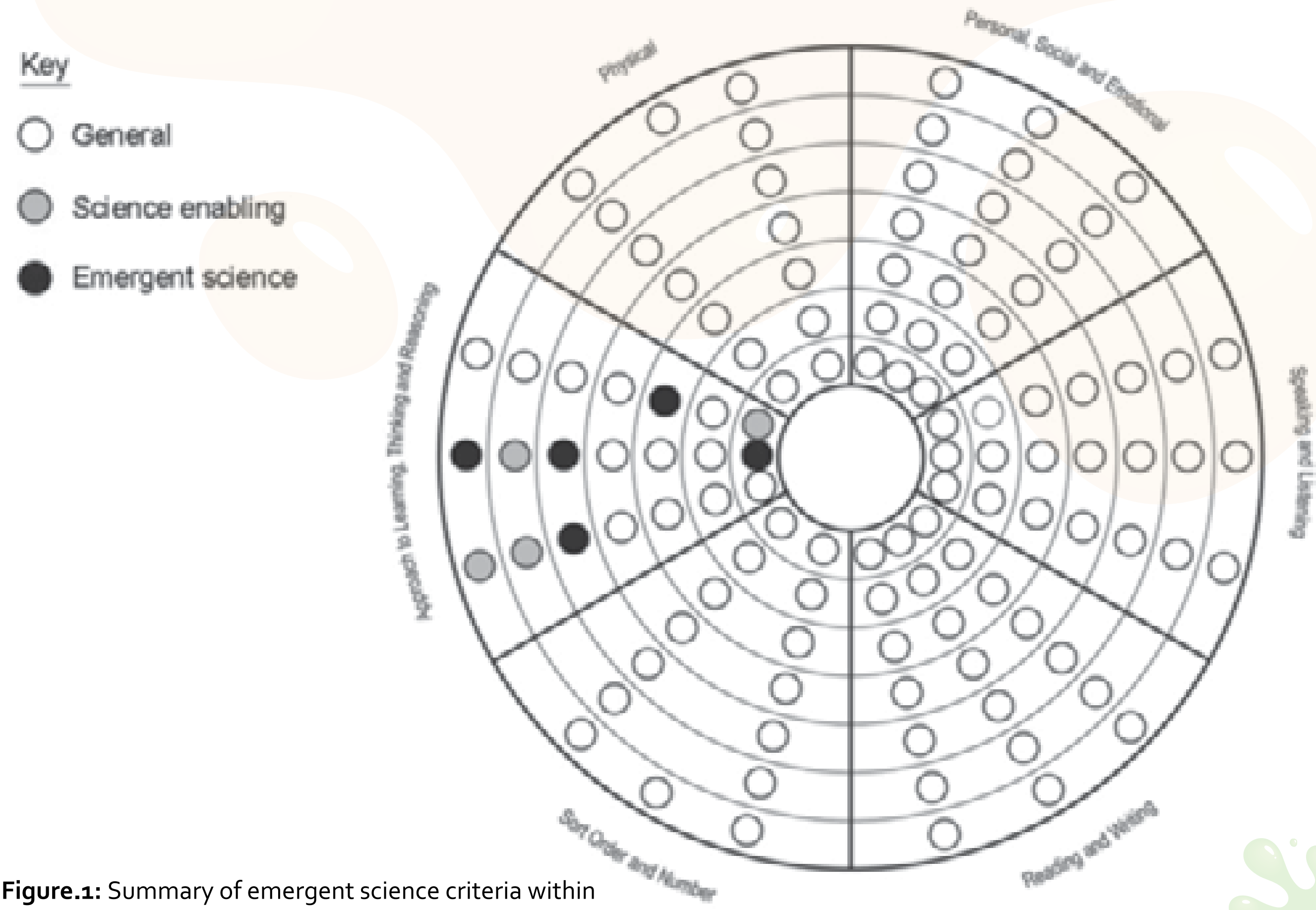

Figure.1: Summary of emergent science criteria within Approach to Learning, Thinking and Reasoning

development. However, the further development of this skill may have parallels in the context of science with children's developing capabilities to distinguish between fact and opinion and appreciation of the need to evaluate evidence. There are several criteria within this area of development that can be argued to represent science-relevant or emergent science behaviours that could become the focus of science-specific interventions. The twenty-one criteria used to assess this area are listed below, from earlier to later emergence. Those judged to be particularly science-specific are shown with two asterisks, those judged to be more generally enabling of science are shown with one asterisk:

1a*	Curious to know what is inside boxes and containers
1b**	Looks for or orients towards a dropped object
1c	Uses objects as intended
2a	Maintains attention for about one or two minutes on a chosen activity
2b	Relates an experience today to one that happened in the past
2c	Experiments with effect of own actions on objects and people
3a**	Shows curiosity about their wider environment and wider surroundings
3b	Uses actions or words to indicate why one activity is favoured over another
3c	Describes experiences or objects in speech, drawing, modelling, construction, movement or music
4a	Remains engaged in an activity for at least 10-15 minutes at times
4b	Remembers events in the past and uses these to anticipate events in the future
4c	Takes on pretend roles and situations…
5a	Chooses to work on a project because the activity is of personal interest
5b*	Gives reasons for why things have happened or are happening
5c*	Can explain how things might change, given changes in circumstances
6a	Copes with reasonable challenges, shows persistence…
6b*	Can hold more than one point of view
6c*	Can describe a sequence of events in a logical way
7a	Reflects on and evaluates the strengths and scope for improvement in their own work
7b**	Plans the steps in an enquiry and explains decisions about the approach
7c*	Explains if a story is real or make-believe, when prompted

Hood (1998) reported that young children show an understanding of the direction in which objects fall. Criterion 1b might therefore be thought of as linking to a later appreciation of the direction in which gravity operates. Criteria 5b and 5c have been identified as emergent science as they are associated with the development of causal reasoning. The reasons children offer for events may not always be correct. They may be based on prior experiences, limited evidence or imagination. Nevertheless, in manifesting behaviours relevant to these criteria, children are showing a willingness to think about effects and their causes. Such behaviours can be thought of as science relevant and can be harnessed and nurtured accordingly.

Similarly, children's capabilities to 'plan the steps in an enquiry' (7b) might readily be translated as a step towards planning an approach to a scientific enquiry. Children's early planning skills in a general or everyday context might gradually be encouraged or 'shaped' from the more general sequencing of steps in pictures to include some of the characteristics of managing a scientific investigation, such as the identification and management of variables. Such behaviours can be thought of as science-relevant and can thus be thought of as having the potential to be harnessed, shaped and nurtured accordingly – the kind of intervention possibilities the authors wish to explore as a next step in their programme of research.

Conclusion

As might be expected, the identification of indications of science-specific criteria is not straightforward. The identification of science-specific possibilities within the whole child in a cross-curricular context is hypothetical and a matter of personal judgement that needs to be fleshed out with further empirical enquiry. The interacting nature of the criteria and their influence on the development of the whole child suggests that some inter-relationships between criteria might be overlooked very easily. The ways in which capabilities in various domains mutually interact and influence development has to be recognised. Some criteria that may be important for science, such as, 'Can hold more than one point of view' (6b), also call upon a complex set of behaviours. For example, language development has an important role to play in the oral expression of ideas and the child's developing capabilities to ask questions, consider different viewpoints and seek evidence. Willingness to express ideas, to suggest ideas for enquiry and to engage in debates around the meaning of evidence requires not only language and communication skills, but also a developing sense of self as an individual having ideas. In this context, the development of a 'theory of mind' (ToM) with a sense that others may have different ideas is a critical emergence. Children will need social and emotional competence and confidence to be able to participate effectively in discussions. Only then might they make suggestions, offer explanations and perhaps give feedback on other children's ideas. Differences in the ways children explain their thinking or call upon evidence to explain how they know might be influenced, in turn, by their reasoning and number capabilities.

The retrospective analysis of an attempt at holistic assessment of development in the early years offers encouraging prospects, proving useful in identifying criteria that could be thought of as relevant to the development and nurturing of science-related thinking and behaviour. The potential of the process is illustrated within one, admittedly fairly circumscribed, area of the curriculum. While the discussion has been informed by an a priori analysis of the CDAP, a programme of further research has been very usefully identified. This study will be undertaken by working with practitioners and their children within their preferred approaches. Once identified, agreed and illustrated, it should be possible to examine the manner in which the behaviours that these criteria describe may be helped to progress. The intention then is to explore the kinds of interventions that practitioners might plan, within their generic approaches, to support the more specific development of scientific thinking.

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Intervention strategies for changing pre-school children's understandings about volcanoes

■ Michail Kalogiannakis ■ Angelika Violintzi

Abstract
Learning natural sciences helps pre-school children to begin to understand the natural environment. A teaching intervention was planned and produced by using the ancient Greek myth of Chimera for the teaching of volcanoes at kindergarten. The basic object of the present research, which is a case study, is the investigation of the ideas of pre-school children about volcanoes, before and after the teaching intervention. The present study also highlights theoretical elements in the use of myths for the teaching of natural sciences in early childhood education. The identification of the children's ideas was achieved through interviews with the children, and the children's drawings. The results of the research showed that the concept of volcanoes is accessible to children of pre-school age; and, following the proposed specific intervention strategies, the representations of volcanoes by children approached the scientific model.

Keywords
Early Childhood Education, Science, Volcanoes, Myths, Chimera

Introduction – theoretical background
The integration of science and mathematics is particularly relevant and appealing in early childhood education. Learning science helps children to begin to understand aspects of the world around them, both the natural environment and that created through the application of science (Harlen, 2008). It is essential to encourage children to develop scientific modes of explanations and modelling (Acher *et al*, 2007) and to develop the science process skills from the earliest school age. Dewey (1918) argued that, since the majority of children are never going to become scientific specialists, it is much more important that they should get some insight of what a scientific method means.

What makes children particularly ready for science is their intrinsic motivation, which refers to doing an activity for its inherent satisfaction rather than for some separable consequences (Eshach, 2006). Jones *et al* (2003) explain this intrinsic motivation by claiming that the same fundamental concepts developed during the early childhood years underlie a young child's understanding of science and mathematics. In early childhood education, science involves not only 'doing' but also 'thinking' and 'talking' about the work being done (Gallas, 1995) and recording activities and ideas (Katz, 1993). To do science is to predict, test, measure, count, record, collaborate and communicate.

Initial ideas of children and the construction of new knowledge
For Campbell & Jobling (2012), *'science in early childhood covers the theoretical underpinnings and practical applications of teaching science in early childhood settings in a way that is engaging and accessible'.* From a very early age, children, seeking to understand and interpret the world that surrounds them, develop certain initial ideas regarding various phenomena that occur, ideas that derive from the observation of the external world (Harlen, 2006; Johnston, 2009). By way of their immediate experiences, they form their own ideas of natural phenomena, before experiencing the teaching of natural sciences at kindergarten. These ideas are often coherent and systematic (Johnston, 2009).

Children's ideas should not be ignored, because they believe them, have worked them out for themselves and, indeed, these ideas have to be the starting point from which more scientific ideas can be developed (Harlen, 2006). This intuitive knowledge in children, deriving as it does from their limited experience, deviates greatly from the scientifically accepted explanations of natural phenomena (Vosniadou & Brewer, 1992), given that the children's simplistic interpretations of the natural phenomena are often superficial and fragmentary. If those initial ideas concerning the various natural phenomena remain unchanged, then an erroneous worldview will be established and children will come to explain newer knowledge based on previous, false views and ideas (Nelson *et al*, 1992). Moreover, it has been proven that misconceptions deriving from these pre-existing ideas persist at later ages as well (Vosniadou & Brewer, 1992).

For the children to develop their new scientific knowledge, there needs to be a conflict between their pre-existing representations and the novel information (Driver *et al*, 1994). The conflict between pre-school children's own ideas and new concepts that they are taught in primary education leads many to find natural sciences too hard. Thus, the teaching of natural sciences at kindergarten must aim predominantly at the development of basic scientific skills; through the cultivation of such skills and systematic research within the context of kindergarten, children create representations and models of interpretation regarding the natural world, which are compatible with the scientific way of thinking (Fromberg, 2006). Children have neither the scientists' conceptual framework nor the time to pursue a topic for a long time, unless of course this has been arranged (Hadzigeorgiou *et al*, 2012). In addition, too many kindergarten teachers have low levels of self-efficacy regarding their science knowledge and abilities, which impacts on their willingness and confidence to teach science in their classroom (Tytler *et al*, 2002).

In 2011, a new curriculum for pre-school education entitled 'New School' (Greek 'New School', 2011) was released by the Greek Pedagogical Institute, which was recently incorporated into the Institute of Educational Policy. For this curriculum, scientific literacy is viewed as very important in order that children can systematically inquire, solve problems, form a critical stance and actively take decisions that support the close relationship of science and technology with society (Greek 'New School', 2011). We argue that it is challenging to design specific intervention strategies and instructional material for early childhood to teach the concept of volcanoes in a manner that reduces a children's extraneous cognitive load. Children are also expected to enrich their volcano-related vocabulary after having been involved in meaningful experiences proposed by this teaching intervention.

The use of myths for the teaching of natural phenomena

There is a lot of research information about the use of story in early childhood science (Egan, 1986; Martin & Brouwer, 1991; Hadzigeorgiou *et al*, 2005). For Egan (1986), a story appears to be more appropriate than other means of communication in describing general ideas about the world. According to Martin and Brouwer (1991), a story can create a world of shared experience. The story can at times communicate in few words that which a dense, technical analysis might require many lines to accomplish (Martin & Brouwer, 1991). For Hadzigeorgiou *et al* (2005), the storyline approach is an imperative way to help children understand certain ideas about science, because stories help children to create a context in their minds. Even exciting stories can be made more exciting if they are complemented by hands-on activities that take place during narration of the story (Hadzigeorgiou *et al*, 2005).

The narration of myths and tales is a widespread and old way of communication, used both by adults and children. For Bettelheim (1976), traditional fairy tales allowed children to grapple with their fears in remote, symbolic terms and get a greater sense of meaning and purpose. It is a practice long employed by human societies to transmit information, explain phenomena, teach moral values, pose questions or solve problems. Natural phenomena, forming as they do a part of human experience, could not fail to constitute an inextricable part of such narratives. It is a well-known fact that narration is dialogical in character (Ricoeur, 2004); at kindergarten level, knowledge is often incorporated within a narrative form. Besides, children may recognise that myth was a means available to humans for the explanation of natural phenomena in the early stages of science's evolution. Children may thereby come to understand the development of inquiry into natural phenomena throughout history, from myth to science (Espinoza-Sandel, 2006). Myths, sagas and other aspects of oral traditions are said to have been vehicles by which any society would pass on knowledge, ideas, and admonitions to its children, in the absence of a writing system (Mendoza & Reese, 2001).

Through the use of myths, children develop a capacity for symbolic-mythological thought, which is complementary to rational thought and a major component of composite, global thought (Pike & Selby, 1988). Concepts of space, natural space in particular, also abound in mythic speech, including those of the mountains, the sea, the plains, the rivers, as well as that of humanised, residential space. Myths in pre-school education greatly enhance the children's ability to participate emotionally in the phenomena under discussion (Mendoza & Reese, 2001). They also allow certain concepts that are difficult for children to experience to be approached in an accessible and playful manner. In the teaching of natural phenomena, myth, besides the study of the phenomenon under consideration, offers information as to how this phenomenon influenced the world historically, socially and culturally (Kesamang & Taiwo, 2002). Essentially, myth contributes to the connection of phenomena taught at kindergarten with history and culture (Mendoza & Reese, 2001; Kesamang & Taiwo, 2002). Myth transposes the phenomena studied onto the realm of fairy tales, and this is meaningful and interesting to children.

In general, myths are said to provide characters and events with which children can identify and through which they can consider their own actions, beliefs and emotions. Children's pursuit of science as a human effort gives rise to feelings of admiration and beauty, as well as inspiring special interests in children (Hadzigeorgiou, 2005). Ancient Greek myths referring to various geological phenomena include those of Enceladus, Chimera, Talos, the Telchines and Hephaestus. The interpretations of the respective myths probably echo facts recorded by archaeological, volcanological and geological researches. In the context of the present teaching intervention, a myth concerning the volcano of Santorini was employed. Relative to the topic of the present study, the volcano of Santorini, represented by its accompanying myth during the teaching intervention in question, constitutes a part of Greece's natural and cultural heritage.

Teaching of volcanoes at early childhood

The children's familiarisation with natural sciences sets the foundation for their evolution as active citizens in the context of an ever-changing world. Despite the fact that extended efforts have been made to detect the children's representations regarding matters of physics, biology and chemistry, in the realm of the geological sciences, research into children's ideas remains relatively limited (Sharp *et al*, 1995; Dal, 2007). In Greece in particular, research studies into children's representations of geological phenomena are very few indeed (Apostolopoulou *et al*, 2009; Kalogiannakis *et al*, 2010; Klonari *et al*, 2011). However, the detection of children's representations is important, given that, through an appropriate intervention, these ideas may be modified, thereby approximating to a greater extent the scientific model (Kalogiannakis *et al*, 2012).

The topic of volcanoes is of particular importance in a country like Greece, where volcanoes constitute part of the ground's very morphology. The phenomenon of volcanoes thus constitutes a topic that might raise interest and attention in pre-school children, as well as contribute to the evolution of children into concerned subjects regarding the environment in which they live (Ortiz, 2006). Volcanoes attract the children's attention to the point of fascinating them, due to their 'power' (Ramirez, 2006), since children are often impressed by things that explode (Espinoza-Sandel, 2006). Besides, the teaching of volcanoes to pre-school children affords them the opportunity to understand that the world is an enormous space that exceeds the limits of their familiar environment (Espinoza-Sandel, 2006).

In research by Giannaletsou *et al* (2009), a teaching intervention took place at a kindergarten, its aim being to change children's ideas, directing them towards the scientific model. Notably, the considerable percentage of children who ignored the way in which a volcano is created was reduced after the intervention. The results showed that, before the intervention, many children had already formed certain initial ideas regarding volcanoes. It is worth pointing out that, after the intervention, their vocabulary was improved as to the number, as well as scientific correctness, of words used. Besides, there were few irrelevant words (e.g., *dragon, tree, truck*) and some of the children's answers regarding the creation of a volcano related to objects and experiences close to their environment (Giannaletsou *et al*, 2009).

Sharp *et al* (1995) found that children aged 9-10 years said that an earthquake took place when a volcano erupted, thereby essentially combining the two natural phenomena. Another piece of research about children's representations concerning earthquakes and volcanoes (Kalogiannakis *et al*, 2010) showed that, before the intervention, only a small number of children gave answers that approximated to the scientific model (e.g. a mountain that spits fire). For this study, the number of children whose answers approximated to the scientific model increased greatly after the teaching intervention.

Methodological context

This research uses a mixed methods design as a combination of using data collected quantitatively and qualitatively (Creswell, 1998). The identification of the children's ideas on volcanoes was achieved through interviews with children, and the children's drawings. The main aim is to investigate the representations of pre-school children concerning volcanoes. These ideas are then modified through an appropriate teaching intervention in order to approach the scientific model. The research, which is a case study, was carried out among 45 children aged 5.5 to 6 years in two public kindergartens in Rethymnon in Crete. The sample included 30 boys and 15 girls.

Research hypotheses

In the context of our research hypothesis we assume that, after the application of the proposed teaching intervention, children are expected to improve their representations of volcanoes by approximating to the scientific model.

Research procedure - teaching intervention

The research was carried out in three phases during February 2010. During the first phase, the children's initial ideas were investigated through conducting individual interviews and asking the children to produce a drawing of a volcano. The interviews were then transcribed (Miles & Huberman, 2003; Cohen *et al*, 2007). In the second phase, the teaching intervention took place. It started with the narration of the myth of the Chimera to the children. In Greek mythology, the Chimera is described as a horrible, fire-exhaling monster, with the body of a goat, the head of a lion, and a tail that ends in a snake's head. According to other descriptions, the Chimera was a three-headed monster, whose middle head spit fire. The monster's appearance was inspired by the fact that, at the foot of the Santorini volcano, lived many snakes; on the slope there were goats grazing and lions nested in its mouth. Hence, in the ancients' imagination, this Chimera monster was created, thus representing the three-cratered volcano of Santorini. The myth's narration was accompanied by the display of pictures, in order to render the narration more vivid. Then, the children were shown pictures of the Chimera and of the Santorini volcano, and were asked which aspects of the two appeared similar.

Children were divided into two groups and sought information on volcanoes in educational books. A discussion ensued regarding the information found in books, in view of approaching the scientific concepts on the phenomenon of volcanoes in a manner appropriate to their age. Through the information available in books, children were enlightened as to how volcanoes are created through the movement of tectonic plates.

The teaching intervention came to an end with an experiment seeking to represent the volcano's explosion, whereby soda was added to vinegar (which had been painted with red tempera) in a plastic bottle (Kalogiannakis, *et al*, 2010). The mixture bubbled and gushed out of the bottle, similar to lava from a volcano. At the end of the teaching intervention, as an evaluation activity, children were divided into three groups and they constructed volcanoes out of clay, which they went on to paint. In the research's third phase, a re-evaluation of the children's representations of volcanoes was carried out by means of individual interviews, involving the same questions as in the earlier phase of the research, and a new set of volcano drawings.

Methodological research tools

The basic questions in the interviews with children were:

(1) what is a volcano?
(2) what comes out of a volcano when it erupts?
(3) how is a volcano created?
(4) how did you learn about volcanoes?

The children's answers, after the relevant thematic content analysis (Miles & Huberman, 2003; Cohen *et al*, 2007) were divided into the following four basic categories:

(a) Don't know
(b) Insufficient
(c) Intermediate
(d) Close to correct

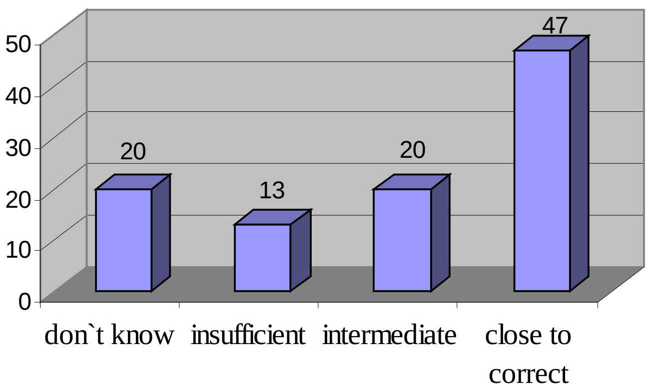
The research's second methodological tool was the children's drawings. This tool was essential, since it is undeniable that many of the representations formed by children on various concepts cannot be sufficiently expressed through language (Driver *et al*, 1994; Dove *et al*, 1999; Johnston, 2009). Similarly, children may find it easier to demonstrate their understanding of certain concepts by drawing rather than describing them (Dove *et al*, 1999). The combination of interviews and drawings helps investigate the children's representations of abstract concepts (Dove *et al*, 1999). Besides, the interpretation of children's drawings is deemed more reliable when accompanied by their oral description (Trend *et al*, 2000).

Results

This section will focus on the results of the evaluation of the children's representations of volcanoes, before and after the teaching intervention, based on their interviews and drawings.

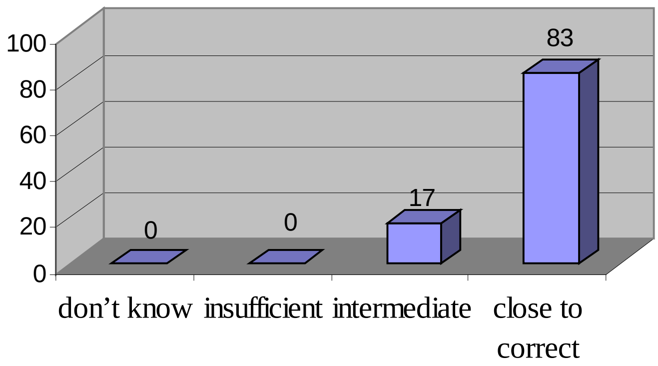
After the first question ('What is a volcano?'), those of the children's replies before the intervention that approximated to the scientifically correct answer presented the volcano as a *'mountain with a hole'* or as *'a mountain that emits fire'*, or *'lava/smoke'*. Deemed as intermediate or confused were such answers as *'a mountain that emits fire and glass balls'*, *'a thing that emits lava and smoke'*, or *'something that emits fire'*. Regarded as erroneous were those answers given by children that presented the volcano as an object that was irrelevant, albeit familiar from their everyday life, such as a 'carriage' or a 'bus'. Finally, a percentage as high as 13% ignored the concept of the volcano altogether (Graph 1):

Graph 1: Children's answers (%) before the teaching intervention to the first question: 'What is a volcano?'



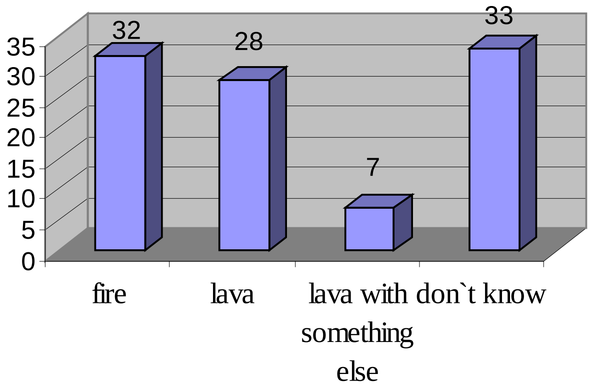
After the teaching intervention, 83% of the children gave answers that were closer to the correct one, mentioning that a volcano is a mountain that emits fire/lava and smoke/fireballs/firebombs or a mountain with a hole/crater that emits fire and smoke. Also, 17% of the children gave intermediate answers such as *'something that throws lava and stones'* or *'emits fire and balls'*. It must be pointed out that, after the teaching intervention, there were no children who gave wrong answers or who did not give an answer as to what a volcano is (Graph 2):

Graph 2: Children's answers (%) after the teaching intervention to the first question: 'What is a volcano?'



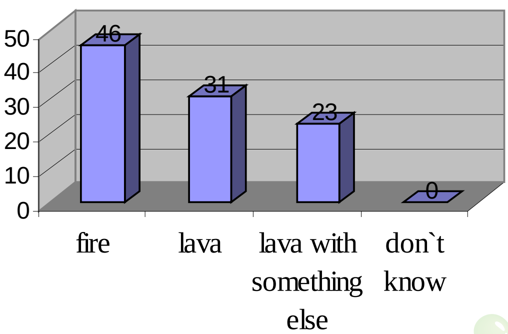
Regarding the children's answers to the second question ('What comes out of the volcano when there is an eruption?') before the teaching intervention, a fair percentage of the children (32%) replied *'fire'*, some others (28%) *'lava'*, a few (7%) answered *'lava with smoke'*, while 33% of the children gave no answer (Graph 3):

Graph 3: Children's answers (%) before the teaching intervention to the second question: 'What comes out of the volcano when there is an eruption?'



After the intervention, 46% replied that what comes out of the volcano is fire, 31% chose lava and 23% lava with smoke/fireballs/firebombs/stones. Not one child chose to ignore the answer to that question (Graph 4):

Graph 4: Children's answers (%) after the teaching intervention to the second question: 'What comes out of the volcano when there is an eruption?'



As to the children's answers to the third question ('How is a volcano created?'), it is worth noting that, before the teaching intervention, no answer was given by any one child. After the intervention, 6 children gave answers that approximated to the correct one (*'stones rub together'*, *'stones and iron melt and come out of the mountain'*) and the remaining 39 children said that they did not know.

The children's answers to the fourth question ('Where have you heard about volcanoes?') before the intervention showed the majority (27) saying that they had heard about it on TV, while the others gave no answer at all. After the intervention, 12 children answered that they had learned about it by reading books, 12 children by looking at pictures, 18 children by taking part in the experiment, while 6 children gave no answer.

The above evidence, comprising the children's answers to the interviews conducted in the course of the research before and after the teaching intervention, seems to confirm the basic research hypothesis. Following the specific intervention strategies, children displayed an improvement in their understanding about volcanoes, thereby approximating to the scientific model.

As for the children's drawings before the teaching intervention, 6 children (13.3%) produced no drawings at all, 6 (13.3%) drew the volcano as a familiar object (bus, boat), 21 (46.7%) drew a mountain, and 12 (26.7%) also drew a mountain, albeit of a rectangular shape. In the children's initial drawings, out of the 33 children who drew the volcano as a mountain, 24 showed fire/lava coming from inside. None of the children depicted smoke in their drawings. Three of the children had appeared, in answering the questions, to ignore what a volcano is; however, one of these children, when asked to draw a volcano, did draw a mountain (see Figure 1).

After the teaching intervention, 42 children (93.3%) drew the volcano as a mountain, and 3 children (6.7%) drew it as a rectangle. All the children drew fire/lava coming out of the volcano, while 39 children also added fireballs, and even smoke (see Figure 2).

Figure 1. Children's drawings of volcanoes before the teaching intervention

Figure 2. Children's drawings of volcanoes after the teaching intervention

Regarding the vocabulary employed by the children, before the teaching intervention, the words most used were '*fire*' (15 children), '*mountain*' (18 children), '*lava*' (12 children) and, less frequently, the words '*smoke*', '*stones*', '*hole*', '*crater*' and '*balls*'. There were also irrelevant words mentioned by 6 children ('*bus*', '*carriage*'). After the teaching intervention, the words used were '*mountain*' (33 children), '*lava*' (30 children), '*smoke*' (21 children), '*crater*' (18 children), '*fire*' (15 children), '*firebombs*'/'*fireballs*' (6 children), '*eruption*' (12 children), '*earth-stones*' (3 children). It is worth noting that no child mentioned irrelevant words after the intervention. The above evidence confirms the first individual research hypothesis.

Discussion – perspectives

In summarising the results of the present research, it should be noted that most of the children had already formed certain initial representations as to what a volcano is before the teaching intervention. These representations derived mostly from television, as revealed in the interviews that comprised part of the research. After the teaching intervention, the children's representations drew closer to the scientific model, while almost all of the children formed an idea as to what a volcano is. The results of the present research are in agreement with the results of other relevant researches (Giannaletsou *et al*, 2009; Kalogiannakis *et al*, 2010), which show that the children's representations of volcanoes may be improved, thereby approximating to the scientific model, after some teaching intervention about volcanoes. The above evidence confirms the basic research hypothesis.

It was also observed that, before the intervention, none of the children was aware of how volcanoes are created, while, after the intervention, the majority of the children continued to ignore the cause. It is true that the thought processes of children face several difficulties in coming to terms with the theory of tectonic plates (Gobert, 2000). It must be noted that, in the context of our intervention, and due to the time limit, the part addressing the cause of the volcanoes' creation, namely the movement of tectonic plates, was only presented through books, which proved insufficient as the sole method for children to digest the information. We therefore believe that, in a future intervention, further methods should be employed, such as conducting some hands-on activities relating to the movement of tectonic plates, which might contribute to an understanding of the creation of volcanoes.

Furthermore, after the teaching intervention, the children's vocabulary was enhanced with regard to the number, as well as the variety, of words. Some children have been able to draw a volcano, taking in such aspects as the shape of the mountain, the lava and the smoke, yet are unable to express these aspects in words, and it appears that certain concepts cannot be conveyed adequately through language by children of that age (Dove *et al*, 1999). It is significant that the topic of volcanoes did attract the attention of the children, who co-operated willingly and with interest, and were enthusiastic about the materialisation of the experiment.

In conclusion, it must be pointed out that the volcano is a topic that may be taught at pre-school age and is met with a positive response from the children, both in terms of understanding and of interest. Also, the practice of teaching through myths appeared to greatly improve the children's understanding and lead them towards the scientific model, thereby eliminating certain initial misunderstandings about the phenomenon of volcanoes.

Children can understand scientific concepts and reason scientifically (Harlen, 2006). Children at the kindergarten in which the intervention was carried out had never worked in such a way, and were impressed by the approach. It would be of great interest to extend this teaching intervention to further activities relating to volcanoes. The use of myths for the teaching of natural sciences provides children with opportunities for the development of their imagination, and should be carefully exploited, especially in the early grades of education, since imagination does not grow immediately, but rather evolves slowly and gradually.

Overall, the teaching in the context of the present research was a very interesting experience, which demonstrates once more that a pre-school class can become a laboratory for young scientists who wonder and enthuse over their own discoveries. It is a pedagogue's greatest joy to assist in those discoveries!

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Inquiry-based learning in the early years through storytelling

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Abstract

Young children learn through informal ways and many teachers use games and stories as common teaching strategies. Young children find it easier to understand new concepts through contexts. Research has also shown how young children's knowledge of animals and plants is limited (Gatt *et al*, 2007; 2008). This paper describes how a teaching methodology based on inquiry-based learning and using storytelling was shown to help children in the early years to learn more about animals and plants in science. The methodology involved the development of five lessons for 7 year-old primary level children and trialling them to evaluate their effectiveness. Each of these lessons was characterised by a story as an introduction, which provided a context for the investigation (inquiry) in science that was to follow. Qualitative interviews with the children and the teachers delivering the lessons were carried out. The results show that the children were very much engaged in the stories and subsequently in the science investigations that followed. The use of tactile resources, such as the Big Book and puppets, motivated and engaged the children more than the use of PowerPoints. In all situations, the children were found to have enjoyed the lessons as well as learnt new science concepts. It has been shown that storytelling can be used to provide a context for inquiry-based learning when doing science with children in the early years of primary education.

Keywords

Inquiry, Storytelling, Animals and plants

Introduction

Science plays an important role in young children's development, particularly in an era of advanced technology and where science is present all around us. Learning science from a young age is being recognised as a major contribution to scientific literacy for the future lives of all citizens (Harlen & Qualter, 2004). Inquiry-based learning, which is the main pedagogy advocated today, focuses on both the understanding of science concepts as well as the process of problem solving and drawing conclusions on observations and evidence gathered. This latter process aspect of doing inquiry includes the development of skills that are of value both for doing science as well as in everyday life.

Contemporary science thus emphasises problem-solving strategies whereby children come up with their own ideas and then trial them (Butzow, 2000). Children's literature can provide a relevant context for doing inquiry in the early years. The use of children's literature to introduce science concepts offers more than a vast variety of vocabulary. It also makes learning relevant by putting science concepts and process skills in a context that is meaningful to children (Henriques & Chidsey, 1997). Several researchers support this teaching pedagogy (Monhardt & Monhardt, 2006; Saul & Dieckman, 2005) and believe that children's literature can be used as an instructional tool in science. On the other hand, researchers have acknowledged that certain story books may present several misconceptions about science concepts (Kazemek *et al*, 2004; Trundle & Troland, 2005; Broemmel & Rearden, 2006) and educators need to offer several inquiry-based thinking questions to raise children's awareness about misconceptions (Trundle & Troland, 2005). Children's literature may thus be utilised to foster an interest in developing science concepts as well as inquiry skills in children, since they find it easier to follow ideas by listening to a story than through memorising facts from a textbook (Butzow, 2000). Through stories, investigations carried out gain meaning.

This article explores the advantages of introducing inquiry-based science activities to children in the early years through storytelling. The study reported here uses storytelling to introduce science concepts related to animals and plants to Year 2 students (aged 7 years) at primary level. Two main differing approaches to storytelling were used: the use of the Big Book, as well as the use of a PowerPoint presentation. The difference in impact between these two approaches in engaging the children in the inquiry activity was also evaluated.

Theoretical background

Animals and plants are common themes that young children like, and appropriate stories may foster interest in and positive attitudes to learning science in an early years setting (Broemmel & Rearden, 2006). Animals and plants are also common themes in the early years curriculum. However, young children were found to lack knowledge of animals and plants (Gatt *et al*, 2007; 2008), which implies that there is a need for effective teaching of these topics.

Children hold many ideas about science phenomena, and these are often incongruent with the scientific explanation. The ideas that children form are influenced by a number of factors. They may be influenced by direct physical or social experiences; by interpreting language from media as well as from school (Qualter, 1996). Children develop these ideas when trying to explain how things work.

Several studies have revealed that children prefer to study animals rather than plants (Baird, Lazarowitz & Allman, 1984; Wandersee, 1986). It is observed that adults and children often fail to notice plants in their environment. This is described as 'plant blindness', as people do not recognise the importance of plants for their survival. Young children share similar ideas about plants (Bell, 1981; Russell *et al*, 1991) and tend to categorise them according to their shape, with no trunk and growing in soil (Rymell, 1999). The main sources of information about plants were identified, including that obtained from parents (Gatt *et al*, 2007). School was not mentioned as a source from where children learn about plants (Tunnicliffe & Reiss, 2000). Therefore, schools need to fulfil a greater role in promoting awareness and understanding of science concepts related to animals and plants.

As children grow in age, their reasons for grouping plants become more complicated (Tunnicliffe & Reiss, 2000). Tunnicliffe and Reiss (2000) also show how children build mental models of the natural and physical environment and highlight how plants tend to interest pupils, particularly if the plants possess striking anatomical features. In an equivalent study on animals, Tunnicliffe and Reiss (1999) again reported that anatomical features were cited far more than behavioural or habitat features. This reflects the emphasis in science teaching on naming and categorising organisms as isolated entities. Tunnicliffe and Reiss (1999) suggest that teachers should start with environments and their significant features and then explore how animals adapt to their particular habitats.

Literature is one resource that can be influential in the teaching of science to children, particularly about animals and plants. However, although children's books have benefits in introducing science concepts to young children, they may also possess several limitations. Particularly in science, texts may be inaccurate and misleading and children may consequently develop misconceptions about scientific phenomena (Kazemek *et al*, 2004). Inaccurate illustrations (Trundle & Troland, 2005), use of fantasy (Broemmel & Rearden, 2006) and elements of anthropomorphism (Gomez-Sweip & Straits, 2006) are common features that may result in children misunderstanding certain scientific phenomena. Texts must therefore be used wisely, as they could hinder rather than promote proper understanding in science.

Literature can be used for storytelling. Storytelling is the art of using language, vocalisation, physical movement and gesture to reveal the elements and images of a story to an audience (Haven, 2000). Using children's literature to introduce science concepts to young children offers a solution to teachers who find science a challenging subject. There is growing consensus among researchers that children's literature can be used as an instrumental tool to teach science (Monhardt & Monhardt, 2006; Saul & Dieckman, 2005). This argument is put forward as it supports young children's development of science concepts (Zeece, 1999). Narratives serve to enrich the curriculum experience of pupils (Howe & Johnson, 1992). Stories can act as a direct stimulus to other learning experiences, such as investigations, drama and art (Howe & Johnson, 1992). The story structure helps children to identify relationships between the material world and their own personal world (Butzow & Butzow, 2000) and a non-fiction book about plants and trees may be of no relevance to a child's world. But, if presented in a story form (for example, *The Giving Tree*, (Silverstein, 1964)), the child's interest will definitely be sustained and learning will take place. However, although stories and poems are the foundation of primary education, very few teachers use these to teach primary science (Feasey, 2006).

Storytelling on its own is not enough. To be effective, it needs to be embedded within the inquiry-based approach of teaching science. Scientific inquiry may be defined as *'the use of the processes of science, scientific knowledge and attitudes to reason and to think critically'* (Martin *et al*, 1998, p.131). Through inquiry-based learning, students develop understanding through using mental and physical skills to gather evidence about the environment (Harlen, 2004). Inquiry-based learning not only helps students to learn *with* understanding, but also to learn *about* learning. Inquiry learning may be identified as constructivist learning, whereby children's ideas are the basis for activities (Harlen, 2006). The inquiry approach may be presented as a guided experiment or an open-ended investigation. Inquiry-based learning is very effective because:

- it views learners as having an active role in their learning;
- it considers science as a product of human thinking, with theories that are socially and culturally acceptable; and
- it takes into consideration children's ideas, which very often originate from their experiences (Harlen, 2004).

Methodology

As has already been indicated, the focus of this study was the use of storytelling to engage children in inquiry-based learning in science. The specific aims of the research were to:

- develop, based on existing literature on the teaching of science to young children and specifically on inquiry-based learning, a theoretical framework for developing science lessons using storytelling;
- develop five teaching activities in the area of animals and plants for Year 2 primary-level children applying this theoretical approach; and
- try out and evaluate the impact of using storytelling when teaching the schemes developed.

The theoretical framework, which was the first step in the study, was developed based on inquiry-based learning and the social constructivist perspective of learning. This meant that the children needed to be engaged in investigations as part of their inquiry, and that they had to do this in groups in order to enable the social construction of meaning. A similar framework was used throughout the lessons. The children were presented with a new experience in the form of the item under investigation. For example, the children were presented with beans, seeds, snails and earthworms, and had to state what they knew about the particular plant or animal. Their ideas were recorded on a KWL chart.

The KWL chart (Australian Academy of Science, 2007) is used to *'elicit students' prior **K**nowledge, determine questions students **W**ant to know answers to, and document what has been **L**earned'* (*ibid*, p.1).

Figure 1: The KWL chart

The teacher then proceeded with the storytelling activity. At the end of the storytelling session, the problem-solving situation was put forward. Further questions were listed in the KWL chart. The children were then placed in mixed-ability groups and discussion followed. Children discussed their predictions and ticked their answers on a Prediction Sheet.

The role of the story in the science activity was to provide a context as well as introduce the scientific question for inquiry. Each of the science activities developed thus revolved round a story, which ended with a question presented in a problem solving situation. The teacher and the children were then expected to devise an experiment to answer the question. From the five activities developed, three activities were based on two stories about plants. The remaining two activities involved stories about animals. The two stories about plants were derived from the fairytale 'Jack and the Beanstalk', but were adapted to the investigation that was to follow.

The five stories were:

- *'Which way shall we plant our bean?'*, exploring the outcome of planting a seed in different positions;
- *'Do plants grow in the dark?'*, exploring if in such circumstances plants grow well;
- *'Which is the fastest seed?'*, investigating growth rate of different types of seeds;
- *'What do snails prefer to eat?'*; and
- *'What is the earthworm's preferred habitat?'*

The 'Jack and the Beanstalk' stories were presented as a PowerPoint presentation. In the first story, three of Jack's friends asked questions about how best to grow their bean. Three ideas were put forward, one by each character in the story, who thought that beans either grow best in the dark, the shade or in sunlight. They wanted to know the best conditions for growth. The children then had to divide into groups to test the ideas presented and then try to solve the children's dilemma. In the second story, the problem involved deciding which way to best place the bean when sowing: right way up, sideways, or upside down. As in the case of the first story, the children then worked in groups to investigate what happened when they sowed seeds in different ways.

'The Tiny Seed Story' and 'Slimy Snail': the three other stories were presented through hand-made 'feely' Big Books. One story about plants was adapted from the book *The Tiny Seed* by Eric Carle (1987). The other two stories about animals were based on the story, *Slimy Snail*, written by one of the authors of this paper. The story about the seed revolved around different seeds and their mode of dispersion. The children had to investigate which shape of seed flew away in the easiest possible way. In the case of the slimy snail story, the children were presented with a story about a very hungry snail, and they had to help him find his favourite food. They needed to carry out an investigation to identify snails' favourite food. In the case of the earthworm, the children were presented with a story about its habitat and the children then had to investigate their natural habitat area at school to see what type of habitat earthworms prefer.

In implementing the methodology, the teacher went through a similar routine of first providing the material and resources, such as the story and the seeds or animals, to use for exploration. The children then engaged in exploration of the objects. At this initial point, the teacher asked open-ended questions to elicit children's ideas and inserted them into the KWL chart. The teacher then introduced the investigation through the story. The children worked collaboratively while exploring objects, sharing ideas while discussing prediction sheets. The teacher then engaged students in suggesting how to test the problem-solving situation and, when necessary, helped the children in planning their investigation, encouraging them to discuss their results and to relate these to their original ideas. The results were then shared with the class.

These lessons were carried out with 7 year-old pupils in three classes in one school. Different classes did the different lessons, due to a special request by the school. The usual class teachers delivered the lessons. After each lesson, five children from the class were interviewed by the researcher, with a total of 25 interviews carried out. The ideas identified by the children at the beginning of the lesson were taken as the benchmark to measure how much the children had learnt about the scientific concepts tackled. Teachers also provided their feedback immediately after the lesson. The children's interviews were audiotaped, transcribed and analysed.

Results

The interviews indicated that all the children enjoyed the lessons. The children were also observed to be very attentive during the storytelling part. This was also noted by the teachers, who stated that, even if they were unsure before the lesson, they felt that the outcome was positive:
'It was a fantastic lesson which the children thoroughly enjoyed. For the amount of activities it had it was a double lesson. It is normal for a primary class teacher to take up two lessons when conducting a fun lesson like this' (teacher).

This response was reflected as the children expressed their feelings about the content of the story, and particularly about the attractiveness of the Big Books. They spoke eagerly about the stories and seemed to embed their investigation within the story:
'It's like Slimy Snail' (pupil).

So, instead of talking about what snails liked to eat, they tended to refer to the 'Slimy Snail' as it was called in the story.

The result was that, when talking about the science concepts, many of the children used the names of the characters in the stories, showing their level of engagement with the context. These connections were also observed during the lesson as the children discussed their observations while carrying out their investigation in groups.

But how effective was storytelling in introducing investigations in science? Combining science with stories enabled children to discuss and reflect on their investigation. They encouraged inquiry because both the characters and the science were appropriate to the children's interest and level. Indeed, in the sequel story *'Can plants grow in the dark?'*, the children were using the names of the characters in the story. This reflected the high degree of the children's engagement in the lesson and in the context presented:
'Tom's has a lot of roots – Wendy's is white' (pupil).

A similar approach was observed in the sessions with the snails, where children were overheard making connections to the story. The children were referring to the snail as 'my snail' as well as 'Slimy Snail':
'Slimy snail enjoyed his meal. It's moving its eyes' (pupil).

The storytelling sessions were so effective and the children became so involved in their play that they were actually using pretend play. A similar impact was observed by Lindon (2001).

The lessons also engaged all children within a mixed ability setting, since all had the opportunity to participate and to experience success in their science activity. They were all able to investigate the seeds as well as handle the snails and the earthworms. When the children shared their views at the beginning of the lesson, all ideas were accepted. Children's enjoyment and confidence increased. They learned to listen to their peers' alternative ideas and became aware of how different children held different ideas.

The use of the KWL chart was welcomed by the teachers, as it proved to be useful in identifying the children's existing ideas in science. The teachers stated that this was a resource that could easily be used with a new topic to assess and monitor children's learning. It also showed how the children could identify what they knew about the science concepts at the beginning of the lesson, and what they learned as a result of their investigations.

The five lessons focused on finding out, and thus demonstrated aspects involved in inquiry-based learning. The children manipulated materials and made observations before arriving at a conclusion. It was observed that the predictions generated more careful observations among the children. For example, in the case of the seeds, the children were seen to consider different aspects of the seed, such as its weight, size and shape. They did this by manipulating the seeds in their hands as they discussed and reflected.

The discussion about the investigation results engaged the children in trying to make sense of what happened and why, even during the post-lesson investigation. Throughout the exploration, the children were incorporating the basic science processes of observation, communication and classification. They were using their senses, sharing their ideas and attempting to solve the problem presented to them. For example, the children were able to make reference to their observations when working out what conclusions they could draw, and could also identify the main reason for making such statements. When the children planted their own seeds and, after two weeks, none had sprouted, they could come up with valid answers to the teacher's question *'why do you think that they haven't sprouted?'*:
'Because they weren't in the sun'
'Maybe we didn't water them enough'
'The seed, when you give them a lot of water, they die'

The children expressed a strong preference for such an approach to science when compared to reading out from a book. They stated that it was more interesting, fun and that they could find things out for themselves rather than reading about them. The lessons also presented some challenges. The prediction sheets were a new approach to the children and some were concerned about what to say, tending to look at what others were writing down. Some of the children did not like the writing part of the activity. This may have been because the children were not accustomed to this type of activity and needed to become familiar with what is expected from them. Possibly, with more experience of such approach, the children may also become comfortable with the use of prediction sheets. It could also be that some children were reluctant to express explicit opinions, which could then be proved wrong.

In considering the level of learning that took place as a result of these lessons, it was noted that the investigations went beyond enhancing the understanding of scientific concepts, but served also to enrich the use of scientific language. In one particular example, the use of the snail's tentacles and/or feelers enabled a discussion among the children on what is the more appropriate word to use. During the interviews, the majority of the children mentioned the snail's antennae and their function several times.

PowerPoint vs Big Book

One of the teachers had the opportunity to deliver the science lessons using both the sequel PowerPoint stories and the Big Book story, *The Tiny Seed*. The teacher commented that both were effective and the children enjoyed both stories. In the case of the PowerPoint presentations, the stories generated discussion, stimulated the investigation, and promoted learner involvement and motivation. Several children mentioned that they enjoyed the element of humour in the sequel story:
'I liked the giant part when he was crying. He was funny'
'Planting of the seeds and I like the story when the giant was crying'.

On the other hand, the Big Book stories stimulated curiosity, as the colourful 3D pages presented science concepts in a form that encouraged children to build a hypothesis, predict events, gather data and test the validity of the events. When the children were asked to comment on the story, *The Tiny Seed*, they did not only refer to enjoyment of the story, but also emphasised the texture and attractiveness of the book. Indeed, the Big Book motivated the children to touch and feel the book. In the case of the snail and earthwork activities, the Big Book generated greater involvement and enthusiasm in

the children. The fact that children were asked to manipulate the detachable paper snail caused direct interaction and participation:
'I really enjoyed the story, it was a lot of fun because I never see a Big Book'.

What do snails prefer to eat?

Which is the fastest seed?

Discussion

Reading stories related to animals and plants to children may be one of the best ways for them to first encounter science when they are young (Goins, 2004). This study has sought to promote three important aspects with respect to doing science with young children. These different aspects include using stories to:

- make abstract concepts concrete and accessible to young children;
- enhance the development of children's process skills involved in inquiry as well as encouraging curiosity; and
- present science in a problem-solving way, where children are then engaged in a hands-on investigation about the world around them.

The overall results of the observations and interviews show that the stories encouraged discussion and reflection as the children associated themselves with the characters in the story. The children were familiar with the characters in the sequel story and they also associated themselves with the characters in the animal story. It is interesting to note that there was no particular confusion between the fictitious story and the science investigations carried out, and the children could easily navigate between fiction and non-fiction. The stories enabled the children to find a purpose for carrying out a science investigation, and this led to meaningful discussions taking place.

The 3-dimensional books seemed to be more effective compared to the use of the PowerPoint presentations when telling stories to young children. The Big Books allowed the manipulation of objects. The children were using all their senses as they touched and manipulated the material and creatures in the book. This shows that children need experiences that allow them to use all of their senses. Carrying out observations requires children to note how things look, but also how they feel, taste and smell. The Big Book appears to have elicited full engagement with children wanting to touch and feel, rather than just see and reflect.

The stories with an element of humour tended to be very attractive to young children. The humour brought in an element of fun, which made the activity enjoyable. The humour thus increased the levels of enjoyment and consequently of engagement. The affective aspect of the way in which the science activity was presented created an atmosphere in which all children enjoyed doing science.

The stories also enabled the children to build on their prior knowledge, to address their own ideas and compare the outcomes of their investigation to how they previously thought that things worked. This was also insightful to the teachers who could measure the level of learning and the shift in scientific knowledge that the children achieved as a result of the learning experience.

Conclusion

The implications of this study are that stories and storytelling, used so much in the early years of education, can also be used to promote the learning of science through inquiry. Stories can help young children to make the link between scientific concepts and the real world, a leap between understanding science and its application that is also a challenge to many older children. The potential of storytelling is great. While one still needs to be careful as to how stories are presented and used for the purpose of promoting science, they can be strong learning resources that engage children who can be easily distracted from school and class activities in a world full of other 'more attractive' things, such as the virtual world of the Internet. In addition, stories do not require much additional cost in terms of resources, which can enable teachers to improve their practice when money for resources may be running dry.

Storytelling in science can be one strong tool to promote the development of inquiry skills, which are not only very important for doing science, but an essential part of the preparation of children to deal with the new challenges that life presents in present day society. If we start children young, they will stand to benefit, not only in science, but also in all other aspects of life.

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Right place, right time: First aid – an integral part of science education

▪ Jane Cooper

Abstract
First aid is an important humanitarian action that all people can offer in some form. A study carried out in nine primary schools across the UK, with approximately 400 children, has shown that children can learn basic first aid skills from the age of five. Teachers were given resources to use and asked to assess the learning of their pupils over a total of two hours. The learning outcomes were achieved with 74% or more of children. Around two months later, approximately a third of the children were individually presented with scenarios that assessed the retention of these skills and their ability to use them. The children responded extremely well, demonstrating a high retention of the first aid skills. Following this research, the British Red Cross produced a free online first aid education resource for primary schools, with differentiated materials.

Keyword
teaching first aid; early years; science; observation; assessing risk

Introduction
Science education involves observation, communication, problem solving and assessing risk, as does first aid education. As a science teacher, I used to find that learning a first aid skill to treat an often familiar injury or illness acted as a motivator and supported the learning of other aspects of science. A Nordic study has shown that children can have knowledge of the organs and bones in the human body from age 6 (Óskarsdóttir *et al*, 2011). It argues that the extent of this knowledge is dependent on cultural aspects such as cooking habits, pictures in books and campaigns to encourage the wearing of cycle helmets. Creating a culture where first aid is learned from age five can:

- act as a motivator to learn the use and position of parts of the body; and
- increase the value children place on parts of their own and others' bodies.

Prokop *et al* (2007) argue that differences in the knowledge of the skeleton and organ systems of animals may be attributed to children's motivation or willingness to be 'alerted' by more interesting factors. They also found that children using three-dimensional preserved animals, rather than two-dimensional pictures, learned the anatomy of organ systems significantly more easily. Could seeing the extent of the chest rising and feeling the breath of a colleague acting as a 'casualty' make as great or possibly greater impact? This activity would emphasise the size and position of the lungs, as well as the importance of exchanging air with the environment.

Some of the teachers on the study were amazed at the experiences of first aid incidents that the children were relating. Driver *et al* (1994) points out that children are developing ideas about natural phenomena before they are taught science in school. Should we not be giving them the chance to gain a greater insight from these situations? Tunnicliffe (2004) argues for a holistic, integrated approach to the teaching of the systems of the human body. First aid learning encourages this.

The familiarity with injury was seen in one of the classes of 5-6 year-olds observed in this study. Here, around a third of the children had experience of either being burned themselves or someone close to them being burned. This did not appear to be unusual when the topic was discussed with other teachers in the study.

Some teachers have taught first aid as part of a topic on the human body, others as part of PSHE, looking at supporting others and social communication. I would argue however that its main role in the science curriculum lies in assessing risk and problem solving. It also encourages a collaborative spirit and teamwork. Phoning 999 calls in the experts who can both support and give a greater input. Science is also about knowing the questions to ask and first aid requires the development of this skill too.

Every single day in the UK there are more than 2,600 open wound injuries, 2,400 bone injuries, 290 injuries from burns and almost 40 incidents of choking. Around one third of these involve children under 15, with 44 % of burn injuries being in this group (British Red Cross, 2006). It is also becoming apparent that, on occasions, people in need of first aid are being ignored and people are arriving in Accident and Emergency units with injuries that could have been considerably reduced had first aid been given. The British Red Cross believes that everyone should have not only the first aid skills to help both themselves and others in an emergency situation, but also the confidence and willingness to use them. Often the earlier a person learns a skill, the more that skill becomes second nature.

To make first aid easy to learn, easy to remember and to give people the confidence to use it, the British Red Cross has simplified its teaching of first aid skills through general public courses for adults, such as *Everyday First Aid*. This course is based on clinically accurate but less complex interventions. The resources produced to help children to learn first aid were based on this course.

It has been shown that young children are not only aware of injuries and the treatment of them, but are also capable of reasoning within their experience and common sense (Tunnicliffe, 2009). This project investigated the following questions:

- Could children as young as five learn first aid skills?
- What knowledge and skills could pupils aged five to eight learn and how?
- Could children retain this knowledge and these skills?

A variety of activities were provided to enable the children to learn. These included talking about previous experiences, card sorts, practical work and role play. The latter has been shown to be an effective method of encouraging learning in adults and also an important tool in early learning in children (Rogers & Evans, 2006).

Research method

Nine schools across the UK were involved in the research. The whole project included 25 classes (see Table 1).

It was initially hoped that the classes would all contain just one chronological age group, but this was not possible as three of the schools involved had classes that contained a few children of the chronologically older age group in the classes volunteering for the study. One school could not offer Year 1 (5 – 6 year-olds) or Year 3 (7 – 8 year-olds) and, instead, offered Year 2 (6 – 7 year-olds). The teacher chose to use the content and materials for 7 to 8 year-old children. This group was used in the pilot phase and the statistics are not included in the main figures. All pupils used in the scenario assessments to test retention come from the appropriate age range.

For the purposes of this article, I have limited the discussion to the results gained from the 17 classes that contained children aged 5 to 8. Fifteen teachers took part in this section of the study. The lessons took place over two weeks, sometimes a little longer if other school activities intervened. As a consequence, the number of children present and the support available to the teacher varied slightly. The researcher visited each class to observe one session and there was a total of 410 children at these sessions. There was a teaching assistant supporting the teacher in two of these observed classes, and two classes had teaching assistants taking the primary teaching role.

The schools came from a variety of areas, both rural and urban, with a range of intakes (e.g. percentage of children with special needs, different ethnic backgrounds, free school meals, etc.). At least two children were autistic and one used a wheelchair.

All parents were asked for permission for their child to be part of the study. One parent requested that his/her child did not participate in the lessons and so separate arrangements were made for this pupil. None of the schools or children involved in the research has been identified in any way, to ensure anonymity. Because of the nature of first aid, there were many disclosures and recounting of experiences by the children and staff and these have been treated with consideration and confidentiality as appropriate. The images within this paper are for illustrative purposes. They do not come from any of the research schools for the above reasons, but from another school that was undertaking first aid sessions for their pupils and kindly agreed to launch our online resource. Parental permission was given for all these images.

Procedure

The research involved:

- the development of specific teaching materials, e.g. lesson plans, group work activities, PowerPoint presentations, for the classroom teachers;
- primarily two age groups being taught first aid: 5-6 year-olds and 7-8 year-olds;
- classroom teachers teaching the equivalent of a two-hour first aid session split into two to eight sessions depending on the age and ability of the groups;
- the classroom teachers and the children assessing the effectiveness of the learning;
- the researcher observing a sample of the sessions; and
- the researcher revisiting around a third of the pupils two months after the sessions to give individual scenarios that assessed their retention of knowledge and skills and their approach to giving first aid.

Table 1: Number of classes and ages of children taking part in the full study

Age of the majority of children in the class	5 to 6 years	6 to 7 years	7 to 8 years	9 to 10 years
Number of classes	8	1	8	9
Number of classes containing a few children older than the majority age	3		3	3

Topics studied

Table 2: Topics taught

Learning Outcome	Age – 5 to 6 years	Age – 7 to 8 years
Safety – checking an area is safe		
Alert an adult if an area is not safe or someone is hurt		
Phoning the emergency services		
Causes of burns		
Treatment of burns		
Recognise unconsciousness		
Treat unconsciousness		

Retention assessments

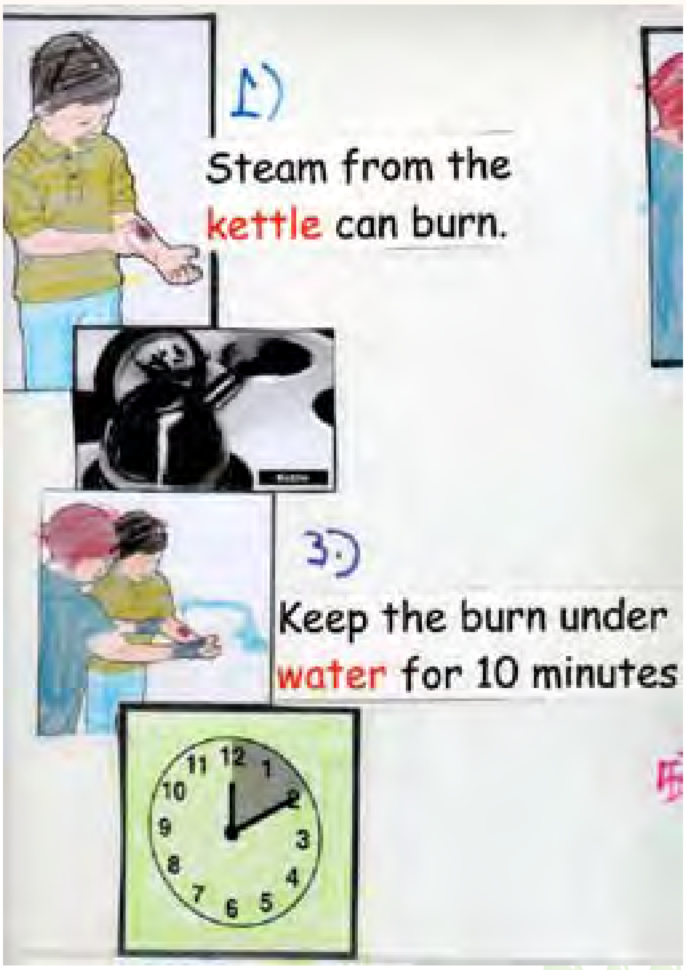
We were able, in the majority of cases, to randomly select the children to undertake the mock scenarios. The children were told that when they entered the scenario room they would find that 'pretend accidents' happened and to do what they could. The 5-6 year-old children were presented with a room containing six hazards: e.g. an electric lead lying across the room, and a broken bottle. They were asked to identify the hazards and, then, another child having 'burned themselves' on a metal spatula came running in. The 7-8 year-old children were given the same 'burns' scenario, with the child then becoming 'unconscious', lying on his/her back. All children were assessed while making a 999 call. The pupils were told that it was extremely important that they did not tell their friends what happened in the scenario room until all the children had completed the activities. We believe, though cannot be entirely sure, that only one child had been informed by her friend of what to expect and this had only a minor effect on her performance.

Key findings

Teacher assessment and pupil feedback

The teachers assessed that between 92 and 100% (depending on the lesson) of the pupils were involved and interested in the lessons. The classes included a considerable amount of practical work and the teachers were immediately able to assess the numbers of children fully participating in this and the enthusiasm with which they did so. Other methods of assessment varied in the different schools. Some teachers asked oral questions of the whole group or individual pupils. Others asked for written or drawn comments. This could take place at the time of the lesson, at the start of the following first aid session, or during another part of the curriculum when the teacher was using the first aid as a vehicle for other forms of learning, e.g. literacy. *'All the children were engaged and focused on the activities. They drew from personal experiences and shared with the class very enthusiastically those which related to the topics'* commented one teacher, while another said that the pupils' experiences were *'quite an eye opener'*. The pupils' feedback was very similar, with between 89 and 99% indicating that they had enjoyed the sessions. Comments from the pupils included *'I enjoyed this lesson because I got to learn really important things that you will do in life'* and *'I enjoyed this lesson because it was fun to learn first aid'.* To respond to certain questions, the children were given a choice of three 'blob men' – green, smiley; orange, straight mouth; and red with a downturned mouth. One child commented that *'I have circled most of the green blobs because I feel I can do them [the first aid] for real'.*

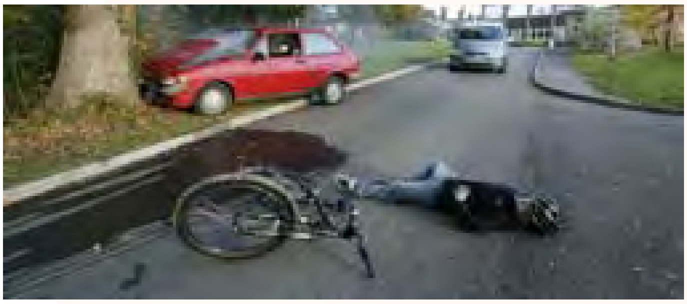
Figure 1: Part of a cut, sequence, stick and colour activity set to enable a child with English as a second language to develop both her science and English skills.



The children were encouraged to speak of their experiences, which varied from burns from hair straighteners to having to phone the emergency services when a sibling was seriously ill. One child, having been taught to phone 999 by his mother, had to do this when he was four as his mother had been badly injured. There was always a buzz during this part of the lesson and time limits had to be put on the discussion. First aid stories were often used as a vehicle for other learning.

Pictures were drawn, cards sequenced, sentences written and role plays carried out to develop a number of skills. Scientific communication was developed and cause and effect was explored. One teacher commented that *'The card sort for the burn was interesting as we discovered not just one correct order, so demonstrating good thinking and reasoning skills'.* The card sequence could either end by calling 999 or this could be done immediately after the burn was put under cold running water, depending on the severity of the burn. The role play involving the emergency service call in particular gave opportunities for individuals to use scientific terms. Scenario pictures allowed the child reporting an incident to develop observation skills.

Figure 2: Scenario picture used by the children to report to the emergency services.



The child acting as the emergency operator had to ask appropriate questions. Often the children were encouraged to use their imagination to make up their own scenarios. The remote control plane hitting a father on the head during landing sounded as if it had an element of truth to it!

Figure 3: Learning how to make a call to the emergency operator (a key first aid skill).

Nearly all the learning outcomes were clearly thought to have been achieved by the vast majority of the pupils. In one school, the children toured the school looking for hazards. One of the hazards identified was an incidence of chairs left where people were walking. The teacher commented that, following this, all the class now tuck their chairs in. Many children initially thought that, when someone is injured, the only person who could help would be a doctor or nurse. After the session, comments and drawings showed that they now believed that there are actions that they could take to help. The learning outcome that presented the most difficulty was how long to hold a burn under cold water. Various techniques were employed to demonstrate that treatment is needed for a long time, from using the egg timer on the whiteboard to singing songs. One pupil who stood by a running tap for ten minutes commented with a heavy sigh that, had he been playing a computer game, it would not have seemed that long, but standing by the tap felt like a *very* long time! Introducing this idea of a 'long time' was felt to be important and the precise timing could be reintroduced when more pupils were able to tell the time.

In some cases the percentage of those achieving the learning outcomes dropped to 30%, particularly when there was a high percentage of children with special needs in the class. Ten percent more of the older pupils, aged 7-8, were believed to have learned how to contact the emergency services. Many were also able to use scientific or technical language to communicate the problem to the operator.

Figure 4: Developing an understanding of burn damage to the skin through role play.

Following the lessons, the children were asked if they felt that it was important to learn first aid. Over 93% indicated that they thought it was, by circling a green 'smiley man' rather than the other two choices. Over 88% believed that they had learned the skills in the session and had the confidence to use them, though this dropped to 80% when dealing with unconsciousness.

The teachers assessed that over 80% of the 7-8 year-old children had learned that someone who was not moving, not responding and lying on his/her back was not in a safe position. Furthermore, they had learned to turn the unconscious person on his/her side with the head tilted back. It was noted that it often took extra time and reinforcement

Table 3: Achievement of Learning Outcomes

Learning Outcome	Average percentage of the class that achieved learning outcome assessed by the class teacher (where the range is not included, this is very narrow)	
	Age 5-6 years	Age 7-8 years
Be able to spot hazards	94%	n/a
Be able to recognise the need to alert an adult. (Or, with 7-8 year-olds, to call 999.)	80% (range 30 to 100%)	96%
Be able to distinguish injuries severe enough to call for an ambulance.	92%	n/a
Be able to call 999	86%	96%
To know that a burn is treated by cooling it	74% (range 30 to 100%)	76% (range 50 to 100%)
To know that a burn is cooled for at least 10 minutes	n/a	52% (range 15 to 75%)
Be able to recognise that, if someone is not moving and not responding, they may not be in a safe position	n/a	80%
Be able to do the following checks: Danger, Response, Airway Breathing	n/a	80%
Be able to put an 'unconscious person' on his/her side with the head back	n/a	86%

to develop the understanding of keeping the airway open. It was only when this understanding had been developed that the sequence of checking the person is breathing and then rolling the person onto his/her side to ensure an open airway was properly remembered. The pupils that retained this knowledge were thought to have developed a knowledge of the position and need for an airway down the throat.

Parents' responses

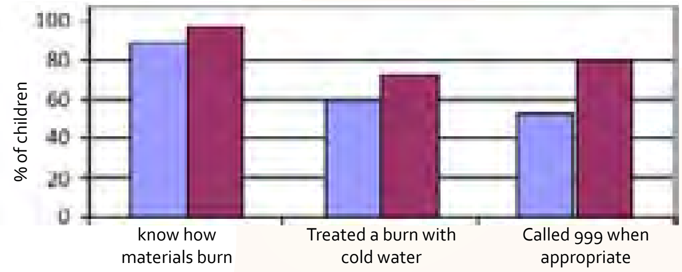
Some of the children passed on what they had learned to their families and one school went on to make a 'Save a Life' tree upon which children put a leaf each time they taught a family member a first aid skill.

One parent commented that *'I had forgotten my daughter was learning first aid until I saw her put her sister in the recovery position (on her side with her head back) while they were playing.'* Thirty percent of parents in the participating schools returned the questionnaires that had been sent home. Ninety eight percent believed that it was important for their child to learn first aid, but only 38% had talked to their child about what to do in an emergency, prior to the lessons. One parent remarked that *'We…shared the knowledge together.'* Following the sessions, 82% of the parents believed that their child would cope better in an emergency. One comment from the parent questionnaire stated that *'My child would not now panic in view of training'.* This was evidenced by one boy whose younger brother cut himself badly on a pane of glass. Their grandmother was caring for them at the time and was clearly unsure what to do. The boy opened the front door and yelled *'Help'.* Thankfully a man nearby had received first aid training and was able to assist and ensure that the injured child reached hospital. The outcome could have been considerably worse, had the child not understood that this was an emergency situation and acted appropriately.

Retention assessment

When presented with an 'injured' friend, all bar one child attempted to help. Children responded to the burn scenarios by covering the burns in water from taps, if available and noticed, or from water bottles (see Figure 5 on page 30). Emergency services were called and occasionally the 'injured' child was comforted and checked over for other injuries. Children who were unsure what to do were shown the telephone, would then call 999 and be asked if they knew what to do or given further suggestions as necessary. Often a little prompting was sufficient to enable the child to carry out the treatment. One girl, whose primary language was not English, phoned her mother to start with. When it was suggested that she phoned the emergency services, she called 999 and, with a little encouragement, was able to answer the questions. The confidence she gained from achieving this was clearly evident in her beaming smile and her later conversation.

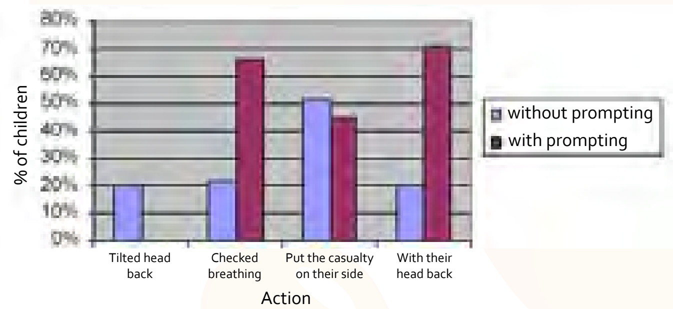
Figure 5: Children demonstrating retention of Learning Outcomes



Key: Blue – children aged 5-6 years; Purple – children aged 7-8 years

One child asked if the number 9 could be shown to him on the telephone, as he knew what to do but could not identify the number. He had been identified by the school as having number recognition problems, but had good verbal skills and the confidence and motivation to ask for help. Once the number had been shown to him, he keyed it in and answered all the questions from the operator with ease and accuracy. This further built his confidence and offered an example of numbers in action. (The question should be raised as to whether further use of the telephone might help with the development of number recognition. Some schools had used a number game to aid remembering 999, but others felt this was unnecessary as their particular pupils were already familiar with their numbers.)

Figure 6: Unconsciousness – The percentage of children acting appropriately with and without prompting



Although the majority of pupils initially forgot to check the breathing and ensure the 'casualty' had his/her head back, with an open airway, they remembered what to do and how to do it when prompted by the researcher who was role playing the 'emergency operator'. Over 50% of children remembered to put the casualty on his/her side (see Figure 6).

Conclusion

All schools participating in the study said that they would teach first aid again the following year, many planning how it would be fitted into the curriculum in the most appropriate way. One teacher was extremely reticent at the start – *'I don't know why the Head chose me; I don't like blood!'* After seeing the improvement in learning during the lessons, there was no doubt in her mind that they should be repeated in future years. Much to her surprise, she had also greatly enjoyed teaching the lessons: *'The children have benefited so much from these lessons. I will definitely be incorporating them into my curriculum plan for next year.'*

The teachers' assessment of the children's learning indicated that the vast majority of children aged 5-6 learned:

- about hazards;
- when to alert an adult;
- when and how to call an ambulance;
- the causes of burns; and
- how to treat a burn.

Approximately the same percentage of the older age group knew to cool the burn, and this was more consistent across the schools. The lack of the ability to tell the time meant that only around 50% learned how long to cool the burn for and, in some schools, this dropped to 15%. The variety of techniques used to demonstrate that the treatment needed to be undertaken for a long period showed the importance that the teachers placed on this aspect. It was also an opportunity for the children to start to learn about estimation.
Eighty percent or over of the older age group were assessed to have learned about unconsciousness and its treatment.

The children learned through a variety of methods, including practical work, role play, using card sorts and talking about their own and others' experiences.

The majority of both age groups had retained their knowledge and skills regarding burns and calling 999 when assessed two months later. The retention of the treatment for unconsciousness was more variable, but with support via a telephone the vast majority of 7-8 year-olds were able to take appropriate action.

Discussion

Teaching about unconsciousness and its treatment was an opportunity to learn about airways, lungs and the need for air. The timing of teaching this topic is debatable, but linking it in with the teaching of breathing would benefit both topics. Using the human body itself links with findings by Prokop *et al* (2007) that the use of a three-dimensional organism aids the learning about the anatomy of animals.

Creating a culture where first aid is learned as part of the science syllabus from age five could enable the easier learning of human anatomy (Óskarsdóttir *et al*, 2011). It could also give children a greater respect for their bodies and those of others, lead to a better understanding of illness and injury in later years and hence a more appropriate use of the National Health Service.

Some of the teachers in the research schools suggested that early years teaching could include additional aspects of first aid, such as treatment for nose bleeds, broken bones and asthma. They felt that these health issues would often be experienced by children of this age and so a greater understanding of how to act and, in time, of the causes behind them would encourage an appropriate response by all the children.

If, as Tunnicliffe (2004) suggests, a holistic, integrated approach is taken to the teaching of the systems of the human body, then first aid can support this. For instance, there is a need to maintain an open airway in a person who is unconscious and breathing, and to apply pressure in the case of a severe bleed to keep the blood inside the body. Both support the circulation of oxygen. In placing an unconscious person on his/her side with the head back to ensure the airway remains open, the chest will be in a position to enable the lungs to expand easily. This reinforces the position and size of the lungs, while demonstrating the role of these organs.

Learning about food and air tubes (oesophagus and trachea), introducing the concept of choking, and explaining the problems behind what happens when 'food goes down the wrong way', can give the knowledge gained a relevance to everyday living. Introducing the simple treatment gives children empowerment and a belief that they can cope in an emergency. Learning about the damage to skin in a burn reinforces the role of skin as a protector. Outbreaks of mass infections in some schools have also re-emphasised the need to teach about hygiene and keeping the skin clean.

Children as young as five can learn basic first aid skills and believe that it is important to do so. We know that some schools using the British Red Cross materials are also successfully using the resources and ideas with children younger than five.

This leads us to believe that other simple first aid skills could be developed. Having a good understanding of the treatment can make the incident less frightening and reduces the risk of treatment myths being picked up. In the research study, 9-10 year-old children were taught what to do if they had a nosebleed. It was clear that many had already been shown the wrong treatment, occasionally maintaining that this *'had made them feel sick'.*

Figure 7: Children showing a knowledge of the correct position and the pressure required to treat a nosebleed (whilst also demonstrating good caring skills at work).

It was noted that, once the emergency services had been called and therefore support was available, the vast majority of children were more at ease with carrying out the checks and placing the casualty in the appropriate position. It could be argued that it is better to teach the children about this aspect of first aid at this age so that, with the support of the emergency services, they could make the appropriate intervention. However, it could also be claimed that it might be better to leave teaching about unconsciousness until the school curriculum had reached the point of developing the pupils' understanding of airways and breathing.

On the other hand, the support a child can get once they call the emergency services is immense. This is a skill that should be taught as early as possible. Teacher assessment and specific retention assessments carried out by the researcher show that the majority of 5-6 year-olds are able to learn to call an ambulance.

Many teachers and parents commented on the need to revisit and progress first aid skills as the child moves up the school, becoming more independent and gaining more experience of life. Part of science education must be about assessing risk, reducing risk of harm and being able to act appropriately should anything unfortunate happen. The teachers, children and parents all believed that their first aid sessions had started to develop aspects of this. First aid is a skill that should form part of life from an early age. Let's make first aid second nature!

The resource produced as a result of this research is *Life. Live it. First aid education for children*.
It is available, free, at the following website:
http://www.redcross.org.uk/What-we-do/Teaching-resources/Teaching-packages/Microsite/Life-Live-it-first-aid-education-for-children

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Jane Cooper, First aid education department,

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 is published twice a year; in spring/summer and autumn/winter. It is 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/journals/journal-of-emergent-science/
Click here for a subscription application.

Early Years Conference: Development and learning from birth to 8 years of age – Friday 5th July 2013 at Bishop Grosseteste University College Lincoln.

This conference is aimed at all those working in the early years with children from birth to 8 years of age. The combination of research presentations, seminars and workshops will provide an opportunity to share ideas and expertise and extend and develop professional practice.

Keynote speaker: Professor Iram Siraj-Blatchford (Institute of Education, University of London)
Pedagogies to support early years development and learning
Professor Siraj-Blatchford is an academic and researcher with a national and international reputation for her work in the early years. Her research has focused on the impact of home learning, staff training, pedagogy, curriculum and assessment on young children's learning and development, particularly those children and families from vulnerable backgrounds.

Workshops, seminars and **discussions** include a focus on teaching approaches and pedagogies involved in:

- play;
- creative little scientists;
- early reading;
- outdoor learning;
- listening to children talk; and
- building relationships.

Cost: £100 (Overnight accommodation available on request)

For more information about the Conference and to download a flyer and application form, please visit our website:
www.bishopg.ac.uk/professionaldevelopment
or contact pde@bishopg.ac.uk or conference@bishopg.ac.uk

Creative Little Scientists Training Summer School

Crete, Greece – 30th June – 5th July 2013

The training course will be based on the teacher education curriculum design principles and guidelines formulated in the EU-funded project, *Creative Little Scientists* (http://www.creative-little-scientists.eu) and aims to promote creative approaches to science and mathematics learning in pre-school and the first years of primary school. More specifically, the objectives of the training course specify that teachers, as a result of the course, will feel empowered to:

- use inquiry-based and creative science education approaches;
- have positive attitudes towards learning and teaching science, mathematics and creativity;
- act as innovators, researchers and reflective practitioners; and
- engage in communities and partnerships with other stakeholders (other teachers, parents, professional associations, experts, etc.).

Participation in this event is funded by the European Commission through the Comenius and Grundtvig programmes; therefore interested teachers or trainers can simply contact their relevant National Agency. The list of eligible countries (EU ones, plus Turkey, Croatia and FYROM) and the contact details of the National Agencies can be found here: http://ec.europa.eu/education/lifelong-learning-programme/doc1208_en.htm

The deadline for applications is January 16th, 2013.

For any further information and details of how to apply, please contact Dr. Fani Stylianidou (fani@ea.gr) and Dimitris Rossis (drossis@ea.gr).

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

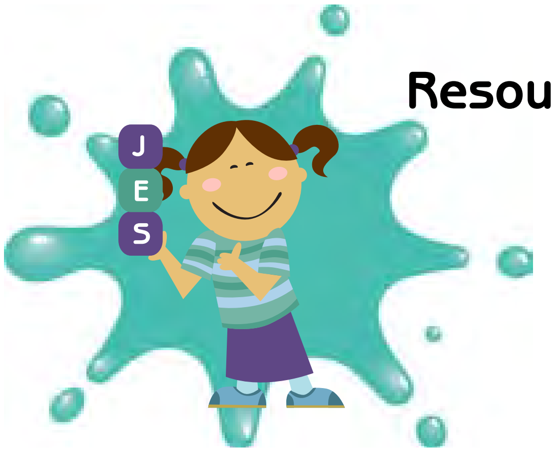
Contents

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



Resource Reviews

Bringing the Froebel Approach to your Early Years Practice by Tovey, H. Published in 2013 by Routledge, Abingdon, Oxon., price £12.99. ISBN 978 0 415 56731 2

This book is part of a series edited by Sandy Green, which looks at a range of historical approaches to early years practice; previous contributions to the series include Reggio Emilia, Montessori, Steiner and High/Scope. The book focuses on the main features of Friedrich Froebel's approach to early years education and development and how they resonate with current practice today, and research. This is one of its strengths and will help professionals to see how the Froebelian approach can be incorporated into early years provision, not only in pre-school, but through the full early years, from birth to 8 years of age.

The emphasis on play, both indoor and outdoor; how professionals can support learning through play and provide a rich play environment for young children, is very relevant today. Although early years professionals are committed to the play approach, it is often difficult in practice to resist the pressures from government initiatives and popular myths that play is of less value than didactic approaches.

The approach and the book are particularly appropriate to early years science, since the key features are those that also emerge from research into effective early years science: learning should start from children's curiosity, involve practical exploration of the world around them, and be meaningful to them.

Jane Johnston
Reader in Education
Bishop Grosseteste University College Lincoln

Education 3-13: 40 years of research on primary, elementary and early years education by Bottery, M., Brundrett, M., Burton, N., Duncan, D., Silcock, P., Webb, R. & Zhang, W. (Eds). Published in 2013 by Routledge, Abingdon, Oxon., price £95.00 (Hb). ISBN 978 0 415 64515 7

This book promised much and I picked it up with great interest. However, it did not really deliver. It is ambitious to have a book that focuses on key themes in education and the research on these themes over the last 40 years, but it seemed that the contributors missed opportunities to look deeply at issues and research that has influenced educational debate, policy and practice and explore the resulting tensions and ambiguities between policy, practice and research. The book is divided into five parts, which focus on:

- learning and teaching (including psychology and philosophy of primary education);
- key challenges in primary education;
- the primary curriculum; mathematics, science, IT and technology education;
- the primary curriculum; English, Humanities and the Arts; and
- primary teachers' work and professionalism.

In reviewing the book, I have focused on a few chapters that relate to emergent science. In Part 1, there are two chapters that are relevant to emergent science. Chapter 1 is a personal view on 'Discovery Learning' by Alec Clegg, which begins by looking at the emergence of discovery as an approach by Edmund Burke and the Plowden Report, but is less than two pages long and gives the reader no indication of recent research into discovery approaches or reading to help to look more deeply at its relevance today. Chapter 3, by Sue Waite, focuses on outdoor learning and is a much longer and more reflective consideration of the research into and importance of outdoor learning, and would be useful for any professional looking at improving their own provision. In Part 3, there are two chapters relating specifically to science. Chapter 10, *Who is a scientist?* by Catherine Tuckey, looks at Chambers' (1983) 'Draw a Scientist Test' and continues with some recent research, but fails to look at the wealth of research in between, which has influenced the debate about the importance of positive attitudes and scientific development. Chapter 13, *'Science is not my thing': Primary teachers' concerns about challenging gifted pupils,* by David Coates, has little research or policy published before 2000 and, again, focuses on recent research. It does discuss the implications of the findings but, without consideration of previous research over the last 40 years (as promised by the title of the book), cannot really situate the research in the developments of the past and present.

Reference

Chambers, D. W. (1983) 'Stereotypical Images of the Scientist: The Draw a Scientist Test', *Science Education, (*67), 255–65

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Science in Early Childhood edited by Coral Campbell and Wendy Jobling. Published in 2012 by Cambridge University Press, price £45.00. ISBN 978 1 10762 331 6

There are few research-based books written for pre-school and kindergarten teachers or for childcare centres. Even fewer scholarly books are about early childhood science development. With its focus on children from birth to age five, this book is a rare find indeed – especially for researchers and students in early childhood teacher education courses.

This comprehensive book reports on the research of eight authors in the field of science with preschool-aged children. It provides theoretical perspectives of children's development in learning science and supports this with reference to detailed and delightful case studies and scenarios that interrogate and illustrate principles of children's learning.

Science in Early Childhood (2012) provides practising teachers with vital knowledge about learning theories related to the acquisition of science understandings, outlining their useful implication. It suggests ways of planning appropriate experiences for children, how to use play pedagogy, and approaches to creating engaging learning environments. It discusses methods of linking into sustainable practices, the development of inclusive practices in science, and how to observe and document science learning.

Most importantly, the book reports how teachers and carers can undertake successful ongoing professional learning. Some of the writing is linked to a detailed Australian framework for early years learning and development, but the advice is research-based and worldly. The academic authors explore current issues and debates as highlighted both by their own research and by a review of broader international findings. For an edited research-based book, *Science in Early Childhood* is surprisingly accessible. The summary provided at the start of each chapter helps the reader align with the forthcoming information and identify the key themes to be presented. The use of case studies, real stories, specific study questions and detailed tasks assist the reader to make the links between the theoretical material and practical applications.
An eight-page appendix, which provides a summary of important science concepts for very young children, assists early childhood teachers to identify what children are likely to be learning through their play. As a grandmother, I was delighted by this thoughtful and useful element! I could also see how the research findings, as well as the play activities described, could be used by primary teachers during the first few years of school science.

This book will provide a welcome addition to the currently patchy availability of authoritative but accessible science education texts. It provides a range of teachers and education student teachers with ways of relating children's learning of science to a curriculum intention.

Judith Mousley
Deakin University
Australia

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/2012

A new development in 2012 is the introduction of an e-membership for primary schools. This enables participating schools to receive all the current benefits electronically, plus free access to the exciting primary upd8 resources (www.primaryupd8.org.uk), at the discounted price of £77+VAT p.a. For more information, please visit the ASE website (www.ase.org.uk)

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 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.

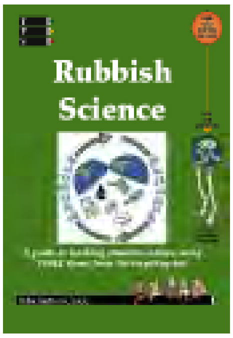
To find out more about how you could benefit from joining ASE, please visit www.ase.org.uk or telephone 01707 283000.

The Association for Science Education

TPS Publishing Ltd. and Partners
Story and Literacy Focused Science Resources for EYFS-KS2

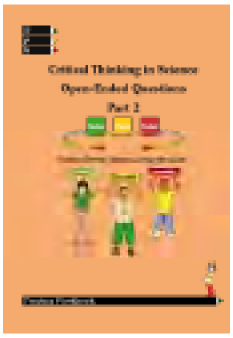
THE DAVIS FAMILY PROGRAMME is centred upon The Davis Family reader book, which is either read to the pupil or by the pupil depending on their ability. The reader book follows the family through their everyday lives and special family events, such as birthdays and holidays.
AB Curriculum have developed English, Maths and Science lesson plans for EYFS through to KS2, following each event, which are linked to the national core and adult curriculum. The programme uses **nasen** approved educational paper craft packs and caters for all ability levels. Learning takes place in a non threatening environment.

DIE CUTTING ACTIVITY GUIDES - AB Curriculum is a company focused on action based educational materials. Our activities are a creative and tangible way of delivering the National Curriculum and covering PSHE topics. Each activity guide enables the pupil to create a completely personalised piece of work which can be treasured and displayed, with all materials being reusable. This programme caters for all ability levels and therefore learners feel they can learn in a non threatening environment. Endorsed by **nasen** and also linked to the adult core curriculum.



RUBBISH SCIENCE - The ethos behind this work is that everyone can have a good basic start in Science. This course is 99% recyclable!! Without harm to the environment. It is sourced with recycled rubbish. Free. Unwanted thrown away items. Young people loving the environment and understanding their responsibilities to it in the future is very precious. The overall message is to encourage future generations at a young age to think about a cleaner, greener, happier planet.

SCIENCE IS A VERB - LET'S DO IT! - The lab manual provides structure for teachers to engage pupils in hands-on, enquiry based interactive learning. The critical portion of any investigation is to have a thorough discussion of results and thinking after the experiment is completed. The real learning occurs, not from the hands-on experiment, but from a deep discussion of the experiment, while making connections to the concept being learned. The process of asking questions and being inquisitive will generate more excitement for pupils and will engage them in a deeper way of learning Science.
In the end, Science is not something to study, it is something to do! **Science is a VERB!**



CRITICAL THINKING is designed to be used by pupils in order to practice answering questions and building their literacy skills in Science. They are designed to help you assess your pupils' progress on an on-going basis. They require the pupil to read and understand the situation described but also to apply the Science concepts studied in order to answer the questions. Reviewing your pupils' use of Science content and their success in communicating their ideas in writing will help you plan further lessons and differentiate your instruction where necessary to ensure higher pupil achievement in Science lessons.

BABY SCIENCE The "Babies" die cutting activities have been designed as a series of personalised activities based on different aspects of pupils' lives. These studies link in with PSHE families as well as Living Things science and require use of literacy and manipulative skills. Topics covered include how parents interact with their offsring leading to the life cycles of frogs and butterflys. To promote literacy skills Baby Science can be accompanied by a sport focused story book series. These books for EYFS-KS3 begin with simple words and phrases, build to encourage pupils to incorporate Poetry into their science learning followed by drama and act it out sessions. Science worksheets also accompany the stories.

For more information visit tpspublishing.co.uk, abcurriculum.com or email andy@tpspublishing.co.uk