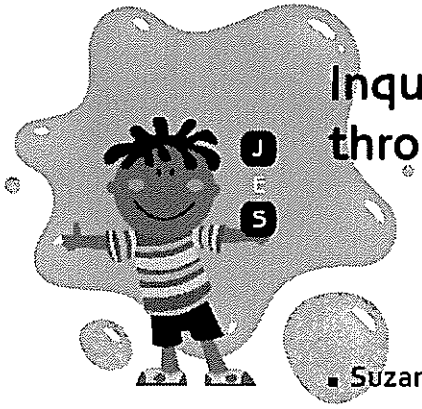

Inquiry-based learning in the early years through storytelling

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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

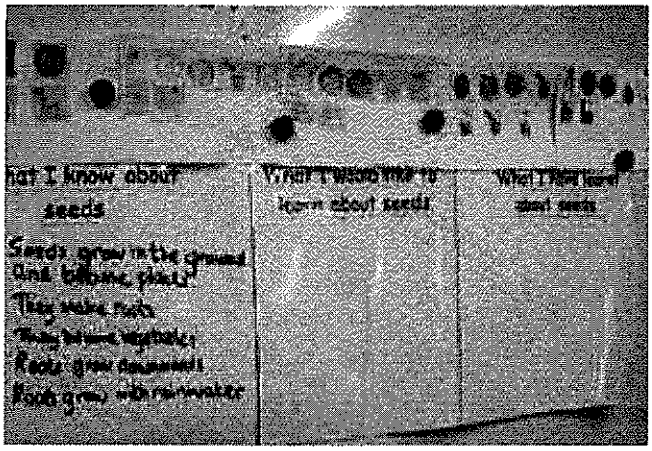
As has already been indicated, the focus of this study was the use of storytelling to engage children in inquiry-based learning in science. The specific aims of the research were to:

- 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 Knowledge, determine questions students Want to know answers to, and document what has been Learned'* (*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.

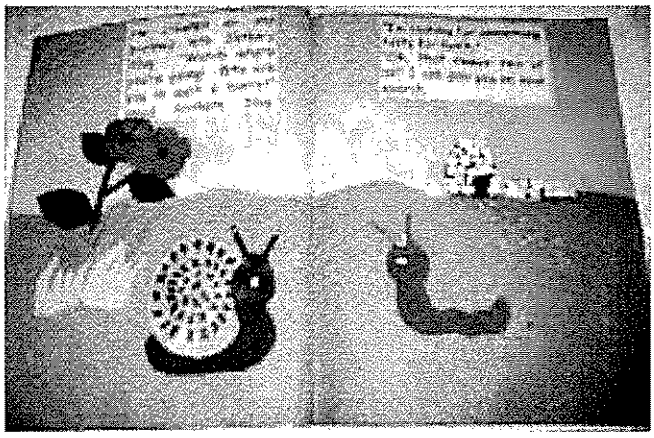
PowerPoint vs Big Book

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'.

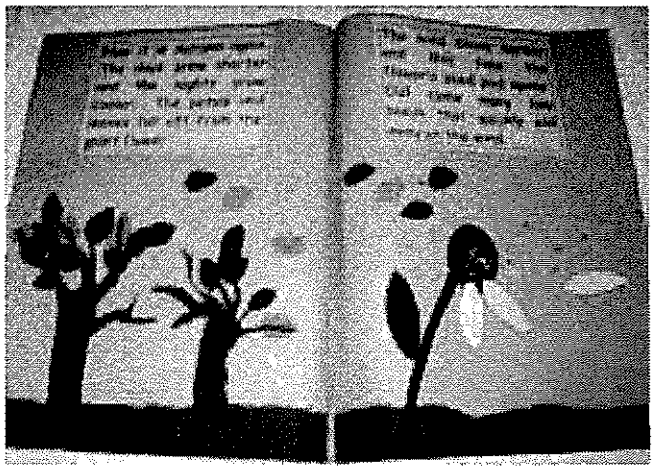
On the other hand, the Big Book stories stimulated curiosity, as the colourful 3D pages presented science concepts in a form that encouraged children to build a hypothesis, predict events, gather data and test the validity of the events. When the children were asked to comment on the story, *The Tiny 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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