

A junior school science unit on the solar system: Learning to think like a scientist

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Abstract

This article highlights the ways in which a Year 1–3 teacher in a decile 8 rural primary school used the Science Learning Hub website (www.sciencelearn.org.nz) to develop her own science knowledge and to introduce her 20 five- and six-year-olds to the planets, and to the research that scientists undertake to extend their knowledge. The research was undertaken as part of the Science Learning Hub's (Hub) ongoing research in evaluating its usefulness for practitioners. Hub researchers observed the class over three days during the second week of the unit, and interviewed the teacher about her approaches to the unit. The research explored how a new entrant teacher might make use of the Hub resources in conjunction with other materials to help children begin to think like scientists. Detail of the materials and two of the activities that were used is given and there is a discussion around how these activities encouraged the children to articulate their ideas and listen to the views of others,

including those of 'expert' scientists. Implications for teaching are highlighted to show how teachers of very young children can stimulate children's interest and curiosity in science, and help children to start a journey towards 'thinking like a scientist'.

Keywords: junior school science, thinking like a scientist, Science Learning Hub.

Introduction

Teaching and learning programmes in the early years aim to provide a wide range of experiences across all learning areas, however, Bull, Gilbert, Barwick, Hipkins, and Baker (2010) relate how science has a low profile and suggest that over time the *New Zealand Curriculum* (NZC) (Ministry of Education, 2007) may have contributed to this. Gluckman (2011) argues that the development of reading, writing and argumentation skills are the major contribution that the primary school years can make to science education – skills currently covered in the Communicating in Science strand of the NZC. Gluckman suggests that stories can play an important role in science teaching. Such a focus on oral language, and interacting with a range of texts, can be complemented with hands-on activities specifically designed to stimulate children's interest in the world around them and in science itself. Such an approach recognises the expertise primary teachers have in teaching 'everyday' literacies, while providing support for hands-on science.

Use of ICT in the classroom

This paper reports on a classroom study that is part of a large ongoing research project into how New Zealand science teachers make use of the Science Learning Hubⁱ (Hub) (www.sciencelearn.org.nz/) website materials. The Hub was developed to make the work of New Zealand scientists accessible to teachers as part of an initiative to support New Zealand teachers to make science more relevant and interesting for their students. The research programme seeks to inform ongoing content development and to provide examples of how the web-based material might be used.

The teacher in this study had been using an interactive whiteboard with her Year 1–3 classes for four years as a tool to support learning (Harlow, Cowie, & Heazlewood, 2010). When interviewed earlier in the year about her approaches to teaching, the teacher was not overly confident of her own science knowledge in the topic area. However, after an introductory professional learning session with content developers, she looked forward to making use of and adapting materials on the Hub for her young children. The solar system can be difficult to teach and learn given its ‘remoteness’ and can be viewed by young children with a sense of the fairy tale or imaginative idealisation. This is where the use of ICT can supply the greatest educational leverage (Perkins, Schwartz, West, & Wiske, 1995). With ICT embedded within the curriculum description of effective pedagogy, comes a responsibility for teachers to incorporate a repertoire of ICTs that serve to enhance student learning and engagement in science. The Hub materials are based on current New Zealand research in science and are aligned with the NZC, enabling access to scientific understandings of local relevance otherwise unavailable to both teachers and students. In this study, the new entrant teacher (Megan) made use of the Hub to refresh her own knowledge, provide real-world visual materials, and enable a scientist to enter her room and speak to the children. To do this she needed to assess and adapt the materials from the Hub to fit with her students. The Hub is designed for year 5–10 students and so her using the Hub required careful selection and/or adaption of the material. In the classroom she needed to talk through with her students what the materials were about.

Thinking like a scientist

The science theme for the term in this small rural school was ‘Thinking like a scientist’. Megan used her understanding of the NZC key competency ‘thinking’ (Ministry of Education, 2007, p. 12) to build on student understanding of good thinking in science. She planned to start a unit on the solar system through the investigation of the children’s own questions, an idea that links back to a constructivist view of learning, which recommends that children should be enabled to take ownership of their learning – and feel that the learning is making sense to them (Biddulph, 1989). When students are engaged in “actively constructing knowledge from a combination of experience,

interpretation and structured interactions with peers and teachers” (Roschelle, Pea, Hoadley, Gordin, & Means, 2000, p. 79), they are more likely to move towards a more expert understanding of science concepts.

Method

This case study was based on the research question: How can a new entrant teacher make use of the Hub resources, in conjunction with other materials, to support her children’s learning?

The researchers observed the class over three days during the second week of a unit on the solar system. Data were collected in the form of videotapes, audiotapes, photographs, field notes, and copies of teaching materials and student artifacts to capture events and produce rich descriptions of what had happened in the classroom (Fasse & Kolodner, 2000). The teacher was interviewed each day after school to explore her thinking about the impact Hub materials had made on student learning and to determine her plans for the following day.

Each lesson was summarised in terms of tasks, time, activity, sub-activity and resources. These summaries were made immediately after each lesson based on field notes and review of the video. Video tapes were fully transcribed to determine how the teacher introduced the ideas and language, made bridges between the Hub materials and the children’s science questions, and how the children answered the questions using their own research and everyday experiences.

Findings

The solar system – using Hub resources to introduce a new science idea/vocabulary

To start her unit on the solar system, Megan had opened a flipchart ‘What we know about the shapes, colours, size, and distances of the planets’ on the interactive whiteboard (IWB) and started a word and diagram list during a brainstorming session

on what the children knew about planets and the solar system. The words were mostly about shape and colour.

Megan then showed the children a short video of a scientist talking about the planets orbiting the sun (Figure 1; Science Learning Hub, 2009a). The video included very clear animated images that appealed to the children. Megan used the video to introduce the idea of an orbit. She explained that one advantage of the video was that the scientist's talk was accompanied by a visual of the planets orbiting the sun, providing a dynamic illustration of the meaning of orbit:

When the woman scientist talks about orbiting and you see that picture of the orbit tracks – that's a good one for showing the children about orbit. So the word 'orbit' went up on our rocket. It [the explanation in the video] just needs to be brought down a wee bit for them. As long as I teach the vocab first – we can use these clips. We start by building up the vocab and then build this [the video] in. To be able to see videos of what we're singing [the class had learned a song about the planets], the planets orbiting around the sun when we sing our song, it's all there to help.



Figure 1. A Hub video of the planets orbiting the sun

This word, like all new words was written onto a flipchart on the IWB for future reference. Megan ensured that she used science vocabulary in conversation.

‘Just right’ – using Hub resources to bridge the familiar and new

Megan encouraged the children to choose a planet and learn about it. Each child found out three facts about their selected planet and presented these at assembly. To begin to address the children’s questions about who is in space and who might be on Jupiter, Megan used the ‘Is anything out there?’ resource from the Hub (Science Learning Hub, 2009b). This was based around the children’s story of Goldilocks and the Three Bears and Goldilocks’ need for her porridge to be ‘just right’. Megan reminded the children of the Goldilocks story and one child retold the story to the class. Then Megan made a link for the children from the story to the possibility of living on another planet and it needing to be ‘just right’. She asked them what they would need to live on a planet and whether a particular planet would meet these conditions:

T: OK. I want you to use the Goldilocks story with our planets. If we were Goldilocks going amongst the planets, and we wanted to find one that was ‘just right’, what would we need to have on our planet for it to be just right for us?

C: [some children make suggestions] water, food, a house, oxygen, fire.

T: Ooh!

C: To keep us warm! [more suggestions] cars, beds, plants.

T: OK, and just like for Goldilocks it would have to be just right for us wouldn’t it?

C: Yes.

T: [pointing to the image of Mercury on the flipchart] If we went to Mercury first, would that be just right for us? What do we know about Mercury already, where is it?

C: Beside the sun.

C: And it’s too hot.

T: Would that be just right for us?

C: No. Because it might burn us.

T: Sometimes when we are cold, we put the heater on, we want it to be hotter...

C: So it's just right.

T: We want it to be just right don't we, OK. [points to Neptune on the flipchart] Could we come out to Neptune?

C: No, that's too cold because it's not close to the sun.

In this sequence of talk Megan encouraged the children to draw on their prior knowledge and what they had learned about each planet, and she complemented this information with material displayed on an IWB flip chart. This example contrasts with the first one in that Megan deliberately chose the Goldilocks activity because, “ These stories have been told for a long, long time. We can learn things from them about other things”. Not only did the students have their knowledge of the Goldilocks story to help them make sense of the activity, they also had their own research into a particular planet. Megan rounded this sequence off by showing the children a video of a scientist explaining why we are unlikely to find life on other planets around stars other than the sun. In this case, as with the orbiting video, she took care to explain any new vocabulary.

In these examples Megan used a range of materials to engage the children in an inquiry into the solar system. In each case the success of the activity relied in part on Megan's careful assessment of what the students might find new and or challenging in terms of new vocabulary and ideas. The IWB allowed her to seamlessly integrate materials from the Hub with some the built-in functionality of the IWB such as flip charts and the ability to display large colourful images. She explained:

We could go through to the Hub from the IWB, look at the video of the planets, listen to the scientist talk, flip through to where I have brought in the graphics that are on the IWB drive, and say to the kids, “Let's put those [planets] in the order the scientist talked about.” It's just so

seamless, instant, and easy.

Megan considered the Hub materials effectively complemented classroom experimental activities.

The Hub has come along at the same time as our new science trolley, which you just want to use. So with the Hub, the science trolley, just the focus on science, we're enjoying it. It's all been enhanced.

The value of using multiple sources of information was evident when two children, who had read that a mother penguin spends a long time at sea looking for food for her young, asked how she could “stay out at sea for so long without getting all wrinkly like I do when I go swimming?”. They went straight to the Hub. When they could not find the answer there they looked up penguins on the internet and also at the school library. Finally they went home to see if their families could help. The next day one of them announced that it was because of “a layer of air trapped between the feathers like a duvet on a bed”. Megan commented that she was pleased to see the children actively constructing new knowledge from a combination of resources. She saw this as evidence of the children transferring their investigative skills to new areas.

Conclusion

This teacher understood a central tenet of good science teaching in that she elicited the children's questions through brainstorming and encouraged them to articulate their ideas and listen to the views of others, including the ‘expert’ scientists appearing in the Hub videos. She learnt alongside the children as she used the Hub materials to help them find information and arrive at an explanation that fitted with their level of understanding. She recognised the importance of developing student vocabulary as part of their learning science.

These findings suggest that the NZC advice on the use of e-learning needs some elaboration (Ministry of Education, 2007, p. 36). ICTs can promote making connections

and expand students' opportunities to learn but this does not happen automatically. Teachers need to assess and adapt lesson materials, including web-based materials, to fit with their specific learning goals and the needs of their students. This requires teachers to be forward-looking to consider what their students might be able to do and learn. Teachers need to use curriculum materials in flexibly adaptive ways if they are to meet their specific contextual needs and springboard their students' learning in productive ways (Beyer & Davis, 2009). Assessing, critiquing and adapting curriculum materials are therefore essential aspects of teachers' work. What constitutes effective curriculum materials design is ultimately a local phenomenon. It arises out of teacher and student goals and expertise, and the classroom practice they negotiate together (Barab & Luehmann, 2003). Web-based resources have the advantage that they are easy to re-configure and re-purpose to suit local students' needs and interests. Web-based resources can support teachers to act as curriculum makers and not just curriculum material users.

Notes on contributors

The two researchers are members of the Science Learning Hub research team based at the University of Waikato.

Ann Harlow is a senior research officer with the Wilf Malcolm Institute of Educational Research. She is experienced in all aspects of educational research, having worked on at least 15 major research project teams for the University of Waikato covering a range of educational topics related to curriculum, learning and teaching, assessment, ICT and literacy and numeracy education spanning early years, compulsory school and tertiary education.

Junjun Chen was a postdoctoral research fellow in the Wilf Malcolm Institute of Educational Research. She was working on the project about teachers' use of the Science Learning Hub and its impact on teaching, learning and student engagement in science.

Megan Brooks is a teacher at Toko Primary School in the Taranaki region of New Zealand. She has been teaching five- and six-year-old children there for over five years. She is an experienced user of interactive whiteboards and has collaborated in several research projects (Harlow, Cowie & Heazlewood, 2010).

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ⁱ The Science Learning Hub is an online portal funded by New Zealand's Ministry of Science and Innovation, formerly the Ministry of Research, Science and Technology, and has been managed by the Wilf Malcolm Institute of Educational Research, University of Waikato since 2007.



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