How Lois Kelly and Kathy Schofield helped teachers in a Ugandan primary school develop scientific thinking with very limited resources

I have learnt that since science is a practical subject most of the things you teach should be practical for students to understand it.

(Patrick, Ugandan primary school teacher)

In the summer of 2010 we spent two weeks helping teachers in a primary school near Kampala to develop their science curriculum. In common with many primary schools in Uganda science was taught as ‘facts to be learnt’. This was partly because the teachers had had little or no first-hand experience of practical science or science enquiry during their own education. As a result they taught science as they had been taught, through chalk and talk. (Primary teachers in Uganda typically leave school with the equivalent of our 16+ exams and then do a two-year teaching certificate. This means that primary teachers may only be 18 when they start teaching.)

Stepping back in time
In addition to the teachers’ lack of experience, the school was very poorly resourced. There was no electricity, no running water and very few books or practical resources in the school. At the front of each classroom was one large blackboard. The children would often share pencils. If a child did not have a pencil another child would break their pencil in half to share it.

Most of the classrooms were in a temporary wooden building and six children sat on a bench only big enough for four, resting their books on a bench in front of them (Figure 1). The teacher frequently had the only copy of a textbook and facilities for making resources were extremely limited. In lots of ways this is reminiscent of early teaching.
conditions in Victorian Britain! The teachers did not own computers so any resources they made were hand-written. Photocopying was expensive, as it had to be taken to a nearby shop. Concern that limited resources and outmoded teaching methods limit children’s science learning in many Ugandan primary schools is not new (Norman and Singh, 2007). This is exacerbated by limited opportunities for continuing professional development for many primary teachers. Primary teachers are not well paid and although the teachers we worked with would have liked to improve their qualifications they could not afford the course fees. The internet is providing greater opportunity to support primary teaching in Uganda through projects such as the Open University’s Teacher Education in Sub-Saharan Africa (TESSA) project (see Websites). However, the teachers we were working with had limited access to the internet and had not heard about the project. Our project was the only professional development the teachers had received since completing their teaching certificates, in some cases more than 10 years ago.

**Supporting the teachers**

We aimed to help the teachers to adapt their approach to science teaching by introducing practical science activities using inexpensive, readily available resources, and games which develop science thinking. We held workshops each afternoon to introduce the ideas to the teachers and then we worked alongside them as they tried out these ‘new ideas’ in their classes. So that we could focus on developing the approaches, we chose two topics where the teachers were familiar with the subject matter: ‘ourselves’ and ‘materials’.

**Developing knowledge and understanding**

Introducing simple games to promote a child-centred approach to teaching and learning highlighted for the teachers the difference between children being able to simply recall information and being able to apply that information. One example of this was the ‘Spinners Game’. This game gave upper primary children (age 10 to 14 years) the opportunity to apply their knowledge of the properties of materials. The children spun the spinners to find, firstly, the name of a material and, secondly, the name of a part of a building; for example they might come up with ‘wood’ and ‘drainpipes’. Then they used the PMI (plus, minus, interesting) technique to think of something positive, something negative and something interesting about wooden drainpipes. At first both teachers and children were quite hesitant to suggest ideas as they were not used to being given open-ended tasks.

We reinforced the role of open-ended tasks in encouraging children to apply their science knowledge by using the ‘Odd One Out’ activity from the AstraZeneca Science Teaching Trust Bright Ideas Project (see Websites) in one of the training sessions with the teachers. The teachers were given shaving foam, cotton wool, flour, salt, cornflour gloop and water and asked to choose one as the odd one out and explain why. Because the teachers’ perception was that science was about learning the ‘right answer’, they were disconcerted when we explained that there was no one ‘right answer’ and that any of the substances could be the odd one out. However, once they had had a go the teachers were more confident to try this in the classroom:

I plan to use the games we played and get my pupils fully engaged by using their minds to really think. (Dinah)

I will try to use newly learnt methods involving children thinking like scientists. (Jim)

**Practical science activities using readily available resources**

We wanted to encourage the teachers to give the children more opportunities to do practical activities in their science lessons and to show them that they did not need specialist apparatus. One Sunday we found a large piece of aloe bark near where we were staying. We were intrigued by the aloe bark, which is quite rough on the outside but very smooth on the inside. The inside surface is also waterproof. The early years teachers were surprised that their children (age 4 to 6 years) soon became fascinated by the various textures of the bark, enjoyed feeling it and learning the vocabulary to describe it. Feeling both the rough and smooth sides of the bark not only helped the children learn the words but also helped the teachers understand that practical experience is more effective than simple repetition of vocabulary.

During the ‘ourselves’ workshops we concentrated on showing how the children could be the main resource for practical science activities. In an early workshop we encouraged the teachers to observe similarities and differences between themselves by demonstrating a ‘same but different’ activity. In this activity a ‘caller’ chose a particular characteristic, for example straight or curly hair, but did not tell the rest of the group, and called two people who had that characteristic to stand at the front. One by one other people who had that characteristic were called to the front until the children (or during the workshops, the teachers) were able to work out which characteristic had been chosen. Once the characteristic had been identified a different person became the ‘caller’ and the activity was repeated. One of the concerns we had when planning this activity was that, because features such as hair colour and eye colour are not as varied in Uganda as they are in England, it would be quite difficult to find a range of different characteristics. We need not have worried as the teachers chose characteristics that had not been immediately obvious to us, such as differences in skin colour.

To show how children gain practical experience of science investigations and develop science enquiry skills we introduced what we
would consider in England, to be standard 'ourselves' investigations, such as 'Is the oldest child the tallest?' and 'Does the person with the largest hands grab the most pasta shapes?' Lining the children up first in age order and then in height order and asking questions that compared the two orders was a novel idea both for the teachers and the children.

The investigation that the children and teachers enjoyed most was 'Does the tallest person jump furthest?' Discussion at the start of the investigation highlighted that a range of factors have to be considered when carrying out this investigation, such as which variables could be controlled, which were dependent on who was jumping, what precisely was being measured and the need for repeat readings. The teachers were very strict with each other when they carried out this investigation, ensuring that everyone stood exactly on the line for a standing jump and marking exactly where each person landed so they could get an accurate reading. The teachers also realised that their first jump might not have been their best jump and so they decided that everyone should have three attempts. This gave us the opportunity to talk about the fact that scientists do not rely on a single measurement in a science investigation but take repeat readings to check the reliability of the result (Figure 2).

During this part of the workshop, the children, who had been left to work independently in their classrooms for the afternoon, crept into the classroom where the workshop was being held to cheer the teachers. By the end the whole school, about 200 children, were watching (Figure 3).

**Did we have an impact?**

At the start of the project we were uncertain how the teachers would respond to the ideas we introduced; after all, we had very little experience of the Ugandan schools. We learnt that the teachers had also been sceptical. Dinah, a very knowledgeable and confident teacher, admitted:

*When I was told you were coming here, I didn’t know how you could help us but I have learnt a lot.*

The head teacher talked about what she had gained from the project. For example she told us that she had always found teaching about states of matter difficult and for the first time she had found a way that would really help the children: using a bed sheet and polystyrene balls (Figure 4). By shaking the sheet to move the balls (particles) around as a solid (slowly), a liquid (rolling around) and a gas (jumping up and down), the particle behaviour could be 'seen'. She explained that instead of using the balls and a sheet, she would use sorghum seeds, which they had in the school kitchen. She would give each child a small handful of the seeds. When the child held the seeds in their hand it would represent the particles in a solid.
To represent the particles in a liquid the children would make the seeds slide from hand to hand, and to represent the particles in a gas the children would throw the seeds up in the air. This was very encouraging, as it showed that the teachers were thinking about how they could adapt the ideas we had shared to suit their own needs using resources to hand, rather than thinking science requires specialist equipment. These examples and the quotes from the teachers showed we did succeed in showing them how children’s science learning is enhanced when they work collaboratively and actually ‘do’ practical work.

**Reference**

Lois Kelly is an independent primary consultant, Kelly Consulting & Training. Email: kellyconsultingandtraining@gmail.com

Kathy Schofield is a senior lecturer in primary science at Manchester Metropolitan University. Email: k.schofield@mmu.ac.uk

This project was organised by Hope One World (www.hopeoneworld.org.uk), an Education Charity based in Liverpool, with support from School For Uganda (schoolforuganda.wordpress.com/about).

**Websites**

Open University Teacher Education in Sub Saharan Africa (TESSA) project: www.tessafrica.net