

WOBBLY BITS

The SPACE legacy



Figure 1 A 7-year-old's ideas about evaporation of water from an open container

(Russell and Watt, 1990: 29)

The SPACE (Science Processes and Concept Exploration) project began 21 years ago, just ahead of the National Curriculum. It was a research project whose findings and processes were built into the Nuffield Primary Science classroom guides for teachers, making these the best example of

Wynne Harlen reflects on the influential SPACE research programme in the 1980s, and on progress since then in developing children's science ideas

research-informed curriculum materials at the primary level. SPACE is probably best known for revealing the ideas

that primary children have, ideas about scientific aspects of the world around them, long before they have had science-based activities at school. But this was not the only significant feature of the project. Through the process it used, it showed a way of helping teachers to change their view of how children learn and their approach to teaching. Most importantly, it provided evidence that when teaching explicitly takes note of children's ideas and skills, there is a gain in developing their understanding. So, as well as the children's ideas that were found, the methods used in the project have also left their mark.

Children's ideas

Many examples of the ideas revealed by the SPACE research are well known and will be recognised by teachers who start from their pupils' ideas. Figures 1 and 2 are children's responses to being asked to draw and write about their ideas.

Other responses were audio-recorded. For instance, a 9-year-old commented that:

In the dark the light from the candle will go further.

While a 10-year-old said this about how an iron nail becomes rusty:

I think the rust is a metal inside the other metal. I think that the rain makes it come and the paint wears off and you can see it.

Such examples illustrate the reason for taking children's ideas seriously, for it is clear that the

children have thought about what is happening and that there is some reasoning based on observations, even though the reasoning and the evidence used are inadequate from an adult point of view. Studying the characteristics and limitations of the children's ideas gives us clues as to how to help children change their ideas to come closer to the scientific ones. In this context 'scientific' means that the ideas not only fit the evidence available but also enable a range of related phenomena to be understood.

Take the comment about rust. It is, after all, often seen under flaking paintwork on cars, bicycles and railings, so why should it not be a part of the metal? Here the idea is based on evidence just from observation of the surface of the metal. Looking inside by scraping a rusty surface or having a nail cut in half, would provide evidence that may cause some re-thinking. But in other cases an alternative idea is much less obvious. For example, the explanations children have for the appearance of a 'mist' on the surface of an empty food can when ice is put inside may seem more reasonable than the idea that it is water that comes from the air around. Ideas such as:

when it's cold the metal lets the water through

or

water from the ice creeps over the edge and down the outside

have a certain plausibility – until they are put to the test. As with the earlier examples, the children's ideas 'work' only in limited and particular situations, and rethinking may be prompted if the ideas are tested in other situations where they could apply.

Towards more scientific ideas

So testing ideas in new situations is a key step in developing them, just as scientists develop their ideas by making and testing predictions based on them. But there is an important difference between the child and the

scientist, which concerns the way in which evidence is sought and used. Children's skills of selecting and processing information need to be developed and it is this as much as wider experience that will enable them to improve their scientific understanding. Hence the 'processes' part of the project's title and the emphasis on developing children's ability to observe, develop hypotheses, plan and carry out investigations and interpret findings.

But what if the ideas cannot be tested in a convincing manner or, indeed, are untestable? By working with teachers to elicit and

teachers to probe the meaning that the children attach to certain words by asking them to demonstrate the meaning. In the SPACE work, teachers were helped to use a number of strategies of these kinds, according to their judgement of what was appropriate in a particular context.

SPACE in action

In order to start from children's ideas it is, of course, necessary to find out what they are. The SPACE team set out to find out the ideas the children were using in the course of normal work. To come close enough to children for this

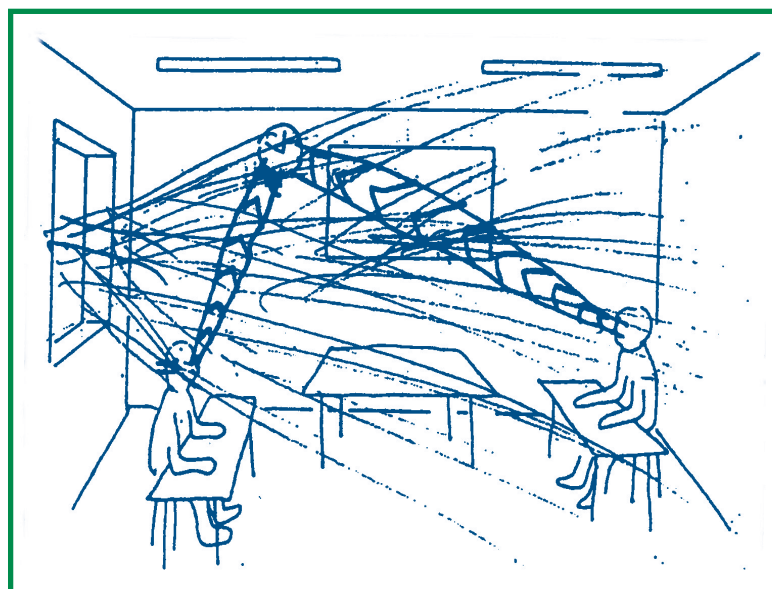


Figure 2 An 11-year-old's drawing of how the two people in the room see the clock on the wall

(Osborne et al., 1990: 20)

study children's ideas on many topics, the SPACE team developed a range of possible ways of helping children to develop their ideas. As well as trying out ideas to see if they work and giving more experience, these approaches include encouraging children to discuss their ideas with others. Trying to explain their reasoning often helps children to recognise where it is faulty. Children-only discussions are particularly useful, removing the authority of the teacher so that children can more easily challenge ideas suggested. Sometimes it is appropriate for

to happen required collaboration with teachers, who thus became members of the extended research team. Groups of teachers worked with members of the team on particular topics, but before embarking on work with children there was a two-day workshop for teachers on the topic. This gave teachers a chance to clarify for themselves their own ideas about the topic, for in some cases the teachers shared the 'misconceptions' of children. There have been several studies, both at the time (e.g. Kruger and Summers, 1989) and later (Harlen, Holroyd and Byrne, 1995), which showed that some primary teachers have understandings of some phenomena similar to those of children. And how can teachers help children to change their

ideas if they don't see anything wrong with the ideas they have?

So in the workshops, teachers were able to explore and investigate the topics, using the equipment and materials they would use with the children. They had the chance to try out their ideas, talk about them and develop a more scientific understanding. When the teachers came to help the research by collecting children's ideas, the experience can only be described as creating considerable excitement. Paying attention to children's own ideas opened new relationships with learners and access to children's thinking that the teachers had no idea existed or was important.

After the initial elicitation of ideas, there followed a period of time for activities that were designed to help children to develop their ideas, using the strategies selected from those mentioned earlier. This 'intervention' usually lasted about eight weeks. For the purposes of the research a stratified random sample of children from the classes involved was interviewed by researchers before and after classroom intervention, whilst the teachers helped in collecting ideas less formally from all the children. Although results for the children varied from topic to topic, in all cases there were significant changes in ideas for some age groups. But the findings of greater relevance here are concerned with the change in teachers.

In the late 1980s when the project was in progress, the prevailing view of science teaching of many teachers was that it was essentially a matter of transmission of knowledge. The majority did not have, or thought they did not have, the necessary knowledge and seriously lacked confidence in teaching it. Often teachers' low level of understanding in science was accompanied by a low level of understanding of science and therefore of the nature and importance of process skills (or

enquiry skills as they are now known). However, when required to take note of children's ideas and give attention to children's ways of reasoning, teachers saw that children were learning without being fed the 'right answers'. As one teacher was quoted as reporting:

The amount of information the children had acquired without being taught per se amazed me, and I was convinced that involvement, observation and experience were invaluable methods of learning. (Quoted in Russell and Watt, 1990)

So what is the SPACE legacy?

The methods used in the project were translated into the Nuffield Primary Science Guides for teachers, which provided suggestions for 'starter activities' that enabled teachers to find out children's ideas and for helping children to develop ideas within each theme. There was also help with planning and assessment, and each guide contained background science for the teachers related to the topic.

Although out of print since about 2004, the guides, and through them the SPACE research, provided evidence of the importance of 'starting where the children are', as well as providing procedures for putting this into practice. Even though the impact of national tests in science has obstructed this more learner-centred approach to teaching science at the top of the primary school (Harlen and Deakin Crick, 2003), many teachers still understand the importance of finding out children's ideas. The promotion of 'assessment for learning' has reinforced this message, but there is still far to go in developing practice in using children's ideas. SPACE made a great start but there remains a key role for research

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in making a match between children's ideas and effective ways of helping progress towards more scientific ideas.

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