Getting Practical

Practical work in school science – why is it important?

Emma Woodley

ABSTRACT The reasons for carrying out practical work are explored and activities to increase the quality and relevance of practical work are described.

For most UK science teachers, practical work is part and parcel of what teaching and learning in science is all about. In fact, the TIMSS 2007 study (Sturman *et al*., 2008) found that, as has been the case for many years, 13- to 14-year-old pupils in England are more likely to spend their lesson time doing practical science activities than many of their international counterparts. It also found that science teachers in England tend to adopt a more ‘hands-on’ approach to their teaching.

Given that such a large proportion of time in science lessons is spent on practical work, it is important to be able to justify that amount of time by understanding the purposes of this type of activity as a tool for teaching and learning. But in order to understand why we use practical activities, we must first consider what practical work in science is.

Earlier this year SCORE (Science Community Representing Education) produced *A framework for practical science in schools* (SCORE, 2009a), defining practical work in science as ‘*a “hands-on” learning experience which prompts thinking about the world in which we live*’. The associated report (SCORE, 2009b) has a list of activities that could be considered to be practical work. These fall into two main categories:

- **Core activities:** Investigations, laboratory procedures and techniques, and fieldwork. These ‘hands-on’ activities support the development of practical skills, and help to shape students’ understanding of scientific concepts and phenomena.
- **Directly related activities:** Teacher demonstrations, experiencing phenomena, designing and planning investigations, analysing results, and data analysis using ICT. These are closely related to the core activities and are either a key component of an investigation, or provide valuable first-hand experiences for students.

A range of activities were also identified which complement, but should not be a substitute for, practical work. These complementary activities include science-related visits, surveys, presentations and role play, simulations including use of ICT, models and modelling, group discussion, and group text-based activities. They have an important role to play supporting practical work in developing understanding of science concepts.

Purposes of practical work

Most practitioners would agree that good-quality practical work can engage students, help them to develop important skills, help them to understand the process of scientific investigation, and develop their understanding of concepts. A further consequence of experiencing practical work, particularly in chemistry, is the acquisition of an understanding of hazard, risk and safe working. These are just some of the many different reasons for choosing to use a practical activity in a lesson. The *Framework for practical science in schools* also identifies a multitude of ways in which practical work can support learning in science, from ‘Personal, learning and thinking skills’ to ‘How science works’ (Figure 1). Any single activity might focus on one or more of these purposes.

A good practical task is one that achieves its aims of effectively communicating a clearly defined set of ideas, but this can sometimes be difficult to achieve. Teachers’ identified outcomes can often be quite different from the outcomes that students perceive. With any activity, communicating its purpose and learning objectives to the students can increase its effectiveness as a learning experience and enable the students to get the most out of it. If the goals and objectives are not expressed in terms of being able to apply scientific knowledge, understanding and skills there is a danger of students simply following 'recipes' during practical activities. When done well, practical work can stimulate and engage students' learning at different levels, challenging them mentally and physically in ways that other science experiences cannot (SCORE, 2009b).

A good question to consider before planning to carry out any practical activity is: What do I expect the students to learn by doing this practical task that they could not learn at all, or not so well, if they were merely told what happens? (Millar, 2002). Asking this question will help to define the objectives of the activity, and justify its use.

Hands-on, brains-on

Really effective practical activities enable students to build a bridge between what they can see and handle (hands-on) and scientific ideas that account for their observations (brains-on). Making these connections is challenging, so practical activities that make these links explicit are more likely to be successful (Millar, 2004).

In planning an activity, the task should be tailored to achieve the identified aims, for example through discussion between students. Allowing time for students to use the ideas associated with observed phenomena, rather than seeing the phenomena as an end in themselves, is vital if students are to make useful links.

Improving practice

As part of the SCORE project on Practical Work in Science, the Association for Science Education is leading a new programme of professional development, called 'Getting Practical' (see *Websites*). The programme is designed to support teachers, technicians and teaching assistants in improving the effectiveness of practical work through using, tailoring and managing practical activities to meet particular aims.

The aims of the programme are to improve the:

- clarity of the learning outcomes associated with practical work;

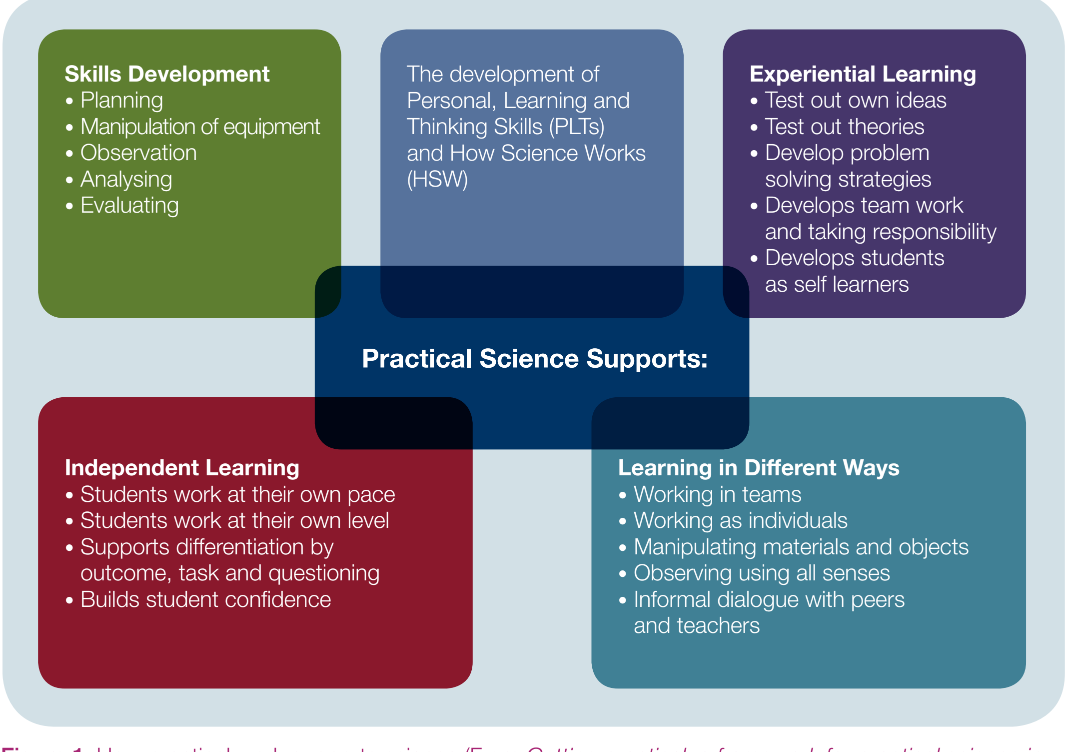


Figure 1 How practical work supports science (From *Getting practical: a framework for practical science in schools* (SCORE, 2009a) p. 7)

- effectiveness and impact of the practical work;
- sustainability of this approach for ongoing improvements;
- quality rather than the quantity of practical work used.

This programme aims to increase the quality rather than the quantity of timetabled practical work, unless a school feels that more practical work is needed.

Bringing together the programme's aims will develop teachers' abilities to assess the way they teach practical science at all levels and increase their confidence in producing good-quality lessons for the benefit of the young people.

References

Millar, R. (2002) Thinking about practical work. In *Aspects of teaching secondary science: perspectives on practice*, ed. Amos, S. and Boohan, R. Ch. 6. London: RoutledgeFalmer.

Millar, R. (2004) The role of practical work in the teaching and learning of science. University of York. Available at: www7.nationalacademies.org/bose/Millar_draftpaper_Jun_04.pdf

SCORE (2009a) *Getting practical: a framework for practical science in schools*. London: DCSF. Available at: www.score-education.org/downloads/practical_work/framework.pdf

SCORE (2009b) *Practical work in science: a report and proposal for a strategic framework*. London: DCSF. Available at: www.score-education.org/downloads/practical_work/report.pdf

Sturman, L., Ruddock, G., Burge, B., Styles, B., Lin, Y. and Vappula, H. (2008) *England's achievement in TIMSS 2007, National Report for England*. Slough: NFER. Available at: www.nfer.ac.uk/research/projects/trends-in-international-mathematics-and-science-study-timss

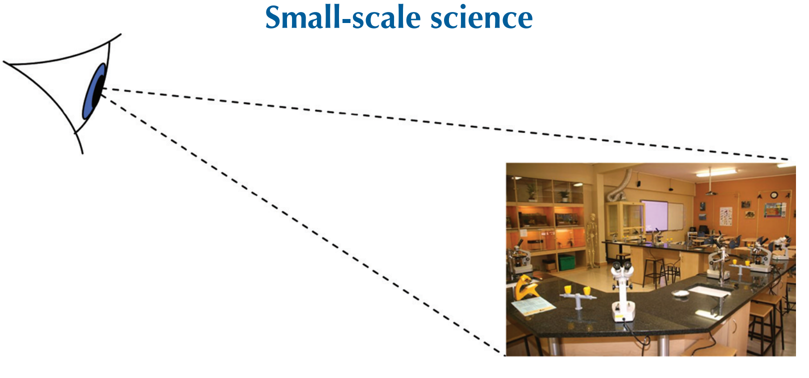
Websites

SCORE: www.score-education.org/2projects/practical_work.htm

Getting Practical: www.gettingpractical.org.uk

Emma Woodley is Project Head, Science, at the Nuffield Foundation Curriculum Programme, working on the revision of the suite of Twenty-First Century Science GCSE courses, and various other projects including a key stage 3 STEM cross-curricular project. She previously worked at the Royal Society of Chemistry where she led on the development of www.practicalchemistry.org and contributed to the SCORE Practical Work in Science project.

Small-scale science



This theme is being considered for the December 2010 issue of *SSR*.

Articles could involve a small-scale view or method in any science subject, such as: reduced scale or microscale chemistry or physics; microbiology and microscopes; practical work using 1 or 10 cm^3 syringes or 1 or 3 cm^3 plastic pipettes; forensic science; or nanotechnology. In fact, they could be about any science carried out at a smaller than usual scale.

It would be good to have contributions from technicians as much of this requires planning and organisation on their part. Those in teacher training might like to set up small student investigations into the attitudes of teachers and pupils to these alternative practical techniques.

We are at the early stages of planning, so the door is open for further suggestions. Please contact The Editor, *School Science Review*, ASE, College Lane, Hatfield Herts, AL10 9AA (**ssreditor@ase.org.uk**) or guest editor Bob Worley on **BobW@cleapss.org.uk**.

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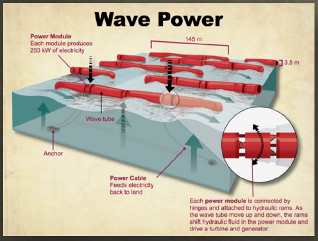

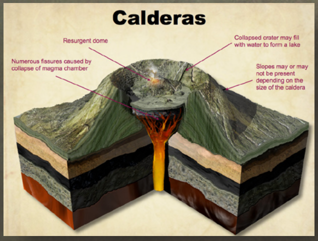

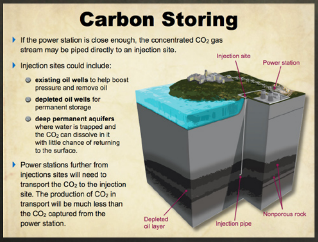

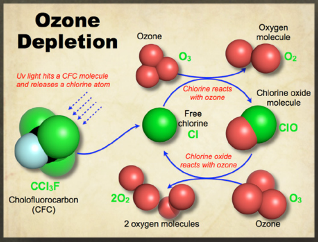

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