

Making Practical Work More Effective

The project *Getting Practical*

During the Annual Conference 2010 of the Association for Science Education we followed the 'Train the Trainer' session for the *Getting Practical - Improving Practical Work in Science Programme*. We are so enthusiastic about this programme that we want to introduce it in the Netherlands.

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The Association for Science Education (ASE), the British equivalent organisation to the NVON, have asked themselves the question: "How can we as a science education community support teachers in enabling more effective practical work in school science?"

The term 'practical work' is broader than the familiar Dutch term 'practicum'. In Dutch schools, 'practicum' stands for one or more experiments in a laboratory setting. In the Dutch version of this article we use the words 'praktisch werk', the literal translation of practical work. This includes not only 'practicum' but also field work, demonstrations and research & design projects of students, more in line with the British definition used for the purposes of this programme.

Practical work is an essential aspect of science education. Students often prefer it to other class activities. They base their choice for science at A-level in many cases on positive practical work experiences that they have had throughout their science education. This also applies to their choice for studies in higher education.

However, there is also criticism. Students sometimes find practical work insipid, ineffective, and a waste of time. A few weeks after carrying out a practical task, many are unable to say what they learned from it. Frequently they cannot tell why they were doing it. They often do not learn what the teacher wanted them to learn.

A large problem is also that practical work in schools is under pressure. The amount of class time for science is diminishing. The preparation of students for examinations (in the UK this is more frequent than in the Netherlands) takes up a lot of time at the cost of practical work. There is a shortage of qualified teachers and technicians; substitutes with another background frequently shy away from practical work. Support for teachers and technicians is therefore necessary.

The influential action group SCORE has written a strategic plan for the strengthening of science education¹. This includes improvement of the quality of practical work. Thorough preliminary research has led to a set of recommendations². These have been further developed in the programme *Getting Practical*.

Getting Practical aims to improve the effectiveness of practical work and as a result, also its quality.

SCORE

SCORE is the acronym for Science COMMunity Representing Education and is made up of six partner organisations: the ASE, the Institute of Physics, the Royal Society of Chemistry,

the Society of Biology, the Royal Society and the Science Council. The President is Sir Alan Wilson. SCORE defines its mission as follows: SCORE partners recognise the importance of taking a strategic approach to strengthening science education. Key priorities include addressing the serious problems of the decline in numbers of young people taking A-level physics and chemistry and the unacceptable shortages of specialist teachers in these subjects in our schools and colleges. The partners believe that the key to maximising the impact of their efforts, lies in a greater degree of collaboration and in having a sense of common purpose. Through this collective action, the partnership aims to increase its influence concerning the direction of science education in the years to come. Further information: <http://www.score-education.org>

The programme *Getting Practical*

The ASE is the lead organisation for the *Getting Practical Programme*. The programme team is part of the ASE professional staff. Kirstie Hampson coordinates the Continuing Professional Development (CPD) activities and Georgina Westbrook coordinates Communications.

The ASE work closely with the consortium of 21 partners for the programme, including SCORE. For this programme a CPD package has been developed and tested. The regional Science Learning Centres offer training ('Train the Trainer') to enthusiastic science teachers who want to become a trainer, either for their own school, or as science consultant to several schools. They must have extensive experience with practical work in school.

Participation in the 'Train the Trainer' course and the resulting CPD course is without charge thanks to financial support from the English government. The trainers, or their school, are paid on the basis of the number of given courses.

The course material for the CPD is for 6 hours. This course can be divided in a flexible way, with 1, 2, 3 or 4 meetings.

By this set-up, where teachers help teachers to teach science, the ASE want to give the programme a sustainable character. When the financing by the government had ended, the expertise remains in the schools.

You can find more information about the programme at www.gettingpractical.org.uk. There is also an excellent wiki providing support for the trainers but is accessible to trainers only. All the course material is available at this site. The trainers can place additional materials on this site and exchange experiences.

The core of the programme

Two renowned experts in the field of science education were asked to give advice about how teachers can improve the effectiveness of practical work: Robin Millar and Ian Abrahams of the University of York. The CPD is based on their article in *School Science Review*³. In our next article, we will present their ideas about the effectiveness of practical work and the results of a study they did in eight schools on current practice.

According to their analysis practical work helps students to make links between two domains.



Practical work supports students at laying links between two fields.

The left box, 'domain of objectives and observables', can be translated literally into Dutch as 'domain of objects and perceptible phenomena'. For the sake of brevity we call this domain 'A'.

It is more cumbersome to translate the name of the right box, 'domain of ideas', because the Dutch word 'idee' has a meaning which differs from the English word 'idea'. The Dutch word

'begrippenkader' is close to 'domain of ideas'. 'Begrippen' can be subject matter concepts, such as energy and Ohm's Law. They can also be a component of '*How science works*' for example the scientific method or the design circle. For the sake of brevity we call this 'domain B'.

The research results of Millar and Abrahams show that the effectiveness of practical work is limited because the students are mainly working in domain A. They experience practical work as 'hands-on' only. The key to making practical work more effective is to design learning activities that are more 'minds-on'. Students learn more of their practical work if they can commute well between domain A and domain B, and this happens when they combine 'hands-on' with 'minds-on'. This must already be taken into account when designing the tasks. 'Cookbook' tasks where students just have to follow the recipe are an invitation to be carried out without thinking. Tasks with a more open character can only be finished when students think. Working with 'minds-on' should also have the teachers' attention when they assist the students during the task and when they look back with the students on what they have actually learned from the practical work.

The usefulness of the programme in the Netherlands

The ASE are proud of the programme. At the Annual Conference 2010 it was a thread at the conference. During the International Day Robin Millar presented the programme in a plenary session. In the discussions in small groups after his lecture it turned out that this international forum recognised the problem and appreciated the treatment.

Several recent Dutch research publications^{4,5,6} give results which are similar to those of Millar and Abrahams. Because of this, we have translated the course material. After trialling it we will probably have to adapt it to the Dutch situation. We are planning to trial it in secondary and primary settings. If you are interested, please contact Henny Kramers, email: praktischwerk@nvon.nl.

After trialling we plan to fit the course into a CPD programme, in which we hope the Dutch Science Teachers' Association NVON will have a role similar to the role of the ASE in *Getting Practical*.

Notes

1. In the Netherlands a strategic plan for the strengthening of science education has been developed by Platform Bètatechniek; www.betatechniek.nl, search for: *agenda 2011-2016*.
2. Complete report: http://www.score-education.org/downloads/practical_work/report.pdf; summary: http://www.score-education.org/downloads/practical_work/ExecSum.pdf.
3. Millar, R. & Abrahams, I. (2009). Practical work: making it more effective. *School Science Review*, 91 (334), 59-64.
4. Schalk, H. (2006). *Zeker Weten? Leren de kwaliteit van biologie-onderzoek te bewaken in 5 vwo*. Thesis. Amsterdam: Vrije Universiteit.
5. Rens, L. van (2005). *Effectief scheikundeonderwijs voor 'Leren onderzoeken' in de tweede fase van het vwo*. Thesis. Amsterdam: Vrije Universiteit.
6. Foeken, M. (2009). Practicum biologie, een analyse, 1. *NVOX*, 34 (8), 356-357.

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