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CONTENTS

ENGAGING TEACHERS WITH SCIENCE LEARNING

Most countries, as far as I am aware, now have a National Curriculum that informs teachers (and others) as to what pupils are expected to learn in science during their period of compulsory schooling. In most respects this is helpful, but one major danger is that teachers then use this as their rationale for teaching science. 'We teach this because we have to.' Teachers need to be teaching to an agenda that they 'own' not simply to a framework devised by others. In fact this seems to have been recognised in England by inspectors from the Office for Standards in Education (OfSTED) in a 2000 Report - although many teachers and head-teachers have not heard the message:

> *"Many science teachers feel under great pressure to cover the content prescribed by the National Curriculum and alas, in consequence are insecure about going beyond it or leaving material out. Some of the best teachers inspected as part of this survey were less constrained by the Programme of Study; they adjusted the content, teaching approach and pace of lessons to meet the needs of their pupils (see Section 5). More-able pupils were challenged by material and ideas beyond those in the National Curriculum and pupils who were struggling were enabled to consolidate basic ideas. All teachers should have the confidence to respond flexibly to the National Curriculum; they need to be reassured that the responsibility for making decisions about how the National Curriculum is applied in the classroom is still theirs".*

Another problem I find with our National Curriculum is the clause that is placed in front of almost every science statement "Students should be taught that …." This can only be valid if the pupils are personally and critically engaged in a learning enterprise. It is particularly unfortunate when these often repeated words from our national curriculum are interpreted as 'the pupils must be *told*' and when success in learning science is measured by only or mainly by examination results this can lead to teachers. Accepting information merely because it comes from 'an authority' or learning meaningless words and/or formulae just for an examination, although we have all done it on occasion, represents a failure of the science process. Such uncritical learning is anti-scientific.

In the latest version of our National curriculum (QCA, 2006.) emphasis is given to 'How Science Works'. The main headings of these are presented below - but for the detail it will be necessary to refer to the original publication.

- How science works:
  1. Data, evidence, theories and explanations.
  2. Practical and enquiry skills.
  3. Communication skills.
  4. Applications and implications of science.

- Breadth of study:
  1. Organisms and health.
  2. Chemical and material behaviour.
  3. Energy, electricity and radiations.
  4. Environment, Earth and universe.

This represents a useful list of processes, skills and issues to be included in the science education enterprise and will be valuable in evaluating science programmes. However, this can not just be taught. Pre-eminently science processes depend upon critical questioning, curiosity to understand and explain, honesty, balance, convincing evidence - and the trust in and integrity of the people involved.

Our pupils should experience science as a lively, exciting, meaningful and personally engaging subject. We as teachers should aspire to engage in its learning *with* our students - we need to know and understand a great deal of science, but some of our pupils will inevitably have different experiences and will know things that we do not. Some of our students may well be intellectually more able than we are and should be able to challenge and develop our understandings as teachers. One thing seems clear: that if students are to become *active* science learners more of them must be encouraged to interact critically with their science curriculum. (Goodwin, 2001) They must be encouraged to ask questions, seek for and evaluate evidence and become convinced about the correctness and value of the science they are learning. In short, learning science must become more like doing science. A recent issue of School Science Review (March, 2007) recognises the importance of this and focuses upon 'Argument, discourse and interactivity'.

An additional suggestion I would like to make for your consideration – since it is a particular interest of mine is to enhance the use of 'teacher demonstrations' with your pupils. This is one way in which we can do interesting and engaging science, share our enthusiasm for science, raise questions and provide evidence. (Although It should NOT be at the expense of practical work that pupils can reasonably and meaningfully do for themselves.)

By organising suitable demonstrations it is often possible for students to enjoy a really *educational* experience whilst minimising expense, complexity and hazard. Perhaps, more importantly, it also gives them the opportunity to share the teacher's more extensive science expertise AND observe the teacher engaging with his/her own subject knowledge *and* with the processes of 'How Science Works'. The use of exciting science teacher demonstrations in the curriculum has declined markedly since the 1980s (reasons may include: introduction of the national curriculum (Donnelly and Jenkins; 1999); inappropriate emphasis on health and safety, concern for the litigious society should anything go wrong; belief that only pupil practical is effective; lack of teacher experience of demonstrations in his/her own science education; only marks in tests and examinations are *really* valued.) This decline may not be the only reason for the fact that pupils seem now to find science in general —and chemistry in particular— one of the most boring subjects on the curriculum. (Osborne and Collins; 2001). Whatever the reasons, it seems clear that for many pupils and teachers learning/teaching science is now less meaningful and less enjoyable than it once was.

The use of teacher demonstrations in science lessons can:

1. Help to *expand* the pupils first hand experience of scientific phenomena and observe a more experienced scientist working with chemicals, equipment and ideas.
2. Free the pupils from the need to 'take care' for themselves and to observe critically the teacher's practical skills. They should all observe the same outcome from the experiment and this helps generate focussed questions and makes the experience more meaningful.
3. Encourage pupils to explore with their teacher 'how science works'. Demonstrations can sometimes be altered or extended to capitalise on pupils' questions or suggestions.
4. Allow pupils to see that science teachers enjoy 'engaging' with science. (It must be more than 'just having fun').

Hopefully you will continue to enjoy science and your students will not be bored. (Interested students can do much better in examinations too!)

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