Some reflections on school science curriculum development in England

Edgar W. Jenkins


I begin by commenting briefly upon what has been achieved in school science education.

- First, we are teaching more science to more students than at any time in history. This isn’t just a matter of the large numbers entered for public examinations, impressive though these are. More pupils are studying the separate sciences at GCSE level and we are now teaching science in some form from the age of five throughout compulsory schooling. The worst may also be over in terms of falling A-level entries in physics and chemistry, although there is clearly no room for complacency, especially when it comes to the supply of physics teachers.

- The evidence from international comparative studies, notably PISA, is that, while there are issues that remain to be addressed, the overall performance of 15 year old students in England was better than that of most of the other 30 OECD countries, although less good than Finland, Canada, Japan, New Zealand, Australia and the Netherlands. For me, the 2006 round of PISA testing in science highlights two issues; the sensitivity of student performance to the instrument used to measure it and the fact that
about a quarter of the variation in UK student performance in science can be attributed to differences between schools, an indication that school standards vary considerably. I should perhaps add that in England, as elsewhere, variation in student performance is much greater than the variation between different education systems with which we might wish to make comparisons.

- Science teaching is now supported by an enormous investment in a very wide but uncoordinated range of STEM initiatives, over 470 according to one survey, directed at improving primary or secondary science education. These initiatives include ambassador schemes, taster courses, SET weeks, web-based activities, prizes, awards and competitions, podcasts, along with the work of the national and regional science centres, institutions of higher education, and the societies concerned professionally with science and science education.

- The wider context, reflecting a need to promote public understanding of, and engagement with, science, is evident in the development of hand-on science centres into a global industry, in an increase in the coverage of science in the print and broadcast media, and in the rapid growth in the number of books that might be categorised as popular science. With authors such as Stephen Hawking, Peter Atkins, Leon Lederman, Paul Davies, Lewis Wolpert, Richard Dawkins, Carl Sagan, Patrick Moore and
Richard Feynman, most aspects of contemporary science now receive some attention.

- We have begun to give rather more attention to science outside the laboratory, a phrase I am using to include both applied science as well as developments such as *21stCentury Science*. Looking ahead, there is the challenge of the Science Diploma which holds out the promise of linking school science with the world of work and offering students the chance to show what they can do and not simply what they know.

- How science should be taught, pedagogy, has not of course, been forgotten, with a renewed emphasis on inquiry-based approaches designed to enhance pupils’ interest in science and improve their learning. In the perhaps rather overblown words of a recent publication from the European Commission, the ‘future of Europe’ requires a renewed pedagogy.

- Let us recognise too that a series of statistics confirm that school students have generally very supportive views of science, even if such views do not lead as many as we might like to choose the physical sciences as subjects for study beyond the end of compulsory schooling.

Without elaborating how all this has come about, it is clear that central government has been the main force driving reform.

We have certainly come a very long way from the days when George Tomlinson, a Labour Minister of Education, could assert that ‘Minister knows nowt about curriculum’ or Sir David Eccles, a subsequent
Conservative Minister, could tell the House of Commons that ‘Of course, Parliament would never attempt to dictate the curriculum’. Today, schools face a statutory curriculum stemming ultimately from the *Education Reform Act 1988*, although much other legislation also has a bearing upon the work of the schools, including that relating to health and safety and to gender and other forms of discrimination. What goes on in science lessons, as elsewhere in schools, is also shaped by the demands of assessment, inspection and accountability.

There have also been other, non-legislative influences shaping school science education. Currently favoured approaches to teaching science owe much to research into children’s understanding of scientific concepts and its underpinning psychology of constructivism. In addition, the work of charitable organisations in funding seminars such as *Beyond 2000* and in pioneering curriculum initiatives such as the Salters’ science programmes and *21st Century Science* has been of seminal importance.

All of this has been played out in the context of globalisation, one consequence of which is that schooling, education and training are now principally regarded and promoted as significant instruments for economic and social change, for building intellectual capital and the capacity for innovation. Science clearly has a major role to play here but it is appropriate to ask whether in highlighting and promoting its economic importance, we have done enough to make it clear to young people what science can do for them rather than what they can do for science, and to capture some of the wonder and creativity associated with scientific inquiry. They, I think, may well want to know rather more about how science articulates with their interests and the issues that are important to them as young people.

The global emphasis on the role of education in promoting economic growth and the knowledge society has become something approaching
an organising principle for education systems and this has accentuated the need for trans-national measures of performance such as TIMSS and PISA. The powerful influence of such measures now amounts to something of a de-contextualised global policy for school science education. There are dangers in this. In addition to the contingency I referred to earlier, school science policy needs to be driven by much more than numbers, ranking and target setting, not least because these can easily become corrupting influences on the way science is taught and the way in which science teachers perceive their task. Performance in tests such as PISA or TIMSS should be among the outcomes of school science education not its goals.

Half a century ago, the universities, through their examination boards, were, unlike now, the guardians of traditional science education, although they were very careful indeed to make clear that how science was taught was none of their business. Who does, and who should fulfil the role of guardian today? To identify Parliament is to overlook a lesson of recent history, namely that it has been possible to promote change on a national, statutory basis by exerting influence within a shifting network of committees and advisory groups which, from time to time, have been given delegated authority over the school science curriculum. One consequence has been that schools, students and teachers have had to contend with confusing shifts of direction in their work. This is perhaps most clear in the successive attempts to accommodate some account of what is now called ‘how science works’ in the school curriculum. This is not the place to explore the intellectual and technical difficulties arising from this commitment, over a century old, to helping students capture this Holy Grail of science education. I would like, however, to pose a few questions.
By focusing on ‘how science works’, are we missing an opportunity to reveal to students something of the differences between the sciences, differences that are conceptual, linguistic, methodological and philosophical? Does a focus on how science works allied with its assessment encourage a narrowing of students’ perception of the many roles that different sciences play in the world in which they are growing up?

Should we be satisfied with the way in which this aspect of the curriculum is being interpreted? Does it allow us to give students an insight, however limited, into what we don’t yet know and why we don’t know it? Is there a risk of science becoming a background against which students discuss issues that are essentially ethical, political or economic and where the underpinning science is difficult and complex? To pose this question in a different way without denying the importance of such issues, are we in some danger of undermining the distinctive contribution that science has to make to the education of all students?

One response to these questions would be to argue that school science must now be redefined, its boundaries redrawn, to reflect the changes that have taken place in the relationships between science, technology and society. Arguably, this is what is now underway in England as elsewhere. If so, we need to recognise a pressing need to redefine what it means to be a science teacher and to help them deal adequately with issues characterised by debate, controversy, ethical dilemmas, subjectivity and uncertainty. There are also difficult issues surrounding assessment. Such redefinition of school science therefore presents formidable challenges, which is not to say that they should or could not be met.
Another response would be to assert that contentious science-society issues are better dealt with outside the confines of school science itself, perhaps in lessons concerned with citizenship.

A third response would link current attempts at reform with earlier innovations such as general science, social biology, the science education for citizenship movement of the post-war years and science as a mode of inquiry associated with the curriculum reforms of the 1960s and 1970s. All of these initiatives reflect in different ways an assumption that the school science curriculum is overloaded with facts to be learnt and that this inevitably makes school science lessons ‘boring’. They also seek to relate science to everyday life and to engage students with science by creating, within the curriculum, a space for what might be called student independence and judgement, a space deemed to be lacking in more traditional, fact-laden approaches to science education.

Science, society and their inter-relationships, along with schools and the resources available for teaching and communication, have all changed profoundly since physics and chemistry were first schooled in the mid-nineteenth century. The form and content of school science has not been immune from these and other changes, although the response has sometimes been tardy. What is clear is that further well-grounded, ongoing review is inevitable and that a number of issues remain to be addressed, some of which concern schools rather than the science curriculum per se and some of which are matters for policy makers and legislators. I offer the following for consideration:

- Narrow the gap between the best and worst levels of attainment
- Encourage more students to study physics in Higher Education especially from state schools
• Continue to address issues of equity relating to gender, socio-economic background and ethnicity in science education
• Exploit the ways in which modern electronic means of communication can enrich the science curriculum and improve students’ learning,
• Make much more use of assessment for learning and encourage students to monitor their own progress
• Help students see ‘science’ as a creative and imaginative activity that plays many roles in the modern world
• Raise the standards of science teaching to the highest possible level and remove any obstacles that prevent or hinder this.

I will end with a comment on the last of these points. In 2007, McKinsey & Co. reported on those education systems judged to be most successful at promoting student learning and identified their distinguishing characteristics. They seem strikingly simple and, interestingly, make no reference to curriculum:

• choose the right people to become teachers,
• develop them into effective teachers who teach consistently well, and
• establish systems and targeted support to ensure that every learner is able to benefit from excellent teaching.

This document was added to the Education-line collection on 4 March 2010