

Science education can make the difference

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I want to make three short points. The first of these will speak to the wider social context in which we are seeking to increase the human resources for science and technology in Europe. The remaining two will relate to issues that receive some, but in my view, not enough, attention in the document we have before us. I take it for granted that the level and nature of students' interest in science and their achievements are determined by a complex set of interactions involving the students themselves, their schools and the wider communities and societies of which they are a part and among which they carry the burden of the future.

My first point stems from the wider perspective of this complex set of interactions. It sometimes seems to me that much of the debate about school science education is in some danger of reflecting a view of science that has become increasingly prevalent in industrialised societies but which, in my view is ultimately self-defeating, perhaps even anti-scientific. The scientific revolution that gave birth to modern science cannot be separated from the social changes that prompted and encouraged it. Historically, the power of scientific ideas and the triumphs of technology have been associated with such concepts as liberty and equality, and, for the nineteenth and much of the twentieth century, with the notion of progress. Today, the world and the public estimation of science are very different, despite the fact that scientific and technological achievements

are without precedent. We live in a world in which safety and precaution have become organising principles, so that even in cases of public concern in which the scientific evidence is fairly unambiguous, the emphasis has now shifted towards accommodating and assuaging anxieties and fears. What, you may ask, has this to do with school science education? My answer is threefold. First, this is part of the intellectual climate in which the young people of Europe are growing up. Like many of their parents, they are more likely to associate science and technology with risk than with progress, and prefer public opinion to professional scientific expertise. This climate has been characterised by the Slovenian philosopher Slavoj Žižek as not so much a fear of error as a masking of the truth that lies at the heart of scientific enquiry. It is that same scientific truth that can lead to findings that are unpopular because they fly in the face of widespread conceptions and/or challenge cherished beliefs and prejudices. Secondly, the school science curriculum is unlikely to remain immune from these changes in the public perception of science and technology and some recent attempts at curriculum reform, including programmes that might be described as ‘issues-based’ can be seen as a response to them. Thirdly, if school science education is to make a difference, those engaged in it, including science teachers and policy makers, need a better understanding than sometimes seems to me to be the case, of the position that science and technology have now come to occupy at the beginning of the twenty-first century. If we wish to know more about why young people are not attracted in sufficient numbers to the study of physical science and technology at more advanced levels, it will simply not be sufficient to look for answers in the curriculum, in pedagogy, or teacher education. We need to look outside the schools as well and see what contribution science education, broadly understood, may be able to make to generating a more supportive climate and, in particular, to challenging the anti-sentiments hostile to science that some see as gaining ground within many industrialised

societies. There is, of course, an important set of tasks here for the professional scientific societies but also for government, the media and individuals to identify and promote core scientific values in the face of what the distinguished historian of science, Gerald Holton, has referred to as an anti-science movement.

This, of course, does not mean that nothing can be done in such areas as curriculum, pedagogy or teacher education. But, if progress is to be made, any reforms need to be part of a coherent strategy, rather than a series of piecemeal initiatives. There must also, I would suggest, be a view of science that emphasises its commitment to scientific truth based on evidence, and acknowledges that, while science has a role to play in decision-making in a democracy, science itself is not democratic.

In the short time available, I want to turn attention to two much more specific aspects of school science education that seem to me not to have had as much attention as they deserve, although both feature in the report that brings us here today.

The first is assessment, the importance of which is addressed very briefly in the context of school science in section 6.3.2.4. Every school science teacher, and, of course, each student, responds to the demands that he or she knows or assumes will be required for success in tests and public examinations. Assessment policy is thus a powerful determinant of what goes on in school science classrooms and laboratories across Europe. We perhaps have all heard the familiar cry of many science teachers that they would 'teach in a different way' if it weren't for the demands placed upon them by the need to prepare students for examinations. Preparing students for public examinations is, of course, part of the responsibility of many science teachers. Unfortunately, assessment

reform has rarely had the same degree of attention as curriculum reform so that, all too often, examinations in school science are at odds with the aims prescribed for the curriculum. In addition, some forms of assessment promote some teaching methods at the expense of others that are more likely to be supportive of student learning, longer-term understanding and interest. If we want school science to promote not only scientific knowledge and concepts but also students' ability to analyse, evaluate and reflect, then the techniques and procedures used for assessment must be supportive of these outcomes. My impression is that more needs to be done to ensure that this is the case and to develop new techniques for assessing school science that assess a much broader range of skills than is currently possible. There is, without doubt, a substantial research agenda here. There is also a need to exploit the potential that a variety of styles and modes of assessment offer to students to monitor and improve their own learning and understanding and to teachers to improve their teaching strategies. At present, too little assessment is used to promote, rather than simply measure, learning. However, none of this potential can be realised without the support of parents, teachers, students and the various agencies responsible for overseeing public examinations in different parts of Europe. There is, therefore, a need not only to look at new ways of assessing a wider range of skills in school science than hitherto, but also to make systems of assessment more transparent, credible and accountable to all those involved in the assessment process.

I turn now to my second relatively neglected aspect of school science education and this is the advice and information offered to students about the range of career opportunities available to those with qualifications in science or technology. The relevant section of the document here is section 6.3.4.1. One of the questions in the ROSE survey asks students whether or not they agree with the statement that school science has opened their eyes to

new and exciting jobs. Although there is a large volume of data still to be analysed, the responses do not seem to be particularly encouraging. If this finding has some general validity, we need to ask why and take steps to address the issues involved. There is evidence, not least from a study undertaken in England in 2000 that science teachers do not see themselves as influential or wishing to be involved in advising students about future career options, although it seems likely that they underestimated the extent of the influence they actually have on their students simply as a result of teaching them. The same study reported that there was little evidence that pupils were aware of explicit links being made in their science lesson between science topics on the one hand and careers or industrial or medical applications on the other. Again, if this finding has a validity beyond England, and I suspect that it has, we need to ask some questions about the role that schools, science teachers and other individuals and organisations play, or should play, in alerting their students to the careers open to them as a result of the knowledge and skills acquired from studying science at school. My strong sense is that we have presented too narrow a picture to young people about the options open to those with scientific, technological or mathematical skills. The dominant message still seems to be that school science is principally for those who will become research scientists. Much more needs to be done to show young people that the knowledge, skills and attitudes they can acquire from studying science are very widely applicable. In recent years, science has become a compulsory subject of study at school in many education systems. Is it perhaps too far fetched to wonder whether this has led the case for science in general education to be taken for granted when young people need to be helped to understand what school science can do for them as well as what they might do for science? More widely, are we still locked into, not just science courses, but systems of secondary schooling that are over-

directed towards higher education for some rather than towards the great diversity associated with life-long learning for all?

So, can school science education make *the* difference as the title of this section of the programme suggests? My answer is *a* difference and a very significant one, providing we address a number of specific issues and acknowledge and respond appropriately to the wider forces currently influencing attempts to reform school science curricula.