THINK!

Where has all the science gone?

Simon Parry, Elizabeth Briten and Mick Allen

consider the current position of science in the primary school

Is primary science still a core subject? The National Curriculum in England states that it is, but a great deal of evidence suggests it is considered differently. The Wellcome Trust (2017: 37) reports that many schools are spending less than the two hours per week on science recommended by the Association for Science Education (ASE), and studies by the Department for Education (DfE, 2016: 194) show that schools in England spend less time on the subject than many of our international competitors. The science sampling tests of 2016 (used to measure the national performance of pupils at the end of year 6 in science, enabling attainment to be compared to previous years) indicated that less than one in four 11-year-olds was reaching the expected level; what sort of outcry would there be if this was the case with English and mathematics?

Even the Ofsted Chief Inspector admits that science is being 'squeezed out' by the narrowing of the curriculum, almost certainly caused by intense focus on the high-stakes testing of literacy and numeracy. We often read that STEM subjects are vital for the future prosperity of the UK, and have been reading this for some time now, but primary science appears to be on the ropes, if not quite out for the count.

In this article we look at what might be done to give children the excellent first experience of science that they deserve, both at a national level and at school level.

At national level

Should the key stage 2 science SAT be reinstated?

In 2009, Ed Balls, the then Secretary of State for Children, Schools and Families, was under intense pressure from the teaching profession, teacher unions and the media to reduce the amount of national testing that was being undertaken in schools. An excessive testing culture was seen by many as damaging to children's wellbeing, impacting heavily on teacher workload, and having little value outside of the generation of school performance tables. In response to this, Mr Balls abolished the key stage 3 (age 13–14) SATs completely; at key stage 2 (age 10–11) the science SAT was similarly scrapped, although, as a compromise, English and mathematics were retained. Although science remained a core subject, since children's scientific knowledge and understanding were no longer being formally tested, its status had effectively been downgraded. At the time these changes were proposed the ASE approved them, arguing that because teachers no longer had to 'teach to the test' this would give the opportunity for children to experience more creative science. This view was felt to be broadly positive for the quality and range of science experiences to which learners would then have access.

However, these changes have meant that teachers now overwhelmingly focus on English and mathematics to the detriment of science and the foundation subjects. This is understandable, given what is at stake if children perform poorly in the key stage 2 SATs. If the science SAT at key stage 2 were to be reinstated then science would have to be taught at a similar level to English and maths, and teaching time would be increased accordingly (although teachers may be focusing on the outcomes of their teaching, rather than on the processes in the classroom). Alternately, scrapping the English and mathematics SATs at key stage 2 would go some way toward relieving the inordinate attention currently given to these subjects in year 6 (age 10–11).

Could Ofsted give more support to primary science?

Two key drivers of educational practice in primary schools appear to be those twin pillars of accountability: SATs and Ofsted. As discussed, science lost its 'protection' of having a SAT in 2009; since then, perhaps Ofsted could have done more to support its core status. A Wellcome Trust report in 2015 stated that science was mentioned in only 27% of Ofsted's primary school inspection reports in the previous year; although this had risen to almost 60% of reports in 2017, it is still a long way behind the 99% that mention mathematics. Would schools take science more seriously if they knew it would be in their next Ofsted report? There may be some more hope for science in the Ofsted Chief Inspector's comments that the curriculum will become a 'central focus' of Ofsted's 2019 framework.

Should the content of the National Curriculum be reduced?

It is pertinent at this juncture to consider whether primary science should be focused on addressing a large body of content knowledge or be largely dedicated to the process of investigation and use of the essential skills of science. The current National Curriculum, introduced in 2013, was considered to be a more academic, knowledge-rich curriculum. This was due to the inclusion of new concepts in key stage 2 adopted from key stage 3 and the addition of former key stage 2 concepts in key stage 1; for example, evolution and inheritance, which is now in year 6, was formerly part of the key stage 3 and 4 curriculum. The content of the science curriculum is now more burdensome than ever in terms of the level of subject knowledge required for effective teaching. As a consequence, it is unrealistic to expect skilled teaching in every primary classroom.

One answer may be to reduce the subject content of the National Curriculum while increasing focus on 'working scientifically'. Reducing the pressure on teachers to address excessive subject content would allow topics to be explored in a creative and exciting manner with time being allowed for whole investigations and deeper exploration of key science ideas. There could be one subject topic per term for each year group with the removal of more complex areas of study such as gears, levers and pulleys, dissolving, food chains, and so on. The new

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focus on the process of science rather than content would promote science lessons that motivate and enthuse the children and encourage the development of key thinking skills alongside a true love of science.

Should there be a new national scheme of work for science?

In 1998, the Qualifications and Curriculum Authority Schemes of Work were introduced alongside the National Curriculum Programmes of Study. The science QCA SoW was loaded with exemplars and suggestions for lesson ideas that were designed to inspire teachers in their science planning. Its structure was heavily based on that of the National Curriculum, although it was only advisory and not a mandatory document. Despite this, primary science coordinators ended up including much of the material in their own schemes of work at school level. The QCA SoW was inevitably set aside when the latest incarnation of the National Curriculum was introduced in 2014 because it was no longer directly compatible.

The QCA SoW was never replaced, although there is some material in the present National Curriculum science document that similarly suggests practical lesson ideas. This non-statutory guidance follows every topic entry, although is very brief. If this material were to be significantly expanded, perhaps being published as a companion volume, then it could provide a rich source of inspiration for primary teachers. If the content were based on activities that research studies have shown to promote children's learning, then this would help enable science teaching in primary schools to become more evidence-based.

Is continuing professional development the answer to low confidence in science?

The Wellcome Trust (2005) highlighted primary science teachers' lack of knowledge, expertise and confidence, and recommended urgent continuing professional development (CPD). More recently, the CBI (2015) stated that the amount of CPD undertaken by primary schools was insufficient to tackle the concerns around teacher confidence in relation to science subjects. It is likely that the situation today is not much different, with limited local authority funding being dedicated to English and mathematics, alongside other national priorities. It is reasonable to conclude then that there is little provision of CPD in primary science and not sufficient to address lack of knowledge among primary teachers.

A less expensive and more effective version of CPD would be for university initial teacher education (ITE) departments to provide support personnel in science, with one member of staff attached to a group of schools. The university staff would be partially funded by the government and so enabled to undertake critical support work. This arrangement would strengthen ITE–school partnerships and would also inform practice within ITE provision.

At school level

Could improved assessment procedures raise attainment?

A 2013 Ofsted report into science stated that, in nearly half of the primary schools visited, senior leaders had set no targets for science and were not tracking pupils' progress, in many cases because they no longer saw science as a priority. Targets, and tracking progress towards those targets, could have a positive impact on children's learning. This collection of data need not be an end in itself: it should support progress and outcomes for pupils. Effective assessment should include the conversion of numbers, letters or levels into targets based on the curriculum, so that teaching following the assessment is adapted, and improved pupil outcomes follow. Bath Spa University, together with the Primary Science Teaching Trust, have designed a structure to help schools to evaluate and develop their assessment of science (PSTT, 2015).

Should we have specialist science teachers?

Specialist science teachers (in line with the teaching of physical education, music and languages in many schools at present) could deliver high-quality science lessons to all the pupils in the school. One barrier to this is the fact that there are already difficulties recruiting science teachers into the secondary sector, let alone into primary schools. Perhaps surprisingly, recent research conducted by Harvard University (Bloom, 2016) suggests that pupil outcomes may be up to 6% lower with a specialist teacher than with their normal classroom teacher, showing how vital the pupil–teacher relationship can be. Of course, rather than a science specialist teaching all the lessons, most schools already have in place a teacher whose specialism is more knowledge or greater enthusiasm in the vital role of science leader.

In conclusion

Are we missing opportunities to exploit children's natural enthusiasm for science?

Studies have shown that during the primary years children are very enthusiastic about learning science in school. They have a natural curiosity to explore new phenomena in a hands-on way, discover how things work and try out novel approaches, all of which mirror events that typically take place during good practical science lessons. However, the evidence suggests that a significant number of children leave primary school having had only minimal experience of hand-on science activities, and that interest in science starts to peak or significantly decline at upper key stage 2 (Turner and Ireson, 2010). Reasons for this are discussed elsewhere in this article; for instance, any drop in interest at year 6 is likely to be due in part to the lion's share of curricular time being given over to English and mathematics in preparation for the SATs, with science lessons, together with foundation subjects, being sidelined.

It is a great shame that we are neglecting opportunities to exploit children's natural affinities for learning science. If primary science coordinators can ensure, when writing medium-term plans, that quality, hands-on science lessons are taught regularly and frequently in all year groups, then teachers would not 'miss the boat' with respect to making the most of children's learning preferences. Particularly, maintaining children's natural enthusiasm for science throughout year 6 would make it less likely that their interest would wane during the early secondary years.

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Simon Parry and **Elizabeth Briten** are both Senior Lecturers and **Mick Allen** is an Associate Professor at Kingston University School of Education. Email: S.Parry@sgul.kingston.ac.uk