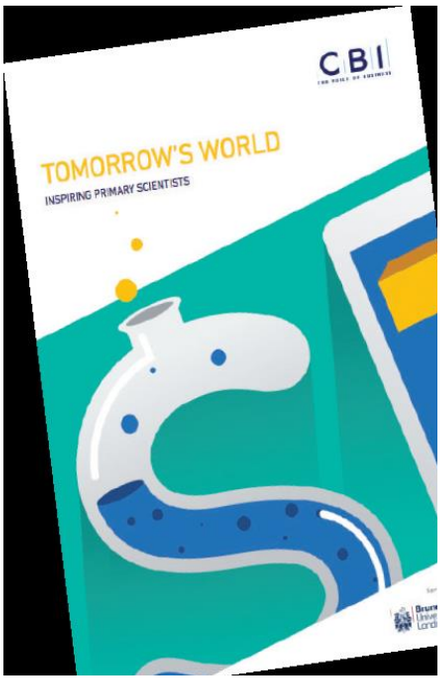
Kelly Dockerty *looks at the implications for teacher training and the findings of the CBI report* Tomorrow's world: Inspiring primary scientists.



STEMING THE GROWTH OF PRIMARY SCIENCE

Science has been somewhat marginalised over the years in primary schools in England under the pressures of testing and inspection in the drive to raise standards in English and mathematics. Although it is itself a core subject, science seems to receive less priority and designated time on our primary curriculum timetables. Curriculum changes over the years, as teachers have strived to teach a crowded curriculum, have resulted in science being taught with other subjects as part of cross-curricular topics, rather than as a 'stand-alone' subject. This cross-curricular pedagogy in science is supported by the Primary Science Quality Mark (PSQM) process, as schools are explicitly encouraged by the award indicators to link science to other curriculum areas on planning documentation, while maintaining its distinctive character (PSQM, 2010–2011). The contribution of science to whole-school initiatives as part of a holistic curriculum should be explicit; for example, recycling to address global concerns for the environment and sustainability.

The recent CBI report, *Tomorrow's world: Inspiring primary scientists* (CBI, 2015), highlights that the status of science needs to be raised, and as part of its recommendations suggests that a target should be set for UK schools to be the best in Europe and in the top five worldwide by 2020. A new education strategy should be developed in which professional development is of high priority and each primary school has a science subject leader to drive a continual focus on science. The report also recommends that Ofsted, through a new framework, should reward schools for community engagement with businesses and universities in subjects such as science, technology, engineering and mathematics (STEM).

In all of this we must not lose sight of the fact that the most important group of people to consider in education are the children. They are entitled to be inspired and taught with enthusiasm by confident, engaging teachers who nurture their needs, developing knowledge, skills and attitudes which will grow with the child as they become confident and successful adults.

The big picture

There is concern in the business sector about how the UK will stay competitive without continual investment in skilling people in the STEM areas. The shortage of young learners choosing science subjects is a real issue. The report calls for industry to play its part in supporting outreach to inspire young people, particularly focusing on forging links with sixth forms and colleges to attract females into STEM careers. It also states that estimates show just 5% of the current teaching workforce has a science-related degree (CaSE, 2014) and, more worryingly, that because primary school teachers are generalists, many of them have not studied science at Advanced level (A-level), degree level or equivalent.

Confidence versus competence

Research highlighted below shows that teachers' perceptions of their own knowledge impact on their confidence to teach subjects such as science, often with negative consequences to learners. Three decades ago, research by Gilbert, Osborne and Fensham (1982)

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Teacher trainees have a cross-curricular 'brainstorm' for planning activities starting with a media article as a stimulus

showed that children are not passive learners and the way they make sense of their experiences leads to intuitive knowledge development called 'children's science' (p. 623). So what do teachers need to know to help children build their intuition from experience? Shulman (1987) emphasised the importance of teachers' knowledge, identifying three key areas:

- **Subject matter knowledge** (SMK) – knowledge about science;
- **Pedagogical content knowledge** (PCK) – the knowledge of methods of teaching science;
- **Common content knowledge** (CCK) – the statutory requirements.

PCK was viewed by Shulman as the most important area to support children's development when working scientifically. Over the next twenty years, researchers added to Shulman's theories, confirming that a lack of subject knowledge and personal confidence is a major issue in the teaching of primary science. As the CBI report highlights, by making links with industry this lack of confidence and gain in knowledge can be supported through a programme of continuing professional development. Advances in technology over the last four decades, particularly in ICT applications, have allowed teachers to access resources and make them available in the classroom. This accessibility can improve both teacher confidence and teaching ability: however, the actual impact on their personal knowledge and application in practice is not yet explicit in the research.

Benchmark expectations – teachers' standards

University training needs to build confidence in trainee teachers to plan creatively to inspire young scientific minds. In England, the Teachers' Standards (Department for Education (DfE), 2011) set the expectations, stating that teachers should make pupils their first concern and are accountable for the highest possible standards of work and conduct (Preamble, p.10). These standards are applicable to trainees, newly qualified teachers (NQTs) and experienced teachers. Inbuilt into the eight standards are clear expectations of the level of knowledge required to teach, made explicit in standard 3 (DfE, 2011: 11) (Box 1).

All subjects are encompassed in the expectation of teachers' knowledge of the curriculum areas, but the standard focuses three of its five sub-statements on English and mathematics; perhaps here too the DfE needs to redress the balance to emphasise the importance of science as a core subject and thus help to maintain its status? What is clearly important is that we nurture the children's curiosity to learn, have positive attitudes and teach a range of transferable skills so that children can apply their knowledge and skills to solve problems in everyday life. I have found in practice with trainees in initial teacher training a way to build confidence is to give them high-quality starting points from which to plan children's learning (Box 2). This may include, for example, using resources from everyday life such as natural materials discovered in the environment during a local nature walk, or articles from the media that enable learning to be set in a real-life context, making learning accessible to all children.

Box 1 Standard 3 of the Teachers' Standards (DfE, 2011: 11)

3. Demonstrate good subject and curriculum knowledge

- have a secure knowledge of the relevant subject(s) and curriculum areas, foster and maintain pupils' interest in the subject, and address misunderstandings;
- demonstrate a critical understanding of developments in the subject and curriculum areas, and promote the value of scholarship;
- demonstrate an understanding of and take responsibility for promoting high standards of literacy, articulacy and the correct use of standard English, whatever the teacher's specialist subject;
- if teaching early reading, demonstrate a clear understanding of systematic synthetic phonics;
- if teaching early mathematics, demonstrate a clear understanding of appropriate teaching strategies.

Summary

Children's education is important and teachers need to support learning by making a creative curriculum accessible to all learners. Focusing on cross-curricular approaches and developing transferable skills when planning to teach, will ensure the breadth of the National Curriculum content is covered, while reinstating the importance of science as part of the core content. Research has shown how important knowledge is to good-quality teaching; through links with industry and universities to support professional development at all teaching career levels, we can ensure that teachers are both confident and competent in delivering the curriculum to skill the next generation. Let us ensure that UK schools are the best by 2020 and inspire young scientific minds!

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Box 2 Teacher trainees using high-quality starting points

Trainees started the session with some theory about Earth and Space as it appears in the National Curriculum for 9- and 10-year-olds in England. Groups of six were each given a recent media article about a natural phenomenon such as the spring tide, a solar eclipse or a meteor shower, and asked to think about using this as a stimulus with children and to consider what activities they could plan. They were encouraged to think thematically, perhaps using cross-curricular approaches (Figure 1).

They planned activities such as:

- creating fact files using ICT software;
- conducting further research using the Web;
- screen printing and sculpting using a range of materials/textiles;
- making solar system models as a design and technology project;
- enhancing mathematical skills by calculating the speed of meteors (speed = distance/time);
- drama activities such as space weather forecasting, script writing, creating weather theme tunes and filming.

All of this grew from a simple media article about a recent natural phenomenon and some imagination and creativity. The trainees also had access to the National Curriculum statutory guidance, in which to frame their activities and intended learning outcomes, which eventually led them to plan a scheme of work for science outlining science lessons for half a term.

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