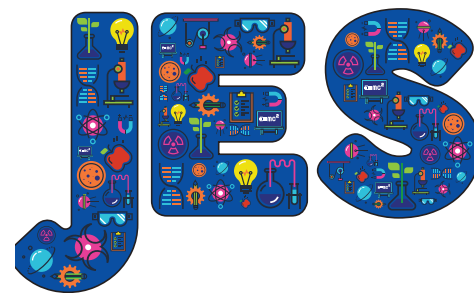


Slowly does it – using research to improve primary science



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Abstract

This is a review of primary science in England since 2016 using data from Wellcome's primary science campaign. This article provides a summary, with the full research reports referenced for readers to access further detail. Data suggest that subject leadership for science is slowly being better supported and that schools are increasing the amount of time spent teaching science. Questions are raised still about teachers' confidence in specific areas of subject knowledge and pedagogical content knowledge, as well as assessment of progress in science and the impact that this has on learners. These data are discussed in the current context in which schools, educators and learners find themselves: one where science has increased importance to mitigate the impact of a pandemic.

Keywords: Primary science, subject leadership, subject knowledge

Background

Primary science education has long been characterised by concerns that it is hard to teach, hard to resource and not quite as important as other core subjects (Wellcome, 2014). Since the introduction of the National Curriculum in 1988 for all schools in England, Wales and Northern Ireland, regular reviews have produced very similar recommendations that primary science needs to be improved (for example, Ofsted, 2013). Interventions and reforms that promise exciting new ideas to solve the problem of the moment and raise standards are launched, but, without buy-in from everyone, such interventions have an impact

only for a short time and rarely lead to sustained change (Ryder, 2015). While the appetite and will of enthusiasts to champion good primary science has always been strong, it is an ongoing battle to change the overall narrative for primary science. But, why? What needs to be done differently?

Wellcome, an independent international charitable foundation, decided to explore what it might take to improve primary science and launched a campaign to run from 2016 to 2021. However, rather than start with designing interventions to address the widely accepted recommendations, Wellcome first commissioned independent market research to understand exactly what was happening in primary science in England, reaching out to teachers and school leaders, including those who did not identify with science. Using questionnaires, interviews and focus groups, the picture that emerged was complex and concerning.

Although teachers and school leaders recognised that science is important societally and has many benefits for learners, several factors led to science being low on the priority list:

- ❑ pressure on school leaders to raise standards exclusively in English and mathematics;
- ❑ lack of recognition and support for science subject leaders compared to that for subject leaders in English and mathematics; and
- ❑ low accountability for attainment and progress in science.

School leaders often wanted to improve science in their schools, but felt that they had to focus on other areas more urgently. With science having such a low priority, teachers may not have thought that they needed to worry much about investing in



it. Consequently, science was often taught through worksheets and was rarely given enough time in the weekly timetable to support good progression. Looking further into teachers' attitudes towards science, it became clear that other factors contributed to their views:

- ❑ perceptions that practical science lessons are harder to manage;
- ❑ no support in school;
- ❑ inadequate or poorly managed resources;
- ❑ low confidence in their own science knowledge or how to teach science; and
- ❑ perceptions that science is hard and for 'sciencey' people.

The market research also showed that, when primary science was given priority and taught successfully, it was the science subject leader, backed by school leaders, who was pivotal in that success. Wellcome identified that science subject leaders (or their equivalent in all UK nations) were the key audience to secure change (Wellcome 2017a, 2017b).

Wellcome realised that it needed to reach out to teachers to engage them over time and, by working closely with other sectoral organisations, to present a clear pathway of support and development to achieve more and better primary science teaching. Explorify, a free digital tool (www.explorify.wellcome.ac.uk) was created in 2017 to reach teachers who might not usually seek support for science.

Annual monitoring surveys have been used to understand changes and impacts on primary science education during the campaign. This paper reviews the state of primary science education in England from 2016 using data collated from the annual evaluation and monitoring.

As we review the data, we must consider the current context in which schools are operating. From late March 2020 until the start of the 2020-2021 academic year, learners were not in school due to the Coronavirus pandemic and their access to quality teaching was limited. Although schools worked hard to support home learning and

many organisations across the science education sector adapted quickly to provide free support, the experience for many pupils will have impacted negatively on their learning and progress (Education Endowment Foundation (EEF), 2020), particularly in science (Canovan & Fallon, 2020). Learning will continue to be disrupted until the pandemic is controlled, and school development priorities will need to be adjusted accordingly.

Methodology

Wellcome commissioned CFE Research to undertake independent evaluation providing information on the state of primary science throughout the UK over the period of the campaign (2016-2021). Methods included the use of computer-assisted telephone interviews, online surveys, depth interviews, study visits and pupil surveys.

Baseline research

Baseline research carried out in 2016-2017 (for detailed methodology, refer to Wellcome, 2017b) with schools throughout the UK comprised:

- ❑ computer-assisted telephone interviews with 902 science leaders (or equivalent);
- ❑ online teaching survey completed by 1010 teachers;
- ❑ 50 depth interviews; and
- ❑ pupil surveys.

Key questions addressed the amount of time spent teaching science and how the curriculum is delivered, leadership of science, views and perceptions of primary science, including teachers' confidence.

Interim evaluation

Evaluations carried out in 2018/19 (Wellcome, 2019) and 2019/2020 (Wellcome, 2020a) used the same type of data collections and analyses as the baseline, but sought to understand key questions about teaching of science in England only (see Table 1 on the next page).



Table 1. Data collection.

	2018/2019 evaluation England only	2019/2020 evaluation England only
Computer-assisted telephone interviews	683 science leaders	831 science leaders
Online teacher survey	713 teachers from 274 schools	421 teachers from 204 schools
Semi-structured interviews	36	32
Case study visits	4 schools	Deferred to 2021

In 2020, data collection was impacted slightly by the COVID19 pandemic. At the time of school closures, the online teaching survey was incomplete and case study visits could not be completed. Teachers who completed the online survey after school closures were asked to refer to their practice prior to the lockdown. The data are statistically robust, even though fewer online surveys were completed compared with the previous years.

Results

Data below (Table 2) have been collated from the baseline report (Wellcome, 2017b) and interim evaluations (Wellcome, 2019, 2020a) to show trends for schools in England. These data relate to how schools lead and deliver science in school through proxy indicators including time allocated for teaching, support for science leaders and their access to professional development (PD) and support for teachers.

Table 2. Key indicators for science delivery and leadership in school (Wellcome 2017b, 2019, 2020a).

	2016/2017	2018/2019	2019/2020
Proportion of schools including science in school development plan	60%	56%	62%
Proportion of schools with science subject leader	95%	93%	98%
Average science teaching time, statutory primary-age pupils, per week	1.7 hours (1 hr 42 min)	1.8 hours (1 hr 48 min)	1.85 hours (1 hr 51 min)
Proportion of schools providing at least two hours science per week	43%	49%	53%
Percentage of science leaders having dedicated management time	52%	49%	61%
Percentage of science leaders accessing professional development for science leadership or school development	52%	54%	57%
Percentage of teachers not receiving any support in school for science	31%	15%	9%



Figure 1. Percentage of respondents reporting high levels of confidence.

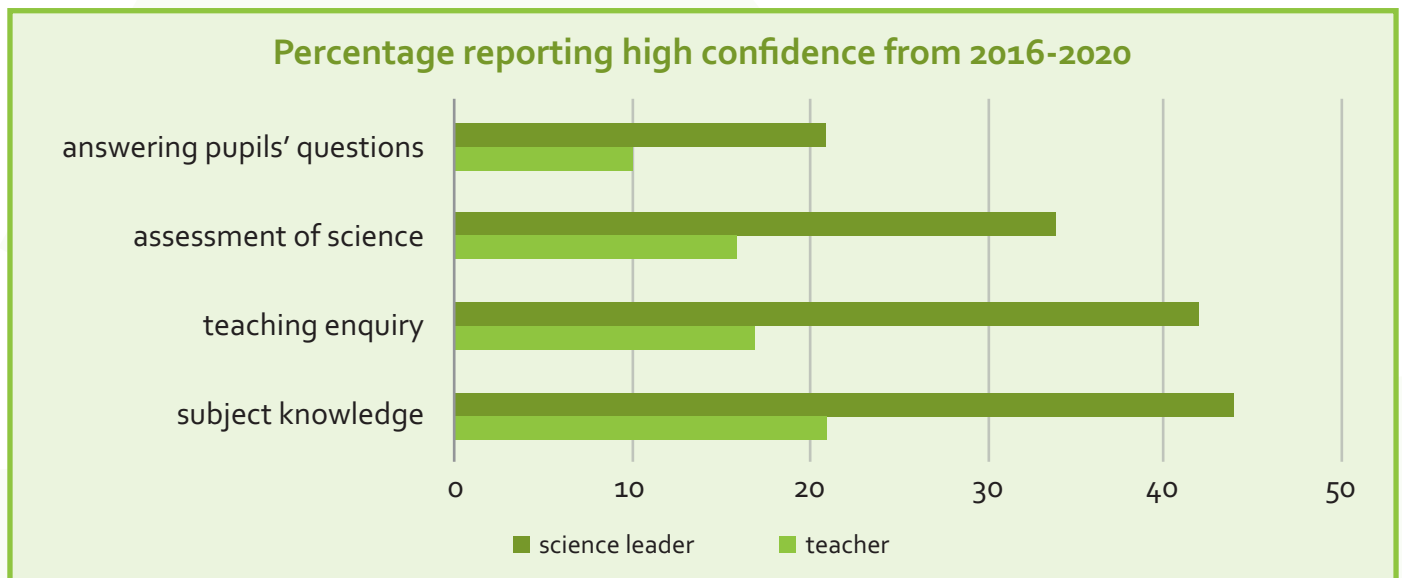
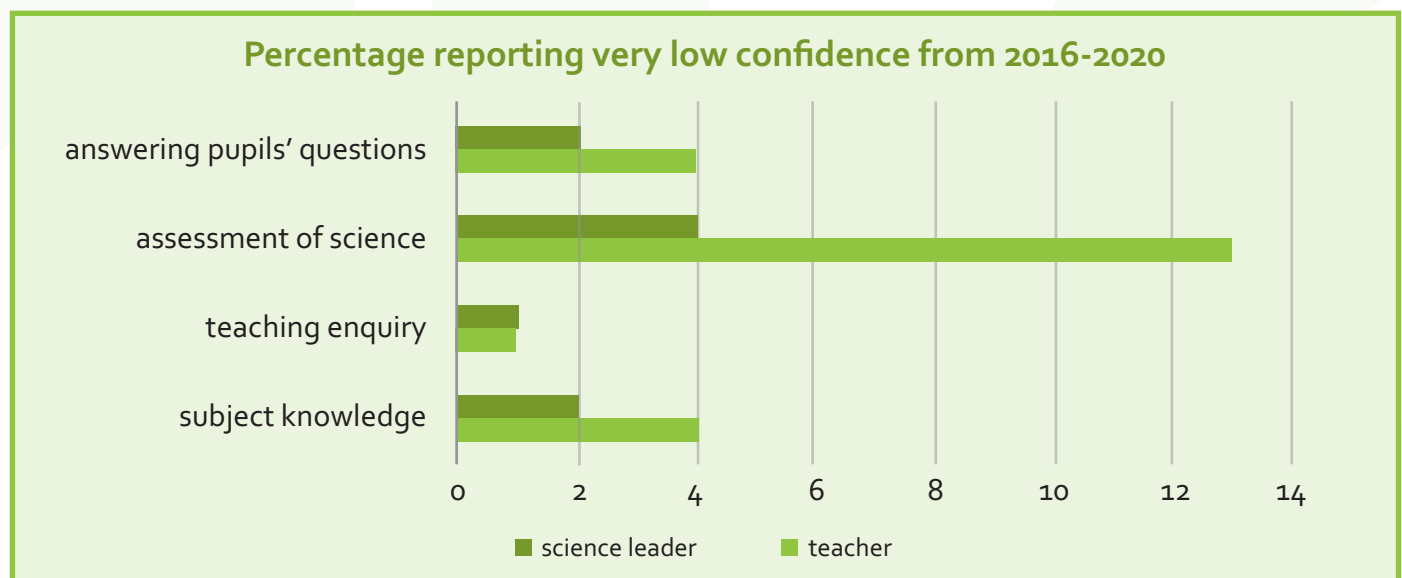


Figure 2. Percentage of respondents reporting very low levels of confidence.



Neither subject leaders' nor teachers' levels of confidence in aspects of teaching science varied significantly over the three surveys. Subject leaders were more confident than teachers in all areas: science subject knowledge, teaching scientific

enquiry, undertaking science assessment and answering pupils' questions. More than a fifth of science leaders have high levels of confidence in these areas (Figure 1).

Table 3. Proportion of teachers reporting low levels of confidence in teaching some science topics.

Science topic	2016/17	2018/19	2019/20
Electricity	12%	11%	15%
Light	12%	9%	12%
Forces	16%	14%	12%
Evolution	23%	21%	21%



Although teachers had indicated in market research that they lacked confidence in teaching science, this was not strongly apparent except in relation to assessment (Figure 2 on page 8).

Exploring levels of confidence around teaching specific science topics showed some anxieties around teaching evolution, electricity, forces and light (Table 3 on page 8). Further exploration showed that teachers were unsure of their subject knowledge and pedagogical content knowledge (for further discussion, see Wellcome 2020a).

Conclusions

Although school leaders agree that it is important for pupils to study science and that scientific skills are transferable (Wellcome, 2017b), the priority given to science in schools is varied. Less than two thirds of schools included science in their school development plan, even though the importance of a balanced and relevant curriculum (including science) has become more prominent since Ofsted revised its inspection framework (Ofsted, 2019). Despite this, there are indications that some aspects of provision for primary science are improving.

It could be argued that the average amount of time given to teaching science in 2016 was unlikely to be enough to secure good progress. By 2020, the number of schools providing at least two hours' science teaching per week has increased by 10% to more than half, and the average time allocated to teaching has increased by nine minutes. However, the timetable allocation is not as important as making sure that science teaching time is used effectively (for further discussion, see full report, Wellcome, 2020a). For example, around two fifths of schools using Explorify reported that they had increased the amount of science teaching because they had included Explorify activities at other times in the teaching week, but others advised that Explorify has helped them make better use of their teaching time as they've improved their understanding of children's prior knowledge:

'The difference is that two hours will be more useful and more meaningful because you're not going over things the children already know' (Wellcome, 2020a).

In England, most schools have a science subject leader and there is strong evidence that science leaders are being given more opportunities for professional development and more meaningful management time for their roles. Many are confident in their role and able to support their colleagues. More than half the teachers reported that science leaders in their schools provide training or coaching and mentoring to help them to teach science better. Since 2016, the proportion of schools that offered teachers no form of support at all for science dropped from 31% to 9%.

Teachers self-report that they are mostly confident about teaching science. However, some have anxieties about teaching certain topics of science, especially forces, light, electricity and evolution. There has been little change in the proportion of teachers who report low confidence in teaching these topics (up to 20%) since 2016. Over one-eighth of teachers report low confidence in assessment of science too, which is also concerning.

Discussion

Primary science provision is improving slowly. Teaching English and maths has always taken priority in schools, but science must have a secure place within a balanced curriculum that prepares pupils for their futures.

The Coronavirus pandemic has put science in the spotlight, but we know that many young people do not see that science is relevant to them (Wellcome, 2020b) and 44% of primary pupils think you have to be clever to be able to do science (Wellcome, 2017a). The pre-campaign market research undertaken by Wellcome indicated too that many teachers simply do not identify with science, so it may be harder for them to build engagement in science with their pupils. Those of us working in the science education sector need to be mindful that our provision is accessible, especially to those teachers who do not see themselves as 'sciencey', so that they can enjoy teaching science. Wellcome's research shows that enjoying teaching science is key to building teaching confidence (Wellcome, 2020a).



More than ever it is vital that children in primary school understand how we use science in all aspects of our lives and that it is relevant for everyone. Making enough time for science rather than leaving it to a weekly slot in the timetable, embedding it fully in the curriculum and linking it to everyday life are essential.

Persistent low levels of confidence in teaching key science topics are concerning. These topics may not be highlighted in the national curriculum for every year group (DfE, 2013), but it is essential that all teachers understand where the science they teach fits in with children's progression in all aspects of science.

Low confidence in assessment (formative and summative) was also flagged by science leaders and teachers. Assessment is integral to good teaching and should be part of the planning process, not a process added on afterwards. The data on low confidence suggest that a sizeable proportion of teachers lack understanding of how children progress in science and that processes in schools are not supporting continuity of learning in science. Schools should audit professional learning needs and make them part of the school development plan.

The positives for primary science come from effective science subject leadership. As Wellcome identified at the outset, subject leaders are the drivers of improvement in primary science. Those new in role have found the support from the sector invaluable. These are teachers and leaders actively seeking to access provision and support that they expect will make a difference in their schools, rather than having change or an intervention imposed upon them, which leads to long-lasting impact (Hubers, 2019). Without recognition, support or mandate from school leaders themselves, the science leader is likely to achieve little or be able to support their colleagues, so it is encouraging that provision to lead science and access to professional development have increased.

Improvement in primary science has been hard fought. To sustain the improvements, the science education sector must continue to support schools

to invest in subject leaders (Wellcome, 2017a) and ensure that science isn't just for the brave, but underpins all of our daily lives.

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