

# Impacts of Professional Development on the Primary Science Classroom Qualitative Comparisons

# Impacts of Professional Development on the Primary Science Classroom

## Qualitative Comparisons

---

**Ian Abrahams, Judith Bennett, Eleanor Brown, Pam Hanley,  
Peter Rudd and Maria Turkenburg – University of York**

### **Contents**

Executive Summary.....	2
Introduction to the comparative analysis.....	3
Science teaching in the classroom – Influencing teaching methods, knowledge and confidence.....	4
Teaching methods.....	4
Understanding science.....	7
Confidence in the science classroom.....	8
Assessing pupils’ work .....	10
Affecting pupil outcomes.....	11
Science leadership across the school – Influencing science status, action plans and colleagues.....	14
School action plans .....	14
The status of science in school .....	17
Sharing and disseminating.....	18
Concluding remarks .....	22
Similarities.....	23
Differences.....	23
‘Dose’ Effect.....	24
Limitations .....	25

## **Executive Summary**

### **Introduction**

This report presents a small scale qualitative analysis of the data from teachers across the three groups who participated in the evaluation of the impact of the Primary Science Specialist Continuing Professional Development programme: the full intervention group, the partial intervention group and the control group. The numbers in each of these groups were comparatively small and therefore caution needs to be exercised in making generalisations from the data reported here. The report presents some of the key differences suggested by the comments of the teachers, both between the intervention groups and the control group, and also between the partial and full intervention groups to consider the 'dose' effect (i.e. whether the full intervention was necessary, or whether the fewer days model, delivered for the partial intervention group, was sufficient).

### **Science teaching in the classroom**

While teachers from all groups talked about the importance of practical investigations, the key message coming through from science coordinators, senior managers and teachers colleagues in the intervention groups was that there was less emphasis on writing up and on 'right and wrong' answers, allowing pupils to think freely. They also focused more than the control group on thinking scientifically and enquiry.

Science coordinators in the intervention groups said that the CPD course had improved their understanding of science and given them more confidence to research ideas. Those in the full intervention group also discussed how the course had helped them to address misconceptions. Teacher colleagues in the intervention groups also mentioned support and enthusiasm from the science coordinator and that they had given them confidence to do more investigations in class. There were no obvious differences in terms of assessment, but some teachers in the intervention groups emphasized doing more assessment through talking and discussion than those in the control group.

Some of the clearest differences were in terms of pupil outcomes. Pupils' enjoyment of science was the key message to come through from science coordinators, senior managers and teacher colleagues in both intervention groups and this was attributed to the CPD course. Science coordinators also said that pupils were thinking more like scientists.

### **Science leadership across the school**

In terms of leadership, science coordinators felt that the CPD course had helped them to raise the profile of science in school. Their teacher colleagues also said that the course had given the science coordinators enthusiasm that had enabled them to put science more at the forefront and push more for the prominence of science. They also said that they had more planning meetings with staff to pass on ideas. There was some indication that the full intervention group made more external partnerships and communicated their actions plans more with colleagues, having more planning meetings. However, science coordinators from both intervention groups talked more than the control group about having regular planning meetings with staff and encouraging practical work and investigations through sharing resources.

## Conclusions

While there were many similarities in the ways teachers from all the groups talked about science, such as working towards the new curriculum and doing more practical work, there were some qualitative differences between the intervention groups and the control group. These were primarily in terms of their approach to science, making it more enjoyable with more freedom to enquire. There were fewer differences between the full and partial intervention groups, suggesting that the smaller 'dose' was just as beneficial to the teachers; however, in terms of the ways they disseminated information there were some small differences.

## Introduction to the comparative analysis

In this report we consider some of the similarities and differences that arose from the qualitative analysis between the three groups in the Primary Science Specialist study. The original report looked at the results of the Randomised Control Trial (RCT) and the qualitative data associated with the three groups in that trial: control group, partial intervention group and full intervention group. Originally ten schools from each group were included in the qualitative data collection, with the science specialist, a senior manager and a teacher colleague interviewed in each school. However, due to turnover or absence not all of those interviews were conducted, and even where they were, not all of the questions were asked consistently to each teacher. Therefore, in this analysis we have tried to indicate how many teachers responded to specific questions in order to gauge the extent of any differences between the intervention and non-intervention groups.

This analysis differs from the qualitative section of the main report in a number of ways. Here we focused on two key areas, returning to the original interview data and recoding it in the qualitative data analysis package, NVivo10. The report is divided into these two main sections: the first is the way science is taught and experienced by teachers in the classroom, and the second is the way that science leadership is demonstrated and ideas disseminated throughout the school. In each section there are a number of sub-sections, each of which is considered from the perspectives of the science coordinators, the senior managers and the teacher colleagues. This new analysis allows us to unpick a little more the ways that the National Science Learning Centre Continued Professional Development Course for Primary Science Specialists (referred to hereafter as the *CPD course*) may have impacted on the science coordinators' teaching and leadership within the school, and to understand their own perceptions of improvements in their practice. By complementing this with the perspectives of colleagues and senior managers we are able to explore the outcomes of the CPD course.

The analysis involved coding responses to the relevant interview questions from the second round of interviews. First round interviews were not included in order to differentiate responses from the intervention groups from the control group *after* the intervention had occurred. Once the responses were coded into the sections of classroom teaching and dissemination and leadership, and broken down into the relevant subsections, the results were fine coded to explore themes emerging from the data within each subsection. This also allowed us to consider the differences and similarities between the groups. Some of this coding was counted to get an idea of how many of the teachers

had responded in a particular way. Where possible, text searches were then conducted within NVivo10 to capture the full range of responses about each issue.

## Science teaching in the classroom – Influencing teaching methods, knowledge and confidence

This section looks at what teachers do in the classroom and how the CPD course impacted on this. The section is divided up into five sub-sections which correspond to the questions asked in the interviews. The sub-sections were teaching methods, understanding science, confidence in the science classroom, assessment of pupils, and pupil outcomes. In each case the issue was considered from the perspectives of science coordinators, senior managers and teacher colleagues, although in some cases there was insufficient data from one of those perspectives to do any analysis. In general it seemed that there were some areas in which there were differences between the teachers from different groups (control, partial, full), some of which were attributed by the teachers to the CPD course.

### Teaching methods

The teachers were asked to comment on the teaching methods and teaching style they use in science lessons. This was followed up with questions about whether the CPD had changed or improved these in the case of the intervention groups. Overall, the impact on teaching methods was varied. Most teachers in all the groups talked about the importance of practical work and enquiry, although this was more prominent in the intervention groups, where there was less emphasis looking for 'right and wrong' answers, and rather encouraging pupils to investigate more freely, with less importance placed on recording and writing up.

#### *Science Coordinator Perspective*

From the science coordinators there were responses to these questions from seven teachers in the control group, seven in the partial and six in the full intervention groups. Interestingly only three teachers, all in the control group, mentioned writing up, but were all also clear that this was part of a mix of activities. Indeed, most teachers in all groups talked about a range of different teaching methods.

*What do I use? All sorts, I guess I try and do as much practical work as I can. A lot of it is children planning their own ideas of how to do an experiment and how they think we might solve the problem. And then I'd usually guide them to be able to carry out the experiment, which would be either in groups ... Sometimes I'd do it as a whole class demonstration. But, yeah, quite a lot of it is exploration and then we come back to the carpet and clear up any misconceptions, or discuss why things didn't work, or how they'd improve it, that sort of thing. (SC Full79)*

There was generally more emphasis on practical and hands on work from all the science coordinators; this was mentioned by four control group teachers, five partial intervention group teachers and **all** the full intervention groups.

*Personally, I like the kids to be as hands-on as possible. (SC Control18)*

*Well I would say that because of teaching KS1 I think it's very hands-on, definitely very hands-on. Yes, very much experimental. (SC Full53)*

Eight teachers talked about modelling and teacher-led aspects of the class (two control, three partial, three full). Twelve discussed student-led and problem solving approaches to planning (five control, four partial, three full).

*So within most Science lessons that you'll see, depending on the topic areas, they'll be presented with a problem at the start of the lesson. ... Then basically they go away and they decide how they're going to find out, they decide what they're going to do, how they're going to do it. (SC Control87)*

Whole-school or cross-curricular work was mentioned by one teacher in the control group, three in the partial group and one in the full intervention group.

*Perhaps one change is that we are now more cross curricular, and also we try to give more real life, relevant science examples, eg fossils [in the new curriculum]. The whole school has gone in much more of a cross-curricular direction. (SC Partial75)*

Thinking scientifically was not mentioned by any of the control group, but was discussed by one of the partial and two of the full intervention groups. Although the numbers are small, these teachers referred to how they had learnt this on the course.

*Just lots of like little ideas that they show us on the course just to get children to start thinking in a scientific way, really rather than just trying to teach something, actually giving them like things to stop and think about, I think that was the main thing for me. I think in the past I'd teach science but I'd just teach them what it was I wanted them to know, whereas there it was very much getting them to be much more open-ended with things. (SC Partial78)*

In terms of changes and improvements the partial and intervention groups commented on a greater focus on practical work, an increased 'effort to do more practical enquiry (SC Partial97), and less need to write 'everything down as independent work' (SC Full3). Although two teachers in the partial intervention group noted that this was beginning to swing back the other way, with less focus on investigations.

*Today there are still practicals and pupil enquiry, but we have swung back to having more teacher-inputted knowledge than we had a year or two ago. There were too many 'investigations' and pupils were perhaps becoming a bit tired of this. (SC Partial52)*

The key changes mentioned by teachers in the full intervention group were less writing, more practicals, more interactive learning, more group, pair and team work and being less controlling. There was more focus on enquiry and getting pupils to think for themselves. The idea that everyone can be a scientist was also a key aspect of the changes mentioned by four teachers in the full intervention group. The full intervention science coordinators were clear that the CPD course had had an impact on their practice, making it more 'hands on' (SC Full34) and less focused on 'right and wrong answers and supporting scientific enquiry' (SC Full86).

One of the full intervention groups also talked about researching ideas and information in advance of the class as a key change in practice since going on the course. This change had also impacted colleagues.

*I think as well especially it hasn't impacted only on mine but also on the way that everybody else is doing it because of being the Key Stage leader. (SC Full53)*

Indeed, some of the teacher colleagues referred to improvements they had gained through help from the science coordinator. The perspectives from the senior managers also tended to confirm the responses from the science coordinators.

### **Senior Manager Perspective**

This question was addressed by senior managers in seven of the schools (one control, four partial, two full). The vast majority discussed the importance of enquiry, investigations and practicals.

*... across the whole school we've got a cycle of every two weeks we should have a practical activity. So let's not worry about the recording of that practical activity, but let's ensure that every two weeks, the children are getting their hands dirty as it were. Physically doing something that they can report back verbally, yes write, yes video, take photographs of, so on the whole I think again, out of the seven classes I would say five regularly do a science afternoon every two weeks. (SM Partial85)*

The control schools, as well as the intervention groups, talked about investigations, but they talked more about writing up the investigations than the intervention groups, which echoed the results from the science coordinators. One of the partial groups noted a more recent move away from investigations, also reiterating comments by the science coordinator.

### **Teacher Colleague Perspective**

There were fewer obvious differences between the three groups of teacher colleagues in terms of the teaching methods they use in the classroom. Six control group teachers, three partial and seven full intervention group teachers responded to this question. Of those all mentioned the importance of practical, hands on activities in science.

*But I think that's got much better over the last couple of years ... So now I am, and they've, the last couple of years have made it much more practical than it used to be. (TC Full34)*

Fewer talked about the need for writing up investigations (two control, one partial, one full). Indeed, some teachers specifically talked about reducing the amount of writing and recording in lessons. All the teachers in the partial intervention group said this, and one teacher from the full intervention group. These teachers referred to changes at school level that had influenced this.

Teacher-led activities were discussed by half the control group teachers but only one teacher from either of the intervention groups. More of the teachers from the intervention groups discussed the importance of student-led or problem solving approaches (two of the three teachers in the partial and five of the seven teachers in the full intervention groups), compared to only half of the teachers in the control group. The idea was that 'science should be for the children to explore' (TC Full48), and teachers tried ideas such as getting pupils to write ideas on post-it notes (TC Partial85) so that they did not feel so constrained.

Differentiation was discussed as an important dimension of planning good science lessons by one teacher from each group. The importance of thinking scientifically and using scientific vocabulary was mentioned by one teacher from each of the groups, as well as letting the pupils lead their learning.

*I think it's really trying to get the, not do so much talking, let the children use the scientific vocabulary and think about asking them questions that are not just black and white. ... But, it's really handing it over to the children really more, because the more they do practically that they can do themselves, then you know. I think the more they'll learn. (TC Full86)*

Two teachers from the full intervention group and two from the partial intervention group mentioned ideas that had been passed onto them by the science coordinator. In each case this referred to giving pupils more freedom to guide their own enquiry and learning, without pressure of looking for the 'right' answer. This was seen to create more of a 'buzz' (TC Full86) about science.

*I know [the science coordinator] tries and promotes there's no right or wrong, let's have a go, what do we think? ... It's trying to promote that love of investigatory things and discovery. (TC Partial85)*

Indeed, the teacher colleagues from the intervention groups commented on how the science coordinator had contributed to their practice in terms of giving pupils more freedom.

*Yes, I have, definitely. I think as well, giving them a little bit more sort of free investigation, I've sort of learnt from the course and from things the other teacher has given to me just to not give as much direction. That's what I've picked up. And I think not giving them directions and sort of thinking, well obviously it's got to be a direction so they're investigating what they should be, but letting them have a bit more of a free range on it. (TC Partial97)*

These comments from teacher colleagues support the idea that the science coordinators are having an impact on what is going on in other teachers' classes through the school.

## **Understanding science**

Thinking about whether the science knowledge of the coordinators had improved as a result of the CPD course was difficult to measure through the self-reported interview data. Moreover, the senior managers and teacher colleagues were often not aware of improvements in the science coordinators' understanding. Generally however, the intervention groups talked more about improvements in their knowledge, and in particular commented on how they were now more able to address misconceptions.

### **Science Coordinator Perspective**

When questioned about their understanding of science, teachers in the partial and full intervention groups said that they felt their knowledge had improved, with three of the partial group and five of the full group explicitly making this point.

Although one teacher from the partial intervention group articulated how the course had helped in a practical way more than in a theoretical way (SC Partial52), implying that pure subject knowledge, as could be measured by a SATs test, may not have improved. However, they commented that by

having a more open approach and researching before the class, their science knowledge in action in the classroom had been improved through the CPD course.

The teachers in the full intervention group commented that the course had given them more confidence with subject knowledge. Perhaps most interestingly four out of five of the teachers from the full intervention group commented on how the course had helped them to address misconceptions about science. This compared to two teachers in the control group who discussed misconceptions and no teachers in the partial intervention group.

*But more focused on knowing exactly what is behind everything and not just explaining it surface level like the unit of work that you read in the unit of whatever ... Now I know I have the confidence because I read, you know, all those fabulous books that they gave us on the course, you know, the one... Misconceptions and so on for Science. (SC Full53)*

### **Senior Manager Perspective**

Neither the senior managers nor the teacher colleagues consistently commented on this or were not directly asked this question. A small number of the senior managers commented that the CPD course had given the science coordinator the opportunity to reflect on science and the science concepts that are appropriate for different age groups (SM Full4).

### **Confidence in the science classroom**

Teachers were asked whether they had a greater confidence in teaching science and both science coordinators and teacher colleagues commented on changes in their confidence levels over the last year. There were fewer clear differences between the groups; although where teachers in the intervention groups mentioned increases in confidence they generally attributed this to the CPD course.

### **Science Coordinator Perspective**

More science coordinators from the intervention groups discussed increased confidence in the science classroom, with all but one of these teachers saying they had more confidence than a year ago compared to only two out of seven of the teachers in the control group. The two teachers in the control group who said that their confidence had improved over the last year attributed this to having more experience and internal CPD (SC Control89).

Six teachers in the partial intervention group talked about increases to confidence, two of those due to having more experience in school: 'experience, leading others, meeting other science teachers' (SC Partial43). Four of the teachers in the partial group commented that their increases in confidence were due to the CPD course. They talked about having more confidence to set up little experiments and trying to get pupils 'to think in a different way' (SC Partial78).

Five of the teachers in the full intervention group talked about increases to confidence in the classroom as a result of the CPD, and they were clear that they had better knowledge and that this would be passed on in the classroom.

*I feel more confident in Science, especially using the science equipment correctly and accurately and I think children pick up on this, and they are more confident in using it as well and using it accurately whenever they're trying to describe something, because they have a*

*better understanding of what it means. ... So, yes, I feel more confident being able to deliver it. (SC Full4)*

### **Senior Manager Perspective**

Few senior managers were directly asked about this; however those that did said that recent CPD had improved the confidence of the science coordinators. In total six senior leaders commented on changes in confidence (one control, one partial, four full). One said they had seen the science coordinator's 'expertise and confidence grow hugely' (SM Full86). Others commented on improvements in quality due to more confidence.

*I know that [the science coordinator] is focussed on vocabulary so the way the children experience it that they probably wouldn't be able to describe it because they're still doing a science lesson, but it's the quality of the lesson which I think is improving and that's very much coming from developed confidence. (SM Full4)*

Most of the senior managers who commented on increases in the science coordinators' confidence were in the intervention groups, but one control group senior leaders also commented on improvements in confidence.

Senior managers commented on how they saw the science coordinators passing on confidence to other teachers.

*The only thing I do know is that staff do feel confident because they've got confidence in the Subject Leader. So where the teachers lack confidence they know they can turn to her and she's secure in her role and subject knowledge and the resources and she's... She has a really strong foundation of knowledge so it really does support us to make us feel confident to know that all we've got to do is go there and she will know it all. (SM Full53)*

### **Teacher Colleague Perspective**

From the perspective of the teacher colleagues, some said that they had improved in confidence. Six teachers said that their confidence had increased over the last year (three control, one partial, two full). In the case of the control group this was often about developing experience. However, for the intervention groups increases in confidence was generally attributed to support from the science coordinator.

*I think personally, as I've previously said, I feel like I've benefited in my teaching of science, and if I've benefited from my teaching, then the children are going to benefit from their learning, because I think I mentioned before that, obvious the way to teach science has changed in my mind, but also my confidence of teaching science. I think before it used to be very much – I used to think of science as a subject knowledge, where a high subject knowledge is required, so I could stand at the front and I could deliver knowledge to the children. But since this programme, and what I've learnt from [the science coordinator], more so, is that I now understand that it's for the children to enquire scientifically, investigate and come to their findings, evaluate their findings themselves. So, from my personal point of view, my class and future classes will benefit, along with probably the year group that I work within from planning, because then I can pass on my knowledge to them. (TC Full48)*

Confidence in teaching science certainly seems from these comments to have been an area where the science coordinators were able to impact on the work of colleagues in the school.

### Assessing pupils' work

The teachers were asked whether the experience of the CPD course had affected the ways that they monitored and assessed pupils' science work. Or in the case of the control if there had been any changes in assessing pupils over the last year.

#### Science Coordinator Perspective

Most of the science coordinators discussed assessment and there were variations in the extent to which they felt this had changed over the last year. Where changes had occurred they generally felt that this was for the better. Two of the control schools talked about whole school changes to assessment.

*We have a monitoring and assessment policy that operates across the whole school. We have to be aware of our 'writing across the curriculum' policy. We also have lesson observations. But we have also given thought to the ways that we can record science outputs. For example we have tried using 'Big Books', where all the children in the class contribute to a big book on a particular theme or topic. This really helps the children to collaborate. (SC Control89)*

None of the teachers in the partial group claimed that the CPD had impacted on the ways they assess pupils. One of this group felt that assessment was not done well in school, describing it as 'sketchy' (SC Partial85).

However, four of the partial intervention group science coordinators discussed how preparing for the new curriculum or assessment processes at a whole school level were driving forward changes to monitoring and assessment.

*We have been preparing for the new curriculum and alongside that we set up an assessment working party. We have been giving a lot of thought to assessment. (SC Partial43)*

Five of the full intervention group talked about improvements to monitoring and assessing pupils and that the course had added to their awareness and practice of assessment in science.

*We are looking at that because we're... I probably wouldn't have done as much of it. It is something that I'm much more aware of. (SC Full58)*

For three of these there was more emphasis on the teacher assessing pupils' progress through discussions with pupils or through assessment for learning (AFL).

*Yes, it has, it's much more AFL at the moment ... there's a lot of conversation going on there, there's a lot of, you know, interaction between me and the children going on there that maybe there wasn't before, maybe it was through books and maybe the whole carpet area at the beginning, but now having the chance to sit with only five of them and talk about something that's happening and, you know, record what they're getting and what they're not, I think that's... it's invaluable, to be honest. (SC Full53)*

This demonstrates areas where the course impacted on teachers, but there is some evidence that this impact was less felt by the teachers in the partial intervention group than the full. This was reiterated by senior managers.

### *Senior Manager Perspective*

In discussions about how pupils' work is assessed, comments from senior managers were generally positive with five people saying that assessment was done well in school. Notably four of these were from the full intervention group. Similarly, three senior managers from the full intervention group said that they felt assessment in science had changed or improved over the last year.

*I think it's probably gone up a bit over the last couple of years, partly through [the science coordinator's] involvement in this project ... And I think partly as well because we are aware that the way that Science is being assessed is going to change again so it's perhaps come back onto our radar a little bit. (SM Full68)*

Some senior managers mentioned that there was room for improvement and that they needed to raise their game slightly 'with assessment for learning procedures in relation to science' (SM Full86).

### *Teacher Colleague Perspective*

Teacher colleagues also made some comments about assessing pupils work. Again they tended to feel this was done well in school, with one teacher from each group explicitly saying this. In the case of the teacher from the partial intervention group, they said that support from the science coordinator had aided this. Teachers from all groups also noted that there had been changes in the way science was assessed with five teachers mentioning this (two control, one partial, two full intervention groups). One of the full and two of the partial intervention groups said that assessment was now done more through talking to pupils rather than through testing, which was perceived as a good change. This reiterated comments from the science coordinators.

*... but say now it's much more about the teachers assessing and it's much more done really through talking to them, talking to the children, you know, discussion, thinking about what they understand from, you know, maybe an activity that we've done rather than this kind of testing and yeah. So, so I think, I think that's a positive. (TC Full34)*

Interesting there were five teacher colleagues who said that they did not think there had been any changes in assessment over the past year. These were all from the intervention groups (four partial, one full). Again, this indicates that perhaps assessment was less of a feature for the partial intervention group than the full.

### **Affecting pupil outcomes**

The teachers were also asked if they had experienced changes in their practice that they thought had affected pupil learning outcomes. There were a number of areas that emerged from the perspectives of science coordinators, senior managers and teacher colleagues as outcomes that were seen to have improved, particularly in the intervention groups. The clearest outcome from the intervention groups was that pupils enjoyed science more, but there were also comments that they used more scientific vocabulary, something that was not mentioned by the control group.

### *Science Coordinator Perspective*

When asked about changes that could affect pupil outcomes teachers either put improvements down to whole school changes, or to the professional development they had received. In the case of the control group, two teachers commented on improvements in pupil outcomes, one of which referred to CPD. The other explicitly stated that it was not CPD that was responsible for improvements to pupil outcomes, claiming these were due to 'whole school policies and the efforts of staff are more important' (SC Control89).

From the partial intervention group, six teachers discussed improvements, two cited whole school changes and four said improvements were due to the CPD. Six of the full intervention group talked about improvements to pupil outcomes and for **all** of them this was considered a result of the CPD. This included aspects such as improving the perception of scientists and the idea that they could be a scientist.

*They've been asked to test this. They've become real scientists. They've gone from the conception of scientists being funny, little people with, you know, sort of, hair out here ... and white coats ... Whereas they now believe that, well actually...They could all be scientists. (SC Full3)*

When discussing the pupil outcomes that had changed over the last year, the science coordinators specifically mentioned enjoyment of science, understanding science better, using scientific or technical vocabulary and thinking like a scientist. In each case there were more teachers in the intervention groups that described improvements in pupil outcomes.

The intervention groups made more explicit reference to pupil enjoyment of science as a key outcome that had been improved over the last year. Enjoyment was mentioned by one of the control group, two of the partial intervention group and four of the full intervention group. For the latter the CPD course was cited as a reason for the heightened enjoyment.

*I think possibly the way that we are teaching it is more exciting ... I'd say that our lessons are more interesting than they would have been. (SC Full58)*

*I think, in terms of the quality of the work in the books as well really, you see that now, you see the enjoyment with the experiments, because there's not, there's not as much pressure as to this is right, this is wrong, because we've gone done the enquiry route and the children justifying their own enquiries at their level. That's pitched, you know, so it sits more comfortably for them all. (SC Full86)*

Another important outcome mentioned was increased understanding of scientific ideas. This was described as a feature of improvements in outcomes by one of the control group, three of the partial intervention group and three of the full intervention group. Again, this shows a difference between the intervention and non-intervention groups, but less difference between the partial and full intervention groups.

Using technical vocabulary was not mentioned by any of the control group, but was mentioned by two of the partial and one of the full intervention groups. The science coordinators saw the children as 'getting better at using a technical vocabulary' (SC Partial75). Similarly, thinking like a scientist was

discussed by one of the partial and one of the full intervention groups and again, none of the control group talked about pupil outcomes in this way.

*I think they're better scientists. Whether their overall knowledge from what they could recall and do on a test is any better, I don't know, but certainly in the way that they think, they are thinking more like a scientist than ... do you know what I mean? Because I think there's a difference, isn't there, between being able to do a test and answer a question. (SC Partial78)*

This teacher's comments also highlight some of the qualitative outcomes that were a result of the CPD course, but that could not necessarily be captured by the measures used in the RCT.

### **Senior Manager Perspective**

Fewer senior managers talked explicitly about improvements in pupil outcomes. Those that did said generally that there had been improvement, or that they had noticed that pupils seemed to enjoy science more (one control, one partial, three full). Again, this was more prominent in the full intervention group, who saw the pupils 'excited about doing science' (SM Full79).

*I think at the time, that [the science coordinator] was teaching the class, I noticed that the children were talking more about science at lunchtimes. (SM Full48)*

Some said that that they did not think there had been a noticeable change in pupil outcomes, but that these were generally good. Comments included that there seemed to be a range of activities going on in science and less emphasis on written work, reiterating comments from the science coordinators.

*So they're not spending all their time writing out objectives and what they're doing and where they – that is great because I like to see that. I don't want to see children having to write out long learning objectives and things. (SM Full79)*

*... if you ask the children now they will comment upon doing learning and learning new things not necessarily writing things down and that's what they really enjoy. (SM Partial85)*

Enjoyment, primarily as a result of less writing and more practical work was the main feature of pupil outcomes from a range of perspectives.

### **Teacher Colleague Perspective**

Fewer teacher colleagues commented on pupil outcomes explicitly. The majority of those that did were in the intervention groups (one control, three partial, three full). The main outcome they mentioned was that pupils seemed to be enjoying science more. One claimed the pupils seemed to enjoy science 'more than in previous classes' (TC Full48), and other talked of 'evidence that the children are enjoying it' (TC Partial85).

Four of the teacher colleagues (two partial and two full intervention groups) noted that this enjoyment across the school had become embedded as a result of the CPD course.

*I'm trying to think what else particularly because I haven't been on the course and it's only second-hand what [the science coordinator] tells me and that's the main thing that's been embedded into our learning now which has been brilliant because it engages children at the*

*start of every topic that we do. So I'd say that's the main things that's changed, and that's throughout the school. (TC Full86)*

For some of the teacher colleagues they talked about this in terms of better attitudes towards science and more engagement and interest in the subject. These comments came primarily from teachers in the intervention groups, and teacher colleagues claimed that the engagement with science was spreading throughout the school.

*I think definitely their attitudes towards science, and I hope, and I predict, that that will happen when you speak to children. And I'd like to think that would be across the school, as opposed to just in a year group that ... As soon as you mention science, then they're – straightaway they're engaged, because they know what's coming up (TC Full48)*

Finally, some of the teacher colleagues talked about better quality science in school, this was mentioned by one teacher in each group.

*The Head said that the quality of teaching and how the children were receiving and the learning that was going on was great, really good. (TC Control38)*

The area where there was the most difference between the intervention and non-intervention groups was in pupil outcomes, where there seemed to be many aspects that participants from all three perspectives felt the CPD course had helped to improve. Overall the way science is taught in the classroom did seem to have been influenced by the CPD course, and there was evidence of this filtering down to the teacher colleagues as well as becoming part of the practice of the science coordinators. In the following section we look in more depth at how science leadership was demonstrated throughout the school.

## **Science leadership across the school – Influencing science status, action plans and colleagues**

In this section we discuss the extent to which the effects of the CPD course spread outside the classroom in order to consider how the course met the aim of developing science across the school. This was explored by asking teachers about how science was included in the school action plan, how they saw the status of science in the school and how the science coordinator shared and disseminated ideas about science. Each of these subsections was considered from different perspectives. Again, while there were similarities in the responses of the three groups there were also some differences which were attributed to the CPD course.

### **School action plans**

One of the ways that leadership across the school was considered was by looking at the place of science in school action plans. All the teachers were asked about this, while there were no clear differences, teachers from the intervention groups were more likely to talk about how the course had allowed them to make bigger changes to the action plan and communicate this more with colleagues.

### *Science Coordinator Perspective*

Most of the science coordinators talked about how science featured in their school actions plans in some way (eight control, six partial, nine full intervention). Only one science coordinator from the control group and three from the full intervention group talked explicitly about science being particularly visible or prominent in the school action plan. Where the science coordinators had been on the course, they commented on being able to push for greater prominence for science across the school.

*It is becoming more prominent, purely because I've pushed at it to become more prominent. I think a lot of staff members thought that once it was dropped from the statutory testing that: "Oh I really don't need to do that. I'll not bother with science this week." I think me being on this project has really brought science back to the forefront. (SC Full3)*

Teachers in each of the groups talked about creative or cross-curricular links between science and other subjects (two control, one partial, two full). Teachers in all groups mentioned the looking at assessment in their action plans. Preparing for the new curriculum was also discussed by teachers in each of the groups (four control, four partial, three full). They saw a need to ensure that 'assessment and monitoring will be aligned with this' (SC Partial43).

*In the school action plan there is a separate section for science, so every subject has their section, and in that we're focusing quite a bit at the moment on the new curriculum and making sure that we're ready for the changes that are coming into place in September. We're focusing on assessment, focusing on parental involvement, website, getting the profile of science... the profile of science is good in our school I think but just getting it out there a little bit more. (SC Full58)*

Science days or weeks were a feature of plans for coordinators in all groups. They discussed inviting the community and families to the science fair (SC Control87). There were differences when it came to discussing external links, either through invited speakers or links with parents and the local community featuring in science action plans. This was mentioned by one science coordinator from the control group, one from the partial group and three from the full intervention group.

*I've also made contact with some STEM Ambassadors which I've not done before, but I've got two STEM Ambassadors coming in. ... So they're both going to come in and do Science based experiments throughout school, do a presentation at the beginning of the week. (SC Full79)*

Moreover, the way that the plan was developed or communicated with colleagues was not discussed by any of the control group and only one of the partial group, but was a big feature of the answers given by three of the full intervention group coordinators. Teachers from the full intervention group also talked about how the course had informed their planning, while teachers from other groups did not say this explicitly.

*Being on the course I've obviously reinvented a lot more and I feel in terms of curriculum, assessments, expectations, planning, it's all been reviewed, progression, everything, it's all been reviewed, all been assessed. ... So on top of that, I'm just taking that a little bit further now in terms of like subject knowledge, helping build other teachers' knowledge on science, helping build their vocabulary is my focus, so what vocabulary are they using within their*

*subjects and are they using the right and appropriate vocabulary, so when I go and watch some science lessons as my observations, that will be my focus. (SC Full86)*

The way that the science coordinators understood the development of the action plan was complemented by the perspectives of senior managers and teacher colleagues.

### **Senior Manager Perspective**

Thirteen of the senior managers were asked about the school action plan (five control, four partial, five full). Of these the vast majority discussed science in terms of the new curriculum and developing the focus of the action plan in response to that (four control, two partial, five full). The senior managers were generally supportive of science and three explicitly discussed the importance of resources and support to enable science in school to be more practical and experimental (One control, two full). Eight senior managers commented on cross-curricular links in the action plans or whole school science days (three control, five full). These were seen as an opportunity to 'get the children's enthusiasm back again' (SM Control46).

Four senior managers said that the science coordinator had regular meetings with staff about development and the action plans (two control, two full), giving 'time to disseminate what they were doing with their action plans' and 'championing the subject' (SM Full34). Two of the control schools mentioned the need for more CPD in science, while, perhaps unsurprisingly none of the intervention schools saw this as a current need.

### **Teacher Colleague Perspective**

Fourteen of the teacher colleagues were asked to comment on the school actions plans and how science featured in them (six control, two partial, six full). Again, many of these mentioned the new curriculum and the impact this was having on the action plan for science (two control, one partial, two full), some noted the importance of assessment within this. Some of the teachers also talked about the importance of cross-curricular links and whole school approaches such as science days or STEM week (two control, two partial, one full).

*We're going to have our Science week. We have a bug man coming in in a couple weeks. So it's our annual Science week, when every class will be given their project, appropriate to their age range. (TC Partial85)*

The main action that many of the teachers discussed was the focus on making science more practical and investigatory (one control, two partial, two full). This was described as 'a have a go attitude to Science' (TC Partial85). This involved cutting down on writing.

*Basically I know that in the school action plan we have got some things to move science forward and a lot was to try a lot more with investigations, trying to get more sort of practical activities, and the way as well that we were recording science as well. We did sort of cut down I think, a lot of us were sort of doing too much sort of old fashioned sort of science you might call it with the method, step one do this, and we've sort of looked at it as a school and to try and do practical investigations and make them more practical and probably limit the amount of writing that we were doing in science, and if there was cross-curricular links, when it came to the writing maybe to do that in like a literacy book. (TC Partial97)*

Only two teachers said that they had discussed the action plan in meetings with the science coordinator (one partial, one full). Monitoring and observation of teachers was also only mentioned by two teachers (one partial, one full).

*It's been more rigorous and [the science coordinator] was saying we're doing more monitoring of books and stuff like that. So we're gathering them in and seeing what's going on there as well, which didn't happen before. We're now looking at Science books as well, in the same vein. (TC Partial85)*

So there were overlaps between the perspectives of the different participants, particularly in terms of the new curriculum and the move towards planning more practical activities in science.

## **The status of science in school**

Following on from conversations about the school action plan, teachers were asked about the current status of science in the school and whether that had changed over the past year.

### **Science Coordinator Perspective**

When asked about the status of science in the school the science coordinators generally had positive responses, with only one of the control groups saying that the status was low. Some said it was good, but that it had not changed over the past year (two control, three partial, one full).

The majority commented that the status of science was better than before (three control, four partial, four full). However the responses from the control group tended to be a little more tentative in their comments. Coordinators from the intervention groups discussed feeding ideas back from the course and how this raised the profile of science in school.

*I think there's been a bit more emphasis on it because people have been going on courses and obviously I've been feeding back and things, so I think people are aware that it's going to be a bigger part of the curriculum. (SC Partial97)*

Most science coordinators from the intervention groups made some reference to the CPD course when they talked about raising the profile or status of science in the school.

*We had a great Science Week and enjoyed it very much. So, you know, those things that are raising the... yeah, the status of Science in the school. ... Since I've come back from your courses it's taken a much higher profile, for a variety of reasons. First of all I've become more confident in, you know, what I can do and what I can't do, I had the resources to just push things forward and be able to do it. (SC Full53)*

### **Senior Manager Perspective**

The senior managers were also asked how they perceived the status of science. Thirteen senior managers responded to this question (five control, four partial, four full). They were also generally positive that science had a high status in the school, with many saying that the status was very high or higher than before (one control, three partial, three full).

Some commented on the fact that now science had no statutory assessment to focus on science had gone down slightly or that it was not seen as a current priority and had taken a back seat (four control, three partial, one full). This was notably less so for the full intervention group.

*Yes, okay. In all honesty, and I think I probably said this last year, when Science came off of the assessments, you know the statutory assessments at the end of KS2, it kind of got pushed to the bottom of the pile. ... So we've had scientists coming in and working with the children, doing workshops and things, so we're trying to keep Science as high profile as we possibly can but our focus has had to be English and Maths. (SM Control31)*

However, many of the senior managers commented on a focus on monitoring and assessment in science aimed at maintaining a high status for the subject (two control, one partial, two full).

### **Teacher Colleague Perspective**

Twelve of the teacher colleagues discussed the status of science across the school (four control, two partial, six full). They were more tentative in their responses in general than the science coordinators and senior managers, with four teachers commenting that science was 'relatively' or 'quite' high status (three control, one full) and four others saying that the status of science was 'good' (one control, two partial, one full).

Three teachers commented that the status of science had decreased since it was no longer assessed (two control, one full). It was seen as less 'high ranking' because it is not a SATs subject anymore (TC Full68).

*As I say, there is clearly ... there is nowhere near the level of timetabled science as there is for English and maths, but that is simply because a school's performance is not assessed on science. (TC Control18)*

Three teachers (one partial, two full) said that science was very much in the forefront, and they put this down to the enthusiasm of the science coordinator.

*... it's been brought to the forefront a little bit more and [the science coordinator] has shared with us the wow starters and encouraged us all to have a go at doing one. (TC Full79)*

*It definitely has changed. ... And it has gone like that because science before I think was really quite boring and there wasn't any sort of wow in it and it's inspiring now and so it really has got a solid place in our curriculum now because we know where we're going, [the science coordinator] through being on the course even had a printed off sheet of the introduction to the new curriculum. (TC Full86)*

This demonstrates the role the CPD course had on raising the profile of science from the perspective of the teacher colleagues, which clearly leads onto how coordinators have felt able to share and disseminate science throughout the school.

### **Sharing and disseminating**

The science coordinators were asked whether, and how, they had shared knowledge and skills with teacher colleagues. These comments were then complemented by how the senior managers and teacher colleagues saw the science coordinators sharing ideas with others.

### **Science Coordinator Perspective**

No clear differences emerged between the three groups to this question from the perspective of the science coordinators. It was answered by six control groups, six partial and seven full intervention

teachers. Two from each group talked about conducting INSET or disseminating ideas via staff meetings.

*I've done staff insets where I've had to – you know give – impart my knowledge and ... I think everyone's really aware that I am the Science Coordinator so they do come and ask me – it could be about I don't know, about resources or about you know an activity or whatever. (SC Full34)*

Teachers from all groups talked about introducing new ideas to colleagues, sharing their ideas and modelling practice (two control, five partial, three full). Some helped with skills and knowledge through learning walks (SC Partial43). One teacher from each group discussed observing colleagues to see if they had 'taken ideas on board' (SC Partial97).

Perhaps the main difference between the intervention groups and the control group was discussion of regular planning meetings with other staff. Four partial and two full intervention groups mentioned this as one of their strategies.

*I regularly meet with the science team – one teacher from each year group. I discuss the latest ideas with these staff and they can raise any ideas or concerns. (SC Partial75)*

Others talked about *ad hoc* or informal support and coaching (one control, one partial, three full). One teacher from the full intervention group and one from the partial intervention group also discussed the focus now put on collaborating with colleagues met through the CPD and sharing ideas across schools in the cluster. This was a key resource for teachers who had received the intervention and in many cases empowered them to make a contribution to their own school environment.

*And also I've got a team of friends that I made on it [the course] whom I can call on if I need something. I've established a network of teachers in London who... I needed something a few weeks ago and I was able to give somebody a ring and go "I don't have these at school, can I come round and collect them", that kind of thing which is really useful again in our borough because we don't have a science thing. So I've got a network of people whom I can email or text or call and if I need something I can get it, which is great to have. (SC Full58)*

One teacher also talked about problems in getting staff to take new ideas on board. This highlights the extent to which the school leadership and school environment impact on how much influence the science coordinator can have. Clearly there are numerous contextual factors that affect this.

*But it is a frustration, so I mean I have, I did a session with all the staff on investigations, so I set up and it was just stuff, simple stuff that we'd done on the course like, you know, the instance, snow, and that sort of thing, I'm just getting them, so we have our own investigation like toolkit I suppose, you know, like the planning and the doing and the reviewing, that type of thing, but I was very keen on the one that we used on the course which is all the post-its that you move down and all that, I found that really helpful, so I'd used that in class last year and they seemed to really like it, the children seemed to really like it, so I was sort of showing staff all of that and just really going through that process of, you know, observing and predicting and, you know, that continually trying to, can you think of a reason why? You know, all that sort of thing, and it was really interesting because I set it all out and as my kids were leaving that day, they were like, "What we doing, what we doing?"*

*and I said, "It's not for you, it's for the staff this time," and they were really disappointed, but the staff, there was just this real reluctance to use it. (SC Full94)*

Despite this, senior managers and teacher colleagues discussed ways in which they perceived the science coordinator shared and disseminated ideas for science.

### *Senior Manager Perspective*

Most of the senior managers responded in some way to questions regarding the sharing and disseminating of ideas through the science coordinator, with eighteen managers making comments on this (six control, five partial, seven full). They saw the science coordinator as an important resource that other staff could call on.

*... because one of the big aspects I think for primary science is that primary teachers are not specialists so it's like specialist knowledge within the school and a port of call if you like for other members of staff to go to, it is a key aspect of making sure that science lessons are high quality. (SM Full4)*

Senior managers said that science coordinators used their leadership role to model good practice, support colleagues and champion science. This gave other staff confidence and ensured that learning from the CPD was shared. (SM Full53).

Many senior managers commented how the science coordinators encouraged practical work and investigations in school (one control, two partial, seven full). This was emphasized more by managers in the full intervention group than either of the other groups.

*Oh yes she did and the practical work has been great. I think the practical work has been a lot more focused, you know and I think we get better group work now. ... So I think I've noticed that the group work has been much more purposeful. (SM Full79)*

Science coordinators were seen to be sharing ideas and resources in the school (two control, two partial, six full). Again, this was a more prominent feature in schools in the full intervention group.

*... the children were so excited and I had parents come to tell me that they wanted to make lava lamps because they know how to do it in school. And [the science coordinator] facilitated that really, really well, she gave us a really good bank of resources; practical resources were always there, if we needed any then we'd just need to ask her and she can order them for us. I mean, she gave us some really good simple experiments that could be done within a writing lesson so it was manageable. ... And it's just an expectation so teachers know... It's embedded so that when we're planning for the unit of work we know that we have to reserve time before that. (SM Full53)*

These resources were shared both through formal staff meetings 'where [the science coordinator] sat down and shared resources and good ideas' (SM Full79), and also through more informal conversations, stimulated by more enthusiasm for science.

*I think primarily it was sort of that word of mouth thing, it was the kind of person that he was. So he came back enthused and, you know, sort of bubbly with it, you know, telling us*

*about what he'd done and... just sharing really. He was very keen to share his learning with me. (SM Full68)*

Observations and monitoring practice were also ways that the senior managers saw the science coordinators supporting good practice in school (four control, one partial, four full), making recommendations to 'be able to then show some good practice and then plan some CPD' (SM Control31). Five senior managers discussed the science coordinators role in planning and organising a science day or science week (two control, three full), in which science coordinators were able to get 'everybody fully involved' (SM Full79).

Generally dissemination was understood through three main channels. INSET or internal staff training, discussion or presentations in staff meetings or through organising planning meetings with other leaders or curriculum groups in school. INSET or training was explicitly mentioned by six managers (two control, one partial, three full)

*She's done two staff INSET; one was to look at the new curriculum and we were comparing the current curriculum to the new curriculum, so we were looking at the differences and she already prepared a new curriculum map for us to trial. So we'll review that again. So that was great. And she's also done an INSET on practical experiments and the use of scientific vocabulary. (SM Full53)*

Staff meetings were discussed by eleven managers (two control, one partial, eight full), again showing that this was more prominent in the full intervention schools.

*We always make science part of a staff meeting on a rolling programme so when anything new comes to light then [the science coordinator's] always the one and planned the most amazing hands-on staff meeting and we're all doing science experiments and making fizzy things and stuff like that ... so he did that for his own evaluation, his own CPD, and he said, and from the information he'd gleaned from that, he could then support the others with what else they could do. (SM Full86)*

Similarly, planning meetings were mentioned by seven managers (one control, one partial, five full), working with teachers on a one to one basis, or small group 'planning for the science that they're going to do in that particular hour' (SM Full4).

### **Teacher Colleague Perspective**

From the teacher colleague perspective there were no obvious differences in the comments made about dissemination from teachers in each of the groups. Fifteen teacher colleagues talked about dissemination in some way (four control, five partial, six full). Interestingly it tended to be the teacher colleagues from the partial group that discussed dissemination more. The most common feature of their observations was that the science coordinator provided support and encouragement to do more enquiries, investigations or practicals (one control, three partial, two full).

*I think generally I would imagine obviously she's put that into place but I think probably from maybe going onto the course she's been on and seeing the way that things have sort of been undertaken. I would imagine probably some impact has come from that because I know that the science planning sheets that were to do with the investigations came from that as well. (TC Partial97)*

Sharing resources was a key way that the teacher colleagues saw the science coordinator offering support (one control, three partial, two full). This could be folders of activities, resources, ideas (TC Full79) or the enthusiasm from the course.

*He's always come back buzzing with ideas. (TC Full86)*

Again, modelling and leading support from the science coordinator were all noted by teacher colleagues in each group (one control, four partial, one full). Inset and staff training was also mentioned by teachers across the groups (one control, two partial, one full). Teacher colleagues appreciated learning from the skills, conversation and staff session of the science coordinator (TC Partial52). Planning meetings (one control, one partial) and staff meetings (one control, three partial, one full) were also discussed.

*In a staff meeting if there's anything that she's sort of picked up from the course, any handouts to give really she would obviously give them and just explain sort of generally what those were. (TC Partial97)*

Only one teacher from each group mentioned a science day or week. Observations and monitoring were discussed as another dimension of the science coordinator role (one control, three partial, one full). Teacher colleagues commented on the science coordinators 'monitoring work and looking at pupils' books' (TC Partial52). A couple of teachers mentioned the support the science coordinator got from other schools in the cluster (one partial, one full), and how she fed that back in the school.

*Yes, she meets us regularly and shares ideas. She is the chair of a science cluster in our town. She shares lesson plans and resources. (TC Partial75)*

Overall the role of the science coordinator in school varied, and while there were many similarities between the three groups there were some subtle differences identified in how the science coordinators who had been on the CPD course were able to raise the profile of science and disseminate ideas throughout the school.

## **Concluding remarks**

This report has looked at the impact of the CPD course on science coordinator practice, both in their classroom and across the school. While the numbers are small and we can make no claims about statistically significant differences between the intervention and non-intervention groups, this data has allowed us to explore in a little more detail some of the nuanced ways in which the course appears to have impacted teachers' practice. Through focusing on their own words, and those of the senior managers and colleagues, we can see that in some areas there are qualitative differences brought about by the CPD course. In some of those it is possible to see a progression in impact, with the full intervention group demonstrating a higher degree of change than the partial intervention group, suggesting that there is a bigger effect for a bigger 'dose' of CPD. However, in other areas there was very little difference between the partial and full intervention groups, and in some cases, such as the perspective of the teacher colleagues to the ways that the science coordinator shares ideas, there seemed to be a greater impact from the partial intervention group. With much of the data there were no discernible differences between any of the three groups.

## Similarities

There were many similarities between the three groups in terms of the teaching methods they said they used in the classroom. Science coordinators all discussed the importance of having a range of activities, with a focus on activities that were student-led and an emphasis on practical work. The teacher colleagues also talked about the role of practical work in their teaching methods. Teachers from all three perspectives discussed increases in confidence over the past year, although all for different reasons. Science coordinators from all groups said that assessment was generally done well and noted the new curriculum as having an impact on this. Teacher colleagues from all groups mentioned changes to assessment processes.

In terms of leadership across the school there were also areas where there were no clear differences between teachers in each of the three groups. When discussing school action plans, science coordinators, senior managers and teacher colleagues in all groups discussed the importance of cross-curricular links with science and the relevance of the new science curriculum setting the scene for the development of school plans for science. Similarly when discussing the status of science in school there were mixed results with equal numbers of teachers from each group saying that the status had improved and others saying that without statutory assessment the status of science had gone down. When it came to how science coordinators share and disseminate ideas through the school there were also consistent messages from all perspectives in each group that this was regularly done through INSETs and staff meetings, as well as through modelling. Senior managers also saw the role of observations and monitoring as important.

It is perhaps unsurprising that we have found so many similarities between the groups. All had signed up to the project and were willing to participate in the qualitative research, implying that they already valued science. However, it is interesting to note that there were also subtle differences between the groups.

## Differences

The discussion of teaching methods used by the science coordinators showed that there were some subtle differences between the groups. Perhaps the main one was that coordinators and senior managers in the control group were more likely to talk about writing up experiments, whereas the intervention groups focused more on having freedom to investigate with less emphasis on writing up and more freedom for students to lead and explore. These comments were echoed in the interviews with the teacher colleagues, showing that some of these ideals were being passed through the school. Science coordinators in the intervention groups also felt that the CPD course had added to their confidence in the classroom and tended to talk about the importance of addressing misconceptions in science. The support from the coordinator also appeared to trickle down to the teacher colleagues with teachers in the intervention groups discussing how the science coordinators' guidance had also increased their confidence in science, and senior managers commenting on having seen confidence grow. Teacher colleagues from the intervention groups were also more likely to mention the role of assessment through talking to students, rather than written testing. Senior managers from the intervention groups also made more comments about seeing improvements in assessment.

Pupil outcomes were another area where there were some differences between the responses from participants in the different groups. The intervention groups tended to claim that the science

coordinator had had more of an impact on pupil outcomes than those in the control group. The main outcome that was mentioned again and again by teachers from the intervention groups across the different perspectives was that pupils enjoyed science more. There were also more tentative differences regarding the use of technical vocabulary and engaging with scientific ideas.

When it came to the way science coordinators lead science within the school there were some small differences. For instance, science coordinators who had been on the CPD course were more likely to say they pushed for greater prominence for science, and often said that the course had given them the confidence to do this. They also talked more about making external links to develop science and about the ways they communicated the action plan with colleagues. Science coordinators said that the CPD course had help them to raise the profile of science and many of their teacher colleagues commented on the increased enthusiasm from the science coordinator as a result of the CPD course. In terms of sharing and disseminating ideas for science, both the science coordinators and the senior managers from the intervention groups noted that there was more focus on holding planning meetings with staff. Senior managers from the intervention groups were also more likely to comment on the way the science coordinator emphasized the role of practical work in science and the ways they shared resources with colleagues. Teacher colleagues confirmed this latter observation.

So while the differences are subtle, there are glimpses from the perspectives of the participants that the CPD course did have an impact on practice, and it appears that some of the features emphasized in the course come through in the voices of the science coordinators and their colleagues, when they talk about how they put their learning into practice in school.

### **‘Dose’ Effect**

The differences discussed above relate to key differences between the intervention and non-intervention groups. Here we make a few notes about the differences between the partial and full intervention groups to consider the effect of the ‘dose’ of CPD received. The differences were generally small, and with the sample size it is difficult to determine the factors affecting these differences. However, we found that more science coordinators in the partial intervention group talked about cross-curriculum connections in the teaching methods. Teacher colleagues in the partial intervention group talked more about reducing writing in science lessons than their counterparts in the full intervention group.

With assessment, the science coordinators from the full intervention group made more claims about improvements and were more likely to attribute these to the CPD course than the partial intervention group. Similarly the teacher colleagues from the partial intervention groups were less likely to note any changes in assessment as a result of the CPD course. Nevertheless, in general most of the differences noted and comments regarding the impact of the CPD course related as much to the partial as the full intervention group, particularly with pupil outcomes, so there seemed to be very little difference in the dose.

The bigger differences in terms of dose effect seemed to be at the level of science leadership across the school. The science coordinators from the full intervention group seemed to make more external links, communicate their plans more with colleagues and comment that the CPD course had improved their planning. The science coordinators from the partial intervention group were more

likely to comment that the status of science had recently taken a back seat. With sharing and disseminating ideas there were also some differences, particularly from the perspectives of the senior managers; the full intervention group tended to comment that the science coordinators encouraged more practical work and sharing of resources and that they shared more in staff meetings and planning meetings with colleagues. From the perspective of the teacher colleagues there were comments that suggested that the science coordinators from the partial intervention group gave more support to colleagues and did more modelling good practice, observation and monitoring. Overall though, it would seem that there were bigger differences between the intervention and non-intervention groups than between the partial and full groups in terms of the impact of the CPD course on their practice.

## **Limitations**

Of course, it is very difficult to draw solid conclusions. There are very small numbers involved and inconsistencies in the ways the questions were asked or the people that responded to particular questions. Turnover in the schools and challenges with participation also contributed to the small and varying numbers of people answering each question. Moreover, the semi-structured style of interviewing meant that participants were able to talk freely about areas of importance to them, giving rise to rich data, but on the other hand, they did not all talk about each area addressed in this report. Indeed, the way some of the questions were framed about change as a result of the course, made it difficult at times for the control group to engage with questions, which may also have skewed the findings.

Nevertheless, despite these limitations, this report has captured some important ideas from the perspectives of the participants. It is clear that for many the CPD course had a profound impact on their teaching and leadership within the school, and these findings may help us determine how to focus courses of this nature in the future.

