

Project title: Developing teachers as leaders of science in primary schools

Julia Mackintosh, Dr Elizabeth White, Dr Claire Dickerson, University of Hertfordshire

We know that by the end of primary school, children start to decide if science 'is for them' (Wellcome Trust, 2014). This informs later decisions concerning whether to study science post-16, which, in turn, impacts on the supply of STEM professionals for the future (Archer et al., 2012). Hence, children's experiences of science at primary school are important. However, many teachers report that science has been given less of a priority in English primary schools over the past five years, often because it has been 'squeezed out with numeracy and literacy pressures' (CBI, 2015, p.15). Teacher leadership has gained attention in recent years as a means by which education reform can be accomplished (Poekert, 2012). It has therefore been suggested that one way to 'reform' the priority of science is to provide continuing professional development (CPD) for science leaders (Ofsted, 2013).

The Primary Science Quality Mark (PSQM) has been recognised as one way that schools might address this issue (CBI, 2015). This is an award programme which aims to raise the profile of science in primary schools by providing them with a framework and professional support for developing science leadership, teaching and learning. Schools can achieve bronze, silver or gold awards (PSQM, 2015). Our small scale study was carried out to evaluate the impact of Royal Society of Chemistry (RSC) bursary-funded PSQM on the teaching and leadership of science in primary schools involved in the scheme for the first time. The schools involved in this study were working at bronze level, but some of them submitted at silver level because they had exceeded the descriptors for each of the criteria for the award.

Aims and outcomes

The aims of the PSQM award programme include: raising the profile of science in primary schools; providing schools with a framework and professional support for developing science leadership, teaching and learning; and celebrating excellence in primary science. Primary school science leaders apply to take part in the PSQM programme and are appointed to local PSQM hubs. These are led by PSQM-trained experts in primary science who support science leaders through the year-long programme of professional development, school-based evaluation, action planning and implementation to develop all aspects of science teaching, learning and subject leadership. This culminates in science leaders submitting a set of reflections and supporting evidence of practice in primary science in their school to meet the criteria for either bronze, silver or gold awards. The main aim of the research project was to explore the impact of the scheme on attitudes and aspirations of pupils and teachers with respect to science. The focus of this paper is the impact of the scheme on the attitudes of teachers towards their role as a leader of science. Data is analysed in relation to the 'spheres of teacher leadership' conceptual model created by Fairman and Mackenzie (2012) which describes ways that teachers demonstrate leadership.

Research methodology and methods

This practice-focused research listened to the viewpoints of primary science leaders, who were 'conversational partners' in the project (Rubin and Rubin, 2005, p.14). An interpretive approach was taken to understand the attitudes, behaviour and thinking of the participants. Data collection methods included: an email questionnaire; semi-structured telephone interviews; a focus group with science leaders; and a review of some of the data available on the PSQM portal (White et al., 2015). As noted by Turner et al. (2013, p. 7) relating to data from the PSQM portal: 'The subject leaders are self-reporting to achieve a PSQM award.'

Professional and honest self-evaluation is expected, but the requirement to demonstrate that certain criteria were met might have influenced the content. Furthermore, the structure of the framework and the questions that the subject leaders responded to will have influenced their reflections.'

Attitudes to science have been evaluated through self-reporting of the science leaders and through their observation and monitoring of the engagement of teachers and pupils. Although there may be some doubt in self-reported attitudes, the observation of behaviours indicating dispositions is thought to be more reliable (Royal Society, 2010). The science leaders were able to observe teaching, displays, scrutinise pupil work, listen to feedback from pupil panels and from their colleagues. They also observed informal interactions relating to the profile of science in their school. In total, twelve science leaders participated in the research.

Evidence

Science leaders were asked whether their attitudes to science had changed since they had been doing the PSQM and about attitudes to science across their schools (other staff, pupils) as well as about any changes in practice. Evidence showed changes in the science leaders' attitudes towards the teaching of science in their own classrooms and to leading science across the whole school, as described below.

Science leaders' attitudes to teaching science

Many science leaders reported that they felt better equipped for their own teaching. Some comments were made relating to the development of subject knowledge, but most were related to science pedagogy. As one science leader said: *I now feel much clearer about what excellent science looks like*. As a result, science leaders reported feeling more enjoyment and confidence when teaching in their own classrooms. As one teacher reported: *I have enjoyed teaching science more since working towards the PSQM as I am thinking more about my teaching*. Some science leaders noted the impact that this change in attitude had on their teaching:

I am more motivated to go away and look at things more deeply, learning on the way with the children... I am more confident and willing to take risks [with my teaching] which is exciting as before I was stuck in a rut.

I am far more critical of my own teaching, I want it to be as good as it can be. It has made me look further for materials, resources and ideas.

Science leaders' attitudes to leading primary science

In common with findings of the Wellcome Trust (2015), a number of participants said that they had initially lacked confidence in leading science. One admitted it was *'quite a scary prospect'* before undertaking PSQM and another said: *before, I was ticking the boxes, doing observations, but I didn't really know what I was looking for*. Undertaking PSQM helped science leaders to understand their leadership role, which made them feel better equipped for leading others:

The principles are there to support it. So now, when I am looking at books, when I am looking at planning, when I am looking at lessons, when I am doing my own planning,

*I keep that in mind and I think that gives me a clear vision. It gives us 'forward motion'
– all together*

Science leaders described how they shared ideas with colleagues at staff meetings, supported other teachers with planning and teaching and monitored learning in science. They were aware of changes in how they were leading science and felt more secure in their leadership role. Responses were typified by the following:

I have developed professionally. I'm more confident, I'm more willing to lead staff meetings and drive things forward. I do learning walks, observe lessons, book scrutinies, which is something that I have never done before

Science leaders could see how their leadership was impacting on other staff and how the attitude of other teachers had changed. Many reported that other staff were talking more about science and were more confident about using resources for teaching primary science. They were excited by the fact that there was more consistency in the quality of teaching science across the school. Pupils were being given more opportunities to work scientifically, answer their own questions and lead their own investigations. They could see that other teachers were being inspired to teach science in a more engaging way because of their leadership and that they were working collectively to develop science: *It is empowering because it feels like I'm not on my own. There are other people with you, working towards the same goal.* However, they also recognised that changing the attitudes of some staff was much harder than others, especially in a year of curriculum change, and they acknowledged that for some, this was still a 'work in progress'.

Finally, science leaders could see how their leadership was impacting on pupils' motivation and enthusiasm for science:

It's really nice to see the children who were not excited by science more engaged. It is the whole class now, not just individual children who had a flair for science.

They could see how developing a wider range of learning opportunities such as learning outside, organising visitors, special events and science trips as part of their leadership role had enriched science teaching and learning beyond the classroom. One science leader reported feeling pride hearing pupils explain scientific concepts to their peers and parents during a science assembly and another, pleasure at witnessing the *wonder and excitement on the faces of Year 1 children when animals arrived in their classroom.* Science leaders could see that their leadership had raised the profile of science within their school.

it's motivating because you feel like it is actually starting to work. It has taken a good 6 months, but slowly, through children's comments, you start to feel like I am actually making a difference

Conclusions

This research found evidence for changes in teachers' attitudes towards teaching and leading science due to engagement with the PSQM programme. Changes may have been due to a change in behaviour, prompting a change in attitude or a change in attitude that impacted the way that science leaders were carrying out their role, both what they were doing and how they

were doing it. To understand what this reveals about developing teachers as leaders of science, these activities were analysed in relation to Fairman and Mackenzie's (2012) conceptual model of the 'spheres of teacher leadership' (see Figure 1). This model builds on the theoretical framework of York-Barr and Duke (2004), and describes the ways that teachers demonstrate leadership with the goal of improving student learning.



Figure 1. Spheres of Teacher Leadership Action for Learning.
(Fairman and Mackenzie, 2012: p.231)

Evidence showed that learning more about effective science teaching from the PSQM programme motivated science leaders to develop their own teaching, to 'take risks' and be more adventurous with their choice of resources. This reflects leadership activities described within spheres A and B, where teachers engage with learning about, experimenting with and reflecting on their own practice. Support provided by the PSQM programme to develop subject leadership impacted on science leaders' understanding and confidence when leading science. Evidence showed that they engaged in activities described in spheres C-E: working across multiple classrooms, sharing ideas and learning with colleagues, with the aim of working collectively to develop science teaching across the school. There was also evidence that working towards the PSQM award encouraged science leaders to attend to the climate and culture of the whole school and to consider their role in the success of all students, showing engagement with activities in spheres F and G. This aligns with the aim of the silver PSQM award, which many of the participating schools achieved, even when they originally enrolled to do the bronze award. Spheres H and I align with the aim of the gold PSQM award and were not demonstrated in the data that we collected from the science leaders.

Therefore, participating in the PSQM programme facilitated movement between leadership spheres (Fairman and Mackenzie, 2012). Science leaders' perspectives shifted from a narrow focus of improving a teacher's learning and practice within one classroom, to broader goals of

improving teacher and student learning school-wide. This relates well to the recommendation by the Wellcome Trust (2015) that ‘a Primary Science Leader should have a whole-school vision for science and be able to lead its development by instigating appropriate initiatives, including providing continuing professional development to colleagues, monitoring progress and contributing to the strategic development of learning in school’. There is also evidence to suggest that the development of an effective science leader impacted on the profile of science within the school and on the attitudes of pupils, echoing the view that

‘...where science has a good profile within the school as a result of dedicated leadership, and where staff are expected to teach exciting, investigative science with access to high-quality science expertise, children are likely to enjoy learning the subject.’ (Wellcome Trust, 2013, p. 3)

Recommendations

1. Extend the study from the current schools who were enrolled for bronze and silver PSQM awards to those enrolled in gold to see whether the science leaders in these schools demonstrated leadership activities in all 9 spheres.
2. Investigate the impact of doing the PSQM on pupil progress/attainment in schools.

This research was funded by the Royal Society of Chemistry.

References

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. & Wong, B. (2012) ‘Science Aspirations and family habitus: How families shape children’s engagement and identification with science’. *American Educational Research Journal*, 49(5), pp. 881-908

CBI (2015). ‘Tomorrow’s World – Inspiring primary scientists’. Available at: http://news.cbi.org.uk/news/over-half-of-primary-school-teachers-say-science-is-getting-squeezed-out-cbi/tomorrow-s-world/?dm_i=7LD,39P28,IP42U4,BP8ZX,1. [Accessed: 17 December, 2015].

Fairman, J. & Mackenzie, S (2012) ‘Spheres of teacher leadership action for learning’, *Professional Development in Education*, 38(2), pp. 229-246

OFSTED (2013). ‘Maintaining curiosity. A survey into science education in schools’. Available at <https://www.gov.uk/government/publications/maintaining-curiosity-a-survey-into-science-education-in-schools>. [Accessed: 17 December, 2015].

Poekert, P. (2012) ‘Teacher leadership and professional development: examining links between two concepts central to school improvement’, *Professional Development in Education*, 38(2), pp. 169-188.

PSQM (2015). Available at <http://www.psqm.org.uk/about-psqm>. [Accessed: 17 December, 2015]

Royal Society (2010). Science and mathematics education, 5–14. A ‘state of the nation’ report. London: Royal Society. Available at: <https://royalsociety.org/topics-policy/projects/state-of-nation/5-14/>. [Accessed: 17 December 2015]

Rubin, H. & Rubin, I. (2005). *Qualitative interviewing, the art of hearing data*, London: Sage.

Turner, J. with Marshall, S., Farley, A. and Harriss, L. (2013) ‘Primary Science Quality Mark: Learning from good practice in primary science. What can we learn about current practice in primary science teaching and learning in England from the Primary Science Quality Mark award programme?’ London: Wellcome Trust. Available at: http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp052809.pdf

Wellcome Trust (2013) ‘The Deployment of Science and Maths Leaders in Primary Schools. A study for the Wellcome Trust’. London: Wellcome Trust. Available at: http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp056231.pdf

Wellcome Trust (2014) 'Primary Science: Is It Missing Out? Recommendations for Reviving Primary Science'. Available at: <http://www.wellcome.ac.uk/About-us/Publications/Reports/Education/WTP057244.htm> [Accessed: 10 May 2016]

Wellcome Trust (2015). 'Developing Primary Science Expertise'. Available at <http://www.wellcome.ac.uk/Education-resources/Education-and-learning/Our-work/Teacher-training/WTS052326.htm>. [Accessed: 17 December 2015].

White, E, Dickerson, C & Mackintosh, J (2015), *Impact of Royal Society of Chemistry bursary-funded Primary Science Quality Mark on primary science teaching: final report*. University of Hertfordshire.

York-Barr, J. and Duke, K. (2004) 'What Do We Know About Teacher Leadership? Findings From Two Decades of Scholarship', *Review of Educational Research*, 74(3), pp. 255-316