# Science within the primary curriculum: a regional perspective on preparation to teach

**Rebecca Hopkin[1] and John G. Sharp[2]**

[1]University of Exeter
[2]Bishop Grosseteste University College Lincoln

Corresponding author: john.sharp@bishopg.ac.uk

## Abstract

*In 1989, the introduction of a National Curriculum of subjects to all maintained schools in England and Wales brought compulsory science education into the primary sector for the first time. As a result of its elevated profile and an immense amount of hard work and effort by teachers and other professionals responding to requirements, science education provision benefited enormously. Despite this, successive overhauls and radical revisions of primary science have brought about many changes, each impacting on the primary profession as a whole. Regional findings from a national 'preparation to teach science' survey underway in England are presented here for the first time. Nearly 20 years on from when the National Curriculum and its primary science component were first introduced, attention is drawn to the continued progress being made and to those factors potentially inhibiting science delivery within the primary classroom.*

***Key words: primary science, National Curriculum, teaching***

## Introduction

On 1 August 1989, the introduction of a National Curriculum of subjects to all maintained schools throughout England and Wales brought compulsory science education into the primary sector for the first time. Such was the importance bestowed upon it, science was placed alongside English and mathematics in what simply became known as 'the core'. Since its introduction, however, successive overhauls and radical revisions of the primary science curriculum have brought about many changes. To date, there have been four *final* versions of the national primary science curriculum, and the struggle to formulate it since its introduction has been particularly well documented (Oakley, 1993; Black, 1995a,b; Ritchie, 1996; Sharp and Grace, 2004). Also in 1989, investigations undertaken at Exeter University as part of the Leverhulme Primary Project began to evaluate the impact of the National Curriculum and its primary science component upon the profession as a whole (Wragg *et al.*, 1989; Carré and Carter, 1990). This early work was subsequently extended by Bennett *et al*. (1992) and Carré and Carter (1993). In brief, teachers were found to be in an initial state of disorientation as a result of the new requirements and demands placed upon them; interpretations of requirements and implementation strategies were found to vary widely from class-to-class and school-to-school. While further research has been undertaken since, as we approach the twentieth anniversary of the national primary science curriculum itself it was considered appropriate to attempt to replicate the work of the Leverhulme Primary Project in order to evaluate how well prepared the profession feels to teach primary science today. In this article, detailed regional findings from the National Primary Science Survey (England), a



ISSN: 1758-2199

major research initiative currently underway, are presented for the first time, and the potential implications explored. Findings are encouraging: respondents' self-perceived preparation to teach primary science and the capacity of their schools to implement and deliver the national primary science curriculum appear to be in 'good health'. Analysis by gender, role in school, teaching experience, school size, science as a curriculum specialism and in-service training draws attention to matters of importance, 'old' and 'new', which require careful consideration.

**Review of literature**

Since before and after its introduction in 1989, the national primary science curriculum has been a topic of considerable discussion and debate. According to Fortune *et al*. (1993), the national primary science curriculum brought with it a number of advantages: it raised the profile of science itself, formulated an initial design, made known expectations and supplied performance information for all interested parties. Nevertheless, the introduction of the national primary science curriculum raised a number of concerns within the primary teaching profession as a whole, and teachers' curricular expertise in particular soon came under scrutiny. Traditionally, part of the 'problem' with delivering primary science lay in the simple fact that most practitioners had little experience of science beyond what they themselves had encountered when at school or during training as a 'generalist'. 'Specialists' were certainly thin on the ground.

In the longitudinal Leverhulme Primary Project, undertaken between 1989 and 1993, researchers at Exeter University began to explore the impact of the introduction of the national primary science curriculum through a two-phase quantitative investigation. The first phase of the Project explored the initial extent of teachers' perceived levels of competence across the entire National Curriculum (Wragg *et al.*, 1989). A questionnaire survey of 901 primary teachers from 152 English and Welsh schools required participants to rate on a 4-point Likert-type scale how they felt about teaching the National Curriculum. Results indicated that teachers perceived themselves as most competent in English, with mathematics in second place. In contrast, teachers perceived themselves to be least competent in science, music and design and technology. In the exploration of specific science attainment targets, the more physical science elements were less well favoured than the more biological overall. However, male teachers perceived themselves to be significantly more competent to teach physics than female teachers and female teachers perceived themselves to be significantly more competent to teach biology than male teachers (Carré and Carter, 1990). The follow-up phase of the Leverhulme Primary Project involved the participation of 433 teachers in 131 schools, 43% of whom were involved earlier (Bennett *et al*., 1992). Administration of the original questionnaire, with only minor alterations and extensions, allowed the researchers to investigate the progression in teachers' perceived competence in the teaching of the National Curriculum following a short period of potential adjustment. Results again indicated that teachers perceived themselves to be most competent in the core subjects English and mathematics and least competent in music and design and technology. However, science ranked third, a substantial improvement. The gender differences observed earlier in science remained (Carré and Carter, 1993). Authors concluded that, while lots of activity was going on, the national primary science curriculum was being met with enthusiasm; however, questions were raised as to whether or not the best or right kind of science was being taught.



ISSN: 1758-2199

Soon after the close of the Leverhulme Primary Project, researchers at the University of Liverpool began to investigate apparent disparities between science education policy and practice across Key Stages 1 to 3 (Russell *et al.,* 1995). This involved a national interview study of 136 Key Stage 1 to 3 teachers, questionnaires distributed to 1500 primary and secondary teachers (with a 59% and 54% response rate respectively) and case studies involving groups of primary and secondary schools. Russell *et al.* (1995) established that, despite being a core curriculum subject, science did not have equal status with English and mathematics. Teachers themselves felt more confident in knowing how children's understanding develops in English and mathematics than in science. Furthermore, coverage of the science curriculum was found to be uneven, with biological components over-represented and physical components under-represented. Factors associated with lower rates of attention included teachers' own lack of background knowledge, difficulties in reconciling pedagogical assumptions and the curriculum subject matter, and the assessment framework they were required to use. Teachers' saw the conceptual demands posed by some content as too great for some children. The study concluded that many teachers possessed neither the subject knowledge nor pedagogical content knowledge to fully implement the science curriculum: a clear rationale for reconciliation between policy and practice was required. The aims and values of introducing science into the primary sector had perhaps been compromised in favour of the delivery and assessment of prescribed content, not all of which had been carefully sequenced.

Over a decade after the introduction of the national primary science curriculum, the Parliamentary Office of Science and Technology (2003) found that teachers' scientific knowledge and confidence remained a fundamental concern. In response to such concerns, the Wellcome Trust funded a scoping study, *the Primary Horizons Project*, which aimed to explore teachers' views and experiences of primary science learning and teaching across the UK (Murphy *et al.*, 2005). Telephone surveys conducted with 300 teachers in English, Scottish, Welsh and Northern Irish primary schools gathered both quantitative and qualitative data regarding teachers' perceptions of their competence in, and implementation of, the science curriculum. Findings revealed that, even following such a long period of potential adjustment since 1989, teachers continued to perceive themselves to be far less competent in the teaching of the physical than the biological sciences. The factors which had the most inhibiting impact upon science implementation were lack of knowledge, expertise and confidence in science, followed by a lack of appropriate teaching resources and curriculum time. More creative teaching contexts and continued professional development were deemed essential.

Since 1989, the primary science curriculum has been supported with a Scheme of Work for science at Key Stages 1 and 2, and the climate of political intervention in schools eventually found its way into Initial Teacher Training where science was tackled head on. Nothing of this passed without sometimes fierce controversy and debate with all developments perhaps compounding the inadequacies of the curriculum itself (Sharp and Grace, 2004). Some issues remain very much unresolved, for example: the choice, relevance and presentation of content, the nature and content of scientific enquiry, the assessment framework, the lack of transparency over the use of evidence-based research, and the training and educating of primary practitioners (see reviews in Newton and Newton, 2000; Shallcross and Spink, 2002; Jarvis et al., 2003; Parker, 2004; Boyle and Bragg, 2005).

**Methodology**

The National Primary Science Survey (England) is an ongoing project funded by the School of Culture, Education and Innovation at Bishop Grosseteste University College, Lincoln.



ISSN: 1758-2199

During the data collection phase of the project, which ran from September, 2006 to June, 2007, 600 primary schools were sampled at random across the Initial Teacher Training partnership clusters of six participating Higher Education Institutions. These included Bishop Grosseteste University College Lincoln itself, the University of Hull, Sheffield Hallam University, Liverpool Hope University, Bath Spa University and the University of Exeter. Randomly selected partnership schools were each provided with a pack of 5 questionnaires in anticipation that the head teacher, science co-ordinator and at least one class teacher would respond. Overall, 303 fully completed questionnaires have been returned from 206 schools (34.3% school response rate and 16.8% participant response rate). Response rates varied by region, with the Lincoln cluster reported here, providing 97 completed questionnaires from 65 schools.

The design of the questionnaire, informed by the work of the Leverhulme Primary Project, consisted of four main parts:

- Part 1: Personal details
- Part 2: School details
- Part 3: Perceived curriculum competence
- Part 4: Science implementation

Parts 1 and 2 of the questionnaire held the primary function of gathering descriptive data regarding the respondents involved in the study (e.g. gender, role, teaching experience, qualifications, responsibilities) and the schools at which they worked (e.g. type, year group taught, organisation and delivery of science), data which would allow the multi-dimensional analysis of findings. Part 3 of the questionnaire required respondents to rate how prepared they felt to teach the twelve key curriculum areas using the following scale:

1 = I feel very well prepared to teach this subject with my existing knowledge and skills
2 = I feel sufficiently well prepared to teach this subject knowing that I can always rely on a little help from colleagues
3 = I feel that with some additional in-service support I would be sufficiently prepared to teach this subject
4 = I do not feel sufficiently prepared to teach this subject at all and require substantial in-service support
5 = I recognise that this is my weakest subject by far and that even with substantial in-service support I have a long way to go before I'll ever feel prepared

Part 3 also required respondents to rate using a similar scale their perceived preparation in thirteen elements of the science programmes of study. The approach adopted here differed from the 4-point Likert-type scale used in the Leverhulme Primary Project in order to maintain consistency with the final part of the questionnaire. Enhancing this closed approach, qualitative data were collected by asking respondents to indicate which subjects and science curriculum elements they most and least enjoyed teaching, and about their in-service training experiences. Part 4 of the questionnaire extended the Leverhulme Primary Project by adopting a 49-item, 7-factor science implementation instrument, modified from the work of Lewthwaite (2005) and Lewthwaite and Fisher (2004, 2005), which measures professional knowledge, professional attitude and interest, resource adequacy, professional adequacy, school ethos, professional support and time. These factors would help to identify how respondents' viewed their own school in terms of how well prepared it is to implement



ISSN: 1758-2199

and deliver the science curriculum as a whole. Respondents were required to rate each of the 49-item statements presented to them using the following scale:

SA = I strongly agree with the statement
A = I agree with the statement
N = I neither agree nor disagree with the statement
D = I disagree with the statement
SD = I strongly disagree with the statement

Ratings were then transformed to scores using a 1 (SA=strongly agree) to 5 (SD=strongly disagree) scale, an individual's summated score for any given factor taking any value within the range 7 to 35 (i.e. the greater the value the greater the inhibiting factor effect). For pragmatic reasons, the language of the original questionnaire was modified slightly for use in England (the original was prepared for use in New Zealand) and the original scale was reversed to avoid confusion with the scale adopted in Part 3. In addition to this quantitative data, qualitative responses were collected by asking respondents to describe how they felt the delivery of the science curriculum might be improved at both a local and national level.

Quantitative data obtained on nominal and ordinal scales from the questionnaires were analysed using non-parametric statistical techniques, the construction and interrogation of an extensive SPSS database taking place at the close of the data collection phase. Qualitative data obtained from the questionnaires were reduced using a simple form of content analysis.

**Presentation and analysis of findings**

Of the 97 respondents drawn from the Lincoln cluster, 80.4% were female (n=78). 12.4% (n=12) were head teachers and 19.6% (n=19) science coordinators. While the majority of respondents who held responsibility for primary science had specialised in primary science when training, fewer than half held a first degree in science itself. 85.6% (n=83) worked in primary schools, the remaining 14.4% (n=14) working in infant, junior or special schools. 63.9% (n=62) of the schools had roles of over 200 children. 52.6% (n=51) of respondents had qualified within the past ten years. With regard to in-service training, only 33.0% (n=32) of respondents had attended school or local authority in-service within the past 3 years, and a minute 5.2% (n=5) had attended training at a regional Science Learning Centre. The majority of respondents indicated that they enjoyed teaching primary science.

When asked to rate how they felt about teaching across the entire National Curriculum 63.9% felt perfectly satisfied teaching science with existing knowledge and skills; a further 34.0% feeling satisfied knowing that they could rely on help from colleagues (Table 1). Only a few felt the need for some in-service support. Reasons given for enjoying teaching science varied but comments included:

> *I enjoy the subject so I have my own enthusiasm, which hopefully I will pass on.*
>
> *It is fun, exciting and practical, and when taught in a very investigative hands-on way children of all ages become very involved and interested, and most importantly have fun!*
>
> *I find the science curriculum clear and well-structured, and so feel I can teach this area confidently and effectively.*



ISSN: 1758-2199

Reassuringly, science as a core subject was ranked in third place behind English and mathematics, and the difference in perceived preparation to teach between English, mathematics and science was not significant (Friedman two-way analysis of variance $X^2$=5.735, *df*=2, *p*=0.057). The table of outcomes by subject presented here reveals that there are clearly some matters of importance to be raised and discussed with respect to National Curriculum provision as a whole. Further statistical analysis found little difference between most of the subgroups of respondents with the exception of science specialists who, as might have been expected, perceived themselves to be significantly more prepared in the teaching of science than non-science specialists (Mann Whitney *U*=478, *p*=0.001). Interestingly, science coordinators and headteachers perceived themselves to be significantly more prepared to teach science than class teachers (Kruskal-Wallis one-way analysis of variance $X^2$=8.586, *df*=2, *p*=0.014).

| Table 1 | Respondents' levels of self-perceived preparation to teach (n=97) | | | | | Median score | Mean score |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| English | 76.3% | 20.6% | 3.1% | 0.0% | 0.0% | 1.0 | 1.3 |
| Mathematics | 70.1% | 26.8% | 3.1% | 0.0% | 0.0% | 1.0 | 1.3 |
| Science | 63.9% | 34.0% | 2.1% | 0.0% | 0.0% | 1.0 | 1.4 |
| History | 54.6% | 42.3% | 3.1% | 0.0% | 0.0% | 1.0 | 1.5 |
| PSHE and Citizenship | 49.5% | 45.4% | 5.2% | 0.0% | 0.0% | 2.0 | 1.6 |
| Geography | 49.5% | 38.1% | 8.2% | 2.1% | 2.1% | 2.0 | 1.7 |
| RE | 46.4% | 39.2% | 10.3% | 3.1% | 1.0% | 2.0 | 1.7 |
| PE | 44.3% | 38.1% | 14.4% | 1.0% | 2.1% | 2.0 | 1.8 |
| Art and Design | 39.2% | 48.5% | 9.3% | 3.1% | 0.0% | 2.0 | 1.8 |
| ICT | 36.1% | 49.5% | 11.3% | 1.0% | 2.1% | 2.0 | 1.8 |
| Design and Technology | 34.0% | 47.4% | 16.5% | 2.1% | 0.0% | 2.0 | 1.9 |
| Music | 24.7% | 41.2% | 20.6% | 9.3% | 4.1% | 2.0 | 2.3 |

(1=very well prepared; 2=well prepared with help from colleagues; 3=some in-service support required; 4=substantial in-service support required; 5=long way to go)

When asked to rate how they felt about teaching across the 13 elements of the science National Curriculum programmes of study, outcomes were particularly revealing (Table 2). Respondents' perceived preparation differed significantly across them all (Friedman two-way analysis of variance $X^2$=122.982, *df*=12, *p*<0.001). Respondents clearly perceived themselves to be most prepared in the biological components of the curriculum with humans and other animals (71.1%), life processes (68.0%), living things and their environment (68.0%) and green plants (66.0%) leading and least well prepared in the physical



ISSN: 1758-2199

components of the curriculum with the Earth and beyond (42.3%), forces and motion (45.4%) and electricity (49.5%) falling some way behind.

| Table 2 | Respondents' levels of self-perceived preparation to teach (n=97) | | | | | Median score | Mean score |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Humans and other animals | 71.1% | 25.8% | 3.1% | 0.0% | 0.0% | 1.0 | 1.3 |
| Life processes | 68.0% | 29.9% | 2.1% | 0.0% | 0.0% | 1.0 | 1.3 |
| Living things and their environment | 68.0% | 27.8% | 4.1% | 0.0% | 0.0% | 1.0 | 1.4 |
| Green plants | 66.0% | 30.9% | 3.1% | 0.0% | 0.0% | 1.0 | 1.4 |
| Grouping and classifying materials | 66.0% | 29.9% | 2.1% | 2.1% | 0.0% | 1.0 | 1.4 |
| Changing materials | 59.8% | 35.1% | 4.1% | 0.0% | 1.0% | 1.0 | 1.5 |
| Variation and classification | 55.7% | 37.1% | 6.2% | 1.0% | 0.0% | 1.0 | 1.5 |
| Light and sound | 53.6% | 40.2% | 6.2% | 0.0% | 0.0% | 1.0 | 1.5 |
| Scientific enquiry | 51.5% | 43.3% | 4.1% | 1.0% | 0.0% | 1.0 | 1.5 |
| Separating mixtures of materials | 50.5% | 37.1% | 9.3% | 2.1% | 1.0% | 1.0 | 1.7 |
| Electricity | 49.5% | 40.2% | 9.3% | 1.0% | 0.0% | 2.0 | 1.6 |
| Forces and motion | 45.4% | 44.3% | 8.2% | 2.1% | 0.0% | 2.0 | 1.7 |
| The Earth and beyond | 42.3% | 46.4% | 10.3% | 1.0% | 0.0% | 2.0 | 1.7 |

(1=very well prepared; 2=well prepared with help from colleagues; 3=some in-service support required; 4=substantial in-service support required; 5=long way to go)

These results were in the main confirmed by written responses in which teachers indicated that they least enjoyed to teach the physical sciences due to lack of curricular expertise, pedagogical issues and perceived conceptual difficulties for children. Further statistical analysis revealed, again, little difference between most of the subgroups of respondents with the exception of science coordinators and head teachers who perceived themselves to be significantly more prepared to teach across over half of the science curriculum elements than class teachers (living things and their environment Kruskal-Wallis one-way analysis of variance $X^2$=6.182, *df*=2, *p*=0.045; grouping and classifying materials $X^2$=7.403, *df*=2, *p*=0.025; changing materials $X^2$=10.065, *df*=2, *p*=0.007; variation and classification $X^2$=15.886, *df*=2, *p*<0.001; scientific enquiry $X^2$=11.049, *df*=2, *p*=0.004; separating mixtures of materials $X^2$=8.432, *df*=2, *p*=0.015; electricity $X^2$=8.815, *df*=2, *p*=0.012; the Earth and beyond $X^2$=10.688, *df*=2, *p*=0.005).

Those respondents who had specialised in science during training also perceived themselves to be significantly more prepared than non-science specialists in all areas of the science curriculum other then the Earth and beyond (humans and other animals Mann



ISSN: 1758-2199

Whitney *U*=551, *p*=0.006; life processes *U*=520, *p*=0.003; living things and their environment *U*=612, *p*=0.045; green plants *U*=545.5, *p*=0.007; grouping and classifying materials *U*=544.5, *p*=0.007; changing materials *U*=480.5, *p*=0.001; variation and classification *U*=488.5, *p*=0.002; light and sound *U*=526.5, *p*=0.007; scientific enquiry *U*=553, *p*=0.015; separating mixtures of materials *U*=594, *p*=0.048; electricity *U*=4544.5, *p*=0.014; forces and motion *U*=502.5, *p*=0.004) and respondents from schools with over 200 pupils did identify themselves as significantly more prepared in the teaching of forces and motion than respondents within smaller schools (Mann Whitney *U*=818, *p*=0.027).

Tables arranged and presented like this, however, need to be interpreted with care. This is not a 'hit list' of which elements should and should not be included in the primary science curriculum even if some elements including the physical sciences have always proved difficult to address. The response profiles by element are heavily skewed towards the more positive end of the measurement scale, an observation strongly reflected in mean and median scores. So, while scientific enquiry appears in the lower half of the table, 94.8% of respondents nevertheless felt able to cope, even if this did require a little help. Similarly, while the Earth and beyond appears right at the foot of the table, 88.7% of respondents felt in a similar position. The wider research literature helps us to understand that the continued isolation of scientific enquiry from the main content areas of science, a distortion of enquiry towards its more technical aspects such as fair testing, and teachers' own beliefs about what is and isn't appropriate for children all contribute, at least in part, to where particular elements end up.

When asked to respond to how well they felt their own schools were prepared to implement and deliver the primary science curriculum, professional adequacy and knowledge (e.g. the pool of subject and subject related pedagogical knowledge available to draw upon), professional support (e.g. within the school's management structure) and resource adequacy (e.g. equipment, ICT, storage, budget) were considered among most inhibiting, though within a profile of generally positive responses (Table 3). The factor with the highest summated mean score, and hence the factor perceived to be most inhibiting, was unquestionably time (e.g. preparation, teaching, competition with other subjects, personal exploration). Least inhibiting was school ethos. Respondents highlighted that science had a relatively high status as a curriculum area within their schools.

| Table 3 | Mean summated score | Mean score |
|---|---|---|
| School ethos | 12.8 | 1.8 |
| Professional attitude and interest | 13.4 | 1.9 |
| Professional adequacy | 14.5 | 2.1 |
| Professional knowledge | 14.9 | 2.1 |
| Professional support | 15.3 | 2.2 |
| Resource adequacy | 15.5 | 2.2 |
| Time | 16.4 | 2.3 |

Further statistical analysis revealed, again, little difference between most of the subgroups of respondents but role, and leadership, within school was important. Kruskal-Wallis one-way analysis of variance identified that class teachers perceived professional knowledge ($X^2$=11.56, *df*=2, *p*=0.003), resource adequacy ($X^2$=8.384, *df*=2, *p*=0.015) and professional



ISSN: 1758-2199

support ($X^2$=10.956, *df*=2, *p*=0.004) to have a higher inhibiting effect upon the delivery of the science curriculum within their schools than science coordinators and head teachers. Respondents who had attended school or local authority in-service training within the last 3 years also perceived professional support to be significantly less inhibiting than those who had not (Mann Whitney *U*=704, *p*=0.01).

Finally, respondents were asked to comment on what they would do to improve the quality of science education provision locally and nationally. Areas for improvement fell into a small number of categories, some comments speaking for themselves:

> *Provide more money in the budget to improve the quality and quantity of resources.*
>
> *Allow more curriculum time to enhance science teaching.*
>
> *Provide more professional development opportunities to improve teachers' confidence.*
>
> *Remove some of the National Curriculum demands, specifically those which do not relate to real-life experience.*
>
> *Allow schools more scope to structure the curriculum for their own circumstances.*
>
> *Abolish science testing within the Key Stage 2 SATs.*

**Summary and implications**

Nearly 20 years on from when the National Curriculum made its first appearance in schools throughout England and Wales, primary science retains its reputation as one of the curriculum's more challenging areas. Despite this, findings from a single region contributing to the National Primary Science Survey (England) point to very real progress being made, particularly since the Leverhulme Primary Project of the late 1980s and early 1990s and other research since. This is good news for primary science and the primary profession as a whole and such findings are to be celebrated. Within the limitations of the overall design, methodology and means of data analysis employed, outcomes from the Lincoln cluster alone are considered encouraging:

- the majority of respondents indicated that they enjoyed teaching primary science;
- science was ranked third behind English and mathematics in terms of how well prepared respondents felt to teach this area of the National Curriculum as a whole, and the difference in perceived preparation between English, mathematics and science was not significant;
- the majority of respondents considered themselves to be either very well prepared to teach across all thirteen elements of the primary science curriculum or could rely on help from colleagues without the need for in-service support; response profiles and mean scores across all science elements appeared generally skewed towards the more positive end of the measurement scale;
- the majority of respondents who held responsibility for primary science had actually specialised in primary science when training and felt better prepared to teach science across the primary science curriculum than those who did not;



ISSN: 1758-2199

- the majority of respondents perceived there to be few strongly inhibiting factors preventing the implementation and delivery of primary science within their schools.

Several matters did come to light as a result of this regional aspect of the survey, however, and these require careful consideration and attention. Some of the more important are presented as follows:

- respondents enjoyed and perceived themselves to be better prepared to teach the more biological aspects of the curriculum than the more physical;
- despite many enjoying scientific enquiry, respondents felt less prepared to teach this element of the science curriculum relative to many others;
- the most inhibiting factor considered to affect the implementation and delivery of the science curriculum across all schools was time, including time to prepare and teach lessons as well as time for personal exploration;
- the uptake of in-service training in science among respondents over the last 3 years was less than might have been hoped for, particularly so at regional Science Learning Centres;
- preparation to teach primary science was perceived differently across the different management levels in schools;
- many respondents felt that science education provision nationally might benefit from a less prescriptive, less tedious and less structured curriculum with more opportunity for flexibility, exploration and stimulation.

Surveys of the type undertaken and reported here, however, also have their limitations. For example, respondents were required to determine how prepared they felt to teach primary science in terms of their existing knowledge and skills, as well as how prepared they felt their schools were to implement and deliver the primary science curriculum. Such perceptions and views lack independent verification and the wider research literature helps us to understand how unreliable this sort of personal information can be. Nevertheless, limitations such as this should not be allowed to overshadow the continued progress observed. Primary practitioners who feel well prepared to teach science are also more likely to feel more competent and confident, and this helps to promote positive attitudes in the classroom. While further analysis of survey findings by role in school reveal more subtle and complex matters for further investigation, the profession deserves a well-earned pat on the back.

## References

Bennett, S., Wragg, E., Carré, C. and Carter, D. (1992) A longitudinal study of primary teachers' perceived competence in, and concerns about, National Curriculum implementation, *Research Papers in Education*, 7(1), 53-78.

Black, P. (1995a) 1987 to1995 – The struggle to formulate a National Curriculum for science in England and Wales, *Studies in Science Education*, 26, 159-188.

Black, P. (1995b) Curriculum and assessment in science education: the policy interface, *International Journal of Science Education*, 17(4), 453-469.

Boyle, B. and Bragg, J. (2005) No science today – the demise of primary science, *The Curriculum Journal*, 16(4), 423-437.



ISSN: 1758-2199

Carré, C. and Carter, D. (1990) Primary teachers' self-perceptions concerning implementation of the National Curriculum in science in the UK, *International Journal of Science Education*, 12(4), 327-341.

Carré, C. and Carter, D. (1993) Primary teachers' self-perceptions concerning implementation of the National Curriculum in science in the UK-revisited, *International Journal of Science Education*, 15 (4), 457-470.

Fortune, J., Peters, G. and Rawlinson-Winder, L. (1993) Science Education in English and Welsh primary schools: a system study, *Journal of Curriculum Studies*, 25(4), 359-369.

Jarvis, T., Pell, A. and McKeon, F. (2003) Changes in primary teachers' science knowledge and understanding during a two-year in-service programme, *Research in Science and Technological Education*, 21(1), 17-42.

Lewthwaite, B. (2005) "The growth is there - but it's not that evident, is it!": a study in science delivery improvement, *Journal of Science Teacher Education*, 16(2), 121-139.

Lewthwaite, B. and Fisher, D. (2004) The application of a primary science delivery evaluation questionnaire, *Research in Science Education*, 34, 55-70.

Lewthwaite, B. and Fisher, D. (2005) The development and validation of a primary science curriculum delivery evaluation questionnaire, *International Journal of Science Education*, 27(5), 593-606.

Murphy, C., Beggs, J. and Russell, H. (2005) *Primary horizons: starting out in science*. London: Wellcome Trust.

Newton, D.P. and Newton, L.D. (2000) Do teachers support causal understanding through their discourse when teaching primary science? *British Educational Research Journal*, 26(5), 599-613.

Oakley, D. (1993) A National Curriculum for science. In: R. Sherrington (ed.) *ASE science teachers' handbook (primary)*. Trowbridge: Redwood. 17-36.

Parker, J. (2004) The synthesis of subject and pedagogy for effective learning and teaching in primary science education. *British Educational Research Journal*, 30(6), 819-838.

Parliamentary Office for Science and Technology (2003) *Postnote: Primary science*. London: Parliamentary Office for Science and Technology.

Ritchie, R. (1996) Science in the National Curriculum. In: D. Coulby and S. Ward (eds.) *The primary core curriculum: policy into practice*. London: Cassell.

Russell, T., Qualter, A. and McGuin, L. (1995) Reflections on the implementation of National Curriculum science policy for the 5-14 age range: findings and interpretations from a national evaluation study in England, *International Journal of Science Education,* 17 (4), 481-492.

Shallcross, T. and Spink, E. (2002) How primary trainee teachers perceive the development of their own scientific knowledge: links between confidence, content and competence, *International Journal of Science Education*, 24(12), 1293-1312.

Sharp, J. and Grace, M. (2004) Anecdote, opinion and whim: lessons in curriculum development from primary science education in England and Wales, *Research Papers in Education*, 19(3), 293-321.

Sharp, J. and Hopkin, R. (2008) How prepared do you feel to teach primary science? *Primary Science Review*, 100, 5-7.

Wragg, E., Bennett, S. and Carré, C. (1989) Primary teachers and the National Curriculum, *Research Papers in Education*, 4 (3), 17-37.



ISSN: 1758-2199

**Acknowledgements**

The authors acknowledge financial support for the National Primary Science Survey (England) from the School of Culture, Education and Innovation, Bishop Grosseteste University College Lincoln who funded the NPSS (England). They also acknowledge the support of Sarah James (University of Hull), Graham Peacock (Sheffield Hallam University), Lois Kelly (Liverpool Hope University), Dan Davis (Bath Spa University) and Rob Bowker (Exeter University) who helped distribute and collect questionnaires from the schools in their partnerships.

Full details from the National primary Science Survey (England) are now available online at: http://www.bishopg.ac.uk/?_id=865&page=9 (see also Sharp and Hopkin, 2008).



ISSN: 1758-2199