Science provision in pupil-referral units

Chris Longman and Shirley Agar

Teachers in pupil-referral units face some unique problems in attempting to deliver the science curriculum

ABSTRACT
The background to the setting up of pupil-referral units (PRUs), the value of teaching science in PRUs and the unique problems faced by the teachers, are briefly outlined. A study investigating the science provision offered by a sample of 26 PRUs is then described. Using interviews and questionnaires, 26 science teachers were asked about a number of issues. It was found that sizes of PRUs varied widely; most of their pupils were in key stage 4; just over half offered GCSE science; about three-quarters had qualified science specialist teachers; resources available were variable and funding felt to be insufficient; accommodation was generally unsuitable for science; contacts with staff in mainstream schools were minimal.

Before the 1993 Education Act, children in England and Wales with special needs or emotional and behavioural difficulties (EBD), who were being educated by local education authorities, may have found themselves in one of many different types of unit. These units went under a variety of names such as Tuition Centres, Study Centres, Community Education Centres and Off-Site Units. These free-standing units had an uncertain legal status. The 1993 Act clarified the situation, stating that pupil-referral units (PRUs) were to be managed directly by local education authorities operating outside local management of schools schemes. Due to their different and varied circumstances, PRUs are not bound to offer the full National Curriculum; however the curriculum should satisfy the requirements of the Education Reform Act 1988 by being broadly based and one which:

> *promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society; and prepares such pupils for the opportunities, responsibilities and experiences of adult life.* (DFE, 1994: l3)

The curriculum on offer must at least cover the core subjects of mathematics, English and science.

Value of science in the PRU curriculum

Few would argue with the relevance of the provision of maths and English for pupils with special educational needs (SEN), but what is the justification for teaching science? Ditchfield (1987) reminds us that science and technology are woven into the fabric of everyday life, providing us with the opportunity for the science curriculum to be relevant and applicable in the lives of young people. She believes that science offers a context for developing important skills such as observation, communication, manipulation, selecting appropriate information, and so on. She also regards science as one of the most powerful subjects in the curriculum for the development of general language skills, awareness of cause and effect, and reasoning skills. These views are echoed by Richardson (1993):

> *Science can be a great motivator. The subject matter can be of personal interest and relevance to the pupil, access need not rely heavily on the written word and its range enables pupils to develop cross-curricular skills that can be used in life after school.* (p. 95)

More recently, McKeon (1994) has seen science as a way of reversing the trend of failure that many children in special units have experienced. Their self-esteem is low and consequently it is desirable to allow them to experience situations where success can be guaranteed, with access that need not rely heavily on the written word. Castle and Parsons (1997) also make the link between self-esteem and success, and suggest that children placed in situations where repeated failure is

the norm may choose to hide this behind a 'veneer of disruption'. McKeon (1994) believes that science has a particular and important part to play in the process of raising self-esteem. The National Curriculum Council (NCC, 1992) also put its weight behind the value of science provision, not only stating that all pupils should have the opportunity to learn science, but giving reasons why:

> *Activities in science have characteristics which will help pupils with SEN achieve success.*
>
> - *They are about first-hand experience.*
> - *Knowledge and skills can be developed in small steps through practical activity, so helping concentration.*
> - *Science activities can capture the imagination and may help reduce behavioural problems.*
> - *Working in groups can encourage participation and interpersonal communication.*
> - *Working on a variety of activities allows pupils to share their strengths and help each other.* (p. 2)

McKeon (1994) believes that it is in the 'doing' of the science that success may be achieved and, by reinforcing this success, the pupil's self-esteem will improve and that 'trend of failure' will be reversed.

Bell (1998) recognises that considerable care needs to be taken in the way science is being taught to these pupils:

> *opportunities will be lost if children are not given access to the science curriculum. If the strategies used to provide that access, however, are ill conceived, then not only will children's understanding of science be restricted, but their self-esteem and confidence may also be reduced further.* (p. 31)

A policy statement for science issued by the DES (1985) explicitly states the value and importance of science education for all pupils between the ages of 5 and 16, including those with SEN:

> *the case for devoting the resources, time and energy needed to bring about change on the scale required rests on the importance of science education to the pupil and to society as a whole.*
>
> *The propositions set out above ... make it essential to provide science for all.*
>
> *These are ambitious goals. The Secretaries of State are confident they can be reached.* (pp. 2, 3, 28)

The science that is currently on offer to pupils is clearly defined by the National Curriculum (DFE, 1995), and PRUs are required to apply this science curriculum to their pupils. The Qualifications and Curriculum Authority (QCA, 1997) has found that:

> *Most schools consider that the National Curriculum for science is appropriate for almost all pupils. Concerns remain about provision for pupils with special educational needs. ... and that GCSE science in general does not meet the needs of less motivated pupils.* (p. 6)

It may be that more flexibility needs to be built into the science curriculum to allow teachers the freedom to teach topics that interest and motivate the disaffected pupils.

The challenge of teaching science in PRUs

Teaching science to pupils in PRUs involves a number of unique considerations that make the requirement to deliver science far from straightforward:

- The fact the pupils are in a PRU indicates that they have a history of emotional, behavioural and educational difficulties that may have seriously affected their access to education.
- Many pupils have missed months, even years, of schooling and so may have large gaps in their knowledge and experience.
- These pupils have often had a bad experience of science as it is frequently from science lessons that they are first removed on safety grounds.
- They come with very limited practical skills.
- The pupils come from a wide range of schools, using a variety of syllabuses.
- The pupils may arrive at any time in their school career.
- PRUs are intended to provide a short-term placement for pupils.
- There are often health and safety issues when teaching science in non-purpose-built buildings.
- There may be pupils with a very wide range of abilities, ages, needs and experiences all in the same small science group.

Alongside these difficulties, some PRUs are very small, with limited staff and facilities, making it difficult for them to provide the necessary subject expertise and the wide range of practical apparatus

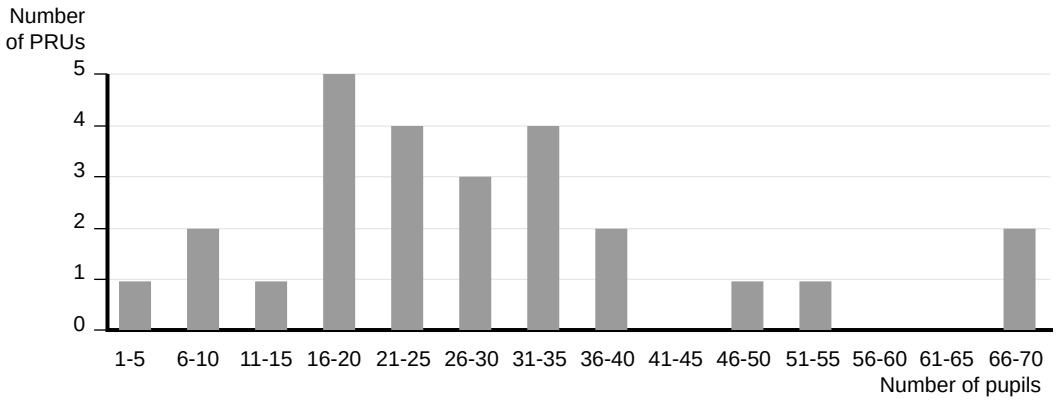

Figure 1 Distribution of size (numbers of pupils on roll) across the 26 PRUs.

required. The requirements at key stage 3 for Experimental and Investigative Science include:

> *Pupils should be taught ... to select apparatus, equipment and techniques, taking account of safety requirements … to make observations and measurements to a degree of precision appropriate to the context.* (DFE, 1995: l5).

To allow the pupils access to the higher levels in assessments involves accurate measuring instruments and a variety of chemicals.

The study and findings

A study was conducted over a period of seven months in 1997 to see how the PRUs were managing to deliver science. Some teachers of science were interviewed; others responded to a confidential questionnaire. The 26 PRUs represented in the study catered for 762 pupils, the numbers on roll varying widely, from the smallest with 5 to the largest with 70 pupils (Figure 1). PRUs at each end of this spectrum may have a unique set of problems associated with their size. The small PRU in particular may have problems with staff specialisation, and may lack the flexibility to provide a broad and balanced curriculum.

The distribution of these pupils across the year groups was also analysed (Figure 2). By far the largest number, 78.4 per cent of the pupils, were found to be in key stage 4 (years 10 and 11, ages 14–16). This dominance of key stage 4 pupils might be expected to affect the teaching within these PRUs, perhaps leading to an emphasis on external accreditation such as GCSEs within the three core subjects of English, maths and science, or requiring a high level of specialist staff to deliver this curriculum.

Science curriculum provision and staffing

Of the PRUs with key stage 4 pupils, 52 per cent offered a GCSE science course to their pupils. These tended to be the larger and middle-sized PRUs. A number of the PRUs with key stage 4 pupils that do not enter pupils for GCSEs, enter them instead for other externally accredited examinations such as the new Certificate of Achievement and the AEB Basic Science course. This leaves five PRUs, representing 20 per cent of the PRUs with key stage 4 pupils, offering no externally accredited course in science. When asked about their reasons for their choice of syllabus, the main one given was that the syllabus was closely linked with a published set of text books, such as the Longman

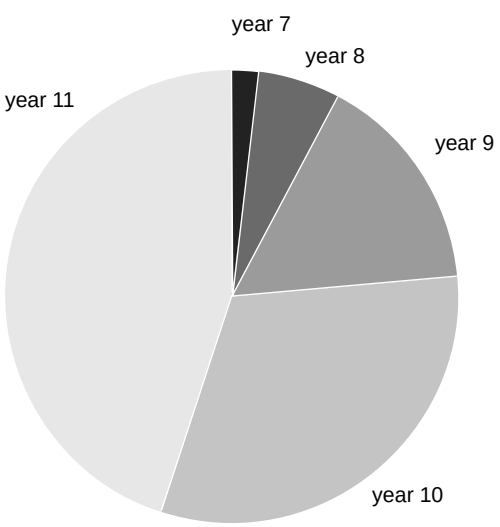

Figure 2 Distribution of pupils across year groups.

Science at Work books. Another reason given was the pupil-friendly questions on the examination papers.

Of the 26 PRUs, 19 had a science specialist. Only one of the seven non-specialist teachers with responsibility for science had been offered INSET. This is an extract from interviewer I's questioning of teacher A:

I: *And you, yourself, are you a science specialist?*
A: *No, no. I suppose my main subject was psychology but I trained for special needs.*
I: *And have you been offered any INSET for science teaching?*
A: *Yes I did go on one course. There was, should I say maybe, a lack of information through to the person who was actually running the course. He thought we were just coming along to look at materials that were available, whereas we wanted more concrete information on what we could do in a room that was really a room in a house with no equipment.*

Another teacher commented on the questionnaire: *'As Teacher In Charge, I drew the short straw and taught science ... I am qualified in English!'*

Accommodation

Teacher A's final comment above shows that the teaching room itself may be a key factor when it comes to deciding what science may be taught. In the questionnaire the respondents were asked to decide to what extent they agreed with the statement 'Science is taught in a suitable room'. As can be seen in Table 1, 65.4% of the teachers of science thought that their teaching room was not suitable, with over half of these feeling that their room was totally unsuitable. A respondent added an additional comment here: *'We are presently building up science resources especially practical stuff for use in a kitchen!'*

The following extracts from interviews with teachers B, C and D show a wide variation in the provision of a suitable room:

I: *I want to ask you about where the science is actually taught. Could you describe the room that you've got?*
B: *Yes it is a converted cupboard. There was a cupboard in the back of the CDT room, and another cupboard off the corridor and the two were linked. They are probably about one and a half metres wide, with a window at one end and a door and a sink. We emptied out the cupboard and put a couple of benches down one side and that's it.*

Other units however are more fortunate and have rooms that are almost purpose-built:

I: *Could you describe the building for me.*
C: *Wonderful! It is an old primary school, just about a 100 years old, big rooms. Before we moved in here from a portakabin, the place was converted for us ...*
I: *So you are in a well suited room?*
C: *Yes, it is a classroom with four sinks, cupboards to store things. That is the only difference between this and any other room. It hasn't got what I would call health and safety equipment, no fume cupboard, nowhere to store dangerous chemicals. So no chemicals are stored here; there are no gas taps. The work that we would do would be very limited.*

Another teacher felt similarly limited by his teaching room:

I: *You have already said a little about the science room. It is not a purpose-built room ...*
D: *No. I mean sometimes the art department spreads itself over to the area that we have devoted; by that I*

Table 1 Teachers' responses to questions on resources devoted to science (n = 26).

	Definitely agree/%	*Agree with reservations /%*	*Uncertain /%*	*Mostly disagree/%*	*Definitely disagree/%*
Science is taught in a suitable room	7.7	23	3.9	30.8	34.6
Adequate time is allocated for the teaching of science	30.8	34.6	3.9	11.5	19.2
Adequate funding is available for the teaching of science	19.2	19.2	0	38.5	23
Other staff are readily available for support in the science lessons when necessary or requested	53.8	15.4	7.7	7.7	15.4
Within this PRU, science is given equal weighting with English and maths	46.2	23.1	3.9	11.5	15.4

mean an area that is partitioned off slightly. There is space to put posters, and the kids' work, up on the wall. The science equipment is stored in a separate room. There is very little science equipment in the science area.

Time allocation and weighting

As can be seen in Table 1, most teachers felt that adequate time was allotted to science and that science was given similar weighting to English and maths.

Support

The science teachers do feel well supported by the other staff, as nearly 70 per cent said they had access to support staff when they felt it was appropriate. One respondent wrote this comment: *'Only because staff are supportive of each other, there is no additional provision in the staffing.'*

Funding and resources

Over 60 per cent felt that their funding was insufficient. The question of funding leads directly on to the consideration of the equipment to which teachers of science have access. Teachers' ideas of a fully equipped laboratory may vary considerably from person to person. A science specialist used to a wide range of apparatus will have higher expectations than a non-specialist who may be very wary of practical work. To overcome this variation, respondents were asked about a number of specific items that would give information about the range of practical science on offer.

As Table 2 shows, a large proportion of the PRUs seem to have access to heat-resistant glassware of some type. But closer analysis shows that a number were unhappy with the condition or type of glassware. Although they ticked their box and so form a part of the 76.9 per cent, their comments included: *'limited and old'*, *'borrowed'*, *'mostly useless'*, *'very little'*, *'kitchen type'*, *'test-tubes only'*, *'small quantities'* and *'second-hand'*. If, with the exception of the second-hand glassware, we remove these from the 'yes' responses, then the percentage with suitable glassware drops to 50 per cent. Microscopes are present in 61.5 per cent of the PRUs. However, their quality varies as these comments show: *'excellent condition'*, *'second-hand and ropy'*, *'car boot gear'*, *'one broken, the other inadequate'*, *'my own'*, *'had some, but threw them out'*.

In practical work, the use of universal indicator is a basic requirement and 73.1 per cent of PRUs had access to this. Sodium metal, which needs informed handling and secure storage (but gets the students' attention!), was available in 15.4 per cent of PRUs.

Table 2 Responses to questions on specific resource items.

Do you have access to:	*Yes/%*
some Pyrex-type glassware?	76.9
Bunsen or cartridge burners	46.2
ray boxes	46.2
universal indicator (solution or paper)	73.1
microscopes	61.5
sodium metal	15.4
ammeters and voltmeters	73.1
a balance readability 1 g	73.1
a balance readability 0.l g	19.2
electric motor kit	46.2

Less than half the PRUs are able to heat anything as they do not have gas and do not use cartridge burners. Comments indicate that this may be due not only to lack of expertise and financial constraints, but also the type of pupils found in PRUs:

B: *We have got some little gas heaters with tripods which I ordered before I realised what the children were like, and I don't think I would use them, certainly not this year.*

Other factors may include the types of accommodation that the teachers find themselves in, and related health and safety implications:

I: *And how well equipped are you?*
D: *There is a fair range of equipment, but unfortunately the facilities are lacking in as much as there is no gas available and we don't have the funds to buy ... I am aware of a special mobile unit which provides you with gas and electricity, but they are big money. We just haven't got the money to buy that.*
I: *What about cartridge burners?*
D: *Well I did think about that but I have yet to find out whether using these little gas burners would be okay here with the fact that we are in temporary portakabins from a safety point of view. We are a little bit worried. But I do find that is quite a restriction, the fact that you cannot heat things very successfully.*

Links with mainstream schools

Problems with facilities and non-specialists may be overcome in part if the pupils are attending mainstream schools part-time for their science lessons:

> *Closer links with mainstream schools would also help more PRUs to ensure reasonable*

Table 3 Teachers' responses to questions about links with mainstream schools.

	Definitely agree/%	*Agree with reservations /%*	*Uncertain/%*	*Mostly disagree/%*	*Definitely disagree/%*
This PRU has good links with the science department of a local mainstream school	3.9	30.8	7.7	11.5	46.2
It is common practice in this PRU for pupils to attend mainstream schools, part-time, for science	3.9	7.7	0	15.4	73.1

> *curriculum coverage and to give priority to the aim of reintegration.* (DfEE, 1997: 86)

The science teachers were asked if this happened in their PRUs; the responses are summarised in Table 3. The responses show that 88.5 per cent of the PRUs do not have pupils attending mainstream schools for science, which puts the responsibility back with the PRUs. The responses also show that just under 60 per cent have poor links, if any, with the science department of their local mainstream school.

The links with mainstream schools were also considered in the interviews:

I: *What about links with secondary schools round about? Do you have any?*
C: *Not really. This is something I am looking at now with the inspector. It would be quite nice just to see what kids are doing in mainstream. But unfortunately once the children are away from them and with us they do not particularly want to know any more. They don't come with anything; after four years at school they have nothing. They can come at the end of their GCSE course with nothing, no coursework. I have to phone the board and phone the school. There is no help really.*

One teacher expressed the concern that there was only the possibility of a one-sided arrangement:

I: *What about approaching a head of science and asking for something?*
D: *No. I have met some of the heads of science. I haven't as yet developed a relationship with any of them to the extent that I could ring them up to discuss or borrow something. There is a school not far from here that would be useful on the odd occasion to borrow something. What worries me is that it would be always like a one-way thing. I would be very conscious of being the person who only contacted them because I wanted to borrow an oscilloscope. I would not be happy with that. You do feel a bit isolated I think ... you feel isolated in a way that you don't mix with other science teachers like you do in mainstream. I knew that when I took the job on.*

Summary of the findings

The main findings of this survey are:

- There is a wide variation in size between PRUs. In this study the variation was a factor of 14.
- A large proportion of the pupils in these PRUs were in key stage 4.
- Of those PRUs with key stage 4 pupils, 52 per cent offered a GCSE science course, with 11.5 per cent sending pupils to study science part-time at a mainstream school.
- There was a science specialist at 73.1 per cent of the PRUs, and 14 per cent of the non-specialists were offered INSET of some kind.
- Most teachers thought the teaching room for science was unsuitable and their funding was insufficient. The provision of equipment was found to be variable.
- Teachers in PRUs have little contact with those in mainstream schools and may feel isolated.

The wide variation in the size of the PRUs is perhaps not unexpected when one considers the wide variety of 'units' from which PRUs sprang. It does raise the question of a possible 'optimum' range of sizes to allow both for the care of the individual and reasonable curriculum coverage. Curriculum coverage becomes more significant when, as this study shows, there is such a high proportion of key stage 4 pupils present. Another key finding was the poor links between mainstream schools and the PRUs. Both types of establishment would benefit greatly from more contact, with a large untapped potential for 'two-way traffic'

in expertise and experience. That the Government has recognised this (DfEE, 1997) is encouraging.

These facts point to a provision that is, in many cases, inadequate when compared to the government guidelines for PRUs. The reasons behind this may be many and varied, but inadequate funding seems to be at the root.

There can be little doubt that the care and education of these pupils is expensive. Wherever they are placed, these pupils, who find themselves in situations in their personal lives that even mature adults would find difficult, should be given equal opportunities to their peers, and the extra support, both educationally and emotionally, that they need. If these pupils are not helped before they leave school, the ultimate bill facing society may far exceed any outlay made pre-16.

References

Bell, D. (1998) Accessing science: challenges faced by teachers of children with learning difficulties in primary schools. *Support for Learning*, **13**(1), 26–31.

Castle, F. and Parsons, C. (1997) Disruptive behaviour and exclusions from schools: redefining and responding to the problem. *Emotional and Behavioural Difficulties*, **2**(3), 4–11.

Department for Education (1994) *The education by LEAs of children otherwise than at school*. Circular 11/94. London: HMSO.

Department for Education (1995) *Science in the National Curriculum*. London: HMSO.

Department for Education and Employment (1997) *Excellence for all children: Meeting special educational needs*. London: HMSO.

Department of Education and Science (1985) *Science 5–16: A statement of policy*. London: HMSO.

Ditchfield, C. (1987) Reviewing developments in science education for young people with learning difficulties. *Support for Learning*, **2**(1), 36–40.

Education Act (1993). London: HMSO.

Education Reform Act. *Local management of schools* (1988). London: HMSO.

McKeon, M. (1994) Reversing the trend of failure for children with emotional and behavioural difficulties (EBD): the role of science. *School Science Review*, **76**(275), 109–112.

NCC (1992) *Teaching science to pupils with special educational needs*. Curriculum Guidance 10. York: National Curriculum Council.

QCA (1997) *Monitoring the school curriculum: reporting to schools*. London: Qualifications and Curriculum Authority.

Richardson, H. (1993) Opening up access to science. *British Journal of Special Education*, **20**(3), 95–96.

Chris Longman is currently Director of Academic and Professional Development at the School of Education, Brunel University. He taught Biology in a London secondary school before moving into in-service teacher education. **Shirley Agar** spent a number of years teaching science in mainstream comprehensives before taking a career break from teaching to raise her family. She is now teaching science in a pupil-referral unit in an outer London Borough.