Assessment for Learning in science

What are teachers doing in England?

As the use of Assessment for Learning increases in schools, **Claire Hodgson** reports on findings from a questionnaire survey of 94 primary (science) teachers, which investigated teachers' understanding of and use of Assessment for Learning in science.

Background

Assessment for Learning (AfL) has been defined as:

> *the process of seeking and interpreting evidence for use by learners and their teachers to decide where learners are in their learning, where they need to go and how best to get there.*
> Assessment Reform Group, 2002

Over a number of years there has been a growing interest in AfL in England, not least because of the move towards personalised learning. In light of the work of Black and Harrison (2004), a research team at NFER became interested in finding out how widespread AfL was in the context of primary science.

by finding out about a pupil's understanding at the start of a topic it is possible to plan teaching to shape future learning and understanding

We decided to carry out a survey of key stage 2 science co-ordinators to discover what teachers think about different AfL strategies and their relevance to primary science, and what AfL strategies are being used in the primary science classroom. Our research focused on primary science teachers in England. To ensure our questionnaire covered all the relevant areas, we first carried out a literature review of publications relating to AfL in primary science.

Literature review

A formal systematic literature search of material published between 1997 and January 2008, including references to both assessment for learning and science in the primary age phase, was carried out (Hodgson, 2009). Following initial selection of appropriate articles, a total of 59 articles were reviewed.

Literature review: key themes

The literature review identified a number of overarching themes, which showed the relevance of AfL in the primary science classroom.

Peer-assessment and self-assessment

In order to support learners in becoming more autonomous and able to identify their own learning needs and develop their own next steps, the skills of peer- and self-assessment are very important – several articles discussed the need to develop these skills though the science curriculum. Within this

area, articles focused on a number of things including:

- the way that peer-assessment can feed into the development of self-assessment skills
- the use of traffic lighting (see Box 1) for peer-assessment and to indicate a self-evaluation by identifying pupil's own learning
- understanding the links between feedback from peers and from teachers
- how the development of an AfL classroom climate can help to promote peer- and self-assessment activities.

Box 1 Traffic lighting for peer- and self-assessment

Learners show their understanding by indicating:

green to show they are happy or have a good understanding

amber to show they have some understanding but would appreciate some further support

red to show that they have not understood the work.

Misconceptions and classroom climate

Research shows that children have a range of ideas about a wide variety of science topics and that some of these ideas are incorrect (Keogh and Naylor 1998, 2004 and 2007; Macro and McFall, 2004; Sato *et al.*, 2005). Also, perhaps more importantly, it can be very difficult to encourage pupils to adopt the correct view. By finding out about a pupil's understanding at the start of a topic and establishing if there are any misconceptions (for example, believing that the moon only comes out at night), it is possible to plan teaching to challenge this idea and to shape future learning and understanding. Closely related to this area is the notion of developing a classroom climate in which pupils are willing to discuss their ideas and are not afraid of being wrong. Research demonstrates that the willingness to discuss ideas in a non-threatening environment is crucial to finding out and addressing pupil misconceptions (Naylor and Keogh, 2004 and 2007; Qualter and Taylor, 1999; Daws and Singh, 1999).

Talk and discussion

The value of scientific talk and discussion was a recurring theme in many articles (Black and Harrison, 2004; Asoko and Scott, 2006; Chin, 2006). The importance of talk in a science classroom was often linked to the development of an AfL climate and as part of the discussions about peer- and self-assessment, questioning and pupil misconceptions.

Questioning

One of the key AfL strategies discussed in the literature is the use of questioning. This refers to those questions asked by both teachers and pupils. Van Zee *et al.* (2001) identified that 'questioning is a frequent component of science talk' (p.160) and Harlen (2006) states that 'questioning is a key feature of scientific activity and of teaching science' (p.167). Black and Harrison (2004) identify that teacher questioning can be used for a variety of purposes, such as encouraging comparison, categorising, grouping and recognising exceptions, and predicting. These have a range of roles within the classroom.

Articles concerned with questioning tended to discuss the use of:

- open questions – for example, questions that prompt further questioning and help to examine conceptual learning by allowing for a wide range of responses rather than seeking a 'correct' answer
- questioning to find out about pupil misconceptions
- questioning to form part of feedback to prompt further learning – for example, the teacher may ask further, more challenging questions based on initial responses.

Feedback

In terms of providing feedback to pupils about their learning, a number of methods are identified which relate specifically to feedback in science. Articles refer to:

- comment-only marking – no mark is awarded but descriptive comments are given in order to identify what has been done well, and what could be done to improve the work (Black and Harrison, 2001)
- feedback to inform next steps
- feedback in peer- and self-assessment
- the relationship between feedback and learning objectives and success criteria.

The development of success criteria is a key AfL strategy. Articles concerning success/assessment criteria discuss the value of pupil involvement in devising them and creating awareness of their importance (Harrison and Harlen, 2006).

Questionnaire

Having carried out the literature review, the findings were used to inform the development of a questionnaire. The purpose of the questionnaire was to find out from teachers what AfL strategies are used in primary science classrooms, and to what extent. The teacher questionnaire survey was sent to a random sample of one hundred primary schools in England. The sample was stratified by key stage 2 science results, geographical region and free school meal eligibility (as a proxy for social and economic status). Quantitative data was gathered from 94 teachers and, in most cases, the questionnaire was completed by the science co-ordinator.

What happens in schools?

Teachers were asked what happens in their schools in terms of assessment for learning. Of the 94 teachers questioned, 86 teachers reported using AfL strategies in their school with 71 teachers indicating that they used such strategies in their own classroom. Nearly two-thirds of teachers (60 teachers) said that they gained an understanding of AfL from in-service training (INSET) received at school, whilst just under half of teachers (46 teachers) had read about AfL in practitioner journals and/or heard about it at teaching conferences. Further analysis indicates that AfL tends to be implemented as whole-school based policy, which is supported by continuing professional development (CPD).

What happens in science?

Just over three-quarters of the teachers (71 teachers) reported that they use AfL in science. Several teachers said it was introduced because of successful implementation in English and maths. Teachers also reported that AfL was used in science because it can 'improve the quality of teaching and learning'.

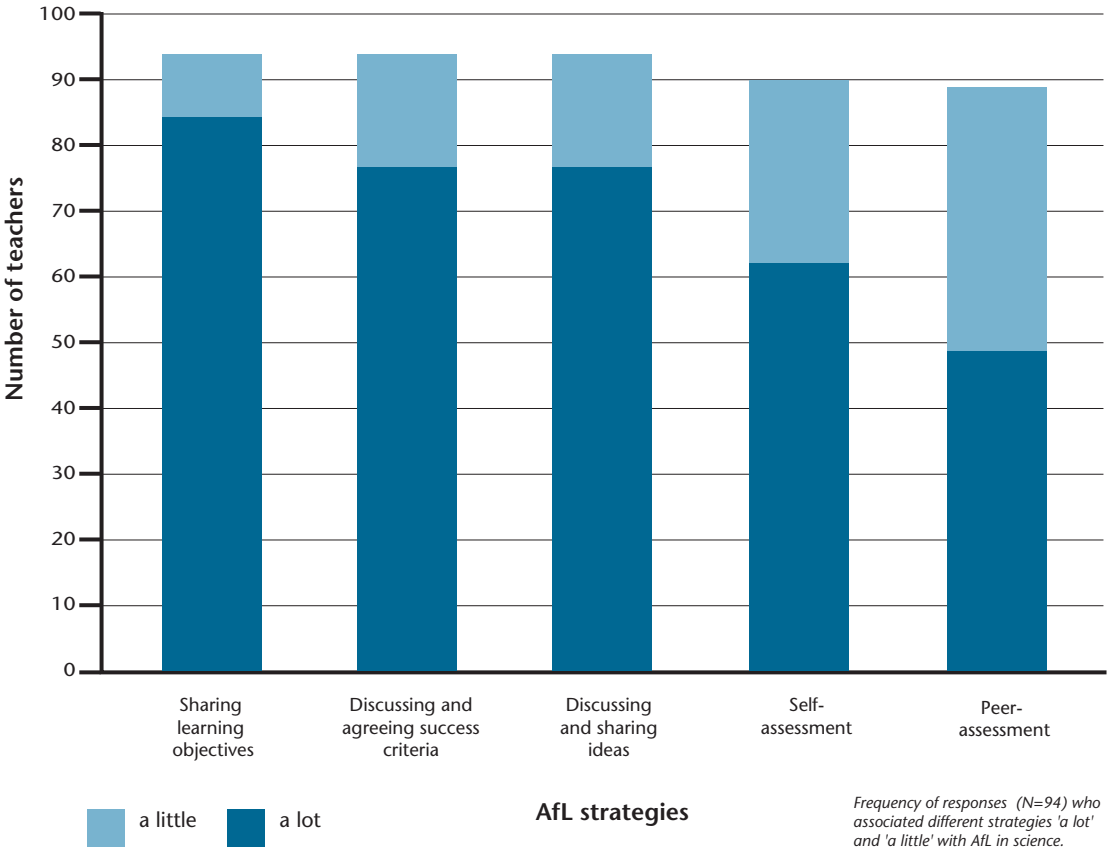
AfL strategies

Teachers were asked to what extent they associated different strategies with AfL in science. Five strategies – sharing learning objectives, discussing success criteria, discussing and sharing ideas, self-assessment and peer-assessment – came out as having a high level of association. Figure 1 shows the extent to which teachers associated each of the strategies 'a lot' or 'a little' with AfL in science.

Teachers were also asked to rate how often they use AfL strategies in their science teaching. Figure 2 shows the number of teachers who indicate that they use particular strategies in *every* science lesson.

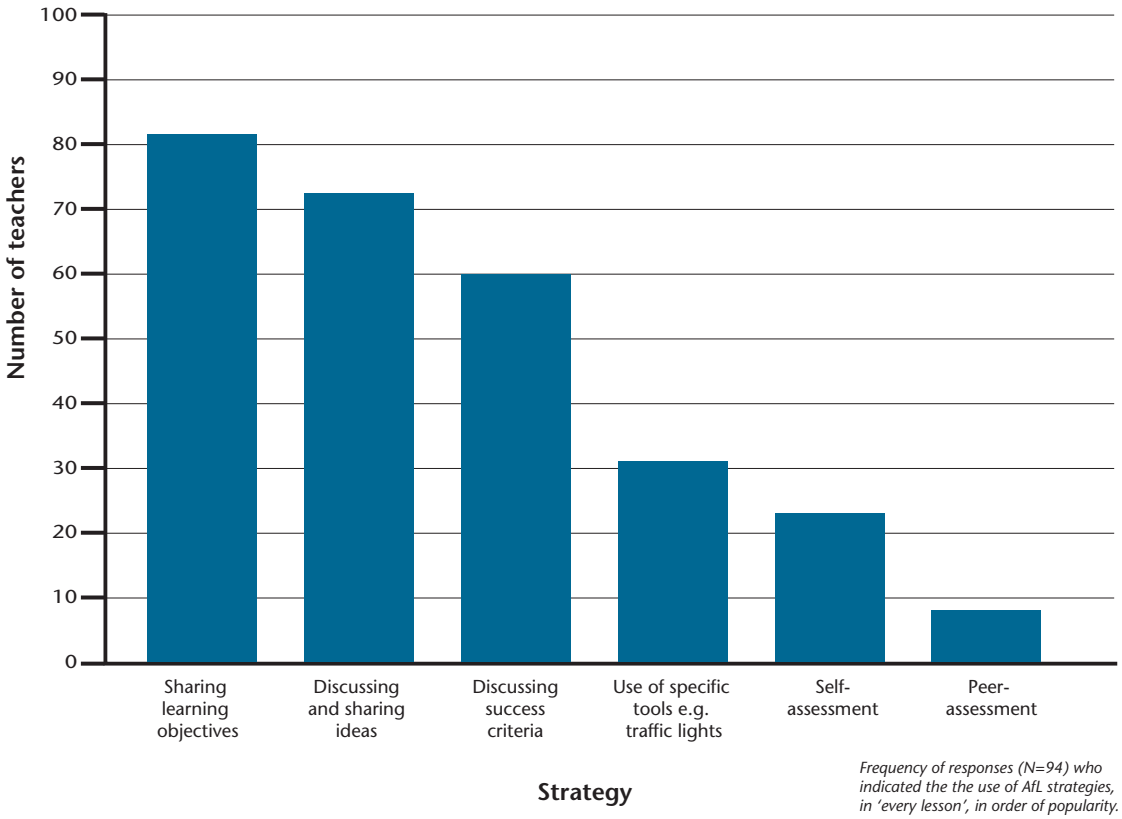
Although teachers associate self- and peer-assessment highly with AfL, which suggests that they consider them to be useful strategies to use in primary science teaching and learning, the proportion of teachers who actually use these strategies is considerably lower than for other strategies. Sharing

Figure 1 Extent to which teachers associated each of the strategies with AfL in science



Frequency of responses (N=94) who associated different strategies 'a lot' and 'a little' with AfL in science.

Figure 2 The number of teachers who use particular AfL strategies in every science lesson



Frequency of responses (N=94) who indicated the the use of AfL strategies, in 'every lesson', in order of popularity.

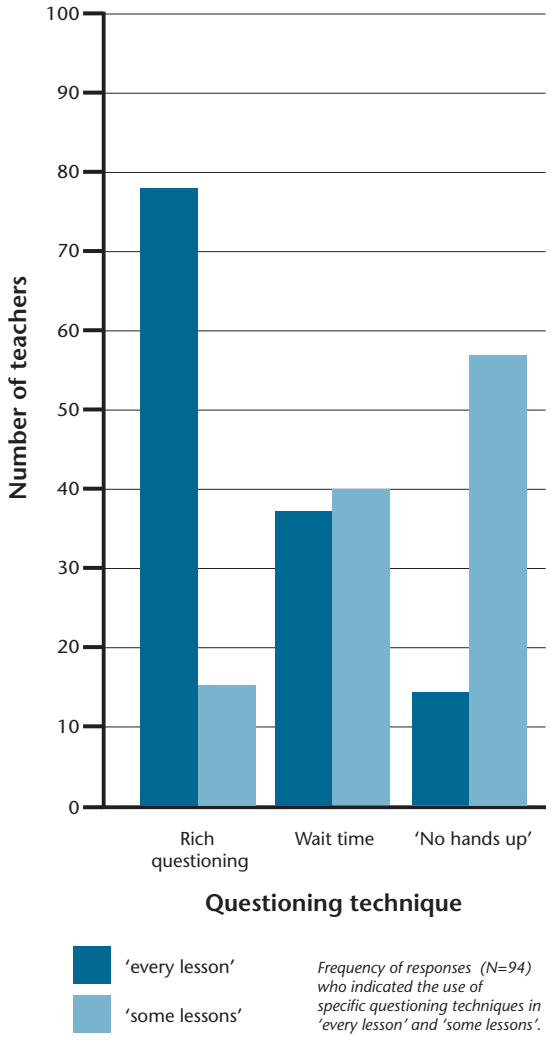
learning intentions and discussing and sharing success criteria are highly associated with AfL, as well as being most popularly used by teachers. This may be as a result of implementation of the national strategies (for example, Primary National Strategy), which recommend such practices.

Questioning

The literature review revealed the importance of questioning in science teaching and learning and this was a view shared by the teachers in the questionnaire survey.

Teachers referred to the use of targeted, open and rich questioning being used to identify and explore children's ideas and misconceptions. Teachers also reported using 'wait time' and a 'no hands up' strategy. Figure 3 shows how often the teachers reported using these different questioning techniques in their own teaching.

Figure 3 Use of questioning techniques



Frequency of responses (N=94) who indicated the use of specific questioning techniques in 'every lesson' and 'some lessons'.

Rich questioning is clearly the most commonly used questioning strategy, used by 77 of the 94 teachers in 'every lesson'. 'Wait time' and 'no hands up' were also strategies used by more than half of the teachers in the survey, but the frequency of use was lower.

Feedback

Although the literature review referred to feedback being a two-way process – from teacher to pupil as well as from pupil to teacher – for the purpose of this questionnaire, questions focused on feedback given from teachers to pupils.

'Next steps' refers to the practice of providing a target or describing what a pupil needs to do next in order to develop their learning and make progress. Seventy seven teachers rated the association between 'next steps' and AfL highly. Sixty nine teachers said that they associate descriptive feedback with AfL in science either 'a lot' (41 teachers) or 'a little' (28 teachers). Several teachers referred to the need to provide marking that gives constructive feedback and informs future planning. Teachers indicated that marking is generally done against defined learning objectives and this reflects earlier comments where they indicated the importance of discussing and sharing the learning objectives and success criteria.

Using AfL in science

Having considered a range of questions relating to the use of AfL in science, teachers were asked to consider the extent to which they agreed with a number of statements (see Figure 4).

The majority of teachers agreed that pupils respond well to AfL in science, that it has helped them to have greater knowledge of their pupils and their needs in science, and that the children's work in science has benefited from AfL. The majority of teachers (80 of the 94 teachers) also agreed with the assertion that AfL makes a valuable contribution to teaching and learning in science.

Nearly three quarters of the teachers (69 teachers) indicated that they would like to make greater use of AfL in science and 76 teachers consider that AfL is 'just good teaching'.

Summary

This research has revealed a number of findings about Assessment for Learning in primary science.

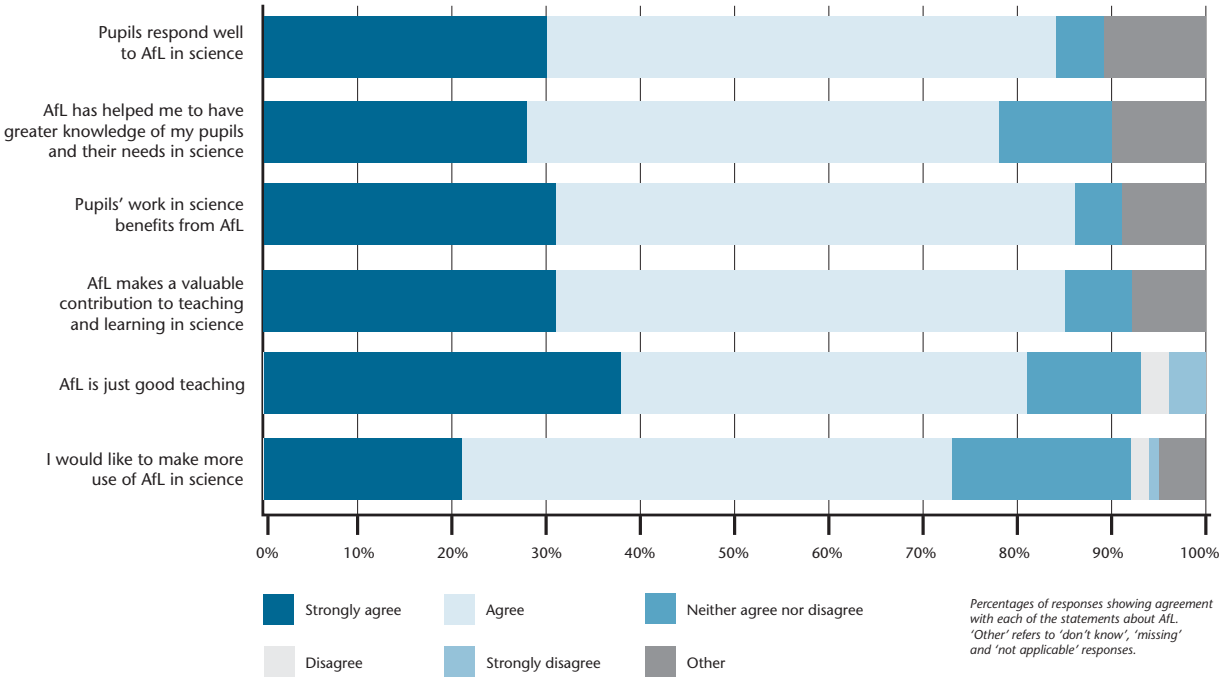
- The majority of teachers questioned indicated that AfL strategies are being used as part of primary science teaching and learning.
- Rich questioning was recognised as being of great importance in developing scientific thinking.
- The majority of teachers questioned said that they make use of feedback to help children to develop their next steps in science learning.
- AfL in science is regarded by teachers as providing valuable information about children's progress in science learning.

Further work

Whilst this research has provided much useful and interesting data it has raised a number of questions and implications for further work.

- The opportunity to carry out case studies at a range of primary schools to see AfL in science in action would show how AfL is being implemented. It would also allow for assessment of the impact that such practices have on teachers and learners. It will be useful to observe how AfL can be embedded into primary classrooms, both within science and across other subjects.
- It would be ueful to repeat the questionnaire survey with other countries in UK as, although AfL is supported

Figure 4 Extent of agreement to statements relating to the use of AfL in science



Percentages of responses showing agreement with each of the statements about AfL. 'Other' refers to 'don't know', 'missing' and 'not applicable' responses.

differently in each of these countries, it would be interesting to make comparisons between their practices and to identify similarities and differences in the use of AfL in primary schools.

What can teachers do?

If you are interested in using AfL in your school these pointers will get you started.

- Reflect on which AfL practices are currently being used in your classrooms and how certain strategies are being used for particular subjects.
- Establish small communities of teachers undertaking AfL action research. For these projects, you should select and develop a few aspects of AfL in depth. Following exploration and investigation of these aspects with your pupils, you can then disseminate learning to other teachers.

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