

Report summary

Improving science in colleges

A survey of good practice

Science education is seen as a key contributor to providing a highly skilled workforce for the continued economic development of the United Kingdom. Although recruitment to science courses in colleges has improved in recent years, the quality of provision remains variable and in 2009/10 the inspection outcomes for science were poor. In spring 2011 inspectors visited 15 college science departments, 12 of which had been judged good or outstanding at their last inspection. A further three colleges were visited either because their provision was in areas of significantly high deprivation or because they had an especially wide range of science courses. This report identifies the factors which helped these colleges maintain their high standard or improve the quality of their science provision and makes recommendations for further improvement.

Science teachers in the colleges visited were well aware of the prior attainment and socio-economic backgrounds of their students and were skilled in developing a common foundation of understanding in science. Taking an interest in the students as individuals from the outset and demonstrating a personal enthusiasm for science created a positive environment for the students and encouraged them to want to succeed. The most effective teachers drew on their experience in science education well to adapt syllabuses to students' needs. Well-devised sequential schemes of work ensured a good balance of theory and practical activities which took account of students' starting points and allowed them to make good progress.

Students made best progress in practical lessons when the teachers actively supported them in setting up apparatus, making observations, and were enthusiastic about the results of their investigations. When teaching the theory aspects, most teachers used questions well to enable students to develop their understanding of scientific concepts and to use scientific terminology accurately and with confidence. However, in a small number of lessons, not all students made contributions and activities were not always differentiated to take into account the full range of students' abilities.

Students could see that their teachers were creating a more adult environment in which they could learn effectively, but were also keeping them on task and working productively. Many science departments had policies that specified the amount of

work that students needed to complete each week and when students could expect their work to be returned to them.

Successful support, both formal and informal, was in place in the best colleges visited to make sure that students gained in confidence and made progress. The mathematical content of advanced science courses was seen as a significant difficulty by the students and teachers surveyed. Some students also found difficulty in making the transition from the short written answers commonly required at GCSE to the more lengthy explanatory text needed for advanced study in science. Additional support sessions in these and in other science-specific areas were provided all year, not just in the run-up to module tests. The performance of those attending was monitored closely.

Information learning technology was used well by science teachers in these colleges to strengthen students' grasp of key concepts and as a means of presenting the results of students' experiments to their peers. The best virtual learning environments contained a wealth of support materials including teachers' guidance notes, examination questions by topic (including answers and mark schemes) and up-to-date web links with explanatory notes.

Many students worked online at home and valued both the easy access that virtual learning environments gave them to trusted science resources and the ability to communicate more easily with their teachers. In the colleges visited it was becoming increasingly common for students to submit their work for assessment online and to receive their feedback in the same manner.

The best colleges had a full range of well-attended science enrichment activities, including industrial and employer visits and field trips to stimulate and interest students. Regular meetings of a discussion forum or science café encouraged students to become part of a community of scientists and familiarised them with the ways in which scientists discuss and communicate informally with each other.

The highly successful science departments visited had well-motivated subject teams that developed high-quality resources and agreed joint approaches to assessment and support for students. They innovated by sharing ideas and practice with each other and actively looked for improved ways of working. In the colleges visited, biology and chemistry teachers were relatively easy to recruit, but it was more difficult to recruit physics teachers. Continuing professional development provided by examination awarding bodies was seen as very useful by science teams, as was the experience of teachers who were also examiners.

National data analysed by Ofsted indicate that colleges with large numbers of students taking science courses have higher qualification success rates when compared with colleges with small numbers taking sciences. Larger science departments had greater potential for innovation and for sustaining improvements. Managers in colleges had to be prepared to support small science departments much more than larger departments.

Science departments in the best colleges visited were actively involved in encouraging local school pupils, especially girls, to consider science courses post-16. However, in some cases colleges were not always able to ensure that school pupils received information about the full range of post-16 science courses available to them in their locality.

The science curriculum in colleges across England is broad at advanced level and offers a wide range of academic and vocational opportunities. However, the number of pathways for students at foundation and intermediate level continues to be limited. In the colleges visited, guidance for students on the wide spectrum of careers opportunities in science, technology, engineering and mathematics was underdeveloped. Such guidance usually depended on the personal experiences of subject teachers and the local knowledge of careers staff.

Key findings

The following factors helped to maintain or improve the quality of science provision in the colleges surveyed.

- In the examples of best practice seen, teachers were very aware of the background of the students and were prepared to identify students' starting points and go on from there. For example, a good proportion of successful teaching in the early stages of science courses was aimed at familiarising students with specialist terminology.
- Teachers were skilled in translating the syllabuses into schemes of work and lesson plans that were meaningful for their students. The most successful teachers were very aware of the sequential nature of learning in the sciences. They encouraged their students to make connections between topics and to make sure that they understood fundamental principles and equations that they would use over and over again.
- The successful science teachers observed were skilled at using questions to generate discussion. The best teachers not only guided students through topics by the use of questions but also allowed them the freedom to take the discussion further and link it to other related areas of interest.
- In the best departments visited, interactive whiteboards were often used very well to present information to students through a wide range of media such as video, internet information, and animations; also to illustrate worked solutions to problems especially where mathematical formulae were involved. Many teachers were adept at getting students to show their calculations or to use the interactive whiteboard to support a presentation.
- Virtual learning environments in science were a trusted resource which students accessed in order to work at their own pace from home. However, in a minority of colleges visited, the virtual learning environments were underdeveloped and contained few links to additional learning materials.

- Additional subject-based support sessions were common in the good and outstanding colleges; they were provided all year, not just in the run-up to module tests. Students without a strong background in mathematics often found the content of advanced science courses difficult. Many students also found writing reports a real challenge. Teachers and managers in the best science departments successfully developed students' writing and algebraic proficiency by extra-curricular support.
- The best colleges offered enrichment activities that were attended by good numbers of students. Examples of good practice included well-organised fieldwork, presentations by employers, trips to field centres and extended project work to broaden students' perspectives on their studies.
- By putting on interesting events and visits for local secondary pupils, science departments in a number of the colleges visited were successfully encouraging pupils, especially girls, to study and succeed in the sciences.
- Training by examination awarding bodies was very useful to science teachers as they gained helpful insights into common misconceptions of students and how they could be further helped to gain good marks in examinations. Where teachers were examiners themselves, the benefits to colleagues and students were clear.
- Analysis of national performance data indicates that colleges with large numbers of students taking science courses generally have higher qualification success rates than those colleges with smaller numbers of students.
- Outstanding leadership and management in science education were characterised by the nurturing of highly effective curriculum teamwork and staff who enjoyed working together, and who shared and developed high-quality resources.
- Successful strategies to improve outcomes for science students included: curriculum teams developing agreed approaches to assessment and support for students; effective initial assessments of students' literacy and numeracy needs specific to the sciences; and staff who were examiners training colleagues in good assessment practice.
- In the colleges visited, close attention was paid to the analysis of success rates and value added data. Subject teams had ready access to management information and regularly analysed and discussed students' attendance, retention and assessment scores.

The survey identified aspects of science provision in the colleges visited which needed further development, even though the overall quality was good or better.

- Although most of the teachers observed used questions well, in a small number of lessons discussions were dominated by a few students and teachers did not ensure that all class members were following and contributing to the discussion.
- The science curriculum in post-16 education is broad at advanced level and provides students with a number of well-established pathways to higher education. However, the number of pathways in science for students at

foundation and intermediate level are limited and do not provide the choice or opportunities that other subject areas offer.

- Students at Key Stage 4 did not always have free access to objective guidance on the range of further education science courses available in their area, or on the full range of science careers that was open to them after their studies.

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