Identifying good practice: a survey of college provision in engineering and manufacturing technologies

This report presents factors which enable post-16 learners to make good progress in the sector subject area of engineering and manufacturing technologies. Between November 2006 and March 2007, inspectors visited 18 colleges where provision in engineering had been judged to be good or outstanding at their most recent inspection. Examples of good practice are given and recommendations for further improvement are made.

Age group: 16–18 and 19+

Published: January 2008

Reference no: 070024

Alexandra House
33 Kingsway
London WC2B 6SE
T 08456 404040

www.ofsted.gov.uk

Reference no. 070024

Contents

Executive summary

The survey was conducted to identify features which enabled post-16 learners to make good progress in engineering. Between November 2006 and February 2007 five inspectors visited 18 colleges where Ofsted had identified good or outstanding provision at their most recent inspection.

A high proportion of the teaching seen was good or better. Many factors contributed to good teaching. Tutors were enthusiastic and inspired learning. The teaching was well planned, met the needs of learners effectively and included an appropriate variety of activity. Tutors made good use of the opportunities provided by the engineering curriculum to motivate their learners. They ensured that learners developed technical and practical competences as well as the wider skills valued by employers. Practical work and the development of theory were integrated well and good use was made of information and learning technology. Questioning of learners, by tutors, was used to good effect. Links between theory, industry and the tutors' and learners' experiences were established to reinforce the relevance of the teaching and the effectiveness of the learning. Health and safety were given high importance.

In 15 of the departments surveyed, overall success rates were high. In the other departments success rates were high in some aspects of their provision, such as work with learners aged 16–18 or in work at a particular level. Learners produced work of good quality. Careful consideration was given to ensuring that they were placed on the right course. The wide range of courses available facilitated this and provided clear progression routes. Learners' additional learning needs were identified early and tackled promptly and supportively. Close attention was paid to learners' effort and progress and there was a strong expectation that they would work in their own time.

The good teaching and high success rates did not happen by chance, but rather by good leadership and management. Close attention was given to the quality of teaching and the needs of learners. Managers knew their provision and tackled weaknesses vigorously. Professional development gave priority to improving teaching. The departments had strong links with employers and were responsive to their needs. All learning centres had outstanding equipment in at least some areas of their work and overall their equipment was of good quality.

Even in these successful departments, areas for improvement existed. Group work was not always well managed and questioning of learners during lessons sometimes lacked sufficient focus. Technical updating and industrial secondment were not given sufficient attention. Virtual learning environments were not used sufficiently. There were instances of insufficiently precise individual learning plans for learners. The proportion of women recruited to the engineering centres was very low. Little use was made of progression data to inform self-assessment.

Key findings

A number of factors contributed to the high success rates and to achieving work of good quality.

- Leaders and managers knew their provision well, tackled areas for improvement vigorously and focused strongly on the quality of teaching and the needs of learners.
- The teaching in engineering was good; it engaged all the learners, was invariably well planned, and included an appropriate variety of activity. Teaching made good use of information and learning technology and referred to industrial practice and learners' experience.
- Questioning of learners, by tutors, was an important feature of good teaching and learning. It helped to engage learners' attention, improved their motivation and developed a productive rapport in the lesson.
- Engineering tutors monitored learners' progress closely. Individual learning needs were identified and additional support was provided promptly.
- Learners were placed on courses in engineering which suited their interests and attainment levels.
- Good use was made of the wide-ranging opportunities provided by the engineering curriculum to develop key skills and wider skills, such as teamwork, which are valued by employers.
- The centres offered a good range of courses in engineering which provided clear progression routes. They had strong links with industry and were responsive to the needs of employers.
- All learning centres had outstanding equipment in at least some areas of operation.

The survey identified aspects which needed further improvement, even though the overall quality was good or better:

- insufficient opportunities were provided for technical updating and industrial secondment for engineering tutors
- the low proportion of women recruited to engineering courses
- the use of college virtual learning environments was underdeveloped in many of the engineering centres visited
- engineering tutors' use of questioning to assess learning and their management of group work were areas for improvement in a minority of lessons
- individual learning targets were not always specific enough to be useful in guiding learning for each learner

- few centres used destination data as a measure of performance.

Recommendations

The survey identified many aspects of good practice in the engineering departments visited. To improve further the quality of provision, the Department for Innovation Universities and Skills (DIUS) and the Department for Children, Schools and Families (DCSF), together with the Learning and Skills Council (LSC) and the Quality and Improvement Agency (QIA) should:

- take steps to disseminate further the good practice that exists in engineering and manufacturing technologies
- continue to work with local authorities, schools, guidance services, employers and colleges to make an engineering career more interesting to women
- establish ways of helping colleges provide access to regular technical updating and industrial secondment
- explore ways of helping colleges collect destination data.

Colleges should:

- increase opportunities for engineering tutors to receive technical updating and industrial secondment
- work with local authorities, schools and employers to attract more women to engineering courses
- ensure that learning targets set for learners at individual progress reviews are precise enough to be able to guide learning
- improve engineering tutors' use of questioning to assess learning, the management of group work and the use of virtual learning environments
- collect destination data more systematically and use it to inform self-assessment.

Background

1. The 18 engineering departments chosen by Ofsted to contribute to this good practice report were graded good or better in their most recent inspection. They all offered substantial engineering provision in several vocational areas, such as mechanical, electronic and motor vehicle engineering. Some departments offered specialist courses in such areas as polymer technology, motor cycle, process control or sound engineering, where there was a demand from employers or learners in the area. Most departments offered courses from level 1 to level 4. They all offered provision directly to employers and to school pupils. Ten of the colleges were lead partners in engineering Centres of Vocational Excellence and two more were partners in such centres.

2. The centres recruited between 250 and 1,000 full-time equivalent learners, with between 100 and 3,000 part-time learners, and between 150 and 500 full-time learners. Most part-time learners were adults and most full-time learners were aged 16–18 years. The number of full-time equivalent teachers varied between 13 and 70. Departmental income came from a variety of sources. Total income ranged from £800,000 to £6 million. On average, 64% of income came from LSC recurrent funding for college-based provision. This was supplemented by LSC funding for work-based learning, fee income paid by employers and individuals and provision fully funded by employers.

3. Data provided by the colleges in the survey showed that 15 of the 18 achieved success rates in 2005/06 which were well above the national averages for adult learners and learners aged 16–18. Success rates in the other colleges were high in some aspects of their work, such as with learners aged 16–18 or in work at a particular level. Learners attained high standards in other skills and attributes valued by employers such as teamwork and a disciplined approach to work. The standard of much of the learners' work was high and none was less than satisfactory.

Factors contributing to good quality provision

Teaching and learning

4. The overall quality of the teaching and learning seen during the survey visits was very good and attendance was high. The teaching generated learners' interest, developed their understanding and contributed considerably to learners' high achievement. The average attendance was 86% and the average class size was 12 learners.

5. The teaching was well planned. In the best examples, there was a clear and logical structure to lessons. Learning objectives were introduced early in the lesson and were used to check on learning as the lesson proceeded. Careful thought was given to ensuring that all learners, regardless of their attainment, were engaged appropriately. Learners' understanding was monitored regularly. Tutors were enthusiastic and often inspired learning.

6. The teaching incorporated an appropriate variety of activity, enabling learners to learn in ways which developed the specific vocational objectives of the lesson and wider skills such as teamwork, thinking skills, numeracy and literacy. The variety helped make the lessons more interesting and motivated learners. Frequent links to vocational practice and to learners' own experience helped make the learning relevant. Good use was made of information and learning technology.

Clear learning objectives, variety in learning activities, and links to vocational practice and learners' experience

In a lesson on steering geometry the learning objectives included understanding the technical terms 'toe in' and 'toe out', castor and camber angles, and the effects these have on a vehicle's performance. They were an integral part of the lesson. They were introduced at the beginning and used during the lesson to focus the learning and check learners' understanding. For example, at one stage the tutor used a series of directed questions to check on understanding and then went back to the objectives to ensure that they had been met. There was excellent variety. Steering sub-assemblies were demonstrated and computer simulations reinforced understanding. Learners, working in groups, presented the results of their previous research into different systems. The tutor made good use of his excellent technical knowledge and of the learners' vocational experience to pose questions and build upon the answers. Constant reference was made to a variety of cars and their steering geometries.

The use of information and learning technology

7. Information and learning technology were used well, helping to link theory to practice, clarifying teaching points, promoting discussion and enriching learning. It enabled learners to work individually on extension tasks, and to simulate expensive equipment which was costly to run, or not available in class sets. Computer simulation helped learners to visualise component operation and make the theory more relevant. Examples seen included its use to portray engineering assemblies and their constituent parts, including sectioned parts, and show how they work. The simulation of the controls of milling machines and robots, and readings from measuring equipment, enabled all learners to gain 'hands-on' experience before operating the real equipment. Simulation was valuable in facilitating control circuit design by, for example, enabling the rapid assessment of the effect on the output of a change in electronic, hydraulic or pneumatic circuit parameters.

Using computer simulation

The charge and discharge of a capacitor and the associated variations in voltage were simulated and displayed on screen so that learners could take readings and plot a graph of voltage against time. The tutor asked learners to predict possible changes in voltage and current and introduced an element of competition which engaged the learners productively.

The audio frequency spectrum was shown and the effect on an input signal of different types of equaliser was clearly illustrated. The demonstrations promoted discussion and enlivened the theory aspect.

A maritime department used a simulator to help learners develop the navigation skills needed and the knowledge required to navigate safely in

the major ports of the world. The simulation enabled learners to practise their navigation skills and ship control in a safe but highly realistic environment. Their performances were videoed to inform future discussion.

8. Digital still and video photography of real life situations which cannot be replicated, or of evidence gathered at other times, was used to add realism to the teaching of theory and increase learners' understanding.

Using video photography to promote learning

Video clips of slow- and high-speed collisions between motor vehicles were used to demonstrate the operation of crumple zones of different design.

Still digital photography was used to show hazardous situations in engineering workshops to prompt discussion about industrial hazards and risks and their mitigation.

Video clips of tests, previously carried out by the learners to determine the mechanical properties of materials, and of mechanical processes observed by them on their industrial visits were used to add interest to the theory of mechanical testing and reinforce its vocational applications.

9. The use of industrial computer programmes such as those for computer aided design and computer aided manufacture enabled learners to draw components and sub-assemblies, and manufacture them.

The use of computer aided design software

Working in pairs, learners used a professional design package to draw real engineering components, such as a connecting rod. Their initial hand drawings of the components were swapped with other groups who converted them into computer generated images. The swapping reinforced the need for accurate dimensioning and detail. In a later lesson the components were manufactured using computer aided manufacture software.

10. The use of virtual learning environments was generally under-developed in the centres surveyed. In some centres good use was made of them by a few teachers, but in only a minority of centres was their use widespread and well developed. In these centres the environments provided tutors and learners with easy access to schemes of work, learning materials, assignments and course handbooks. Assignments were released for use by learners to a set schedule. Completed assignments were submitted through the environment, and their receipt was logged; marked work was returned together with the tutors' feedback notes. Evidence to support work-based assessment, such as

photographs, videos and worksheets, was created in digital form, and made available to assessors through the environment. Chat rooms within the environment enabled learners to work collaboratively and share problems with tutors or fellow learners. Individual learning plans were stored and progress against them was monitored. The advantages of using the virtual learning environment included ready access to information which was easily updated, the location of learning materials in one place as a shared resource, improved management of learners' progress and ready access to learners and tutors, even when learners were located in their workplaces.

The use of differentiation

11. Tutors used a variety of techniques to ensure that all learners, regardless of prior attainment, learned appropriately. In one centre the learning objectives were differentiated by, for example, setting the more capable learners more challenging targets. In another, the learners were allocated to different sets and worked to more, or less, challenging targets.

> **Differentiated learning objectives**
>
> In a lesson on computer aided design and manufacture it was expected that all learners would be able to produce a three dimensional model, edit the computer programme and produce a machined component. The more confident learners were expected to incorporate more complex design features and instruct other learners on how to use the computer controlled machine.
>
> In a practical welding lesson the sets were allotted tasks of increasing difficulty. Learners in the highest attaining group were expected to work with more autonomy, make more rapid progress and take more responsibility for determining material selection and welding parameters, carry out quality control tasks, and assess reasons for possible non-conformance. Members of the lowest attaining group were provided with greater degrees of individual support and more time was allowed for the completion of tasks. The differentiated objectives provided realistic targets for each group, improved learners' motivation and were achieved.

12. Good use was made of questioning by the tutor to ensure that all learners were engaged in learning. Questioning was used to engage learners' attention and draw on their experiences. Tutors often built upon the answers provided to clarify misunderstanding, introduce humour and develop a productive rapport with the learners. In weaker lessons questioning was not focused enough to achieve these outcomes. Where the tutor knew the learners well, questions were devised more effectively and directed to particular individuals, developing an atmosphere of inclusion and improving motivation. Good use was made of

electronic voting pads in a few lessons to enable the tutor to quickly assess the understanding of all the learners.

The use of questioning to introduce the lesson, maintain interest and build on learners' experience

A lesson on transmission systems was introduced through a series of quick-fire questions, some directed at named individuals, some more general. The questioning ascertained how much of the set pre-lesson preparation had been completed and determined learners' existing levels of understanding. Named and other learners contributed appropriately and productively. The tutor's good knowledge of the learners was used well, for example, 'Joe, you work with this (named) company. Can you tell us why they use...?' The questioning motivated the learners and the rapid fire nature of the early questions set a business-like tone for the rest of the lesson. Humour was introduced through the teacher's amusing reminiscences of working with a racing team. The learners responded well. They were well prepared for the questioning and the teacher had clearly spent time building their confidence and ensuring that they were comfortable with directed questions.

13. Group work was used well in a few lessons, but it was not widely used. In this good practice the tutors had planned the activity well, ensured that learners were well briefed about their roles, and kept a close watch on the contributions made by each learner.

Using group work to provide differentiation, promote learning and introduce a competitive edge

The groups examined some of the components of a gardening appliance, listed the material properties required and suggested, with reasons, alternative materials. Each group presented its findings to the class. Group members were given specific roles and were well briefed about what was required of them. The tutor kept a close watch on progress and prompted additional lines of enquiry where appropriate. The learners responded well and all of them learned, from their own and their colleagues' work, and clearly enjoyed the lesson.

Learners, working in pairs, built and tested electro-magnets. They were kept 'on task' through handouts which clearly outlined what was to be done and by time limits set for each step. A competitive element was introduced by rewarding the group that produced the strongest magnet, as measured by which could freely support the most crocodile clips. The competition motivated the learners and all of them enjoyed the task.

14. At least partly because of the work of the former Department for Education and Skills' Standards Unit and more recently the QIA's work on their National

Teaching and Learning Change Programme, the engineering departments surveyed have developed activities designed to promote group work, discussion and conceptual thinking and to introduce a competitive element to the learning. The activities seen included a domino activity where learners had to match function, description or definition to components or concepts and a variety of quizzes. When these were introduced carefully and managed well and where learning points were summarised by the tutor they were effective in promoting interest, developing thinking skills and enhancing learning. In a few cases these activities were poorly managed and learners learned little.

Practical and project work

15. Most of the practical work seen helped make the theory more relevant, enabled productive group work and developed a range of skills in learners, including measurement, research, problem solving, calculation and report writing. This work also enabled learners to develop the skills of independent learning.

The use of practical work to develop learners' understanding of the theory of process control and materials technology

A unit on process measurement included five assignments to develop general theory, and knowledge of pressure, flow, temperature and displacement systems. Another unit on materials technology required assignments to be completed on material structure and classification, materials testing and selection, and modes of failure. These assignments required research, practical work, report writing, calculation and problem solving and gave learners suitable opportunities to work collaboratively.

16. Practical work, when linked to contact with real customers, helped provide industrial relevance, improve learners' motivation and develop their communication skills.

The motivational effect of links to real work

Learners were preparing to repair customers' cars. The tutor had written on the whiteboard the customers' comments about what they thought was wrong and suggested, with good humour, what might actually be wrong. He made reference to repair jobs he had undertaken in the past and stressed the importance of going the extra mile to please the customer. The learners consulted parts lists using the computers in the workshop and contacted a parts supplier to arrange the purchase of parts. They telephoned customers and met them. This industrial relevance was made possible by the close links the tutor had with the industry and by the college's wide customer base, developed, in part, through the department's MOT work for customers. The realistic working environment motivated the learners to work quickly yet carefully.

17. Well devised and well managed project work helped learners to develop many of the skills and attributes valued by employers, including key skills. These extended assignments often provided opportunities to solve real engineering problems, link theory to practice, work in teams and develop perseverance and self-confidence. The incorporation of formal project management techniques into some project work introduced skills associated with planning, risk assessment, meeting deadlines and evaluation.

18. Assignments sometimes involved the design, manufacture and testing of an engineered product. The links to real products and to real industrial problems provided added realism to the teaching and increased learners' motivation.

Projects undertaken by employed learners which offer workplace relevance and illustrate the value of company related project work

One group of apprentices designed a mixing machine for an oil/water-based coolant which made sure that the oil did not contaminate the public water supply. Another group designed an access barrier with an automatic cut-out for a travelling bed grinding machine. They prepared reports which were subsequently presented to their employers.

19. The best project work undertaken by full-time learners was equally exciting and motivating.

Examples of project work by full-time learners

Visits to a national grid power station and to a petrochemical company led to assignments on transmission theory, power sources and sustainability.

Learners formed part of a pit team for a car competing in a prestigious 24-hour racing event. The team gained sixth place overall and second in class. The experience contextualised the theory learned on their motor sports course and provided valuable evidence for their curricula vitae.

Learners renovated a police car required for use on a popular television programme. The work was of an excellent standard and provided photographs that were used in departmental publicity. The work for such a prestigious customer helped to motivate the learners.

Key skills

20. Data provided by the departments for 2005/06 showed that the large majority had achieved high success rates in key skills in that year. Features which contributed to these high success rates included:

- the allocation of clear responsibilities for key skills provision within the department

- arrangements to ensure that each learner studied at the right level for each key skill
- rigorous monitoring of learners' progress
- an engineering curriculum which was designed to provide good opportunities for key skills development
- the use of vocationally relevant assignments to compile evidence
- online testing.

Successful key skills teaching

The head of the engineering department was responsible for key skills teaching and assessment. The work of the 'essential skills' team within the department covered key and basic skills to facilitate teaching from below level 1 to level 3. It included early assessment of incoming attainment, careful allocation of each learner to the correct level for each key or basic skill, and opportunities to move between the levels. Online testing enabled learners to take tests when they were ready and not necessarily during work time, and to take practice tests prior to actual testing.

The vocational curriculum included lots of opportunities to develop and practise key skills. The key skills portfolio contained a small number of vocationally relevant assignments which were designed by the essential skills team to cover the three main key skills and also 'improve own learning and performance'. These assignments were managed and assessed by the essential skills team who were part of the vocational course teams. Many were also personal tutors, responsible for monitoring learners' overall progress on the vocational course, thereby having the authority to ensure that key skills were properly developed and providing the opportunity to use the pastoral curriculum to develop key skills.

The use of library staff

21. Library staff can contribute effectively to teaching and learning. They can play a valuable role in ensuring that learners make good use of learning resources and help course teams devise a curriculum which supports the development of wider skills such as study skills and self-managed learning.

The contribution of library staff to the engineering curriculum

Library staff were linked to the department and were part of each course team. They managed an induction activity designed to acquaint learners with library resources and their use, and contributed to the design and management of the learners' first assignment, which required them to make good use of the information resources available. Staff advised on assignment design generally, ensured that relevant resources were available well before assignments were issued and listed websites and

other resources relevant to each assignment. They checked that course handbooks included up-to-date book and other resource lists and ensured that the library book stock was up to date.

Health and safety

22. The teaching of health and safety was generally good. In one department, for example, learners were required, during their induction period, to complete work books and assignments related to health and safety and undertake risk assessments. The work was developed and reinforced through the pastoral curriculum, within units of the vocational curriculum, and before and during practical work, for example by learners conducting their own risk assessments.

23. Health and safety were reinforced by the good practice displayed by the learning centres themselves. They emphasised the wearing of protective clothing, workshops were laid out well, equipment was maintained regularly and appropriate signing and posters were displayed prominently. Lesson plans, schemes of work and progress reviews gave appropriate attention to issues related to health and safety. Staff received regular professional development, insisted on safe practice and reinforced it regularly.

Monitoring, review and reporting of learners' progress

24. Each learning centre visited monitored closely and reviewed carefully individual learners' progress against their learning plans. When conducted rigorously these processes had a considerable impact on the achievement of high success rates. Formal review meetings were held at least once a term.

25. In the best examples the first review was held early in the course, after learners had completed sufficient work to enable individual effort, progress and attainment to be assessed and to establish the standards and discipline required by the department. Assignments were scheduled early to ensure that these first reviews were well informed. The frequency of reviews was adjusted to meet the needs of each learner. For example, in one department, a robust risk assessment of each learners' progress resulted in a traffic light scheme whereby learners marked 'red' or 'at risk' had their reviews brought forward and conducted more frequently until they were removed from the 'red' category.

26. Progress reviews for work-based learners were most successful when there was an input from the employer. Some colleges encouraged companies to provide mentors who were company employees, who supported apprentices in the workplace and supplemented the work of college staff. Mentors helped to identify suitable optional national vocational qualification (NVQ) units, ensured that the related resources were available, took part in the apprentice's progress reviews, delivered appropriate training before the next review and helped ensure that assessment opportunities were identified and used.

27. The compilation of portfolios of work-based evidence is a central feature of work-based learning. Those centres which were most successful in ensuring that portfolios were compiled in a timely fashion and incorporated the required evidence gave the process careful attention and the learners close support.

The compilation of a work-based learner's portfolio of evidence

Clear guidance on the importance of the portfolio and on what it should contain was given at induction. Learners examined completed portfolios and received advice from more advanced learners on pitfalls and good practice. During progress reviews the evidence to be included in the portfolio was checked rigorously for authenticity and to ensure that the full range of work was covered. The rate of progress in achieving competence was compared with the planned rate to help ensure timely completion. Action plans for the short and medium term were established to ensure that the learner knew exactly what was required to produce new evidence. Workplace supervisors contributed to progress reviews and helped to ensure that assessment opportunities were planned and taken.

28. Action plans were most effective in guiding learning when they were clear and specific about what the learner had to do in the short and medium term. In the worst instances, action plans were insufficiently precise to be effective in guiding future learning. Action planning was more effective where learning facilities were made available to learners outside formal teaching time and where 'catch-up' slots were incorporated into the timetable.

Flexible arrangements to help learners complete extra work

Learners diagnosed as needing extra support in a particular subject were given a mandatory programme of additional lessons and could be directed to drop-in surgeries when needing help with a particular topic. Tutors directed learners to make use of supervised time in the learning centres, engineering laboratories and workshops, where they could use equipment and materials to undertake assignments in their own time.

In another department the teaching year was divided into six terms. At the end of each term course teams reviewed learners' progress and planned catch-up activities where required. These arrangements helped ensure that learners did not fall behind permanently.

29. Most of the learning centres visited had firm expectations that learners would undertake self-study outside formal teaching. Homework was written into the lesson plans and schemes of work. The expectation that this work should be completed was high and its completion was monitored by tutors during lessons.

A strong culture of independent study

In a lesson for first diploma learners the previously set homework required completion of a task. At the beginning of the lesson the tutor asked each learner to produce the completed written homework and present an answer to one question to the group. It was clear from the responses that the culture of independent study had been established within the group. This is not always the case for full-time level 2 engineering learners.

30. Regular progress reports about each learner to parents, managing agents or employers, where appropriate, helped to improve success rates.

Reporting to parents and employers

Reports included information on attendance, time keeping, the meeting of deadlines, effort and progress for each unit and for the course as whole. Each aspect was graded on a five point scale with clear grade descriptors for each point. Each tutor supplied comments on the support required and what action was required by the learner. The personal tutor provided an overall summary. Tutors were available at parent or employer evenings to discuss these reports.

31. Successful centres celebrated the success of their learners. For example, 'value added lunches' were organised in one department to which parents and employers were invited and which were attended by the college principal. They were used to present awards for high attainment and achievement. In other colleges, learners' work was displayed prominently in corridors and on classroom walls; it contributed to department newsletters and sometimes to external literature. For example, learners' success in a motor racing competition was featured in the Institute of the Motor Industry magazine.

Course range

32. The learning centres visited offered a wide range of vocational areas and opportunities to study at different levels. This meant that learners could be placed on courses that were appropriate to their attainment and interests and provided with suitable progression routes. Courses at lower levels which provided an introduction to several vocational areas were particularly helpful to learners who were undecided as to which vocational route to follow.

33. Additional qualifications, for example in health and safety, computer aided design, or in specific NVQ units, improved learners' employment prospects. However, unless measures were put in place to ensure that these courses were completed successfully they reduced a department's overall success rates, even though they were not the main qualification the learners aimed to achieve.

The use of additional qualifications

One department provided qualification courses to support progression to employment, an apprenticeship or to higher education. For example, its full-time level 2 course comprised a first diploma together with a level 1 craft qualification and key skills. At level 3 the curriculum included the national diploma together with, in the first year, a level 2 craft qualification programme and key skills training at the levels to meet the advanced apprenticeship requirements. In the second year additional qualifications, such as a GCE AS in mathematics or information technology, were available to those wishing to progress to higher education.

Learner support

Recruitment and induction

34. The learning centres visited made considerable efforts to ensure that prospective learners knew about the provision and were placed on appropriate courses. Tutors visited schools, interviewed learners and provided taster sessions in the college which incorporated lessons, practical work, design and build projects and a general introduction to the department. The centres were often contributors to the 14–16 curriculum provided for school pupils.

35. Most of the centres visited made efforts to attract female learners. Examples of the efforts made included the use of female tutors and learners in visits to schools and their inclusion in promotional literature. One department provided an engineering course for pupils at a girls' school, and others offered events for women which included practical challenges such as a design and build project and talks; one challenge event required teams comprising equal numbers from each sex. Another department held a four-day event annually, comprising team building, visits and a design and build project. It attracted 24 girls from eight schools in 2006/07. In spite of such arrangements the centres visited recruited few women. In the lessons observed only one in 20 of the learners was female.

36. A good feature of induction was the provision of early assignment work, designed to enable learners to use a wide range of learning resources, develop basic skills, study skills and good habits such as meeting deadlines and producing good work. In this way the learners were set clear standards for behaviour and for the quality of their work at an early stage.

Initial assessment and the provision of additional support

37. The learning centres visited reported that learners often suffered from deficiencies in skills which are important in engineering. They found that

learners' progress was hindered by weaknesses in mathematics, particularly in algebra and trigonometry, in using mathematics to solve problems, and in report writing. Many learners were unable to organise their learning well enough without help.

38. All the centres visited assessed learners' skills at the beginning or before they started their courses. All centres assessed full-time learners' attainment in the application of number and in communications. Most assessed mechanical ability, sometimes linked to aptitude in the key skills. For example, one department required automotive learners to remove a cylinder head, measure the length of the stroke and write a report. Assessment was often undertaken in the summer term prior to entry in September. The early provision of the results, together with other sources of information such as school reports and interviews, helped the centres to determine what additional support was needed for each learner and, importantly, to have this support ready for the induction period.

39. The timely provision of additional support was an important factor in enabling learners to succeed. The learning centres provided the support in several ways, such as through drop-in sessions, in-class support and timetabled lessons. Learning support tutors attended course team meetings. They knew which learners required extra support, provided it sensitively and monitored learners' progress carefully. Reports on learners' attendance at support sessions and on their progress informed each learner's general progress reviews.

40. In many of the lessons observed, additional learning support was provided to ensure that learners with learning difficulties and/or disabilities made sufficient progress. This support was enhanced where tutors were well informed about the lesson content and could contribute to the technical aspects of the lesson as well as provide general support. The recruitment and training of engineering tutors to provide additional learning support helped one department to provide relevant support. Other support tutors were helped to develop specific engineering expertise by working mainly with engineering learners.

Providing good individual support

The support tutor worked closely with the motor vehicle finishing section. She knew the learners well and had developed good technical knowledge by previously completing the course. The learners appreciated her technical knowledge which she used skilfully to help them catch up when needed. A key feature of her work was the way in which she produced pictures of the body finishing processes to help learners who could not easily visualise the correct sequence of operations and were also poor readers.

Leadership and management

41. Leadership and management of the centres were good and were critical to the achievement of high success rates. Managers established a clear strategic direction and communicated it well to their staff. The strategic priorities informed vocational area development plans. Managers possessed an accurate view of the quality of the department and areas identified for improvement were tackled systematically. A strong focus was given to improving the quality of teaching and learning, to the needs of learners and to ensuring high success rates. Staff were often empowered through delegated budgets, a 'can do' culture and appropriate professional development. Management arrangements ensured that accommodation, equipment and technical support were readily available to support teaching. Communications were good within the centres, meetings at each level were clearly scheduled and good practice was shared readily. Strong course coordination was an important feature of successful courses. Coordinators ensured that their courses were well planned and delivered.

42. Quality assurance systems were well established and understood, and led to improvement. Data on learners' achievements were easily accessible and accurate. The quality of teaching and learning was assessed by direct lesson observation and improvements made where needed. Regular reviews of the provision were undertaken and a team approach was taken to developing self-assessment reports which were accurate and candid. Strengths and areas for development were identified clearly and were justified by well marshalled evidence. The centres operated within a management ethos which emphasised the importance of continuous improvement. Action plans focused clearly on the areas for improvement identified in the self-assessment report. The implementation of each action was monitored closely.

An effective improvement strategy

Where a course was considered to be under-performing, the course team could bid for additional resources to help improvement. Their improvement strategy was considered by senior managers and successful bids received funding to cover, for example, additional teaching hours for 'difficult' subjects, or for revision sessions, more practical work, or more in-class support, or to pay for additional equipment, books and study resources.

43. Few learning centres used destination data as a measure of effectiveness. Indeed, only half of them collected such data systematically. Data collected during the visits showed that, on average, four out of five learners who completed the course successfully went on to a higher level course, an apprenticeship or to employment with training.

Staffing and staff development

44. In the departments visited approximately nine out of 10 lessons were taught by full-time or fractional full-time tutors and nearly all the rest by part-time tutors employed directly by the colleges. Full-time and fractional full-time tutors were technically appropriately qualified, and nearly all held a teaching qualification or were working towards one. The average age of these tutors was 46 years. About a third of them were over 55 years of age, indicating possible future succession problems. Technicians ensured that equipment was readily available and played an important role in ensuring that practical lessons were of good quality.

45. The content of professional development programmes was informed closely by the college's strategic needs, the areas for improvement which had been identified through self-assessment, and the individual needs of staff, which had been identified through appraisal. These development programmes were used to give strong support to the planned improvements in the quality of teaching and learning. The attention given to technical updating and to industrial secondment was less strong. In only a third of the departments had more than half the tutors undertaken a significant industrial placement in the previous three years.

Capital equipment and accommodation

46. All the departments visited were well resourced, and in a third of them the resources were outstanding. Most of the learning centres had at least one area of work where resources were outstanding. A few workshops were cramped for space. Many of the centres had undertaken significant upgrades of equipment in the previous four years. Sources of funding included funding for Centres of Vocational Excellence and donations or loans from industry. For example, computer controlled machine tools were often provided and updated free of charge or at much reduced cost, and vehicle dealers or manufacturers provided new motor cars and instrumentation.

47. Such arrangements benefited all partners. Learners benefited by being able to use modern equipment and colleges benefited by being able to run courses for industry, and in some instances by undertaking research and development work. Companies benefited by having show areas where they could demonstrate equipment and undertake development work, and by recruiting learners who had worked with their equipment.

48. Many of the departments visited had benefited from major improvements to their accommodation during the previous three years. These developments were often spacious and of high quality and helped the learning centres develop links with employers, including enabling them to host company training seminars in the college. The provision of teaching areas close to or within practical areas enabled tutors to combine practical work with teaching theory.

Employer engagement

49. Most of the departments visited were very responsive to the needs of employers. They operated apprenticeship schemes and/or provided day release courses for apprentices from other schemes. Half of the learning centres visited recruited over 100 apprentices annually. Nearly all provided day release courses for apprentices on schemes managed by other providers. They recruited employed adults, sometimes in substantial numbers; four of the centres visited had recruited over 800 employed adults.

50. Departments worked with sector skills councils, awarding bodies and employers to introduce new qualifications which met employers' needs. For example, one department had recently developed a national certificate programme, an engineering maintenance course, and new level 4 courses which provided progression for ex-apprentices, in response to local employer needs. The department was working with employers to tailor NVQs to meet specific needs, and with sector skills councils in the development of the new diploma in engineering.

51. The learning centres visited often went to considerable lengths to tailor their provision to meet the needs of employers. For example, over half of the centres provided training on company premises and a similar proportion operated flexible timetabling such as block-release programmes, evening training, training to suit shift patterns and weekend work. The content of a course was sometimes tailored to suit the needs of a particular employer, for example by selecting particular units. One college had developed training centres on the premises of 12 major employers.

Meeting employers' needs

A bespoke course was devised to meet the needs of a company which operates nationally. The course, involving electronic control techniques, was delivered at several of the company's sites and also in the college. It was designed around the company's equipment and applications. A piece of equipment had been specially designed by the department to simulate the company's systems and was used during the college-based work.

A 30 week course for unemployed 16–18-year-old learners involved 20 weeks in college and 10 weeks with a motor vehicle manufacturer. Teaching and assessment were carried out by college tutors and company staff. The resources, donated by the company, and the curriculum matched the company's assembly line operation. Emphasis was placed on good discipline, attitude, teamworking and personal responsibility. Nearly all the learners gained employment at the end of the programme.

52. In order to achieve this flexibility some learning centres had established teams of tutors, sometimes within a separate business development unit or directorate, who were employed on different conditions of service to other tutors.

A team's work with employers

A team of five, comprising staff with recent industrial experience, taught business improvement techniques. Members of the team were employed on flexible part-time contracts. They had a high degree of autonomy and met formally each month to consider progress. Much of the teaching was 'on the job' with related theory also taught on company premises. One company visited said that the training had resulted in better communications, improved visual management of the work areas, and improved flow of work. The confidence of staff to change things had improved as had their ability to think innovatively and collaboratively.

53. The benefits of working closely with employers included improved credibility for the department among employers, increased understanding of the needs of industry, professional development for tutors, improved equipment, more opportunities for work experience, and improved employment opportunities for full-time learners.

Notes

The survey was conducted between September 2006 and February 2007.
A sample of 19 colleges was selected from the colleges where provision in engineering and manufacturing technology had been graded as outstanding or good at their most recent inspection. Two of these colleges had combined their engineering provision into one engineering centre, so that 18 separate engineering centres were visited. The survey visits were conducted by one of Her Majesty's Inspectors for Schools, one inspector from the Adult Learning Inspectorate and three Additional Inspectors. They observed 68 lessons, held meetings with learners, tutors managers and employers' representatives, scrutinised policies, schemes of work and self-assessment reports and reviewed examples of learners' written work.

Useful websites

The British Educational Communications and Technology Agency provides useful e-learning resources and links to alternative sites to access further digital and interactive technology materials for use by tutors: www.becta.org.uk

Further information on qualifications in engineering can be found on the Qualifications and Curriculum Authority (QCA) website:
www.qca.org.uk/qca_5542.aspx
For the diploma visit www.qca.org.uk/qca_13483.aspx

The Quality Improvement Agency's website has useful information on innovation and excellence in the post-16 learning and skills sector: www.qia.org.uk

The QIA excellence gateway is for post-16 learning and skills providers. It is the new home for Excalibur.[1] Here you will find examples of good practice and self-improvement, suppliers of improvement services and materials to support teaching and learning:

- http://excellence.qia.org.uk
- Excalibur Good Practice Database: http://excellence.qia.org.uk/goodpracticedatabase

The National Forum for Engineering Centres is a self-help, independent membership body of employers, group training providers, professional training companies, further education colleges and specialist schools committed to the exchange of best practice in post-16 learning in engineering and technology: www.nfec.org.uk

The New Engineering Foundation is a grant awarding charity which supports the development of vocational education in science, engineering and technology. Through its fellowship scheme, funded by the Gatsby Charitable Foundation, it provides opportunities for tutors of engineering and technology to undertake short secondments to industry: www.neweng.org.uk

The website includes a knowledge centre for tutors to share good practice: www.neweng.org.uk/lt460/implementation/default.asp

The Joint Information Systems Committee (JISC) supports education and research by promoting innovation in new technologies and by the central support of information and communication technology services. Its work covers areas useful for the teaching of engineering: www.jisc.ac.uk/whatwedo

JIVE is a national partnership led by the UK Resource Centre for Women in Science Engineering and Technology at Bradford College. JIVE aims to address occupational segregation in the science, engineering, construction and technology sectors. The partnership provides many ideas on how to attract women to engineering and retain them: www.jivepartners.org.uk

The Department for Children, Schools and Families provides links to a range of learning resources: www.teachernet.gov.uk/teachingandlearning/resourcematerials

[1] Excalibur is now called the Good Practice Database.

Colleges participating in the survey

Blackpool and The Fylde College
Bridgwater College
Burton College
Chesterfield College
City of Sunderland College
Gateshead College
Hull College
Lambeth College at Clapham Centre
Newham College of Further Education
North Trafford College of Further Education
South Cheshire College, Crewe
South Devon College, Paignton
Sutton Coldfield College
Tameside College. Ashton under Lyne
Telford college of Arts and Technology
Warwickshire College, Royal Leamington Spa
Wirral Metropolitan College

Barking College. Romford*
Havering College of Further and Higher Education, Hornchurch*

*A joint provision called The Thames Gateway College, Rainham