# Meeting technological challenges?

Design and technology in schools 2007–10

Using evidence from Her Majesty's Inspectors' focused surveys of primary and secondary schools, this report evaluates the provision of design and technology (D&T) in the curriculum. Most pupils in all of the schools visited enjoyed designing and making products, solving problems and seeing their ideas taking shape. Achievement and provision in D&T were good in about two thirds of the primary schools and just under half of the secondary schools, particularly where up-to-date technologies were used and explained accurately to pupils. However, a lack of subject-specific training for teachers undermined efforts to develop pupils' knowledge and skills, particularly in using electronics, developing control systems and using computers to aid designing and making. The report also addresses the challenges presented to schools in modernising the D&T curriculum so that it keeps pace with global technological developments.

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# Executive summary

This report draws upon evidence from design and technology (D&T) subject survey visits by Her Majesty's Inspectors (HMI) to primary and secondary schools between September 2007 and July 2010. The inspections evaluated how well the subject was meeting its National Curriculum aims and promoting high levels of achievement. Part A of the report focuses on the achievement of pupils, the quality of D&T provision and how effectively the subject was managed in the schools visited. Part B focuses on key challenges in D&T, most notably how schools can keep pace with rapid technological change and address issues of gender stereotyping in preparing pupils for the future.

Inspectors found that a considerable challenge facing schools is the modernisation of the D&T curriculum so that it keeps pace with technological developments, enabling pupils to learn about innovative new materials and to investigate practically how and why they work. Tackling this issue, particularly in secondary schools, is fundamental to the improvements that need to be made and essential if pupils are to become confident and capable members of a technologically advanced society.

Inspectors found excellent examples in primary and secondary schools and in sixth forms of pupils developing original ideas to solve real problems for people in their communities and further afield. In outstanding secondary schools, students learnt how modern materials and new technologies worked and how to design and make with them. In so doing, pupils developed the skills to think, design and shape their future. They had a secure understanding of how technology was changing the society they lived in and how scientific and technological developments currently taking place might bring about further change. Not all students in all of the schools visited experienced D&T of this high calibre. Many teachers were not keeping pace with technological developments or expanding upon their initial training sufficiently to enable them to teach the technically demanding aspects of the curriculum. The variation between the best and weakest provision was unacceptably wide.

Pupils' achievement in D&T was good or outstanding in 54 of the 89 primary schools visited, and in none of them was it less than satisfactory. Children mostly got off to a good start in the Early Years Foundation Stage, where a well-planned range of purposeful activities supported their early development of practical skills. Good teaching, observed in more than two thirds of the primary schools, was characterised by careful planning and challenging practical tasks. Information and communication technology (ICT) was used well in D&T in just under half of the 67 schools where the quality was evaluated. The quality of teaching and assessment and their impact on pupils' achievement were better overall than in those schools visited for the last three-yearly report. Nevertheless, assessment remained weaker than other aspects of teaching. Inspectors' visits in the final two years of the survey took place against a backdrop of discussion nationally about the primary curriculum. This was reflected positively in the schools visited through good enrichment activities, and in purposeful designing and making in response to real needs.

The needs of all pupils in D&T were met well in the highest performing primary and secondary schools. Pupils with special educational needs and/or learning disabilities and lower-attaining students made good progress as a result of the good individual support they received. Most pupils in all of the schools visited enjoyed designing and making products, solving problems and seeing their ideas taking shape.

Pupils' work in D&T from their primary schools was rarely built upon by the secondary schools in the sample. Teachers planned the curriculum without reference to what had gone before. This lack of continuity led, in the less effective schools, to weak curriculum planning at Key Stage 3. Pupils said they found projects and units of work in D&T easy and the nature of the work was pitched too low or duplicated earlier learning of the type commonly seen in primary schools. This did not challenge pupils sufficiently, particularly the most able.

Achievement in D&T was more variable in the secondary schools visited than in the primary schools. It was good or outstanding in just under half of the 89 secondary schools visited; in nine schools achievement was outstanding, but in another four it was inadequate. In Key Stage 4, attainment at GCSE was markedly different for male and female students, as was their choice of D&T options. As in primary schools, secondary teachers used a wide range of strategies to involve students in lessons and enable them to take responsibility for their learning. More outstanding teaching was seen in secondary schools, where lessons included up-to-date technologies which were demonstrated and explained accurately to pupils. However, most of the schools visited had not made sufficient use of subject-specific training to enable teachers new to the profession, and those who were more experienced, to continually update their subject knowledge. This often resulted in an out-dated Key Stage 3 curriculum, an issue which also related to the upper end of Key Stage 2. In around a third of the secondary schools, too little use was made of electronics, computer aided design and manufacture (CAD and CAM) and control technology in the teaching of D&T. Consequently, the take-up of GCSE courses in electronics and in systems and control was low, reflecting the national picture.

To enable education in England to keep pace with global technological change, new approaches are needed to teaching pupils how to apply electronics in combination with new materials and how to apply control systems in all aspects of the subject, including food technology. The responsibility for tackling the challenge of ensuring that the D&T curriculum keeps up with technological developments is primarily that of schools. However, the review of the National Curriculum, announced by the Secretary of State for Education on 20 January 2011, provides an opportunity to guide schools and to encourage their re-evaluation of how they are enabling pupils to learn about innovation and to investigate practically how and why modern materials work.

## Key findings

- Most pupils in the primary and secondary schools visited enjoyed designing and making products and gained much satisfaction in acquiring technical skills and in

seeing their ideas take shape. They were well motivated by the active learning strategies and practical problem-solving aspects of the subject.

- Achievement in D&T was good or outstanding in just over three fifths of the primary schools and just under half of the secondary schools visited. In these schools, the teaching was challenging, tasks were interesting and relevant and pupils benefited from the use of up-to-date ICT and other technology.
- Achievement that was no better than satisfactory was the result of weaknesses in teachers' planning and assessment, and work that was pitched too low, lacked relevance or duplicated earlier learning. Secondary schools rarely built upon pupils' experience of D&T in their primary schools.
- In just over a quarter of the primary schools and about a half of the secondary schools visited there were insufficient opportunities for pupils to develop knowledge of electronics, systems and control, and computer aided design and manufacture (CAD/CAM). This is a key weakness at a time of rapid technological advance.
- Take-up of GCSE courses in the essential technological areas of electronics and systems and control has been low, due mainly to the lack of relevant expertise among teachers. Dated approaches to work on resistant materials and textiles frequently reinforced stereotypical gender choices of courses in Key Stage 4.
- Good and outstanding teaching encouraged pupils to be innovative and creative, and enabled them to draw effectively upon their technological understanding and skills to produce ideas and manufacture prototypes. However, the quality of teaching about design in secondary schools generally did not enable pupils to evaluate critically and question what they see around them in order to challenge stereotypical and poor design.
- Good or outstanding curriculum provision across the age range was enhanced by the use of visits and visitors to support teaching and learning. In the secondary schools seen, good provision was also characterised by effective collaborative planning within departments and constructive partnerships with industry and with other providers.
- Schools generally had not made sufficient use of subject-specific training to enable teachers to continually refresh and develop their practice to teach the technologically challenging and more modern parts of the curriculum and to stay up to date with developments in research and innovation.
- Primary and secondary school subject leaders were often unaware of how to find out what D&T training was available to them. Governors and school leaders lacked nationally available information and guidance on how to keep up to date with modern resources and materials for D&T.
- Health and safety were taught well in the primary and secondary schools visited. Staff were vigilant and pupils demonstrated good attitudes in following health, safety and hygiene rules.

## Recommendations

The Department for Education and the Department for Business, Innovation and Skills should:

- ensure that all pupils have a minimum entitlement to learn about innovative new materials, electronics, and systems and control, and combine their scientific and technical understanding to design and make practical products and systems
- explore how schools can access the latest technological advances in materials and processes
- investigate how schools may be assisted in identifying and securing high-quality subject training in design and technology.

Primary schools should:

- ensure that teachers have regular high-quality training to teach pupils how to use ICT in D&T, particularly control systems, and to enable older pupils to use tools and equipment safely
- improve the use of assessment of pupils' progress in D&T, ensuring that pupils know how well they are doing and what they should do to move on to the next level.

Secondary schools should:

- ensure that teachers have access to high-quality subject professional development to enable them to teach students about modern and smart materials, electronics, and systems and control, make effective use of computer aided design and manufacture resources, and stay up to date with developments in research and innovation
- provide a balanced D&T curriculum that is well pitched to build upon the primary curriculum and includes the technologically challenging and more modern parts of the subject so that students can apply their scientific understanding and develop greater technical rigour in designing and making
- improve assessment so that learning activities, particularly in Years 7 to 9, are challenging and well matched to the needs of each student
- improve the quality of teaching about design to enable students to critically evaluate and question what they see around them, to challenge stereotypical and poor design, and become better informed and discerning consumers
- make sure that D&T resources are up to date to reflect 21st-century technology, are used effectively and represent good value for money.

# Part A

## Introduction

1. Design and technology is the part of the curriculum in which pupils learn to design, make and evaluate functional products or systems in terms of their fitness for purpose. Much of the learning in D&T should take place through practical and technological activities in which pupils design and make products.

2. Pupils are expected to build upon their early childhood investigations to explore progressively how things work. They learn how to use hand tools and how computers are used to support designing and making. As they do so, they learn about processes and the working characteristics of materials. They also learn about structures and the practical application of mechanisms and pneumatics, to make moving toys and models. As pupils move into the upper stages of Key Stage 2, they are expected to learn about, and make, simple circuits for alarms and torches, use computer programmes to control systems and products, and develop awareness of computer aided design and manufacture (CAD/CAM) to make quality products.

3. Throughout primary and secondary education pupils progressively learn how products were designed and made to meet the needs of people who used them in the past, and how this happens now, including the impact of industrial production methods. As they grow older, pupils learn about how products and systems affect the quality of life, and about the social, ethical, economic and environmental considerations they raise.

4. Revisions to the Key Stage 3 National Curriculum in 2007 organised the knowledge, skills and understanding outlined in the previous paragraphs into the key processes of designing, and four key concepts based on designing and making, cultural understanding, creativity and critical evaluation.[1] In doing so, the emphasis on pupils learning about good design and applying technological knowledge to develop innovative products and processes was strengthened. More emphasis was placed on sustainable design in which pupils designed and made products and systems to take greater account of their impact on the environment.

[1] The National Curriculum statutory requirements for Key Stages 3 and 4, Department for Children, Schools and Families and the Qualifications and Curriculum Authority, 2007.

5. At Key Stage 3, students are required to apply their knowledge, skills and understanding of the key concepts and key processes of designing to make products in three broad areas:

   - systems and control (including electronics)
   - resistant materials (such as wood, metal and plastics)
   - either food or textiles.

6. At Key Stage 4, students have an entitlement to study D&T. In response to this, schools provide a range of specialist D&T courses at GCSE level based on the product areas at Key Stage 3 and including graphic products and product design. Schools are increasingly providing opportunities for students to continue to develop their technological studies through vocational subjects such as catering, engineering, manufacturing and construction.

7. Post-16 students have opportunities to study to achieve vocational qualifications or to study design and technology at GCE A level. Nationally in 2010, 18,377 students chose to enter D&T AS-level examinations, with 15,231 students entering for A-level D&T.[2] Such entry rates were higher than for engineering and ICT, but relatively low compared to science and mathematics subjects.

## The Early Years Foundation Stage

8. In 54 of the 89 primary schools visited, inspectors looked at the provision made in the Early Years Foundation Stage to support children's early development of practical and craft skills. Teaching and progress were outstanding in four of the schools observed, good in 42 and satisfactory in eight. During the three-year period of the survey, teachers in these schools reported that children often started school with more awareness than previous generations of how to operate everyday products such as remote controls, televisions and computers. In the last year of the survey, it became commonplace to see children taking photographs and short video footage of the models and products they made in Reception classes. Children were quick to learn how to operate such technology, partly because of the good teaching but also because of the well-designed and robust equipment the schools provided. It was also commonly reported by teachers, and observed by inspectors, that a large proportion of the children seen started school with limited practical skills or familiarity with basic craft skills such as using scissors and pencils with accuracy. Practical activities designed around developing these skills were effective.

9. In most of the Nursery and Reception classes observed, activities were well planned and purposeful, with a consistent focus on developing children's awareness of the world around them. For example, practical activities were

[2] GCE/Applied GCE A/AS and equivalent examination results in England, 2009/10 (provisional).

strongly focused on children using construction materials to make the products they saw, or to create the flying cars and rocket ships they imagined. Children were also actively involved in food preparation and tasting. This enabled them to begin to use basic tools and equipment, as illustrated in the following example.

> Excellent planning by Reception class staff enabled children to work independently to make banana bread. Staff developed a production line and each stage of the recipe was broken down into simple written and visual steps. As children came to each stage, they acted on the instructions: for example weighing ingredients, cracking and mixing eggs, mashing bananas and, finally, ensuring that their mixture was poured carefully into the tray ready for baking. Adult supervision was unobtrusive, but readily available to provide further support if needed, and at critical points in the process.

10. Children's independence in the Reception classes seen was encouraged through well-focused modelling of activities and questioning by staff. In response, children's use of resources and their modelling skills were combined to good effect and showed evidence of their thinking and planning. For example, in one school children made their own unique repeating-pattern necklaces with different shapes and colours of beads. Some children worked very quickly while others showed sustained concentration. In another school, one boy worked carefully all morning to make a detailed model of a rocket. Not all children, however, showed this level of dedication. In teacher-led activities, children learnt how to use a wide range of construction kits, for example to make the highest tower they could. They learnt to organise and think about the components they might need. During activities of their own choice, the children used the resources available to construct artefacts quickly, with a clear purpose in mind, as shown in the following example.

> There was a strong sense of purpose in the way children worked in the Nursery and in the products they made, although this often evolved as children thought about what they were doing and were influenced by the excellent resources. For example, one girl made a shelter, which became a home, and later evolved into a bat cave to match her Batman outfit. As its purpose changed, she made small adjustments to the structure she had created.

11. Systems of assessment of children's achievement were usually embedded well in these schools providing the Early Years Foundation Stage. In the best practice observed, teaching assistants recorded children's achievement and charted their progress in small steps, for example by highlighting their thinking and decision-making alongside children's sketches or photographs of their models as they developed them. The example below is taken from one such record.

‘D decided to make a speed boat but changed his mind and made an aeroplane which would land on water. He tried it but decided the cardboard wasn’t good enough so adapted it and made the wings out of straws.’

Where the records were less helpful, they were overly focused on what children experienced, for example recording, ‘We tasted pizza’, with little comment about the skills and learning that were developed.

## Design and technology in primary schools

### Achievement in D&T

12. Pupils’ achievement was at least satisfactory in all 89 primary schools visited and good in 51. In three of the primary schools achievement was outstanding. In all the schools, most of the pupils observed clearly enjoyed D&T because of the opportunities to investigate and develop their own ideas to solve problems creatively, and to use their ideas to create products. Pupils were generally enthusiastic, and their behaviour in D&T lessons was good. The pupils followed health and safety rules very well and understood why it was unsafe for them to use particular equipment without adult support. The general tone of pupils views are reflected in the comments below.

‘D&T is challenging because you have to develop original ideas. You cannot copy something, but you have to put your own creative stamp on the things you design.’ – Year 6 pupil

‘We expect our products to work and they do. Testing and making changes is a step-by-step process. We learn by doing.’ – Year 5 pupil

‘Sometimes when we have D&T in our heads, we still think about it when we are at home – thinking how to solve problems.’ – Year 2 pupil

‘I enjoy everything with D&T – it is so amazing.’ – Year 2 pupil

13. Pupils in the vast majority of the schools learned to use tools with increasing accuracy and assemble components carefully to make well-finished products. In the most effective schools, pupils showed particularly good progress in achieving this level of practical competence because, according to their teachers, their skills in manipulating materials and using scissors for cutting and shaping had been weak when they first started school. They were keen to develop these skills when they had specific problems or challenges to solve that fired their enthusiasm. For example, following a talk by the Royal Society for Protection and Care of Animals, teachers at one school put together a challenge for Year 1 pupils to design an animal house to reinforce the messages about being a responsible pet owner.

The brief was simple: ‘Provide your animal with a home with food and water, a sleeping area and an area for exercise. There must be a door

that opens and closes securely to keep your animal safe.' Pupils' thinking was informed by investigation into the needs of their chosen animal and the technical problem of making the home secure. Their efforts resulted in good homes for snakes, elephants, guinea pigs and rabbits. While the possibility of escape by some animals remained a concern in some models, most children had solved this with an effective fastening device.

14. Where pupils made very good progress, the challenge in designing and making became increasingly sophisticated for older and more able pupils, who applied more complex principles and techniques to construction tasks. For example, by the end of Year 6 in one school, pupils had developed good technical drawing skills in two and three dimensions, and were applying knowledge of structures, forces and materials in a bridge-building project. In 23 of the schools visited, pupils' understanding of practical processes was enhanced by links with external partners. These were well planned and a feature of a good curriculum. Where pupils' achievement was outstanding, it was characterised by high levels of knowledge, understanding and technical skill, and also breadth in applying these. This was exemplified by pupils in the primary school below, where the coordinator had a background in physics and an interest in practical engineering. From this starting point, he taught a series of units of work on themes such as story books, moving toys, musical instruments, alarms, slippers, controllable vehicles, shelters and fairgrounds.

Pupils in Year 5 who create moving toys gain a very clear insight into components such as slider, follower and shaft in cam systems. They understand the functions of circular, eccentric, drop and pear-shaped cams.

In Year 6, pupils gain a very good understanding of simple elements of parallel and series circuits and gear ratios. They use kits to model the work before developing their controllable vehicles, some of which have pulleys arranged to give suitable gearing and a parallel circuit to work both motor and lights. They are able to put this work into a wider perspective as they visit the nearby farm tractor museum to study transmission systems.

15. Original and high-quality design underpinned the achievement in the good and outstanding schools visited. In these schools, pupils communicated their ideas very clearly with accurate and well-annotated drawings. Pupils from an early age learned to evaluate their work as it progressed, talking about their likes and dislikes. Where they made good progress, pupils often evaluated against specific criteria, and became adept at modifying their designs and prototypes in the light of testing and evaluation.

16. Pupils' practical and design work was most accurate where they consistently applied their basic skills of literacy, numeracy and scientific understanding, for example in using a technical vocabulary or in measuring components accurately. Pupils' key skills of working effectively in collaboration with others

made an important contribution to developing their capacity to solve problems, and prepared them well for later life.

17. Where pupils' progress and achievement were weaker, the application of the design process in the schools visited had shortcomings. In particular, pupils followed a linear approach, which meant that they undertook evaluations only when their products were complete and did not review their work as it progressed. This meant that in some cases they designed products which could not be made, or which contained obvious design flaws so that they did not function properly. Weaknesses also arose where pupils' D&T work was limited to a few experiences, particularly in the latter stages of Key Stage 2, or consisted of narrow experiences such as making models that did not allow them opportunities to incorporate users' views into their designs. Where this happened, pupils struggled to reach the standards expected for their age.

18. In six schools, practical work was finished poorly and components were inaccurately measured. Too much of the D&T in these schools involved working with junk materials, such as cereal boxes, paper and tape, which constrained pupils' learning about how to work with accuracy and precision, especially in Key Stage 1 and lower Key Stage 2. The pupils sometimes repeated the skills they had learned in earlier years rather than building upon them and developing new ones. Weak application of underpinning knowledge about mechanisms or, as seen in one school, about structures and forces in a project on stability diminished pupils' learning and the quality of their work. Although pupils were often aware of the design process, progress was sometimes no better than satisfactory because projects were not planned to help them think as designers, as the examples below demonstrate.

> Year 2 pupils were making cushion covers using batik and a sewing machine. They were dependent on the adults around them for support because of health and safety issues, but had no previous experience of batik to inform the design of their covers. This meant that they developed intricate pictures drawn in wax that did not work well. Similarly, pupils in Year 3 made puppets using Modroc.[3] They were expected to design them having never used Modroc before. In addition, they had no opportunity to practise with it, so the success of the finish was less than it should have been.
>
> Pupils and teachers were content with work that did not sufficiently build on past standards. So, for example, the quality of junk modelling in Year 4 had not advanced much further than when the pupils were in the Reception classes. Although measuring skills were encouraged, particularly in Years 4–6, the quality of finish of a lot of the work was undermined by inaccurate measuring. For example, when Year 5 pupils were constructing

[3] A plaster- and resin-impregnated gauze material used for modelling.

greenhouses to grow seeds, many of the materials cut to cover the wooden frames were ill-fitting because of simple measuring mistakes.

## Quality of teaching of design and technology

19. The quality of teaching was good in 62 of the 89 primary schools visited and outstanding in two other schools. Teaching was satisfactory in the remainder.

20. Teachers drew effectively on well-developed generic teaching skills and a good knowledge of the pupils in their class to support the teaching of D&T. The better teachers observed relied upon nationally developed and commercial schemes of work, adapting them to fit their particular circumstances. Almost all of the teachers had at least a sound understanding of the units of work they had chosen to teach, but, despite this, many acknowledged a lack of subject knowledge, expertise and confidence in teaching the full range of D&T skills.

21. Where the quality of teaching was outstanding, teachers had a secure and shared understanding of D&T. Planning built firmly upon pupils' earlier learning, ensuring progressive challenge and breadth to their designing and making. Teachers knew what fascinated and excited the pupils in their class. They combined this knowledge with a well-defined and consistent focus on finding out how products work and how well they fit the purpose of the user, as the example below shows.

> A Year 2 class considered how a Roman soldier might move, the situations he might encounter and what this meant in terms of developing the criteria for a fastening device to hold his cloak securely. A wide range of teaching and learning strategies were evident in each classroom. Well-focused questioning, imaginative use of role play, and good use of products and collections of artefacts helped pupils analyse how products work and supported their excellent designing and making. Pupils' responses to teachers' efforts were unequivocal as they were securely developing independence and becoming reflective learners: 'It's fun, we enjoy designing and making.' 'It is difficult to get your product just right, like you imagine it to be. I am learning to plan deeply each stage of making. As you get older, you make more decisions about materials.'

22. Good teaching was characterised by:

- detailed lesson planning which made good use of available time, met pupils' needs and developed their learning
- adapting work to offer suitable challenge to all groups of pupils, including the more able
- effective use of resources to support learning and particularly to support pupils' investigations, testing and analysis of products
- questioning to challenge pupils' thinking, particularly about the function of products and the needs of users

- well-managed discussion in lessons to include all pupils' views
- teachers' high expectations, and accurate use and modelling of subject-specific terms and technical language
- inclusive approaches that met the needs of individual pupils, including those with special educational needs and/or disabilities and those at early stages of learning English as an additional language
- maintaining interest and relevance by linking D&T tasks to pupils' interests, establishing real contexts for their work, and building upon their knowledge and skills in other subjects.

23. In good lessons, teachers selected and used products wisely to illustrate key points that pupils needed to think about when later creating their own products. For example, in one school a teacher brought a well-chosen range of garments with different fastenings, fabrics and construction to the lesson to support pupils in their research and development of ideas for their own garment. In another school, a teacher made good use of a local gallery to acquire examples of automata; his effective use of these products led to excellent focused learning about mechanisms and set the scene for pupils to later make their own cam-based toys. Such teachers went to great efforts to select resources to inspire pupils, and to develop their awareness of the use of materials and ingredients, as in the following example.

> Pupils were provided with an impressive array of bread products from the local bakers and from larger supermarkets which cater for a more culturally diverse population than is present in this rural village community. Breads were selected on the basis of different methods of production. The pupils were exposed to a rich range of tastes, textures, smells and shapes of bread during the tasting session. They used all their senses to support their investigations and produce a very wide range of descriptive words to illustrate their experiences. All pupils accurately used the star chart method (to test and rank in order) to identify the bread with the best characteristics of taste, texture, smell and costs. The experience of a volunteer grandparent was used to extend pupils' learning further. She explained about the range of bread products available when she was their age and her experience more recently. They were amazed that today was the first time in her long life that she had seen such a wide range of breads.

24. In the good and outstanding lessons seen, teachers made effective use of focused tasks and demonstrations to show pupils different methods of manufacture. Teachers used resources well, bringing together demonstrations on film and in photographs, and used examples of their own work. Pupils valued this variety and one pupil expressed the general consensus when he stated: 'Our teacher explains her own ideas of how she would tackle a problem. This is useful in getting started and seeing what she is looking for from us.'

25. Good questioning by teachers typically led to classes contributing to the development of success criteria in response to design briefs. It prompted pupils to think through the kinds of problems they might encounter and to share strategies they might use to solve them. Pupils were encouraged to ask their own questions through paired, group and whole-class discussion, as seen in the following Year 6 lesson.

> Working in groups, pupils were challenged to develop and improve the functionality of the bridges they were building. The focus on function arose from the earlier class discussion and evaluation. Pupils applied their earlier knowledge in a focused way to explore, test and answer the following key questions as the lessons proceeded.
>
> - What type of mechanism will open and close the bridge?
> - When making the prototype bridge, how you can strengthen the bridge so that it will hold a greater weight?
> - What type of support between the two beams will make your bridge sturdier?
> - What materials would be used when making a real beam bridge?

26. The creative pooling of ideas was a feature of some good lessons, with pupils critically evaluating and extending or improving the ideas. This feature of learning from others was structured formally: for example, in one school, pairs of Year 2 pupils who solved problems in different ways, and boy/girl partnerships, worked together to design and build a powered buggy. Elsewhere, two Year 3 pupils were seated together so that one learned from the other how to set out an annotated diagram. In another school, four Year 2 pupils were chosen to teach a specific skill to other pupils. Other schools featured 'show and tell' assemblies in which pupils talked about the product they had made and explained to the rest of the school how they solved a particular problem or difficulty they had encountered.

27. The teaching assistants seen generally made well-judged interventions to guide pupils, particularly those with special educational needs and/or disabilities, but they did not stifle the pupils' independence and creativity by doing pupils' work and thinking for them. Resources were adapted well to overcome barriers to participation in design and practical work for pupils with physical disabilities or learning difficulties, as shown in the following example.

> A pupil in Year 4 with cerebral palsy who was confined to a wheelchair was unable to speak without the aid of a computer. He had only some control over arm movements, but was well integrated into a group of pupils making torches. He was helped by CAM software, and specially designed tools, such as a stapler, that enabled him to make an equitable contribution to the work of his group.

28. Teachers' assessment of pupils' design and technology capability was good in 26 schools and outstanding in a further two. Assessments at the end of the unit

or project were more common than was the case in schools visited for the last D&T survey published in June 2008.[4] However, the use of the data to identify pupils' progress was at an early or developmental stage in most of the schools visited. In the 11 schools where assessment was well established, regular and accurate, it made a considerable contribution to pupils' good learning, because teachers planned effectively to develop pupils' skills and understanding over time.

29. Effective assessment was characterised by consistently applied procedures, effective monitoring of pupils' progress in lessons and high-quality feedback to pupils. In two of the schools, pupils were set D&T targets and could relate them to their current work. The targets were based on research skills, developing ideas and planning, making and evaluating work, and were derived from National Curriculum levels. Effective assessment of pupils' progress was not over- complex but was consistent and informed teachers' planning, as this example of good practice shows.

> Key Stage 1 pupils had produced individual plans to support them in making a fruit salad. Working in pairs, they tasted them and analysed the results to find the most popular, flavoursome salad. The teacher's assessment record identified the things that all pupils could do, with annotations next to each pupil's name identifying the strengths demonstrated. They showed for example that: 'Nathan is now confident in planning'; 'Rebecca has a good understanding now of what a pictogram is and how it is constructed'; 'Andrew was very good at talking about where fruits come from and gave excellent instructions when working with a partner'. The lesson plan also set out the next challenge for each of these pupils.

30. Good use was made of computers to support pupils' D&T work in just under half of the 67 schools where sufficient evidence was available to make a judgement. Pupils used computers effectively in D&T to research, analyse and present data from questionnaires. Older pupils frequently used them to make presentations to their class and others: for example, in one school, to explain to governors about the eco-friendly products they had made from recycled materials. Computer aided design and computer control were used, for example, to develop pupils' skills in designing packaging and enable them to learn how to programme basic instructions. However, lack of teacher expertise meant that this was not widespread and, as a result, learning experiences for pupils were limited.

31. Inspectors found little outstanding practice of teachers using computers with the class, although the following example of Key Stage 2 pupils undertaking a

[4] *Education for a technologically advanced nation: design and technology in schools 2004–07* (070224), Ofsted, 2008; www.ofsted.gov.uk/publications/070224.

video conference tour of a local packaging manufacturing company illustrates what highly effective practice can look like.

> Pupils in Years 5 and 6 were commissioned by the company to develop new packaging. As part of an initial investigation, 10 pupils visited the company site with a teaching assistant to find out more about the company and its existing product range. A video conference link between the school and the company was established for the lesson. Pupils in school listened attentively and watched how a mock-up package is scaled up to the actual size. Factory staff explained how CAD and CAM are used. Pupils asked good, well-focused questions: for example 'What training do people have to use the machines? 'Is the factory designed in a specific way to aid production'? 'Can you give us some examples of products you have made?' A lot of information was given in response and teachers had already wisely planned to record it so that pupils could review it later. Pupils watching in school asked for close-ups of the products, and for digital photographs to be taken. The video conference made a good contribution to pupils' learning.

## Quality of the curriculum in design and technology

32. Curriculum provision was outstanding in five of the schools visited, good in 54 and satisfactory in 29. In only one school was the curriculum judged to be inadequate.

33. Almost all of the schools visited drew upon national guidance to meet the basic requirements of the National Curriculum programmes of study. In the most effective schools, teachers confidently planned their own units of work and projects to develop a curriculum best suited to the wider context of the school and its pupils. In a quarter of the schools the curriculum lacked balance, particularly at upper Key Stage 2, because pupils had too few opportunities to learn about circuits or computer control, or how to use ICT in D&T. A lack of teacher expertise to teach these technically challenging aspects was frequently at the root of this problem.

34. Where the quality of the curriculum was good, meaningful links were made between design and technology and other subjects. These were particularly effective when pupils had opportunities to develop and apply knowledge and skills from science, such as the use of electricity and circuits, to support the designing and making of torches and simple alarms. In schools visited in 2009 and 2010, the use of cross-curricular themed activities as the means of teaching D&T was more commonplace, but quality varied. Where D&T was well planned as part of a thematic curriculum, pupils learned, for example, about construction techniques and inventions by studying historical buildings and periods of history. Such links made learning purposeful and relevant, as in one school where pupils compared products in their homes with what Victorians used, looking at differences in materials, for example in hot water bottles and irons heated in ovens. D&T thrived in the schools visited when pupils were

encouraged to think independently about solutions to simple and complex problems in the world around them.

35. Where the planning of cross curricular themes was weak, insufficient thought was given to which D&T skills would be developed further and how new learning that built upon them was to be introduced. In the schools where the curriculum was no better than satisfactory, it led to superficial or unchallenging D&T teaching and learning. Designing and making activities, although identified by these schools as contributing to the design and technology curriculum, sometimes had more relevance to art than to technology.

36. Where the primary curriculum was good, it drew effectively and strategically upon a range of external individuals and organisations to provide expertise, resources and relevance to design and technology. Links with partner secondary schools, particularly, though not exclusively, those designated with a specialism in technology, helped primary schools to overcome shortages in resources or facilities, for example for food technology. Businesses and local organisations were actively cultivated by 12 schools to set pupils exciting and challenging design and make activities, and provided the professional expertise of, for example, chefs, engineers, architects and designers, to support and guide the pupils. Participation in science, technology, engineering and mathematics (STEM) activities also helped eight of the primary schools to develop further awareness of engineering and science. The expertise of parents across a variety of design and manufacturing occupations was sought and used well to support the curriculum. The impact of such specialist expertise is illustrated in the reactions of these pupils.

> 'We learnt from a visit by scientists that sometimes you can look at nature to develop and apply ideas from birds and little insects – it's called biomimicry.[5] For example, finding out how they stick to things because of pads on their feet.'
>
> 'We tried this. I made a bowl based on a shell and based the idea for the legs of my chair on the shape of a horse's leg.'
>
> 'To improve D&T we should do it more often.'

37. Enrichment activities were strongly represented in good curriculum provision. Visits and participation in local, regional and national competitions and initiatives provided stimulating contexts for D&T work. They contributed to pupils' enjoyment and achievement of D&T. For example, in one school, decisions to participate in a national initiative had a considerable and rapid

[5] Biomimicry is the scientific study of nature's models which scientists and engineers then imitate or take inspiration from to develop innovative technological processes and solutions to solve human problems.

impact in developing pupils' technical cooking skills and knowledge of sustainable food.

38. After-school clubs were a feature in many effective schools, offering pupils the opportunity to further develop their interests and practical skills in cookery, engineering, construction or textiles. For example, one school established a business link with a restaurant to support their after-school cookery club. In the previous year all pupils in the school had visited and worked with the restaurant and its chef. Pupils reflected on what they had learnt from their experiences.

> 'When we went to the restaurant kitchen we didn't expect it to be so big or the walk-in fridge – we all fitted inside – the pans are huge and staff had to work quickly.'
>
> 'After we made the onion bread, I went home and made another.'
>
> 'After cooking at the restaurant I now make pizza once a week. It has made me want to cook more.'
>
> 'We saw baked Alaska being made: they were small because you have to eat sugar and cakes in moderation. I ate one in a restaurant later: I liked the changes in temperature.'

39. Where the curriculum was weaker, links with external individuals or organisations to bring resources, challenge and expertise to the curriculum were handled in a piecemeal way. This did not support the progressive development of pupils designing and making skills.

## Effectiveness of leadership and management

40. Leadership and management of D&T were at least satisfactory in all 89 of the schools visited. They were good in 60 schools and outstanding in another four. Where the subject was well led, consistent monitoring and evaluation practices were established, or were developing swiftly. This gave leaders a secure and accurate view of the quality of the curriculum, teaching and learning, and pupils' attainment. In addition, where leadership of D&T was outstanding, specialist D&T training and support for the coordinator, including regular time each term to carry out monitoring duties, were key features. Regular reviews were undertaken which informed developmental work, and training strengthened D&T provision.

41. In 40 of the 89 primary schools visited, headteachers provided a strong drive to support improvement in D&T. Their effective management of D&T was firmly demonstrated in the care and priority given to good resources, health and safety. Headteachers ensured that the subject was well led and coordinated efficiently. In these schools, headteachers had clear views about the purpose of D&T and valued its contribution to school life. This represents a more positive picture than that found in the schools visited in the previous D&T report

published in July 2008.[6] The five reasons headteachers most commonly gave for valuing the contribution of D&T were:

- the positive impact it had on pupils' thinking, problem-solving, creative skills and personal development
- pupils' 'huge enjoyment' of D&T and its contribution to speaking, listening and literacy development
- the contribution it made to developing pupils' general awareness of the world of work and preparation for the future
- the good impact on inclusion and the opportunity D&T provided for pupils to apply a different set of skills and a chance to shine in a different area of the curriculum
- its useful contribution to cross-curricular work.

42. Accurate self-evaluation of D&T was a good feature in 49 of the 76 schools judged for their self-evaluation. Governors brought useful scrutiny and critical support to the evaluation and monitoring of D&T in 10 of the schools. Best practice also involved parents' and pupils' views in the evaluation and led to actions to bring about improvements, as in the following example.

> Parents were invited into school during the working day during each term and a D&T activity was run for them to work alongside their children, enabling them to take something away which could be continued at home. D&T was chosen because discussion and questionnaire responses showed that parents did very little making and modelling at home. In the D&T coordinator's discussion with pupils they also said they did not make things at home, where activities centred on playing football and computer games.

43. Health and safety were secured well in all schools. Procedures were generally good, risk assessments were in place in nearly all schools and staff were vigilant in lessons. Pupils had good attitudes to health, safety and hygiene and followed their teachers' instructions. In two schools where an over-cautious approach was taken, adults were using tools and equipment rather than teaching older pupils to use them safely.

44. Weaker aspects of leadership and management included underdeveloped systems for monitoring the effectiveness of teaching and for tracking and analysing pupils' attainment and progress. Barriers to improvement included unsettled subject leadership and little or no access to training and professional development in D&T. It was common for there to be no external subject training, and this made it more important for D&T coordinators to train and

[6] *Education for a technologically advanced nation: design and technology in schools 2004–07* (070224), Ofsted, 2008; www.ofsted.gov.uk/publications/070224.

support teachers. The impact of good support from the coordinator is illustrated below.

> Newcomers, newly qualified teachers and more experienced and established teachers in the school have a clear understanding of D&T as a result of the purposeful way it has been planned and organised, and the individual support they received from the coordinator. One teacher explained how this had prepared her for teaching D&T. She said she felt more confident, had more ownership of D&T teaching and had ideas for D&T projects that she can develop in the future.

45. Training needs were acknowledged by the schools and could be consolidated into five main areas: assessment; technical making skills using materials and ingredients; knowledge of mechanisms; electronics; and control. However, just 25 of the survey schools benefited from external training and support during the period 2007–10. Barriers to meeting training needs were:

    - lack of provision and sources of support to replace the loss of D&T expertise in local authorities
    - difficulty in schools knowing in a timely way what appropriate courses are available
    - external training perceived as expensive and sometimes lacking in quality.

46. Teachers in a few schools faced shortages in resources, particularly equipment for working with food ingredients and computer control. Consequently, their pupils had a limited experience of design and technology.

## Design and technology in secondary schools

This section focuses on findings in Key Stage 3 and Key Stage 4. A separate section (paragraphs 107–120) deals with findings in relation to school sixth forms.

### Achievement in design and technology

47. In nine of the 89 secondary schools visited, achievement was outstanding; it was good in 35 schools, satisfactory in 41 and inadequate in the remaining four schools. Students generally enjoyed the opportunities the subject provided for practical and active learning, working on individual projects and using their own ideas to create products that worked realistically. In discussions with inspectors, a common theme emerging among younger students was that, although they found great satisfaction in acquiring technical skills, they did not always find D&T as challenging as their other subjects.

48. Nationally, D&T continues to be one of the most popular subjects at GCSE after English, mathematics and science. Almost all maintained schools provide courses at Key Stage 4. Standards in GCSE D&T, as measured by proportions of higher grades achieved, have continued to improve steadily. However, the number of 16-year-olds who chose to enter D&T GCSE examinations fell over

the three years of the survey at the rate of approximately 20,000 students each year. An analysis of patterns in national results, which is reflected in the evidence collected from the survey schools, reveals two important issues.

- Nationally, students' take-up of D&T GCSE electronics and systems and control is much lower than that of other D&T GCSEs. Teachers in three quarters of the survey schools lacked the confidence and expertise to teach these essential aspects of D&T. As a result students lacked the underpinning knowledge and experience because they were thinly covered in the curriculum, and in ten of the schools they were missing from students' experience at Key Stage 3.
- Fewer girls than boys choose to enter GCSE examinations in the subject, but they continue to outperform boys nationally in D&T examinations at all levels. Nationally, the difference between boys' and girls' performance continues to be wider than in any other subject, with little evidence of it narrowing. Given the higher take-up of D&T by boys, the need to tackle this difference is critical. Both of these issues are discussed in more detail in Part B of the report.

49. Outstanding achievement was evident when students:

- demonstrated high commitment to acquiring, analysing and applying knowledge
- worked with increasing responsibility and independence, making choices and taking decisions about their work
- were extremely productive, demonstrating good project management and efficient use of time, including their use of computers to aid design and manufacture
- worked constructively with others and managed risks exceptionally well to manufacture products safely and consider suitability for users
- responded to ambitious challenges, showing significant levels of originality, imagination or creativity, and produced ideas and manufactured prototypes that were varied and innovative.

50. Outstanding achievement occurred when students had opportunities to acquire a secure understanding of the properties of materials and to use them with increasing confidence to undertake innovative or unusual designing and making. The following example demonstrates how such learning was planned effectively to enable a class of Year 7 students to develop their understanding of plastic materials and processes.

Lesson aims for the next 60 minutes are clearly focused on the difference this lesson is to make to students. They must:

- understand the key difference between thermoplastic and thermosetting plastics and understand how heat can change properties
- learn how to use the line-bending process
- begin to apply the information to create design ideas for a new plastic product.

The teacher knows that all the students can recognise products, have worked with at least one material, and learnt the technique of vacuum forming earlier in the year. In groups, students are to use this limited knowledge to sort images and names on cards quickly into groups of products, materials and techniques/processes. Working together, most are able to do this successfully within the deadline set.

Two students safely demonstrate how to bend acrylic sheet using the strip heater, while the teacher keeps up a series of open questions to the rest of the group encouraging a strong scientific investigative approach, for example: 'What do you think will happen to this piece of plastic? How will it change its properties? What do you predict the difference will be?' Pupils are thinking and responsive: they can see the difference between the localised heat of the strip heater and the all-over heat of an oven or vacuum former. They ask questions as designers, for example: 'What size sheets can you get? What does it cost? In what ways does acrylic come, apart from sheets?'

Students are again asked to predict what they think might happen during the teacher's competent demonstration of one thermosetting plastic and one thermoplastic. Relevant, thoughtful answers show the students are thinking and challenged by this approach. Working with two lists of materials, the teacher draws the link back to how they worked earlier, drawing upon a small group of known facts to identify materials that share similar characteristics. They correctly conclude that acrylic might indicate the group of materials that are thermoplastic, but they need to be sure. They watch, fascinated by changes taking place as the teacher demonstrates polymorph, a material which is also on the list. They correctly conclude it is a thermoplastic.

Working in pairs, using inspirational images, students quickly mock up in card their own ideas for new acrylic products that could be made using the line bending technique. Unusual ways to hold an egg, toast or cutlery quickly take shape and students are very keen to explain who might use them and how they might set about making them.

51. Good achievement was evident in schools where the progress of different groups of students was analysed effectively and used to inform teaching and learning plans. In the schools visited where D&T was good or outstanding, there were examples of students overcoming barriers to learning and making better progress in D&T than in their other subjects. Personal support for students with special educational needs and/or learning disabilities and for lower-attaining students enabled some individuals to make good progress, as in this example.

> Over the last 12 months the school has concentrated on developing students' knowledge and basic making skills such as beating, creaming, measuring and food hygiene. A digital photographic record accompanies the folders of students who have difficulties with writing and evaluating, and clearly demonstrates the progress they have made. For example, a student's earlier work to make simple biscuits to a given basic recipe shows uneven colouring and slight burning. Towards the end of the year the practical work is more appealing and has developed in complexity, showing that the student has begun to exercise some decision-making, for example adapting the ingredients in a pasty recipe to meet his specific dietary needs. Photographs record key moments in his progress, such as the first time he used weighing scales independently, his selection of vegetables from the range available to make his soup, using a blender without support, and holding and cutting fruit correctly. Photos also show the student on a shopping trip to choose the ingredients needed for spaghetti Bolognese.

52. Disaffected students were rarely seen within the sample of schools but where they were found, D&T departments played a key role in securing their good achievement.

> A small group of disaffected boys has studied construction and motor vehicle maintenance in Years 10 and 11. One Year 11 student, who has just completed this course, has achieved a distinction in construction. He returned to school to speak to the inspector about his experiences. He regards the D&T department as a safe haven and a place where his talents have been put to good use. He explains that he saw little relevance to school except for D&T. He sought his teacher's advice as to whether he would be suitable for the construction course and he is proud of the skills he has learnt. He says he is more confident. He is proud of his achievement and his teachers' efforts, which he and they agree have now got him back on track. He has a clear view of his future and has secured a place on an advanced construction course.

53. Where students underachieved, it was because too much of the work they had been given included low-level tasks that did not challenge them sufficiently. Examples included a majority of work during Key Stage 3 that required all students to follow instructions with almost all decisions about designing and making taken by the teacher. Where the majority of student's experiences of

D&T were like this, it inhibited the development of their designing and making capability. Similarly, students' progress was inhibited when they repeated tasks, such as making a fruit salad, normally undertaken by very young children in primary schools, which provided no obvious additional learning.

54. The schools identified that adequate but uninspiring work during Key Stage 3 could be overcome with extensive intervention, support and coaching at Key Stage 4 to enable students to pass examinations. However, this promoted students' dependency on teachers to support them in designing, planning and managing their work, particularly where there had been insufficient opportunities for students to take responsibility for making design decisions and developing project management skills in Key Stage 3.

55. With the support and encouragement of their teachers, some students invested considerable effort in working towards examinations, using their own time after school, at weekends or in holiday periods to ensure coursework was complete. The schools generally provided intensive revision to support and prepare students for GCSE examinations. While the commitment and hard work of staff and students was impressive and ensured that students achieved well, the regular use of these strategies masked weaker practice in earlier key stages. The narrow focus on knowing only what was needed to pass a specific examination did not provide a well rounded D&T education for students, as this successful A-level D&T student acknowledged:

> 'This school has been great. My teachers have been really supportive. I have gained more qualifications than I thought possible when I arrived here but I would like to have learned more about D&T.'

56. D&T had a good impact on students' personal development. Students' commitment and attitudes to learning were highly positive, particularly at Key Stage 4. This was demonstrated in their good behaviour in lessons, their high take-up of examinations, and their rates of participation in after-school clubs to complete coursework and help with revision.

57. In almost all of the schools visited, students knew about and applied health, safety and hygiene rules and used equipment safely in classrooms and workshops. Where their achievement was good, their knowledge also extended to them acting responsibly as designers and makers, to ensure that the products they designed and made took account of relevant British Standards and health and safety legislation. Where achievement was outstanding, students' planning demonstrated greater awareness of the concept of risk, and greater knowledge of control measures and alternative methods to realise their design ideas.

## The quality of teaching in design and technology

58. The quality of teaching and learning was outstanding in four of the schools visited, good in 47 and satisfactory in 37. In only one school was it inadequate.

59. In almost all of the schools teachers displayed good class management and effective and safe use of tools and equipment, including CAD/CAM processes. Most of the teachers seen established good relationships with students, based on mutual enthusiasm for the subject.

60. Where teachers' subject knowledge was good, it was wide, enabling them to understand the properties and working characteristics of a number of materials, and encompassed an understanding of what is good design. This enabled teachers to make better connections for students between the various materials and properties that they were studying. Outstanding subject knowledge, often the result of recent teacher training, was evident in the effective use of up-to-date technologies with students. The effect of outstanding teaching on learning is illustrated in this school.

> Excellent subject knowledge enabled teachers to challenge the thinking of their students. Teachers' enthusiasm for their subject was infectious and students responded very well to their high expectations when designing and making. Students were punctual to lessons, enthusiastic, fully engaged and reluctant to stop work. They were eager to do well and persevere with design problems, were self-motivated and frequently demonstrated initiative. Students were encouraged to design for 'real' clients and were excellent at consulting with members of the local community to support their research and development of ideas. The use of high-quality modern tools and equipment in a well-organised environment had a positive impact on the quality of making. A broad range of teaching methods were employed and expertly matched to the range of student learning styles.

61. Good teaching was demonstrated when teachers:

- questioned students skilfully and effectively to extend their thinking and understanding and to assess their progress
- used teaching methods that enabled students to take responsibility for their learning, promoting their independence and inspiring and challenging them to be innovative and creative
- assessed students' work effectively and systematically and used the information to inform teaching to meet individuals' needs
- provided specific, accurate and positive feedback
- made effective use of support staff who themselves fully understood the purpose of the work.

62. Lessons that inspired students' learning and challenged them in innovative and creative ways were carefully crafted. The best teachers observed not only demonstrated good teaching and promoted good learning, but also created a palpable sense of excitement and enjoyment, as these examples demonstrate.

> Year 9 students had had very little experience of textiles. In the previous lesson, the teacher introduced new learning when she demonstrated how to construct a seam. This lesson was designed to develop learning but first she needed to make the link with the previous week's work. As students filed into the lesson they were met with huge images of a seam and a sandwich on the interactive white board and the question: 'How is a seam like a sandwich?' They were intrigued. They quickly set about the task in pairs and small groups. They used different approaches; some looked at both images for visual clues, others ignored the images and started to pool their thoughts about what they recollected from the last lesson and from their shared common experience of making a sandwich. All approaches were effective. They made the connections quickly and were ready with their answers to the teacher's question after only a few minutes. This lesson got off to a good start with students keen to find out the next challenge. The teacher knew where earlier learning had been most successful.

> Students made two products in previous lessons in which knowledge of safety points, hygiene and hazards were taught in context as they cooked. In this lesson students were given the role of safety inspectors: they were kitted out in white coats, each had a clipboard, a hygiene and safety checklist, and an evidence form. During the teacher's demonstration of making flapjacks, the next product they will cook, they have to identify the rules the teacher is following, what she isn't doing that she should do and how to improve. All the students gave a 'thumbs up' to show they understood the task. Before the demonstration began, students worked enthusiastically in pairs to organise how they would set about the task: they worked out who would take responsibility for identifying the different points on the checklist and the kind of evidence they might see. During the demonstration, the students' attitudes were excellent: they listened attentively to the teacher's running commentary as she pointed out changes occurring in the mixture, and they took their role very seriously. Their notes were very detailed, step by step, demonstrating that they all knew the basic rules, and over half the class had gone further, recording key factual points about the ingredients. Their notes also provided a detailed guide for them to use in the next lesson when making their own flapjacks. At the end of the lesson the teacher took in students' work to make her assessment.

63. Where lessons were no better than satisfactory, they were dominated by lengthy teacher inputs, with relatively low student involvement. Lessons involved a narrow range of teaching and learning strategies and were focused on teaching content. All students were given the same work rather than, for example, using different tasks or resources matched to individual students' needs. Students were frequently busy with activities and sometimes enjoyed them, but their progress was limited.

64. In contrast, good and outstanding lessons were effectively planned to enable students to participate, encouraging them to take more responsibility for their learning and promoting their independence, for example, by demonstrating, discussing and presenting their work and ideas for critical analysis. These lessons involved paired, group and whole-class work. Well-planned use was often made of additional adults and other students to assist learning, as the following set of examples demonstrates.

> A Year 11 class were struggling to catch up with work due to the extended absence of their regular teacher. The teacher's lesson plan included very specific use of other adults and students during work at a critical point in the course. While one group of students who required intensive support worked with the teacher, another group worked with the trainee teacher, learning about industrial manufacture from his recent industrial experience. At the same time, a sixth-form student was demonstrating soldering to assist and supervise a small group of three students in making their products.

> In a Year 8 textiles lesson the teacher planned for students who already knew how to use the sewing machines to act as buddies to support those who were unfamiliar with them. This led to students making faster progress in the lesson and in acquiring specific skills and confidence in using the machines.

> In a Year 10 resistant materials lesson, the teacher planned with a student for him to give a demonstration of his idea for speedier, accurate cutting. This helped others in the class to adopt the technique and improve the construction quality of their products.

65. Where teaching was most effective, students were taught specific strategies to help them in developing ideas and different methods of planning and research into products. Teachers demonstrated, with their own work and that of other students, how to develop ideas and communicate them to others, technical features and different approaches to planning. In lessons and in departments where this regularly happened, students found these examples inspirational. However, this good practice was not a common feature of the schools visited. Excellent practice in this respect still has some way to go: it was very rare to see systematic planning by the teaching team to enable all students to build up

a good repertoire of such skills and ensure that by the end of a key stage they each had, for example, a bank of three or four different methods of planning or research that they could use independently in the next stage. The example below illustrates how this is done well.

> Good teaching in this school featured a range of strategies that, when used skilfully and in combination, accelerated students' progress. For example strategies such as '4x4' supported the development of an idea, and 'accessfm' helped them to analyse designs.[7,8] Word banks and word walls supported students in understanding technical terms and promoted accuracy in spelling and writing. Booklets, developed by teachers, supported students effectively at Key Stage 3 during each unit of work. The best features included examples of teachers modelling mood boards, how to write specifications and how to use writing frames. These strategies were built upon at Key Stage 4 and involved teaching additional strategies, moving on from 'spider diagrams' to more complex mind maps and SWOT analysis (strengths, weaknesses, opportunities and **t**hreats) of products. Students compiled personal logs and were beginning to set targets for themselves to keep a closer track on their coursework. Students liked using these strategies, finding them useful aids to support their learning in D&T and more widely across the school.

66. Students with special educational needs and/or disabilities made good progress in lessons when teachers and support assistants worked in partnership to employ a range of teaching methods suited to their learning needs, as in the example below.

> The learning support assistant (LSA) assigned to D&T was a trained chef and supported students with special educational needs and/or disabilities in food and textiles. He was familiar with the operation of the computerised sewing machine and the current module of work, on designing hats, for Year 8 students. He drew on both effectively when providing individual support to a girl with cerebral palsy who was using the machine to complete a panel for her hat. As a result of good earlier support, a positive bond was established between the LSA and the girl. He listened to her on a communication device and helped her to ensure that her ideas and strong feelings about racism could be translated onto the hat. She was clearly confident in using the sewing machine and had made rapid progress to master this, having been a total beginner six weeks earlier. She was carefully putting the finishing touches to a logo that she

[7] 4x4 is a quick group activity to help a student develop and model ideas. The 4x4 activity is included in Key Stage 3 National Strategy D&T pilot: training modules published by DfES 2003. Ref: DfES 0312/2003.

[8] Accessfm is a mnemonic used to help students to remember to analyse and evaluate products in terms of the following: aesthetics, cost, customer, environment, safety, size, function, materials and manufacturing. The term is the copyright of Bluefish Works Ltd.

had designed that stated: 'Stamp out racism.' She was proud of the hat she was making and the professional quality she had been able to achieve as a result of using CAD and CAM in this project. The teacher had had little experience of working with students with the level of disability that this girl has. As a result of the work of the LSA, the teacher, watching what the girl could do and where she had difficulties, had a better idea of how to adapt future textiles work.

67. Where students with special educational needs made less progress, the best practice in using active teaching methods and resources was not shared sufficiently across the teaching team.

68. Where ICT, and particularly CAD and CAM, were readily available to support designing and making, they made a good contribution to students' learning. In the best practice observed, computer based equipment was used effectively with traditional machines and hand tools to develop and extend students' understanding and experience of materials and their knowledge of current manufacturing processes. This had a positive impact on the precision of making, as it enabled students to work to fine tolerances and resulted in students achieving a professional quality in the products they made.

69. Good and excellent use of ICT and CAD/CAM was evident where:

- students developed fluency in using computers for nutrient modelling and CAD/CAM as a result of expert teaching and well-planned opportunities for all students to experience increasingly advanced technology and software
- teachers made good use of computers and CAD/CAM to model ideas, demonstrate and explain how to use tools and techniques, and enable students to create highly professional and well-designed products
- students with special educational needs, and in particular those with specific physical disabilities, were able to overcome barriers to making accurately and were able to realise their ideas to a high standard
- school leaders and governors were well informed about the impact their investment in resources had on students' achievement
- schools planned investments effectively in order to keep their resources up to date.

70. However, insufficient investment in resources in the less effective schools meant that not all students in all year groups were able to develop their use of ICT, CAD and CAM to a high level. These schools had to restrict access by younger students, particularly those in Key Stage 3, in favour of students undertaking a specific examination course. In some instances, where schools lacked up-to-date ICT and CAD/CAM resources, students cited this as a reason for choosing not to proceed with D&T at GCSE and A level.

71. Expensive CAM equipment, for example laser cutting machines, was becoming more commonplace in schools. However, where staff lacked the expertise and

knowledge of how to exploit their features, they were used in fairly limited and often low-level ways, for example to engrave and cut stencils. This was in marked contrast to good and effective use of the equipment, when students were progressively and quickly challenged to develop two- and three-dimensional applications by making a variety of components and parts for a wide range of products such as chairs, flat-pack storage solutions and eco-vehicle designs.

72. The effectiveness of assessment in D&T varied considerably but was strongest at Key Stage 4 in most of the schools visited. Weaknesses in assessment inhibited the quality of learning, particularly at Key Stage 3. The best practice, which featured ongoing assessment of students' work as the lesson progressed, involved not only being alert to students who were struggling but also using methods to find out when students were finding the work easy and were ready to move on. Effective discussion of students' progress in their learning depended on the teachers' questioning being sufficiently probing.

> Throughout the department, D&T teachers built in effective opportunities to get and to give feedback to students as they moved through their project or unit of work. Best practice involved teachers regularly marking students' practical work and providing perceptive written comments to them about the quality and accuracy of their making skills. These were positive and clear, identifying strengths and development points. Plenaries to evaluate learning were not restricted to the end of lessons, but some teachers confidently used mini plenary sessions throughout the lesson to gain a quick view of how students were responding and to help tailor the learning more closely to meet their needs.

The flow of feedback between teacher and students as lessons proceeded enabled misconceptions to be tackled quickly and students' learning and progress to flourish, as in the example below.

> Year 11 students had used a specific CAD package in Year 10, but needed to revisit and consolidate their understanding of how to use it in this new task to develop and realise ideas for a disposable camera. The teacher took the students through the order of the work, reminding them how to construct a basic CAD drawing. As he did so, he highlighted a pair of lines and asked four students at what angle they intersected. The answers he received varied widely; a show of hands revealed that the lack of understanding was widespread and students were guessing the answers as 300 degrees, 150 degrees, 180 degrees and 120 degrees. He quickly readjusted to deal with this misunderstanding, demonstrating with his hands and objects 360 degrees and asking students to identify 90, 180, 270 and 360 degrees. From his visual reminder, students correctly judged the angle between the lines he drew to be 120 degrees. He took students through common faults he had identified in their work, again checking that students understood how to solve the problem of non-attached lines, and recapitulated on how to use layers and fills. Learning and progress

were good. The clear understanding established through the teacher's input helped students to be confident in using CAD. They worked quickly and independently, and several were adventurous, trying some unusual shapes for their disposable camera.

73. Assessment during lessons was most effective when it encouraged students' independent thinking and evaluation, but least effective where the teacher over-directed the evaluation and where practice was inconsistent. Students needed to know from the outset what was being assessed and how. The example below illustrates some of the weaknesses observed in the assessment of D&T.

> Within this department, teachers' lesson plans do not identify clearly where assessment opportunities might take place. The learning objectives for lessons are focused on the tasks students must complete rather than what they will learn, know or understand by the end of the lesson. Although teachers know the completion rates for tasks, they do not have the qualitative information as to why some students did not complete them or why some students completed them incorrectly. This lack of dialogue with students does not help teachers in planning their next lesson. Assessment in lessons is undertaken but does not develop students' independence as learners because strategies for self-evaluation are not built up and still rely on the teacher too much. Some students know which aspects of their work are being assessed and receive clear guidance for coursework and others would like this. The quality and rigour of feedback comments varies.

74. Over the last three years, the technology to use electronic portfolios has developed so that students' achievement can be recorded in different ways, through use of voice recording, digital photography and video footage in addition to writing.[9] Such developments are at an early stage and were relatively uncommon in the schools visited. Where they were seen, their purpose was mainly to support the development of students' portfolios of coursework for examinations. However, the examples observed suggest that the opportunity to use them more widely, supported by appropriate training for staff, could help to overcome a common problem in capturing student's achievement more fully.

## Quality of the curriculum in design and technology

75. In the 36 of the 89 secondary schools where the curriculum was judged to be good, and in the eight where it was outstanding, students received a D&T education that had breadth and depth, and schools organised their resources,

[9] An electronic portfolio is a digital collection of documents that may include photographs, video and sound to reflect a student's work over time. Portfolios may be used for schools' own internal use or may be used for gathering evidence for assessment purposes for some examination boards.

specialist staff and staff training effectively. In almost all of the 40 schools where it was judged satisfactory, students did not have sufficient opportunities to learn about electronics, systems and control, and CAD and CAM. In five of the schools, curriculum planning was inadequate because parts of the subject were just not taught.

76. When technology, the forerunner of D&T, was first introduced into the school curriculum in 1989, a method of organising the teaching in the form of a carousel was advised for Key Stage 3. This involved students moving in groups from one specialist teacher to another, which enabled teachers who had narrow specialist skills in one area of D&T to contribute to teaching the new subject. However, this method had disadvantages in disrupting learning, particularly for students with special educational needs and/or disabilities, who had difficulty in connecting different aspects of the subject. It also made the tracking of students' achievement problematic.

77. Although organisation in the form of a carousel continued to predominate in the survey schools, increasingly it was better adapted to meet students' learning needs. For example, in several schools, staff were trained, supported and deployed well to make the most of their initial teacher training to teach at least two areas of D&T. This resulted in better use of teaching time because of less frequent changeover of groups of students moving from one specialist teacher to another, and promoted greater continuity of learning. In other schools teachers worked in different paired specialisms, with two teachers sharing responsibility for teaching a group of students. Knowing their students well, the two staff could track their progress efficiently and judge their attainment. On the other hand, training in another school, mostly provided by the specialist D&T teachers within the team, had enabled each teacher to teach all or most of the units of work in the Key Stage 3 scheme of work. In this instance, there was no disruption to learning by classes rotating between teachers.

78. A good curriculum was secured where departments had:

- worked collaboratively to build students' knowledge, understanding and skills efficiently
- developed constructive partnerships with other providers to widen opportunities for students to study, and had not allowed a lack of facilities or specialist staffing on their own site to become barriers to learning
- established provision of extra-curricular activities, visits and visitors to enrich the D&T curriculum
- ensured that contexts for designing and making and resources to support learning were regularly reviewed and developed to be fresh and up to date
- made effective use of industry and work-related contexts to deepen students' awareness of the relevance of D&T to the next stage of learning and work.

79. A good curriculum also took account of the needs of all groups of learners. For example, in one school, a specialised six-week programme of food technology was developed to meet the specific needs of a small group of students who were particularly vulnerable, with the objective of developing their social and communication skills. The programme focused on building teamwork and enabling them to take responsibility as they made the food. This helped them to rejoin their peer group for the remainder of the year. A good or outstanding D&T curriculum also provided opportunities for broader educational development by supporting students to apply knowledge and skills in new contexts, particularly in English and mathematics and, to a lesser but increasing degree, in science. This is demonstrated in the following example.

> In this inner city 11–16 school, the D&T curriculum is moulded to meet the key learning needs of students to develop skills in English, mathematics and science and to develop their confidence as learners. The D&T scheme of work meets the basic requirements of the National Curriculum at Key Stage 3 and different approaches are being tried for Year 7 that focus on a competency framework for acquiring skills. Planning shows that Year 7 students undertake a balance of focused practical tasks and projects in which they design and make, but with more emphasis on using language and literacy skills in group and paired work in evaluation. Cross-curricular links are specifically referenced to the practical application of scientific and mathematical skills in electronics, systems and control units. Courses at Key Stage 4, while taking account of the examination board syllabuses, provide time in Year 10 to explore techniques and undertake mini-projects to support students in managing their time and developing skills to support them in their later major coursework project. The department recognises that students in Year 10 still need to express themselves better when presenting their ideas, hence an emphasis on finding out, explaining and presenting ideas was noted in several textiles units of work, and was also observed in a graphic products lesson. These key learning skills are designed to contribute to students' social development and future economic well-being.

80. In contrast to this, where inspectors found weaker curriculum planning and lack of coherence in schemes of work, particularly at Key Stage 3, the planning tended to be carried out by teachers working as individuals rather than as a teaching team. At worst, the curriculum students experienced was a series of unconnected projects. Students' progress was hindered by poorly trained staff and by duplication of past work rather than building upon earlier learning and achievement. This was seen in the schemes of work where projects or units of work were pitched at too low a level and where tasks focused on decoration rather than on providing meaningful design challenges for all students. In such schools, teachers' awareness of the wide range of resource materials, competitions and sources of guidance about good practice was under-developed. Where the curriculum was no better than satisfactory, the emphasis tended to be placed on subject content rather than on the development of skills. A weak feature of schemes of work was that while they often described

in detail what students would do in a project or module, they did not focus sufficiently on what they would learn. This did not provide sufficient support to teachers in assessing students' knowledge and understanding.

81. A lack of challenge in the curriculum for higher-attaining students, particularly in Key Stage 3, was evident in many schools. In these cases, the key barriers to improving achievement were:

- failure to build sufficiently on their earlier achievement in D&T in their primary schools – at worst D&T began again for them
- tasks which were set at too low a level, or duplicated students' earlier experiences, making little demand on their thinking
- too few opportunities at Key Stage 3 to enable students to develop their knowledge and skills of research, testing and analysis, to enable them to independently manage projects and design and make products.

82. A general lack of awareness of what students had done and achieved in their primary schools was encountered during many of the visits. It was commonly claimed by teachers that students did not do D&T in primary schools. Indeed, inspectors encountered this initially during their discussions with students. However, careful probing about the kinds of things they had made or designed found evidence to support the view that students had experience, but it was so different from what had been explained to them about D&T in their secondary schools that they had discounted it.

83. The nine of the 89 schools where achievement was outstanding had measures in place to identify what students could do within a short period of their arrival at secondary school. Examples included teachers using the first lesson for discussions with students about their experiences, setting a specific task as a test or using the first project or module in Year 7 to grade students roughly and provide a baseline for their performance. However, this practice was not widespread. Most of the secondary D&T teachers that inspectors spoke to recognised a need to develop better continuity of learning for pupils when they moved between primary and secondary schools, but were concerned that they did not have the capacity to tackle this.

84. The revised National Curriculum at Key Stage 3 was published in 2007. Around a third of the secondary schools visited for the survey had begun to make changes to the curriculum for students in Years 7–9 as a result. In these schools, teachers revised or developed new units of work and modified the organisation of teaching. Five schools were taking action to tackle the gaps in their provision of food, textiles, electronics and control. However, approximately two thirds of the schools had not made any changes to provision, despite there often being a need to do so: for example, to modernise the traditional curriculum in which steady-hand games, wooden boxes, pizza-making and the ubiquitous cushion covers had become long-established fixtures. The need for schools to update the Key Stage 3 curriculum was also noted in the previous

D&T report published in July 2008, and is emphasised by this typical comment from a Year 9 student:

> 'My dad likes it when I do D&T because I am making the same things he did when he was at school.'

85. Despite the greater emphasis on environmental design in the revised National Curriculum and in D&T GCSE and A-level specifications, it was thinly covered in around two thirds of D&T departments' schemes of work.

86. Teachers understood the principles of environmental sustainability. However, the implications for rethinking designing and awareness of the potential benefits of applications of modern and smart materials to design solutions had yet to be explored in most of the schools visited.[10] Acquiring materials that have been produced sustainably in sufficient quantity and cheaply enough for students to use remained a barrier for teachers in bringing about real changes in classrooms and workshops. Where making from recycled materials was seen in the schools, it was better developed in textiles than in other areas of D&T, as in this example.

> In this Year 10 textiles lesson, the teacher demonstrated examples of products made from recycled materials, such as fleece made from plastic bottles, dresses made from bags and jeans, cushion covers made from seatbelts and bags made from recycled carrier bags. As students worked in small groups to make a garment from recycled materials, they were asked to consider how and where the product would be made, shipping costs and the wider impact on the environment.

87. Generally, the schools surveyed struggled to identify how to raise awareness of the concept of 'culture' and how to apply this meaningfully when designing and making. Some of the teachers observed did not have a clear understanding of how to tackle this new concept across D&T and would have welcomed further guidance and support. Initially, social and cultural influences have proved easier to explore through food. The best work in the schools visited enabled students to learn about the qualities of different ingredients and their significance in specific cultures, and to understand why and how they were reflected within the associated cuisine. Where schools did not define sufficiently what was to be learnt in units of work or 'food across the world' projects, they went little beyond the tokenistic, such as selecting and making a recipe, and tasting.

88. During 2007–10, a national emphasis on cooking and healthy eating, and the wide range of food initiatives and schemes this generated, led to more opportunities for practical work with food and a greater concentration on

[10] Modern materials are continually being developed through the invention of new and improved processes. Smart materials respond to differences in temperature or light and change in some way. Refer to paragraph 122 for examples.

making meals. In almost all of the schools visited pupils had opportunities to work with food ingredients in Key Stage 3 and to continue to pursue their studies post-14 to obtain qualifications. The 'Licence to Cook' initiative gathered pace during the period of this survey.[11] In 2009–10 three quarters of the survey schools were aware of it. Where the initiative had been applied thoughtfully and was supported by good preparation, it had a positive effect on students' motivation in lessons and aided their progress in acquiring food preparation skills and awareness of healthy lifestyles. However, opportunities to teach practical nutrition as an integrated part of learning how to make a dish were missed in some lessons. In discussions with inspectors, many students explained how they enjoyed the greater emphasis on practical learning. Their comments suggested they were developing greater confidence in cooking, and relished the opportunities to taste and use new ingredients that they had not previously experienced. The following quotes are typical of the many views expressed by the students surveyed.

> 'In food tech we have to consider healthy foods in everything we do. We have learnt how to make healthy food taste good.' – Year 9 student

> 'I now cook every day. I look at labels now on food items before making a decision about what to eat and buy.' – Year 8 student

89. In half of the schools visited, the D&T curriculum contributed well to preparing students for the next stage of learning and work, through work simulations, work-related contexts, use of industrial CAD software and awareness of computerised manufacture. Where the curriculum was outstanding it had a strong emphasis on current technological developments. Students used and learned about structures, mechanical, electronic and control systems, and new and smart materials.

90. Although the provision of suites of three and four GCSE D&T courses still remained the practice in all but two of the schools visited, inspectors found a wider range of opportunities for students to continue their studies in the vocational areas of engineering, construction, and hospitality and catering. This feature, found in 31 of the schools visited and also noted in other Ofsted reports, was more widespread and courses were more fully embedded in the curriculum than at the time of the previous D&T report published in July 2008.[12] Excellent practice was noted in several courses, as exemplified below.

> Students were used to accepting responsibility within the kitchen. They quickly suited up in their own monogrammed chef's whites that they had purchased at the start of the course. On entering the kitchen they

[11] Licence to Cook is a programme to support secondary school students in learning how to cook and understand the principles of diet, nutrition, health and safety, and wise food shopping.
[12] *Implementation of 14–19 reforms, including the introduction of Diplomas* (080267), Ofsted, 2009; www.ofsted.gov.uk/publications/080267.

checked to see who was to be the 'chef of the day', a role that is rotated among the group over the term. The nominated student chef organised the kitchen, allocated responsibilities for checking fridge and freezer temperatures, preparation of the menu dishes, plating and serving roles. Teamwork was excellent and students worked collaboratively to complete tasks, particularly as the deadline for serving the food loomed. Students checked the food by taste testing and using temperature probes to check that the chicken was cooked through thoroughly. They knew why this was necessary and produced products of high quality; the taste and presentation of the food was excellent. The commitment of the professional chef who taught the courses was first rate. Through his contacts, students had catered for a range of external events. Under his supervision, all catering students were involved in running a restaurant every Tuesday and served meals to students and staff. The money raised from this business venture was ploughed back into the school.

Fifteen students, amongst the first in England to study the Engineering Diploma, chose the course because they wanted to try something new and practical. Two terms into their course they had a wide knowledge of the different types of engineering and were aware of possible careers. They could use specialist tools and processes with fine precision to interpret engineering drawings and make components accurately. They had disassembled a motor and in doing so found out how it worked; they then reassembled and tested it. They had learnt to work in teams, had bonded with their other course members and felt they were learning together. One student said "I never dreamt I would be doing this, I feel I have learnt a lot in nearly two terms". Two students had regular meetings with staff which focused upon improving the course. The school has responded to their suggestions, for example by slowing the pace in mathematics and increasing it in D&T.

91. In 12 of the 89 schools visited, BTEC courses in engineering, construction, catering and fashion were an established part of the D&T options chosen by students. National Diplomas in engineering and in hospitality and catering were taking place in six of the schools visited. Students were enthusiastic about their courses. Where D&T teachers had previous experience and training in engineering, construction or catering, they were able to use this to teach students on the courses. However, this did not always provide opportunities to promote continuity with earlier learning as, in many cases, the course content was approached as if students were starting with no prior experiences.

92. Inspectors found instances, in around 10 of the schools visited, where students with special educational needs and/or disabilities struggled to explain what they knew in response to theory-based written examinations. In these cases, schools were not working closely enough with examination boards to find alternative methods to enable students to convey what they know and can do.

## Leadership and management of design and technology

93. Leadership and management of design and technology were good in 45 of the 89 schools visited and outstanding in 12. They were satisfactory in 27 schools and inadequate in five.

94. A firm approach to tackling earlier difficulties of weak teaching and unsettled staffing and leadership was frequently observed in the good management and coordination of D&T. Senior leaders' challenge for improvement was a key feature in the schools in the midst of transforming D&T at the time they were visited. In these schools, the effects of good leadership and management were evident in actions already being taken to improve and bring consistency to key aspects of provision such as curriculum planning, assessment and marking or tracking students' progress, though they had not necessarily yet had an impact on students' outcomes.

95. Where leadership and management were outstanding, the proactive support, interest and involvement of the headteacher, senior leaders and governors were key features. The headteacher, governors, staff and parents shared a common purpose and vision about how D&T contributes to the education of students. In these schools the subject was well resourced, a clear strategy to ensure high-quality department leadership had been secured, and governors were regularly briefed about developments in D&T. The celebration of success was conspicuous, and was astutely complemented by a sharp definition of what needed improving. The D&T department was often at the forefront of wider development and initiatives in these schools.

96. In the schools where D&T was outstanding, and in many of those where it was good, the subject was led by enthusiastic, committed and inspiring teachers who brought about changes of culture and ethos quickly among staff and students. They communicated a vision for D&T that was relevant to students' aspirations as well as to national and local needs. As a result, staff, parents and students had a clear understanding of the purpose of D&T. The example below illustrates such features.

> This is an 11–16 specialist technology college serving an inner-city area with high levels of economic and social disadvantage. Leaders have a clear vision for D&T that is informed by national guidance but also by local needs and the developments taking place to rejuvenate the construction and manufacturing industries, which employed generations of local families in the past. The emphasis in D&T is on providing a breadth of opportunities for students to enjoy, and for this to be reflected in their successful achievement of qualifications, and acquisition of knowledge and practical skills. Senior leaders see D&T as a means of providing for students' aspirations, including enabling them to enter professions and manufacturing areas associated with designing and making in different contexts. Parents share this view. They keep a close eye on how this vision is being implemented through discussion with their children about

their work and in the products that students make and which are taken home.

97. In the outstanding schools, heads of department had quickly developed teams to work together coherently and had established a track record of improving staff performance and student achievement. They had a clear view of what excellent teaching looked like and had strategies in place to bring this about across the school. Improvements were continually sought, monitored and evaluated. In one school, for example, the head of department had made excellent use of research to inform assessment practice in the subject.

98. Where leadership and management were good, subject leaders' monitoring and evaluation of teaching and learning were squarely focused on improvement. Specific strategies such as lesson observation and scrutiny of students' work led to a clear understanding of teaching strengths. This promoted a high level of consistency in teaching, assessment and feedback to students. Effective self-evaluation was also informed by students' views and consultation with parents.

99. In the schools where leadership and management were no better than satisfactory, monitoring and evaluation practices were less well developed. For example, a lack of challenge in the work of some groups of students was not identified early enough or the evaluation of students' progress lacked consistency. Teachers did not use common methods of assessment or give sufficient feedback to students. Where systems for identifying and sharing best practice among the team were insufficiently established, this led to a slow pace of development. In weak departments monitoring and evaluation were irregular.

100. Most of the D&T departments seen did not make use of specific performance data for students with special educational needs and/or learning disabilities. Subject self-evaluation did not routinely focus on the attainment or progress of these students as individuals or as a group. In departments that demonstrated good inclusive practice, the analysis of students' results was common.

101. Health and safety policies and practices were secure in almost all schools visited. Risk assessments were in place and lessons were managed effectively and safely. Teaching about health and safety was good and students followed and respected health and safety rules when working with materials and using machinery and hand tools. In the best practice, observed in 15 of the 89 schools, updating staff health and safety qualifications every five years and providing training for new staff was part of regular practice. In five of the schools, teachers effectively managed large group sizes in rooms which were very cramped for practical work. In doing so they had to restrict the types of activity undertaken to ensure that students remained safe.

102. In 39 out of the 89 secondary schools visited, accommodation was well designed and used to support learning. Resources were used effectively in the best schools; they were carefully matched to the tasks and were of sufficiently

high quality for the activities. A promising development was the decision by schools, often serving areas of high economic and social need, to fully or partially fund food ingredients. As a result of this 'active inclusion', all students were able to participate in learning, and such initiatives were often part of the school's intent to play a wider role with the families and society it served. Technicians made an effective contribution to supporting students' learning in most of the schools, as illustrated below.

> The expertise of two workshop technicians makes a big difference to new teachers' confidence in using equipment. The technicians act in a similar way to a research and development department in a company. They play a vital role in exploring machinery and CAD resources to find out what is feasible and to experiment and push the equipment to its limits. The technicians' area is labelled with things that are easy to find but also has an air of Q's workshop (in James Bond films) with gadgets and gizmos they have experimented with. They contribute to departmental meetings, often presenting what they have found out or teaching aids they have developed.

103. In 28 of the schools visited, insufficient access to the essential tools of computers to aid design and manufacture, to undertake nutritional modelling and to support a modern technological education constrained students' achievement. Keeping up to date and having sufficient resources for computer aided manufacture, was an issue in eight of the good schools. The ability of governors and senior leaders to make purchasing decisions was hampered by a lack of independent information and guidance about the latest technological developments.

104. The essential need to continually refresh and develop teachers' practice was not often met in the schools visited. Frequently, professional development was narrowly focused on training to support teachers in preparing students for examinations. This reflects the practice noted three years ago in the previous D&T report published in July 2008. Training to support food teachers in using the Licence to Cook programme became more evident in schools from midway through the survey inspections as the national training programme gathered pace. Most of the schools inspected in the final year of the survey had implemented the programme and were able to identify a positive impact of the training on students' motivation.

105. The training needs that were most often not met in the schools judged just satisfactory related to the quality of teaching; for example there was a need to develop teachers' competence in using a wider range of teaching methods and in improving the consistency of assessment. A further systemic need was to update teachers' subject knowledge so they were better able to teach the technical aspects of D&T.

106. Barriers to meeting training needs in secondary schools were identical to those facing primary schools. In many of the schools, staff were reported to be

reluctant to take time away from lessons for external training events because of the possible negative impact on students completing examination coursework. Some staff had not undertaken any subject training during the previous three years and one head of department had had no subject training for 15 years.

## Design and technology in school sixth forms

107. Nationally, standards in D&T post-16 have remained broadly steady during the period from 2007 to 2010. During the same period the proportion of students entering AS- and A-level examinations in D&T fell slightly, despite an increase in 2008.

108. A total of 45 11–18 schools were visited as part of the survey. D&T courses were taking place in 31 of the schools, all of them leading to AS- and A-level qualifications, mostly in D&T product design but also engineering and food technology. Students undertaking specialist D&T courses were often using them in combination with courses in mathematics and science subjects. Students undertaking courses in graphic design and textiles were more likely to be entered for art and design than for D&T AS- and A-level qualifications.

109. Students' views of their courses were positive in almost all of the school sixth forms visited. However, many students commented on the difficulty of the step up from GCSE to AS level and then to A level. Students studied D&T because of a strong personal interest, and in many cases they also had career aspirations in design, engineering or the food industry. Students used their experience and qualifications in D&T to progress to university and degree courses in a range of disciplines associated with the specific focus and content of their courses, such as sports equipment design, architecture, product design, engineering, food nutrition and fashion design.

110. D&T teachers provided good advice and guidance to students to support them in meeting their aspirations. For example, in one case where 40 to 50 students regularly undertook A-level D&T, staff had compiled a database of the universities that welcomed applications from students who had studied the subject. Students said they found this very useful and referred to it when making their applications.

111. The quality of teaching observed by inspectors was at least satisfactory and mostly good or outstanding in school sixth forms. Students demonstrated commitment in lessons. Teachers prepared students well for the examinations and had detailed understanding of the specifications. The environment in which teaching and learning typically took place is illustrated by the example below.

> Sixth form teaching is excellent. Students join the course from different schools and have a very wide range of prior experience. Teachers quickly form the students into groups which are supportive of each other and where relationships are very constructive. There is an air of businesslike enjoyment. Here theory and the skills of designing and manufacturing

produce coursework projects that are innovative and of commercial quality.

112. Where teaching was good or outstanding, teachers drew effectively upon their own degree courses, their experiences and their contacts within industry in order to challenge students and to develop and maintain the relevance of courses. In lessons, students had opportunities to further refine and develop earlier skills. They recognised from their specific studies in food, textiles, resistant materials, product design and engineering that trial and testing of ideas was an essential development tool of professionals, and this often helped them to move from a good to a great idea and from the mundane to the innovative. Teachers employed methods that enabled students to learn from each other and were effective in developing strategies to allow them to give and receive constructive criticism. The examples below illustrate some of the outstanding work observed.

In this excellent A-level lesson, based loosely around a *Dragons' Den* format, students have an opportunity to briefly explain their ideas and proposals for manufacture and receive friendly and helpful advice. The whole session is recorded so that students review their performance and use it to hone their presentational skills as well as their product.

In an A-level lesson, students were being challenged to work out the performance criteria for well-known everyday objects. They worked together as a community of designers and in discussion considered the features of a battery-operated electric drill, electric kettles and a flush toilet, making the lesson relevant and memorable.

113. In many of the lessons seen, teachers acted as consultants, allowing students to make decisions and take responsibility for their mistakes. In the best cases, students were expected to delve deeper in their study periods, particularly in challenging their thinking about the purpose of products, their construction, and the social and moral responsibilities of designers.

In this school sixth-form D&T students shared their research into a broad range of products which individually inspired them: for example clocks running on human waste, cows milked by robots, Heston Blumenthal's research into unconventional and unusual combinations of ingredients, and the materials, proportion and styling of Philip Treacy's hats. This prompted some students to research further and this influenced their ideas in their own coursework.

In this Year 13 lesson, students watched the video of the organic and fluid form of Antonio Gaudí's work and compared it with that of Mies van der Rohe. Students' focused discussion following this also includes other current examples of inspiring architecture that they have researched such

as the cooking-pot-shaped Soccer City stadium in South Africa, and the inspiration for the 'Bird's Nest' Beijing National Stadium. The teacher picks up on their interest and asks them focused questions to encourage further sharing of information and ideas. For example, students are asked how they think this has been constructed, and what materials have been used. The teacher demonstrates what has inspired him in his work. Students are encouraged and quickly sketch ideas to incorporate the styling of the architects into designs for potential products.

114. Where teaching was no better than satisfactory, teachers tended to stick rigidly to a narrow range of teaching methods, drilling students only in what the syllabus required and what they needed to do to reach their target grade. In a few cases, access to equipment, particularly computers to support designing and manufacturing, was limited.

115. Assessment was consistently effective in sixth-form lessons, with good written feedback and marking of coursework a routine part of the programme. Successful assessment strategies included mentoring, teachers acting as consultants, one-to-one support and the use of peer review. Students knew what was expected of them: they had copies of the course syllabus and assessment criteria. Personal feedback was commonplace, ensuring that students knew the next steps to take.

116. Where A-level D&T flourished in the sixth forms visited and the quality of work was high, the curriculum included opportunities that enriched students' learning about the industrial and professional applications of D&T. Visiting practising designers, engineers, fashion designers and food technologists contributed to courses. Working with clients enabled sixth form students to experience directly the high demands required. Students valued and recognised the benefits of this approach, as this student summarised:

> 'Working with a client has been very challenging but it is the thing that has inspired me most in this course because it has given me a taster of what it will be like in my future career. I am even more certain that I want to become a product designer.'

117. Generally, not enough client-based work took place, and opportunities for students to experience the challenge of this work were at risk because of the constraints of examinations or time in the sixth-form courses. Courses that included designing and making, in response to the specific needs of a variety of clients who represented a range of social, human and business needs, enabled students to directly experience the value of D&T. As a result of such work, students were often able to gain a good understanding of the relationship between good-quality designing and making and the difference it can make to improving the quality of life for individuals and groups in society. A student who had just completed a well-designed AS-level product design course, which included working with a client, explains some of the considerations he and his teachers had to bear in mind.

> ‘Having a client gives you direction, a specific route to go down. It can be very creative but also more challenging because you have to refer continually to them and work to their constraints. You can work more quickly and being offered a client to work with is good. I found that it can still be creative but it has problems for the exam. It could limit the amount of research in your folder and you wouldn’t get as many marks. It streamlines the process though and this might benefit some students. The briefs I had earlier on (in Key Stage 4) were a bit too open. For example, if you can’t think of a theme for a board game then it can be difficult to get going.’

118. Leadership and management were closely focused on ensuring that provision built upon the specialist expertise of teachers and enabled students’ needs to be met. Combined sixth-form courses at AS and A level, shared by schools with very small groups of students, made cost-effective use of resources. Where results fell short of expectations, the reasons were rigorously investigated. In the best practice, evaluations informed the further development of courses.

119. Technicians provided good support for sixth-form students through their practical assistance and specialist knowledge of materials and techniques. In discussions with inspectors, sixth-form students regularly commented on how helpful they found this technical assistance to be. The example below illustrates the effectiveness of technician support.

> The technicians are highly respected by students in Years 10–13. They are seen as experts but they also convey an enthusiasm for solving problems. They treat each student’s ideas and designs with respect and make a serious attempt to work with them to help them solve technical problems. Students in Years 12–13 feel they are taken seriously as designers and engineers and this greatly aids their confidence and self-respect.

120. Professional development and training were available to all teachers. However, as for GCSE, this focused mainly around examination board moderation meetings and developed teachers’ knowledge of assessment criteria and syllabus. This had a positive impact in almost all schools in enabling teachers to provide students with focused specialist advice. The few examples of wider subject-specific training included updates on technical developments associated with CAD/CAM, tools and equipment, and training at middle and senior leadership levels.

# Part B. Meeting technological challenges

## Updating the curriculum

121. The teaching and learning of design and technology in schools take place against a rapid rate of technological change. The challenge to keep the curriculum up to date and exciting is vital if the potential of D&T to help all pupils become confident and capable members of a technologically advanced society is to be realised. Scientific and technological research and invention continue to develop new materials and processes, such as functional foods, synthetic flavours, hydrogels that absorb up to 500 times their own weight in water, and photochromic materials that react to changes in temperature by changing colour.[13] Resources that enable pupils to work with innovative and modern materials such as these provide what some academics are calling 'a high octane boost to learning' in D&T.[14] This is because they represent an opportunity to think and investigate in practical ways how and why such technologies work. In so doing, they enable pupils to develop greater technical rigour in designing and making, and also to apply their scientific and mathematical understanding.

122. Since 1999, the D&T National Curriculum has required that pupils learn about the inventions of new and smart materials, particularly at Key Stage 3. The emphasis on pupils investigating how products are designed and made, and how they may develop in the future, was restated in the revised National Curriculum in 2007. Inspectors found that just over a third of the secondary schools surveyed were moving forward in modernising their curriculum, but were still at relatively early stages in providing pupils with opportunities to experiment and innovatively create using the new and smart materials highlighted above. In the schools that had modernised, pupils were using smart materials and made effective use of ICT and CAD/CAM; they were better able to think innovatively and creatively about how things work, developing their ideas through working directly with components to test and improve the products and systems. Examples seen included pupils designing and making their own fully functioning USB data pens, speakers and docking stations for mobile phones and iPods.

123. If D&T is to meet the challenge of providing a relevant and exciting curriculum for pupils, it is imperative that they are able to make connections in their learning and apply knowledge of scientific and technological developments. Such development has brought about modern and smart materials with enhanced properties and new processes. Pupils will need to physically explore

[13] Functional foods are those that are produced to include pharmacological and health benefits, such as reducing cholesterol, and include staple foods fortified with a nutrient that would not usually be present to any great extent, for example, bread fortified with folic acid. (See *Understanding smart foods*, British Nutrition Foundation and D&TA, 2001.)
[14] Professor John Cave, Middlesex University.

the properties of such materials and their working characteristics to understand the implications for designing and making. In doing so they learn how to adapt and modify products to improve their functionality to better meet users' needs. Parents and pupils, governors and headteachers could expect to see more of the following examples taking place in schools.

> Pupils are using modern and smart materials in their designing and making, for example to create their own paints using thermochromic dyes. They apply them to electronic devices they have made, such as bathtub warning devices to let the user know the temperature of water and avoid the risk of scalding. Ultraviolet (UV) light warning dyes are being incorporated into wearable garments that change colour, alerting the user to safe and unsafe levels of UV so that they can take action to modify their behaviour and protect themselves against high exposure. Pupils are using the thermo-electric pump characteristic of Peltier cells to make mini fridges for themselves. Conductive fabrics are being used as soft circuits and pupils are using them, for example, to make heated gloves.

124. The lack of an overall research and development capability to help the subject move forward in schools was a key finding in the previous D&T report published in July 2008. This remains so, and moving to the forefront of development rather than slipping back will be a major challenge without it. It is critical that schools stay up to date, given the additional challenge provided by rapid scientific and technological change, which shows no sign of diminishing.

125. The national programme for science, technology, engineering and mathematics (STEM) has the potential to contribute to tackling the challenges that face D&T and help schools to modernise their curriculum. STEM aims to develop support for schools in order to encourage young people to develop the skills needed to become the scientists, engineers, technologists and mathematicians of the future. The STEM programme predates this survey, but it is only within the last two years that the reach of its work has grown to the extent that it has begun to be reflected in the schools visited.

126. In the 12 secondary schools and eight primary schools visited where STEM activity was taking place, different elements of the programme were observed: for example, provision of training for teachers, visits from engineering ambassadors, forging links between D&T, mathematics and science departments to provide after school STEM clubs, and participation in challenge competitions, events and activities to raise pupils' awareness of careers in engineering, technology and science. These schools found that pupils generally enjoyed the activities and were more aware of careers, but the programme had little impact beyond this. Most of the remaining survey schools were not aware of STEM or how to use it to help them to develop and modernise the D&T curriculum.

## Achieving a balanced curriculum

127. A critical challenge for schools is to ensure a D&T curriculum that includes electronics, systems and control, and the use of CAD/CAM for all pupils. Inspectors found that the more technologically challenging aspects of D&T were given too little attention in just over a quarter of the primary and a third of the secondary schools in the survey. This led to a lack of balance in the curriculum, particularly towards the upper end of Key Stage 2 and in Key Stage 3. Other countries, in developing their technology curriculum, emphasise the study of electronics, CAD/CAM, and systems and control. This adds to the challenge to maintain and develop these aspects of the D&T curriculum in England, to keep up and to contribute to preparing pupils for future roles in the design, technological, engineering and scientific industries.

128. Those countries that are most advanced in the teaching and development of electronics, CAD/CAM and robotics have the common feature that learning in these areas starts early. In Ireland, parametric modelling (using a computer to design objects by modelling their components with realistic behaviours and attributes) is a key feature of CAD/CAM, as it is in England. Electronic systems and control are developed both in junior and senior schools, with robotics in the engineering and technology syllabuses at secondary level. In Cyprus, CAD/CAM, electronics, robotics, and systems and control are used for experimental work and in real-life projects. In the very best work seen in the survey schools, pupils also designed and applied their work to a real situation. In France, CAD/CAM and robotics feature strongly but, as in Israel, little is taught about food or textiles. As discussed in the introduction to this report the study of food or textiles is an integral part of D&T in England. Research also shows that courses in robotics as a specialism within the field of systems and control are developing fast in countries such as China.

129. Although robotics is happening in schools abroad, specific courses in robotics have yet to take hold in schools in England. None of the survey schools provided such courses, although in two of the secondary schools pupils were observed assembling 'jitterbug' robots (that appear to dance) and line-following robots from a kit of parts as part of a general D&T course. However, pupils in the survey schools did not have opportunities to undertake courses in robotics or achieve such qualifications at Key Stage 4.

130. The low entries in GCSE D&T electronics and systems and control reflect the scale of the problem in England. In 2007, of the 320,000 students who entered GCSE D&T examinations, only 4.5% opted for electronic products and just 2.9% for systems and control examinations. By 2010 this had declined to 4.3% of entries for electronics and 2.2% for systems and control.[15]

[15] Department for Education, GCSE and Equivalent Results in England, 2009/10 (Provisional).

### Maintaining teachers' specialist knowledge and skills

131. The government is supporting a national programme to train teachers to update their knowledge of electronics and provide wider access to CAD/CAM.[16] While this shows a determination to tackle the lack of teacher expertise in electronics, systems and control, and CAD/CAM, as reported by Ofsted three years ago, the programme has so far been on a relatively small scale, insufficient to bring about the systemic change needed to tackle this entrenched problem.

132. Given the scale of development needed to modernise the curriculum and the challenge to develop teachers' knowledge, new approaches to teaching pupils how to apply electronics and control are called for. Examples could be using electronics in combination with new and smart materials, and applying systems and control across all aspects of the subject, including food technology.

133. Headteachers and subject leaders in almost all of the primary and around half of secondary schools held the view that sources of external D&T-specific training, advice and support were limited. Few local authorities remain active in supporting and advising on D&T. The support work of agencies such as the Design and Technology Association (D&TA) and the Specialist Schools and Academies Trust has helped subject leaders in the survey schools who are members of these organisations to stay informed about developments in D&T. High-quality training by good schools, universities, charities, private organisations and consultants needs to be better coordinated so that all schools are aware of the training provision available.

## Gender in design and technology

### Improving boys' achievement

134. Raising boys' performance and closing the gap with girls continue to be challenges facing many schools. The higher attainment of girls compared with boys is an international phenomenon. It is evident in England in core subjects in primary and secondary schools and in examination results in the vast majority of subjects. The attainment gap, particularly at ages 14–19, in D&T is one of the widest and has grown since 2007.

135. Factors that helped the survey schools to promote outstanding and good attainment of boys in D&T and to identify any barriers to attainment were investigated during the visits to 30 of the primary and 24 of the secondary schools in the sample during 2008/09. Inspectors' observations and analysis of pupils' work found no gaps between the performance of boys and girls in D&T in any of the primary schools visited. The factors that encouraged and

[16] The Digital D&T project began in 2008 and is funded primarily by the Department for Education. It provides a teacher training programme to support the teaching of CAD/CAM and electronics in secondary schools.

supported good achievement were the same for boys as they were for girls. They are already identified in the strengths in good teaching and learning noted earlier in this report.

136. In seven of the secondary schools visited, successful action had been taken to improve boys' attainment. This involved introducing work that better suited students' needs. For example, one school took time to find out what boys enjoyed and were interested in and where and why they struggled to learn. New courses were introduced to appeal to their interests, with an emphasis on practical techniques of demonstration and factual recall in questioning to help improve their knowledge and understanding. A greater emphasis on breaking examination courses into smaller manageable units, alongside a sharper focus on identifying those needing support, helped most students to manage their time better and improve their performance in examinations.

137. Good achievement by both boys and girls was characterised by students making progress in the key processes in D&T: developing and communicating ideas and designing, making, planning and organising their work, as the example below demonstrates.

> This school bucks the trend: there is no difference in attainment between boys and girls. This is due to the consistent approach by the teaching team to engage and involve students actively in planning, and in taking a high level of responsibility in recording their progress in the making of products and in managing their work independently. In this school, students respond well to the high expectations placed on them to take ownership for tracking the development of their designing and making. Planning diaries help students to work out what they need to do in advance of making. Students record very specific but brief details of what they need. For example, a Year 10 student who is making a workbench for his four-year-old brother includes his brother's height, hand size, arm span and waist height to inform his scale drawings and support his calculations for the quantity of material he will need. Students record their work as it develops, taking photographs on mobile phones or digital cameras to download later into computer-based portfolios. Brief annotations alongside the photographs enable students to explain when and why they made decisions to amend their work. This approach minimises paperwork and places the focus securely on designing and making high-quality original products.

138. A key barrier to raising the attainment of boys was the lack of opportunities for students to develop the skills of project management. These skills are essential to success in D&T examinations and boys often appeared less capable at organising their time and identifying the priority of tasks than girls. In some instances, inspectors found that the first time boys had had to manage projects was in their major GCSE coursework assignment.

139. Strengths in the way that some boys were keen to experiment with new ideas, and learn from mistakes by constantly revising and making changes to the prototype or ingredients in real time are not easily recognised or rewarded by current methods of examination assessment. Opportunities to use additional methods of recording through video, sound and photograph represent a positive step forward in documenting a cyclic development process in designing and making. Their potential for assessment purposes needs to be exploited. More technologically efficient and effective means of recording may go some way to tackle the unproductive practice of students investing extensive amounts of time in producing neat coursework folders after designing and making has taken place.

140. The proportion of boys studying GCSE D&T courses in resistant materials was greater than that of girls. Inspectors found that traditional methods of manufacture, using hand tools and working mostly in wood rather than metal and plastics, dominated some courses. In such situations, making took place at a much slower pace and the nature of the material was less forgiving if mistakes were made, compared with pupils' work with food or textiles. Pupils were at a disadvantage in their use of time and were more likely to take fewer risks in their design ideas because of the manufacturing constraints. Where machines and CAD/CAM were employed, and other materials such as metal, plastics and polymorph were included in resistant materials courses, this helped to increase the pace and quality of designing and making. In such situations students had broader knowledge and skills and their attainment was higher. A more imaginative approach generally to materials and methods has the potential to raise the attainment of boys in D&T.

### Challenging stereotypical designing in design and technology

141. Overall, much more could be done to enable pupils to become better informed and discerning consumers. The secondary school students observed were very quick to pick up on gender-related clues in their research and analysis of products. In their daily lives young people are consistently bombarded with a bewildering array of advertising, packaging and 'decoration', which passes for design, in a vast sea of products. In discussions, students said they wanted to make their work as professional as possible, but often in doing so they also adopted stereotypical language and imagery superficially in their own work. The rigour and quality of the design briefs teachers set were crucial to challenging engrained attitudes to stereotyping which are features of poor design. Inspectors found that this was not happening enough. A typical design brief asked Year 9 students to design new packaging for a company making breakfast cereals:

> The packaging produced by the class was based on the measurements of existing cereal boxes: the focus for their designing was limited to the applied graphics on the box. The resources to support them in designing were existing cereal boxes and the students produced similar designs. One girl had developed more original graphics. Her cereal package was entirely

pink and she explained her reasons: 'Usually women do the shopping, the colour is attractive to women as well as the flower pattern.' Her original idea brought her high marks, but the teacher missed the opportunity to challenge the stereotypical view that this young designer was expressing.

142. In the best practice such comments were questioned by individual teachers, but this was inconsistent, often within the same department, as in this example.

In this Year 8 class students are held to account for the design decisions they make. The teacher challenges one girl, 'Why are you painting this [product] pink when you have already decided the seaside theme with a range of blues was to be a feature. How does this fit?'

Students are undertaking a technical exercise using a CAD drawing package they are unfamiliar with. The teacher instructs the class in how to select colours and use fills. 'Girls, you'll probably want to paint this pink… pink for ladies.' The boys make their own choices.

143. Subject leaders' monitoring rarely focused on stereotypical design. Inspectors found that generally teaching about good and bad design was not sufficiently rigorous to enable students to critically evaluate and question what they see around them.

## Challenging stereotypical subject choices

144. Despite all boys and girls studying D&T from ages 5–14 years, when they have an opportunity to select an area of D&T to continue to study at GCSE level, the choices boys and girls make have been distinct. In 2007, national data shows that girls chose mainly to study food and textiles and were well represented on graphic products courses. Boys chose mainly to study resistant materials, electronics, systems and control, and engineering. However, there are signs that this is changing.

145. In visits to 24 of the secondary schools, inspectors focused on how schools were promoting and supporting pupils in making decisions about their choice of D&T courses beyond the age of 14. All of the schools visited reflected the national patterns in students' choice in relation to some of the D&T courses they provided in Key Stage 4.

146. Almost all of the 24 schools recognised that traditional stereotypical views of gender roles had an influence on pupils' choices and were taking action to tackle this. For example, schools used role models in their staffing in efforts to challenge students' pre-conceptions about gender and resistant materials, food and textiles. The schools also ensured marketing materials for courses positively countered traditional stereotypes. Almost all of the schools had revised the courses they offered and made presentations to Year 9 students focusing on the contribution such courses made towards future economic well-being, careers and life skills.

147. The impact of the schools' work was reflected well in relation to the specific courses they had targeted. For example, one school increased the amount of teaching of electronics in the Key Stage 3 scheme of work. As a result girls chose to study electronics at Key Stage 4 in considerably greater numbers than had ever done so before. In several of the schools, new courses had a positive impact in engaging more boys and girls in engineering. In another school boys were increasingly choosing to continue to study food technology in Year 10 because the course was practical and engaging and appealed to their interest in a future career in catering.

148. The 24 schools reported little progress in encouraging more boys to take up textiles. The traditional craft content of the textile curriculum at Key Stage 3 did little to engage them further. Students were quick to identify the shortcomings, typically suggesting: 'What use will making cushions be to me?'; 'I am not interested in making clothes'. In this respect the 24 schools were no different from almost all of the secondary schools surveyed during 2007–10. Students had little awareness of textiles in the 21st century, such as developments in fibre technologies and smart textiles, and the wider range of technological applications of textiles in medicine, architecture, sport and information exchange. National data on examination entries suggest that the narrow approach taken to textiles, particularly at Key Stage 3, has not only lost the interest of boys but also risks losing girls' interest in this aspect of technology as well.

149. Patterns of entry nationally in GCSE D&T examinations during the period 2007–10 reflect the findings in the survey schools. As the number of students entering D&T examinations has fallen, the proportions of boys and girls taking food technology and graphic products are approaching parity. Increasing numbers of both boys and girls are moving away from the stereotypical choices of the past and opting for other D&T courses such as product design.

150. One of the reasons for the rising take-up of courses in product design, while all other courses in D&T have fallen during 2007–10, is the wider range of opportunities to study in a multi-disciplinary way. Students can design and make using combinations of materials, for example using metals, plastics and electronic components such as light-emitting diodes (commonly known as LEDs) to create a range of different lights and mirrors. The opportunities presented by product design courses are closest to achieving the kinds of multi-functional products that pupils frequently told inspectors they would like to make in D&T in the future.

> 'I think pupils will make more cool electronic gadgets that do a variety of things like mobile telephones and iPods.'
>
> 'Projects will be more exciting, more advanced than they are now.'
>
> 'There will be no sewing: there may be more advanced techniques.'

‘Computers and new technology will be used more.’

‘I would like pupils in the future to make real things, real size, as a class. I saw a film about pupils making a classroom out of tubes.’

151. The nature of the challenges above make extensive demands on teachers to remain up to date, particularly in relation to the latest developments in materials science and emerging technological processes. The pace of change to modernise D&T has to increase rapidly during the next three years if pupils’ hopes are to be realised.

## Notes

This report is based on evidence gathered by Her Majesty’s Inspectors and additional inspectors focusing on design and technology during visits to a sample of schools in England during the period from September 2007 to July 2010. The sample consisted of visits to 89 primary schools, 89 secondary schools and two special schools from a variety of geographical and socio-economic contexts. Thirty-one of the 89 secondary schools provided sixth form D&T courses leading to AS- and A-level qualifications. Approximately 30 secondary and 30 primary schools were visited each year. No school that was in one of Ofsted’s categories of concern (that is having a notice to improve or requiring special measures) was included in the sample of schools visited. During the visits, inspectors observed lessons, held interviews with staff and students, undertook a scrutiny of pupils’ D&T work and analysed school progress data and D&T documentation, including monitoring and evaluation records.

The report was also informed by evidence gathered through research and meetings with members of the international technology education community and individuals representing organisations such as the Qualifications and Curriculum Development Agency, the Design and Technology Association, the Eurydice network at the National Foundation for Educational Research, the Nuffield Foundation, Middlesex University Teaching Resources Unit and the Technology Education Research Unit at Goldsmiths, University of London. HMI also gathered information and views from a range of organisations concerned with design and technology education. These included the National Association of Advisers and Inspectors for D&T, the Design Council, the British Nutrition Foundation, the Royal Academy of Engineering, the Specialist Schools and Academies Trust and the Institution of Engineering and Technology.

# Further information

## Publications by Ofsted

*Education for a technologically advanced nation: design and technology in schools 2004–07* (070224), Ofsted, 2008; www.ofsted.gov.uk/publications/070224.

*Implementation of 14–19 reforms, including the introduction of Diplomas* (080267), Ofsted, 2009; www.ofsted.gov.uk/publications/080267.

*Food in schools* (090230), Ofsted, 2010; www.ofsted.gov.uk/publications/090230.

## Other publications

The National Curriculum statutory requirements for key stages 3 and 4, Department for Children, Schools and Families and the Qualifications and Curriculum Authority. 2007.

*The National Curriculum Key stages 1 and 2: handbook for primary teachers*, Department for Education and Employment and the Qualifications and Curriculum Authority, 1999.

*The National Curriculum Key Stages 3 and 4: handbook for secondary teachers*, Department for Education and Employment and the Qualifications and Curriculum Authority, 1999.

*Design and technology: a scheme of work for Key Stages 1 and 2*, Qualifications and Curriculum Authority, 1998.

*Design and technology: a scheme of work for Key Stages 1 and 2, update to the teachers guide*, Qualifications and Curriculum Authority, 2000.

*Understanding Smart Foods*, British Nutrition Foundation and the Design and Technology Association, 2001.

## Websites

www.bluefishworks.co.uk for resources and information about accessFM, to support the teaching of design in primary and secondary schools.

www.data.org.uk is the subject association for D&T and provides information about training courses and guidance materials to support primary and secondary schools in implementing D&T in the classroom.

www.foodafactoflife.org.uk provides further details and resources about functional and smart foods.

# Annex A. Providers visited

| Primary school | Local authority area |
|---|---|
| Anston Park Junior School | Rotherham |
| Archibald Primary School | Middlesbrough |
| Ashley Church of England Aided Primary School | Surrey |
| Aspatria Richmond Hill School | Cumbria |
| Bangabandhu Primary School | Tower Hamlets |
| Bempton Primary School | East Riding of Yorkshire |
| Bickerstaffe Voluntary Controlled Church of England School | Lancashire |
| Blowers Green Primary School | Dudley |
| Burton-upon-Stather Primary School | North Lincolnshire |
| Byley Primary School | Cheshire |
| Canewdon Endowed Church of England Voluntary Controlled Primary School | Essex |
| Cherry Burton Church of England Voluntary Controlled Primary School | East Riding of Yorkshire |
| Christ Church Bentinck Church of England Primary School | Westminster |
| Crofton Anne Dale Junior School | Hampshire |
| Crofton Junior School | Wakefield |
| Crook Primary School | Durham |
| Derwent Community School | Derby |
| East Oxford Primary School | Oxfordshire |
| East Whitby Community Primary School | North Yorkshire |
| Edna G Olds Primary and Nursery School | Nottingham |
| Emmbrook Junior School | Wokingham |
| Fordley Community Primary School | North Tyneside |
| Forestdale Primary School | Birmingham |
| Fowey Primary School | Cornwall |
| Furzefield Primary School | Surrey |
| Grassington Church of England Voluntary Controlled Primary School | North Yorkshire |
| Greenfields Junior School | Hampshire |
| Greenhill Primary School | Oldham |
| Grove House Primary School | Bradford |

| | |
|---|---|
| Hampsthwaite Church of England Primary School | North Yorkshire |
| Hamsteels Primary School | Durham |
| Hartburn Primary School | Stockton-on-Tees |
| Highwood Primary School | Essex |
| Hillside Community Primary School | Lancashire |
| Holland Moor Primary School | Lancashire |
| Holy Trinity Church of England Primary School | Birmingham |
| Hotspur Primary School | Newcastle upon Tyne |
| Husthwaite Church of England Voluntary Controlled Primary School | North Yorkshire |
| Kender Primary School | Lewisham |
| Langdale Church of England School | Cumbria |
| Linden Primary School | Leicester |
| Lobley Hill Primary School | Gateshead |
| Lymington Junior School | Hampshire |
| Maundene School | Medway |
| Meltham Moor Primary School | Kirklees |
| New Park Community Primary School | North Yorkshire |
| North Nibley Church of England Primary School | Gloucestershire |
| Packmoor Primary School | Stoke-on-Trent |
| Perry Hall Primary School | Wolverhampton |
| Priory Lane Junior School | North Lincolnshire |
| Redlands Primary and Nursery School | Nottinghamshire |
| Richard Hill Church of England Primary School | Leicestershire |
| Richard Taylor Church of England Primary School | North Yorkshire |
| Rivington Primary School | St Helens |
| Robert Shaw Primary School | Nottingham City |
| Roos Church of England Voluntary Controlled Primary School | East Riding of Yorkshire |
| Saighton Church of England Primary School | Cheshire West & Chester |
| Sherburn Church of England Voluntary Controlled Primary School | North Yorkshire |
| Shotton Primary School | Durham |

| | |
|---|---|
| Sinnington Primary School | North Yorkshire |
| St Alban's Catholic Primary School | Cheshire |
| St Chad's Church of England Primary School | Leeds |
| St Francis' Catholic Primary School | Kent |
| St James's Church of England Primary School | Dudley |
| St James the Great Roman Catholic Primary School | Southwark |
| St John's Primary School | Newcastle upon Tyne |
| St Martin's Church of England Primary School | North Lincolnshire |
| St Mary's Catholic Primary School | Calderdale |
| St Mary's Church of England Voluntary Aided Primary School | Kent |
| St Matthew's RC Voluntary Aided Primary School | South Tyneside |
| St Michael's Church of England Primary School | Enfield |
| St Patrick's Roman Catholic Voluntary Aided Primary School | Sunderland |
| St Paul's Church of England Combined School | Buckinghamshire |
| St Peter's Roman Catholic Primary School | North Yorkshire |
| St Therese of Lisieux Primary School | Stockton on Tees |
| St Wilfrid's Roman Catholic Voluntary Aided Primary School | Gateshead |
| The Leasingham St Andrews Church of England Primary School | Lincolnshire |
| The Mayflower Primary School | Essex |
| The Willows Church of England Primary School | Warwickshire |
| Theale Church of England Primary School | West Berkshire |
| Tividale Community Primary School | Sandwell |
| Trafalgar Junior School | Richmond upon Thames |
| Wattville Primary School | Birmingham |
| Weston Park Primary School | Haringey |
| White Mere Community Primary School | Gateshead |
| Windmill Primary School | Leeds |
| Wold Primary School | Kingston upon Hull City of |
| Woodley Primary School | Stockport |
| Zetland Primary School | Redcar and Cleveland |

| Secondary school | Local authority area |
|---|---|
| Abbey Grange Church of England High School | Leeds |
| Abraham Guest High School | Wigan |
| Addey and Stanhope School | Lewisham |
| Adeyfield School | Hertfordshire |
| All Hallows Catholic School | Surrey |
| Alleyne's High School | Staffordshire |
| Altwood CofE Secondary School | Windsor |
| Ashby School | Leicestershire |
| Bitterne Park School | Southampton |
| Blessed George Napier Catholic School and Sports College | Oxfordshire |
| Blessed Robert Johnson Catholic College | Telford & Wrekin |
| Bridlington School Sports College | East Riding of Yorkshire |
| Broadstone Middle School | Poole |
| Budmouth Technology College | Dorset |
| Castle High School and Visual Arts College | Dudley |
| Chipping Sodbury School | South Gloucestershire |
| Clough Hall Technology College | Staffordshire |
| Costello Technology College | Hampshire |
| Cowplain Community School | Hampshire |
| Crookhorn College of Technology | Hampshire |
| Danetre School | Northamptonshire |
| Deansfield Community School | Wolverhampton |
| Dorothy Stringer High School | Brighton & Hove |
| Dunraven School | Lambeth |
| Earlsheaton Technology College | Kirklees |
| Fairfield High School | Bristol City |
| Fartown High School | Kirklees |
| Firth Park Community Arts College | Sheffield |
| Garibaldi College | Nottinghamshire |
| George Eliot Community School | Warwickshire |
| Hampstead School | Camden |
| Hanham High School | South Gloucestershire |

| | |
|---|---|
| Hanley Castle High School | Worcestershire |
| Hasland Hall Community School | Derbyshire |
| Hatfield Visual Arts College | Doncaster |
| Hodgson School | Lancashire |
| Kesgrave High School | Suffolk |
| Kingsdown School | Swindon |
| Lady Hawkins High School | Herefordshire |
| Lavington School | Wiltshire |
| Lister Community School | Newham |
| Longfield School | Darlington |
| Lyng Hall School | Coventry |
| Manor College of Technology | Hartlepool |
| Matthew Moss High School | Rochdale |
| Monk's Dyke Technology College | Lincolnshire |
| Monkseaton Community High School | North Tyneside |
| Moorside Community Technology College | Durham |
| Nailsea School | North Somerset |
| Norlington School for Boys | Waltham Forest |
| Northallerton College | North Yorkshire |
| Notre Dame Catholic College | Liverpool |
| Okehampton College | Devon |
| Ormesby School | Middlesbrough |
| Perry Beeches School | Birmingham |
| Prenton High School for Girls | Wirral |
| Queen Elizabeth School | Cumbria |
| Rossett School | North Yorkshire |
| Roundhay School Technology and Language College | Leeds |
| Ryburn Valley High School | Calderdale |
| Sacred Heart Roman Catholic VA School – A Specialist Science College | Redcar and Cleveland |
| Saints Peter & Paul Catholic College | Halton |
| Selly Park Technology College for Girls | Birmingham |
| Shaftesbury School | Dorset |
| Sir John Leman | Suffolk |
| Small Heath School | Birmingham |

| | |
|---|---|
| St Catherine's Catholic School for Girls | Bexley |
| St Francis of Assisi Catholic Technology College | Walsall |
| St George's Technology College | Lincolnshire |
| St Thomas More Catholic School and Technology College | Warwickshire |
| Stoke by Nayland Middle School | Suffolk |
| The Byrchall High School | Wigan |
| The King David High School | Manchester |
| The Park Community School | Devon |
| The Tiffin Girls' School | Kingston upon Thames |
| The Wavell School | Hampshire |
| The West Somerset Community College | Somerset |
| Thrybergh School and Sports College | Rotherham |
| Tottington High School | Bury |
| Trentham High School | Stoke-on-Trent |
| Ullswater Community College | Cumbria |
| Up Holland High School | Lancashire |
| Verulam School | Hertfordshire |
| Welland Park Community College | Leicestershire |
| William Allitt School | Derbyshire |
| William Beamont Community High School | Warrington |
| Woodham Community Technology College | Durham |
| Woodroffe School | Dorset |
| Wrenn School | Northamptonshire |

| **Special schools** | **Local authority area** |
|---|---|
| Foxwood School | Kent |
| Marshfields School | Peterborough |

# Annex B. GCSE attempts and achievements in Design & Technology at the end of Key Stage 4 in schools

| | Attempted GCSE (in thousands) | | | Achieved grades A*-C | | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Total | Boys | Girls | Total |
| **All Design and Technology** | | | | | | |
| 2010 | 139.2 | 116.2 | 255.4 | 57 | 74 | 64 |
| 2009 | 148.0 | 126.2 | 274.2 | 56 | 72 | 64 |
| 2008 | 161.2 | 137.8 | 299.0 | 55 | 71 | 62 |
| 2007 | 171.5 | 148.8 | 320.2 | 53 | 69 | 60 |
| **Electronic Products** | | | | | | |
| 2010 | 10.1 | 0.9 | 10.9 | 64 | 77 | 65 |
| 2009 | 10.9 | 1.0 | 11.9 | 63 | 77 | 64 |
| 2008 | 12.5 | 0.9 | 13.4 | 62 | 74 | 63 |
| 2007 | 13.5 | 0.9 | 14.4 | 60 | 76 | 61 |
| **Food Technology** | | | | | | |
| 2010 | 22.4 | 39.7 | 62.1 | 52 | 70 | 64 |
| 2009 | 23.5 | 43.2 | 66.7 | 53 | 70 | 64 |
| 2008 | 24.6 | 47.9 | 72.5 | 51 | 67 | 62 |
| 2007 | 25.1 | 55.0 | 80.1 | 49 | 65 | 60 |
| **Graphic Products** | | | | | | |
| 2010 | 29.7 | 21.6 | 51.4 | 53 | 72 | 61 |
| 2009 | 32.7 | 23.7 | 56.4 | 52 | 70 | 60 |
| 2008 | 35.6 | 26.0 | 61.6 | 51 | 69 | 58 |
| 2007 | 41.3 | 29.4 | 70.6 | 49 | 67 | 56 |
| **Resistant Materials** | | | | | | |
| 2010 | 56.7 | 10.6 | 67.3 | 56 | 73 | 59 |
| 2009 | 62.5 | 12.1 | 74.6 | 55 | 70 | 57 |
| 2008 | 66.8 | 12.6 | 79.4 | 54 | 68 | 56 |
| 2007 | 73.4 | 14.0 | 87.4 | 53 | 67 | 55 |
| **Systems & Control** | | | | | | |
| 2010 | 5.2 | 0.4 | 5.6 | 68 | 78 | 69 |
| 2009 | 5.7 | 0.5 | 6.2 | 63 | 83 | 65 |
| 2008 | 6.9 | 0.6 | 7.4 | 61 | 80 | 62 |
| 2007 | 8.6 | 0.7 | 9.3 | 59 | 77 | 61 |
| **Textiles Technology** | | | | | | |
| 2010 | 1.2 | 34.7 | 35.8 | 47 | 76 | 76 |
| 2009 | 1.3 | 38.5 | 39.8 | 41 | 76 | 74 |
| 2008 | 1.4 | 40.1 | 41.5 | 37 | 74 | 73 |
| 2007 | 1.5 | 43.0 | 44.5 | 38 | 73 | 71 |
| **Other Design and Technology** | | | | | | |
| 2010 | 22.0 | 11.9 | 33.9 | 57 | 73 | 62 |
| 2009 | 19.9 | 11.4 | 31.3 | 55 | 72 | 61 |
| 2008 | 22.3 | 13.6 | 35.9 | 54 | 72 | 61 |
| 2007 | 17.4 | 9.9 | 27.3 | 54 | 71 | 60 |

Source: Department for Education, GCSE and equivalent results in England, 2009/10 (provisional).

## Note to Annex B

'Other Design and Technology' includes all other combined syllabuses of which Design and Technology is the major part.

For each subject only one attempt is counted, that which achieved the highest grade.

Includes attempts and achievements by these pupils in previous academic years.