Design and Technology's Contribution to the Development of the Use of Language, Numeracy, ICT, Key Skills, Creativity and Innovation and Thinking Skills

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Adapted from the QCA design and technology scheme of work for Key Stage 3 Teacher's Guide

Abstract

This work summarises the contribution of design and technology to the development of language, numeracy, ICT, key skills, creativity and innovation and thinking skills. Adapted from the Qualifications and Curriculum Authority (QCA) scheme of work for the Key Stage 3 Teacher's Guide, the article identifies the teaching and learning pertinent to each of these curriculum connections.

The *use of language across the curriculum* requirement in the National Curriculum for 2000 indicates areas of language to be used in all subject teaching. Clear links can be made between design and technology and the National Curriculum requirements for mathematics, and the subject will continue to respond to ICT developments as reflected in the rapid changes in the communications industry. Key skills provide a foundation for common areas of learning in Key Stage 3 schemes of work through the six areas of competence, whilst creativity and innovation are mentioned specifically in the importance of design and technology statement. The scheme of work includes activities that enable pupils to reflect on their own thinking processes and to clarify and reflect on their problem solving strategies when working collaboratively or alone. Designing and making assignments require pupils to use the full range of thinking skills.

Use of language across the curriculum

The *use of language across the curriculum* requirement in the National Curriculum for 2000 indicates areas of language to be included in all subject teaching.

This aims to encourage pupils to use language, both spoken and written, to think, learn, express ideas and to use information and evidence to support their analysis, ideas and views. Pupils also need to be able to read texts with understanding, evaluating their usefulness and reliability.

The National Literacy Strategy in primary schools is an ambitious programme designed to equip the vast majority of pupils with the literacy skills they need to be successful in secondary school. These skills need to be reinforced and built on in order to maintain and improve these standards. Helping pupils with the language demands enhances their learning in design and technology and supports the development of literacy skills.

Pupils are likely to be more successful if there are consistent approaches to writing, speaking, listening, and reading across the curriculum. This should be part of whole school policies, to promote effective and coherent approaches to the teaching and learning of language. To assist schools in this process, QCA has developed a set of expectations in language and learning for each of Years 7, 8 and 9. These language objectives have been built into the schemes of work for all subjects, and are highlighted in the Language for Learning box on the back page of each unit, along with specialist vocabulary.

In design and technology, general accuracy in using language includes:

- the use of technical terms, oral or written, whilst communicating design intentions to teachers and peers
- clarity in recording specifications and planning manufacture
- clear summaries of attitudes and reasons for them, in expressing evaluative judgements.

Technical terms and concepts for design and technology abound and are essential to effective participation in the subject. They include:

- the expression of ideas (terms such as *concept model, design specification, texture, harmony, balance* and *proportion*)
- those relating to materials and making processes (terms such as *malleable, components, ingredients, solder, vacuum form* or *whisk*)
- description (*such as hard, workable, lightly cooked* or *well done*)
- the language of evaluation (such as *better because..., more suitable to..., compromise* and *optimise*).

Patterns of language associated with design and technology include:

- annotation of visual material
- oral expression combined with gestures and the physical presentation of samples
- extended text in expressing plans, purposes and intentions
- reasoned explanations in communicating evaluative summaries.

Accuracy in using language in design and technology is rigorous and exacting. Written and spoken language must be accurate. Its accuracy has a real purpose and can be tested, for example, if a written set of instructions is inaccurate, poorly laid out and confusing, the product will not be made to the quality required. Note, however, that it is important for you to listen carefully and sympathetically when pupils are struggling to articulate a new

and, for them, difficult idea. You can ask questions that help them express their views more clearly. Or if a pupil is having particular difficulty you can explain their ideas back to them and ask if your explanation makes sense.

Numeracy

Clear links can be made between design and technology and the National Curriculum requirements for mathematics including *number and algebra, shape, space and measures* and *handling data*. During planning and realisation and when they evaluate processes and products in design and technology, there will be opportunities for pupils to collect, sort, represent and analyse data in lists, diagrams and graphs, make estimates, measure lengths and angles to an appropriate degree of accuracy and to calculate, when they draw to scale or work out the effects of loads on a structure as examples.

ICT

Design and technology will continue to change rapidly to incorporate developments in ICT in the adult world, offering many applications which are specific to the subject, enhancing and extending the ICT experiences pupils receive in other areas of the curriculum. These include contextualised use of the generic applications such as word processors for report writing, desktop publishing for design folio presentations, databases for information capture, organisation, analysis and retrieval and spreadsheets for data manipulation and presentation. Other generic software suitable for Key Stage 3 includes multi-media authoring software for on-screen presentations, incorporating animation, sound, image and video capture and origination as well as text, paint and draw programs. Specialist applications offered by design and technology at this stage should include computer-aided design and manufacture, computer control of systems and the use of new integrated electronic devices. By the end of the key stage, pupils should be competent and confident in the use of many computer applications such that these become tools for habitual use at Key Stage 4 and beyond.

Key skills

The Key Stage 3 schemes of work provide a foundation for the common areas of learning defined as key skills, namely:

Communication

Pupils will find this skill essential in design and technology: in oral work (listening, describing effects or observations, discussing, interchanging ideas with other pupils and teachers); in reading to extract information; in written reports or recording of ideas in presentation, both formal and informal. In design folios, in drawing throughout the design process, in flow charts showing production schedules; using images and making displays.

Application of number

These skills are inherently important in design and technology and can also be exploited beyond that which is merely necessary to the task in hand to play a major part in developing concepts and skills. Being numerate is a product of success in learning mathematics and pupils benefit from applying their skills across the curriculum, particularly in the context of real needs. Numeracy demands practical understanding of ways in which information is gathered by counting and measuring, and is presented in graphs, diagrams, charts and tables. Some aspects of design and technology, such as *food technology* and *electronics*, intrinsically require accuracy and precision and are self-fulfilling in this respect – resulting in patent failure or success. Some of the units are designed to exploit this potential. The units, as a whole, include opportunities for the calculating of nutritional content; costing possible products; communicating data and concepts; framing arguments in a reasoned, numerically supported fashion; the numerical control of machines and the production of scale drawings.

Information technology

These rapidly changing technologies naturally enhance almost all aspects of design and technology, from information and communications technology (ICT) to help research, through computer-aided design (including visual presentation and analysis tools) and computer-controlled systems to computer-aided manufacture (including sewing, milling, cutting, engraving). Increased access to electronic and communications technology, including the Internet and national and local grids for learning, offer particular value to design and technology due to its eclectic nature, releasing pupils from the limits of information and other resources held in the school. Other significant uses of ICT skills in the subject include interpreting, exploring and analysing information; developing and displaying data, using computer models; and evaluating the role of software and ICT itself. New computer applications will continue to emerge to support the subject at Key Stage 3 in ways not yet exploited, such as *virtual reality imaging*.

Working with others

Key Stage 3 offers particular opportunities for both group projects and peer support for individual work for specific tasks, stages or whole units, including the sharing of ideas; effective group planning; group investigating; allocating roles and tasks in the group; keeping a log of responsibilities; and respecting the well being of others. Unit 7E – 'Activity week' (optional)/Unit 8D – 'Using control for security'/Unit 9D – 'Using control for electronic monitoring' each provide a framework for team-working.

Improving own learning and performance

Pupils will make good use of these skills in the design and make assignments, particularly in the planning aspects of assignments. Specific examples in individual units include pupils keeping a log of their work; planning particular activities or a sequence of tasks; adapting work methods to changing circumstances; planning independent ways of working; organising the workload; practising and improving techniques; and prioritising decisions on timing stages of production.

If focused practical tasks are presented as teacher support to resource pupils in making decisions, then a significant aspect will be evaluating the process and the product, as well as negotiating future targets at the end of a design and make assignments (DMA).

Problem solving

In design and technology, problem solving can range from adhoc ingenuity in making to strategic project planning and the consideration of significant alternatives in designing. Particular ways in which pupils can develop their problem solving skills in this subject include the sorting, comparing and analysing of data or information; researching; understanding patterns or seeing connections; preventing hazards; recognising issues; sequencing; recognising different factors; explaining the workings of a system or design features; formulating and testing ideas; suggesting approaches; selecting options; predicting or making judgements and decisions and justifying their reasons and arguments; applying their ideas in a creative way, both in innovative designing and in ingenious making; developing criteria for product success, and refining ideas and evaluating their products.

If your pupils know where they are learning important key skills during the Key Stage 3 design and technology course they will understand the wider contribution this subject is making to their education. This will be particularly beneficial for those pupils who study GNVQ at Key Stage 4.

Creativity and innovation

Creativity and innovation are mentioned specifically in the 'Importance of design and technology' statement at the beginning of the new Orders. You can enable your pupils to be creative by providing lessons in which the class has the time to use different strategies to generate a wide range of design ideas. Your pupils can become innovative by taking some of these ideas and turning them into useful applications relevant to the designing and making assignment in hand. Design and technology is about the practical application of knowledge, skills and understanding – it shifts the focus away from what pupils know and places it on what they are able to do with that knowledge. The creative and innovative problem solver can be helped to develop the ability to formulate new solutions when designing, to transfer general knowledge and understanding to a relevant designing and making context and to focus attention in pursuit of a goal within that process. In order to 'create', pupils need confidence to learn in areas that are unfamiliar. The design and technology process of developing, planning and communicating ideas supports them as they formulate design questions then suggest design solutions which lead them to discovering ways forward and hopefully to invention.

Thinking skills

The scheme of work includes activities that enable pupils to reflect on their own thinking processes, and to clarify and reflect on their problem solving strategies when working collaboratively or alone. Designing and making assignments require pupils to use the full range of thinking skills.

Information processing skills

These enable pupils to locate and collect relevant information, to sort, classify, sequence, compare and contrast, and to analyse part/whole relationships.

Some examples of activities that develop these skills are:

Unit 7C Using ICT to support researching and designing

Show pupils how to use ICT to search for source material to help then when designing, and how they can become more discriminating in the way they seek information, e.g. How to access existing computer databases to seek information on materials and processes, how to go on-line for a virtual visit to see how others design and manufacture products.

Unit 9B Designing for markets

Discuss with the pupils how to identify who the user is and research what the user wants,

through product research and user research, e.g. how they can go about finding out what products other businesses are producing, comparing existing products, asking potential customers to test products, providing questionnaires for the potential users

Reasoning skills

These enable pupils to give reasons for opinions and actions, to draw inferences and to make judgements, to use precise language to explain what they think, and to make judgements and decisions informed by reasons or evidence. Some examples of activities that develop these skills are:

Unit 7A Materials

Discuss values issues relating to sources of materials, e.g. organically produced foods, finite resources, recognising that when answering the question 'Am I using the best material for the job?' it may not be a simple decision about choosing the material most appropriate to meet the functional needs of the design. For example, what happens to this product after it has been used? What effect will it have on the built and natural environment? How does the existence of this product have a social, cultural or economic effect?

Unit 9A Selecting materials

Explore how the development of new materials and technologies has allowed designers to achieve things that were not possible before. For example, we now have sufficient understanding of the chemistry of materials so that we can tailor make materials to have the properties we want – and in future we are likely to see materials made to measure for a huge range of applications. Ask the pupils – what areas of research should we focus on? What products might be made? Who will benefit?

Enquiry skills

These enable pupils to ask relevant questions, to pose and define problems, to plan what to do and how to research, to predict outcomes and anticipate consequences, and to test conclusions and improve ideas. Some examples of activities that develop these skills are:

Unit 8D Using control for security

Ask pupils to survey security systems in local or city shops. Make a list of all of the various systems, e.g. Security tags, security guards, in-store video surveillance, street video surveillance, staff bag searches. Try to establish who the winners and losers might be.

Unit 9E Ensuring quality production

Discuss how items are produced cheaply and in quality so that they all come out the same. What kinds of materials, equipment and processes are most suitable when many identical products have to be made? How serious would it be if one product was below standard? Discuss how to investigate the best method for producing an item and how to collect data when testing to help make a choice between two methods.

Creative thinking skills

These enable pupils to generate and extend ideas, to suggest hypotheses, to apply imagination and to look for alternative innovative outcomes. Some examples of activities that develop these skills are:

Unit 8B Designing for clients

Have a class debate – where do new ideas come from. If possible use examples from designers and older pupils about how their ideas emerged. Discuss and allow pupils to try out strategies for generating new ideas e.g. brainstorming, word extension, analysing products, using part of a visual image, taking everyday objects and thinking up new uses for them, visiting places, talking to people, using the work of a design movement, other times and cultures, instant modelling with a variety of materials, experimenting with materials and processes, observing changes as a result of fashion trends and lifestyle shifts, collecting images that inspire, reviewing films, going to exhibitions and galleries.

Unit 8F The world of professional designers

Design and make assignment – In the style of Ettore Sottsass, the famous Italian designer, and his contemporaries established a design group known as Memphis. They decided to follow just one rule in their designing – the outcome must be fun. Design an unusual gift for a friend or relative. Investigate the work of modern designers and use their ideas as a source of inspiration

Evaluation skills

These enable pupils to evaluate information, to judge the value of what they read, hear or do, to develop criteria for judging the value of their own work and others' work or ideas, and to have confidence in their judgements. Some examples of activities that develop these skills are:

Unit 7 Building on learning from Key Stage 2

Ask the pupils to bring in a piece of design and technology work from their primary school to show to the class. Discuss the work with the pupils, pointing out particular skills

and knowledge that they already have and how these will be used in the coming months. Ask them to make a list called 'what can I do already?' focusing on their strengths.

Unit 9F Moving onto Key Stage 4

Show pupils how they might analyse and record their progress during the project and reflect back over the Key Stage 3 course: for example:

- Self assessment of skills.
- Thinking about or discussing the criteria for good work and reflecting on what aspects of their work meet those criteria.
- Reflecting on their own experience of their learning and becoming more aware of their preferred learning styles.
- Reflecting on their enjoyment and effort.
- Target setting and ideas for improving their products, the process and their learning. Planning their own progress, for example writing targets and discussing them for the next project with prompt questions such as What did you do best? What do you need to work at? What advice and help have you been given? What is the most useful thing that you have learned? What will you do differently next time?

Undertaking tasks to develop thinking skills

Research has identified three major phases in undertaking tasks which offer significant opportunities for developing pupils' understanding of, and skills in, thinking: framing; doing a challenging task and plenary or debriefing. These can be interpreted in design and technology as follows:

Framing	Getting pupils interested.	Launching the brief for a DMA enthusiastically and thoroughly.
	Indicating purposes.	Including stating why the task is worth doing.
	Giving confidence.	Showing how prior experience and FPTs will help them.
	Clarifying procedures.	Looking ahead to the stages a DMA will go through.
Doing a challenging task	Increasing challenge (perhaps for some not all).	Giving open-ended briefs. Questioning pupils' intentions; providing conflicting information; reducing instructions and making pupils sort difficulties themselves. Using extension tasks.
Plenary or de-briefing	Reviewing with individuals, in groups or as a whole class.	Evaluating pupils' approaches to their designing and making. Using their products to reveal the weaknesses in their designing and making processes. Revealing equally worthwhile alternatives. Preparing them for future DMAs.

The strategies for achieving closer attention to thinking skills in the design and technology context include:

- teacher reflection on, and modelling of, thinking skills
- pair problem solving
- co-operative learning
- group discussion.