Effective

Information and Communication Technology

Revised edition

Nigel Zanker

Series Editor: Professor Trevor Kerry

The Series Editor

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Statement of principles

The books in this series are based on a particular philosophy of teaching, which was largely developed (but not fossilised) in the 1980s as a result of the Teacher Education Project in the Universities of Nottingham, Leicester and Exeter – of which the series editor was Co-Ordinator. This philosophy has stood the test of time and, it is argued, better meets the needs of teachers as professionals than some more recent developments, such as some competence models, which tend to trivialise the art and science of teaching. The principles of this philosophy are as stated:

Practical teaching consists of skills

- Skills can be isolated and identified
- Skills can be broken down into component parts
- Skills can be studied and taught
- Skills can be learned
- Skills can be reflected upon and refined
- Skills can be evaluated and assessed

Each book takes a particular teaching skill and uses the latest research and practice to illuminate it in ways of immediate interest to all teachers.

Editorial: Skills for the future

The pace of change in society is constantly accelerating. This change is reflected in the world of education. Indeed, Drucker sums it up like this:

> *Every few hundred years in Western history there occurs a sharp transformation ….. Within a few short decades, society re-arranges itself – its worldview, its basic values, its social and political structures; its arts, its key institutions. Fifty years later, there is a new world …*
> *We are currently living through such a transformation.*
> ***(Drucker, P (1993) Post-Capitalist Society. New York: Harper Business, p1)***

> *What will be taught and learned; how it will be taught and learned; who will make use of schooling; and the position of the school in society – all of this will change greatly during ensuing decades. Indeed, no other institution faces changes as radical as those that will transform the school.*
> ***(Drucker, op.cit. p209)***

Yet it could be argued that even those changes have been modest in scope and pace compared with the changes that are likely to occur in the early years of the twenty-first century. Already the portents are visible of events are visible of events which may affect radically *Schools for the Future.* These are just some of the changes of the recent past:

- the advent of the new learning technologies
- consumer choice and its implications for schools
- a re-definition of the nature of schools in the education process
- the changing place of Britain in the global economy and in the development of global markets
- concerns about environmental issues and the use of resources
- re-valuation of the place of non-teaching staff in the education process
- the pressure to achieve 'more for the same' brought about by budgetary constraints and increased emphasis on targets and performance measures

So how should schools be responding to these challenges, and what can be done to support them?

School responses

Schools are already exploring solutions for a changing world. Some of these approaches can be broadly categorised as follows:

Increasing the emphasis on learning

Traditionally, the world of education has concentrated on teaching, making the assumption that learning will follow inevitably. However, the emphasis of the late 1980s and the 1990s on assessing and recording standards of achievement has forced a re-thinking of this simplistic view. Students' learning rather than teachers' teaching is increasingly seen to be at the crux of the education process: the emphasis has moved from inputs to outputs.

Re-aligning teachers to be 'directors of learning'

The increasing emphasis on the process of learning has caused many schools, and teachers themselves, to review the teaching function. Teachers often now conceptualise their roles more in terms of 'directors of learning' than as purveyors of teaching. The change is a subtle one which does not deny the traditional ' art and science' of teaching; but it concentrates more on the use of those skills to bring about learning in the student.

Assessing the implications of the new technologies

Among the most powerful resources which teachers, as directors of learning, have at their disposal is the developing technology bound up in Information Technology. This opens up entirely new avenues of communication, making access to data simple, self-study a powerful tool, and availability if information international.

Extending teachers' roles to be managers of the learning environment in its widest sense

Old-fashioned concepts of 'one teacher, one class' for primary schools, or of 'one subject specialist, one class' in the secondary sector are, in the scenario we have painted, as redundant in the twenty-first century as Victorian pupil-monitors are today. The teachers of the future may exercise less of a role in class control or in the traditional skills of exposition: they may well be the programme-makers and resource creators of the future. They will not 'do the teaching', they will manage (in every sense) the intellectual environment that students will inhabit.

Reappraising patterns of learning

One of the implications of the picture painted here is that not only will teachers' roles and patterns of working change, but so will those of the learners. With more and more computers home-based, even portable, not all learning will need to take place in schools as they are currently modelled. The purposes of school buildings and their patterns of use will become subject to reappraisal.

What must we do?

Education stands at a cross-roads. One of the ways in which some educationists are dealing with this is to establish projects, such as the *Schools for the Future* project with which I have been involved at the University of Lincolnshire and Humberside. The project is primarily intended to support developments and changes for this twenty-first century world. It is attempting to do this in a number of ways, as shown below.

Through an analysis of change as it affects education

The project will be alert for, and seek out, the global and national trends in education which are likely to affect schools and learning in the immediate future.

Through research into innovative practice

In particular, the project will seek out innovative practice, large or small-scale, in Britain and overseas. Whenever, possible, we will try to explore at first hand not just the problems and their solutions, but the decision-making processes and creative approaches which have been used.

Through a specific research project on the use of school time and plant

The project team is already involved with a Funding Agency project in a group of schools in London. Here we are experimenting with one of the fundamental issues to face *Schools for the Future:* the structure of the school day and the school year. This is a collaborative venture located in three schools in which we shall be monitoring and evaluating not only the outcomes (in terms of new patterns of attendance and their effects), but also the kinds of radical thinking which are used to arrive at solutions.

Through an examination of the developing uses of new technologies in schools

One of the keys to future developments in education will, inevitably, be the uses to which new technologies are put. These are already developing as a powerful tool for communication, and to a lesser extent for learning. These parallel developments are set to continue; and the ways in which they are adopted into, and woven into the fabric of, educational provision in the future are potentially very challenging to traditional thinking about schools and their functions. The project will seek to explore both innovation in this field, and to speculate about alternative models of learning.

Through an examination of the decision-making processes and mind-sets needed to bring about dramatic change

This project is about dramatic, rather than marginal, change. In the project's studies of innovative practice we shall be as concerned with the thinking process leading to change as with the change itself. These are largely uncharted waters, and we shall be breaking new ground in exploring this issue – which may have implications for the selection and education of leaders for the future.

Through dissemination of best practice

A fundamental purpose of this project will be to pass on to the education world the lessons which we are able to learn. We shall do this through whatever channels are most appropriate: visits, courses, conferences, books, journal articles, in-service training events, the Internet and the media. Our main concern will not be to provide examples of practice which others may copy directly in their own situations, but to tease out the principles which others may apply to reach their own conclusions in their unique situations.

What are the broad philosophies behind the project

Schools for the Future is based on the principles of re-engineering. Michael Hammer defines re-engineering as:

> *The fundamental rethinking and radical redesign of business processes to bring about dramatic improvements in performance.*
> **(Hammer, M and Champy, P (1997) The Re-engineering Revolution Handbook, New York: Harper Business, p3)**

At the heart of the re-engineering philosophy is the client/customer. Re-engineering is about providing a better service in a changing environment; but it is more than tinkering with structures to achieve marginally more acceptable results. Re-engineering uses the best insights from other management theories (team-work, total quality management, etc), but is much more than the sum of these parts. It is a mind-set that uses creative thinking in a focused way to achieve quite different ways of working. It is anticipatory rather than reactive.

Re-engineering and teaching skills

This series of books of teaching skills has developed out of my interest in re-engineering as well as from my long-term involvement with the initial and in-service training of teachers. Part of the intention of the series is to identify those traditional teaching skills which will continue to be fundamental to the teacher in the twenty-first century, and to provide a means of support for those who wish to acquire or improve them. Thus class management is likely to remain a fundamental skill for teachers: but its nature will change to accommodate the new roles for teachers as directors of learning and as managers of para-professionals in the classroom. However, other skills, such as the exploitation of the new technologies, are of recent origin and will have to be assimilated by all teachers, including those who perhaps trained for a school system which operated rather differently in the recent past.

Education is changing rapidly; and the nature of the teacher's job is changing, too. Some people find change only negative and disturbing. This series treats change as a positive phenomenon: one which challenges and excites. Hopefully, these books do not lose sight of traditional wisdom nor of the continuing values of which the profession is rightly proud. But they do look forward in a spirit of progression and development to where schools are going rather than to where they have been.

Professor Trevor Kerry
Series Editor

Chapter 1

Why we need a manual of information and communication technology teaching skills

Introduction

The theme running throughout this series on *Effective Teaching Skills* is to consider the states of affair in a particular area of teaching and to propose ways forward to maximise the effectiveness of that area. The underlying philosophy is not to throw out the old to make way for the new, but to consider what exists and how it may be reengineered 'to bring about dramatic improvements in performance' (Hammer and Stanton, 1995). However, reengineering does require an organisation to be willing to sacrifice old ways of doing things in the interests of making improvements. In this book the starting point, based on reengineering principles, is to help teachers to address the problems of integrating Information and Communication Technology (ICT) in their lessons, their subjects and their school's curriculum provision.

In 1997 the Government recognised the need to allocate funds to address the problems in integrating ICT into schools, which had faced schools for a decade or so. This funding, the New Opportunities Fund, spread over the period from April 1999 to December 2002, is intended to support the ICT training for teachers and librarians in the UK. The emphasis is to be on skills-based training rather than allocation of additional resources. What is yet to be seen is whether it will live up to the claims of 'making a real difference to standards of pupils' achievements' and that the 'training for school teachers will ensure that they have the confidence and competence necessary to make effective use of ICT in subject teaching'. (DfEE/TTA, 1998)

Critics argue that the funding, equivalent to a few hundred pounds per teacher per year, may not go far enough to bring about improvements in the use of ICT in teaching and learning. This is because the problems with ICT in schools may have been as a result of insufficient funding for resources. However, it is not universally accepted that the problems are essentially associated with resourcing, especially considering that large amounts of money

have been spent on providing IT resources, since the early 1980s, by successive funding initiatives.

Unfortunately, new technology quickly becomes old technology because of the pace of technological change; a pace that has accelerated in the last two decades (and continues to do so). The consequences of this are that funding providers have been unable to keep abreast, and that educational institutions use ICT resources until either they become unserviceable or until funding for replacements can be found; the former invariably being the more usual, which then necessitates the latter. Reengineering alone may not bring about the desired change because it requires that each of the processes and resources are in place - but not necessarily working together. If the problems facing ICT in education are acknowledged as mainly a consequence of lack of resourcing, then the solution may be simple: provide the resources and the rest might follow, on the grounds that if we give teachers the tools they will do the job. Unfortunately, this has not been so; resources have been provided but without the required support and training.

The provision of skills and resources may not be as simple as it appears. Whether or not the problems relate to reskilling or resourcing, the real issue that is often overlooked is that of knowing how. Skills-based training requires that, having learnt the skills, the recipient of the training not only knows how to apply and adapt the skills to the workplace situation but is also given the opportunities to do so. Skilful performance is typified by knowing how to apply skills to changing situations. If this is not the case then all the learner has learnt is a series of tricks. As every teacher knows, no one technique will work in every situation. A skilled teacher is one who applies and adapts teaching techniques according to the prevailing circumstances, *ie* can employ strategies that match lesson objectives to meet the needs of all pupils.

In applying such principles to the use of ICT in the classroom, we should ensure that the skilling process includes more than theoretically knowing how, and when, to apply the skills. To bring about change this must be through monitoring and support of the realisation of these skills in the learning environment. It is important at this point that there is no confusion between knowing how to *use* and knowing how to *teach* using ICT resources, though the two are closely interlinked. Indeed, it would be difficult, but not necessarily impossible, to

know how to teach using ICT resources without knowing how to use them; a matter to be explored in more detail in Chapter 2 in this book.

To summarise, a chicken and egg situation exists. The problems facing integration of ICT into schools, arising from each of resources, skills and knowledge, may have acted to prevent one from bringing about improvement in the other. The aspects of skilling, resourcing and knowing are dependent on each other to varying extents. It is important not to neglect one aspect at the expense of the others when considering training needs and curriculum provision.

One of the principal reasons, then, for needing a manual of information and communication teaching skills is to allow educators to consider the relationship between the knowledge, techniques and resources needed to provide effective teaching and learning opportunities in institutions and the classroom. Two general criteria of effectiveness are:

- the extent to which there is a match between knowledge, techniques, resources and outcomes;

- whether techniques and resources are fit for purpose in raising levels of attainment and progress.

The main concerns running throughout this book are:

- the nature of both new and traditional teaching techniques;

- the relationship between technological advances and their effectiveness in promoting good attainment and progress in children's learning.

The commentary and activities that follow are aimed at raising your general understanding and development of skilful performance in using ICT resources. This book is essentially a practice manual of what you can do with ICT in promoting effective teaching and learning.

For each activity in this book you should note your responses on paper or use the ICT resources available to you. Whatever method you use it is important that you give some attention to each activity. This is because the activities will allow you to build up a picture of where you are now, where you are going to and how you are going to get there in developing your own and your learners' ICT capability. You should keep a log of personal development. The activities are designed to allow you to respond irrespective of your level of experience and expertise.

Activity 1

Identifying the ICT resources you already use

The purpose of this activity is for you to consider the ICT resources that you have used recently.

Make a list of the ICT resources that you have used in the last few weeks. Your list does not have to be restricted to computer systems – for example, it can include photocopiers, all types of camera, videos, *etc*. In fact, it should include any electronic means for handling or communicating information.

Now think about the ICT resources that are available to you and consider reasons why you did not make use of them.

Keep your written responses in a file so that you can refer back to them for use in Activity 5.

Past and present

In *The Children's Machine*, Papert (1993) tells a parable about a party of time travellers from an earlier century. Members of this party include groups of surgeons and teachers who are transported into operating theatres and classrooms to observe present-day developments in their respective professions. He suggests that the time-travelling surgeons would be unfamiliar with the objects and techniques in the theatre and would have difficulty in taking over the operation. However, the time-travelling teachers, whilst puzzled by some

of the objects and techniques in the classroom, would have less difficulty in taking over the class. Papert concludes his parable with the question:

> 'Why, through a period when so much human activity has been revolutionised, have we not seen comparable change in the way we help our children learn?'

In considering an answer to this question, many educators may be indignant and possibly reply with the question, 'Should we have seen change in the way we help our children learn?' and the supplementary question, 'If so, then why should we?'

My own answer to Papert's question, after some considerable reflection, would be a reserved, 'yes, we should have seen changes, albeit subtle.' I believe that in recent decades these advances have changed the way we help our children learn. However, the problem I have with the question is the concept of comparable change in relation to the objects and the techniques. In the field of medicine the impact of the objects, through technological advances, has had a strong influence on the techniques. This has resulted in the development of new techniques and the discarding of many traditional techniques. Nevertheless, many traditional techniques do still exist because they work in relieving or curing patients' ailments. It is only those techniques, superseded by better ones, that have fallen by the wayside. In the field of education the same is essentially true, but the influence of technological advances on the techniques may be less obvious.

In education, the concept of comparability may not extend to the discarding of traditional techniques in order to make way for new techniques to the same extent. It may be that educators have given insufficient consideration to the validity and reliability of more traditional techniques in the present-day classrooms, *ie* change by accident. Alternatively, it may be that those techniques are perceived as still having a place because they work in promoting the required learning, *ie* change by design. In other words, teachers quite understandably stick to techniques that they know are safe and that work. Either way, by accident or by design, such techniques may exist alongside new techniques, each of which, old or new, may make use of the technological advances arising through the impact of the 'objects'.

Activity 2

Examining your philosophy to change in education arising from technological advances

In Activity 1 you may have been surprised at the number of ICT resources that you make use of other than computers. In this activity you will start to consider the extent of change in teaching styles arising from technological advances in the last few decades.

Re-read Papert's parable above and my own response to his question about comparable change.

Use his question as a basis for considering your own philosophy to educational change arising from technological advances. Keep your written notes safe in your file.

Comparing technological impact on how we were taught and how we teach

Each of us has early recollections of how we were taught, or how we taught at the start of our educational careers. We are unable to go back a hundred years but we can go back a decade or so. For the next activity you will need to select some point in time in your own past. This could be either at the start of your educational career or some time in your own education at school. If you are a primary teacher and you have decided upon sometime in your own education, then you will need to recall you primary education. Similarly, if you are a teacher in a secondary or tertiary institution then recall your education in that phase. In Papert's parable he refers to 'techniques' and 'objects', which we understand as teaching methods and resources. To consider the extent of change we need to compare a then and now situation. The example in Figure 1, below, shows a comparison of the resources available in 1978 and now for three teaching methods.

Figure 1

The impact of technological advances on three teaching methods over a period of almost three decades

Method	Resources (1978)	Resources (now)
Chalk and talk	notes; chalkboard and chalk; photographic slides; overhead projector	as in 1978 with alternatives such as marker-board; data projectors; presentation software
Group work	activity sheets (spirit duplicated)	activity sheets (photocopied, word-processed); computer to help produce, edit and store worksheets; DTP software for better layout; (pictures easier to include); photocopying technology.
Finding information	textbooks	as in 1978 with alternatives such as CD ROMs, Internet

Activity 3

Identifying the impact of technological change on your own practice

Using Figure 2, in the first column build up a list of teaching methods you use today. For the activity to have some value include a minimum number of 10 methods. There is no maximum limit to the number of methods in the list, and it can be added to at a later date.

In the second column select some point in time in your own past. Insert the year you have selected and list the main resources required for each of the methods to have been effective. (By 'main', I do not mean the inclusion of furniture or essential services; likewise do not include learners as resources.)

In the third column list the resources that could be used (or that you do use) even though they may not be available to you, or you do not make use of them yet. Again, exclude furniture, fittings and learners.

Figure 2

Template for Activity 3

Method	Resources (then)	Resources (now)

Activity 4

Analysing your responses so far

When you have completed Activity 3 using Figure 2 as a template, you should start to analyse your responses. Some key questions emerge, which at the moment you may only be able to provide incomplete answers. These questions include:

- Do your responses to Activity 3 affect your answer to Papert's question?
- Do you know what technological advances are available to you? If your answer is yes, then:

  To what extent do you make use of the technological advances which you have available to you?

  Do you have access to the technological advances to make an impact on your teaching?
- How many of the teaching methods in your list did not exist in the year you considered in the scond column? If your answer is none, then how many teaching methods can you think of that are new?

Activities 3 and 4 are intended to suggest that, in education, there may not be many new teaching techniques and that old techniques have become adapted to make use of technological advances. There are flaws in the activities because little interpretation has been provided on what is meant by technological advances, teaching techniques, or teaching skills. These are matters that will be explored in greater depth in strands running throughout this book.

The key issue that arises from this is that, whilst there may be few new techniques, there may be many new skills, using advances in technology, which teachers need to develop in order to make their teaching more effective in maximising learners' attainment and progress.

Identifying your professional development needs

The next three activities (5, 6 and 7) will allow you to consider your own situation relating to the resourcing, skilling and knowledge aspects of ICT in your school and to start to identify and prioritise key professional development needs.

Activities 5, 6 and 7 can be adapted to fit a range of circumstances. If you are:

- a trainee teacher then you will be considering your initial teacher training needs;
- a qualified teacher then you will be considering your continuing professional development needs;
- a Head of Department (secondary school) or Subject Coordinator (primary school) then you will be considering departmental or subject needs;
- a School Coordinator for ICT and/or a Senior Manager then you will be considering whole school needs.

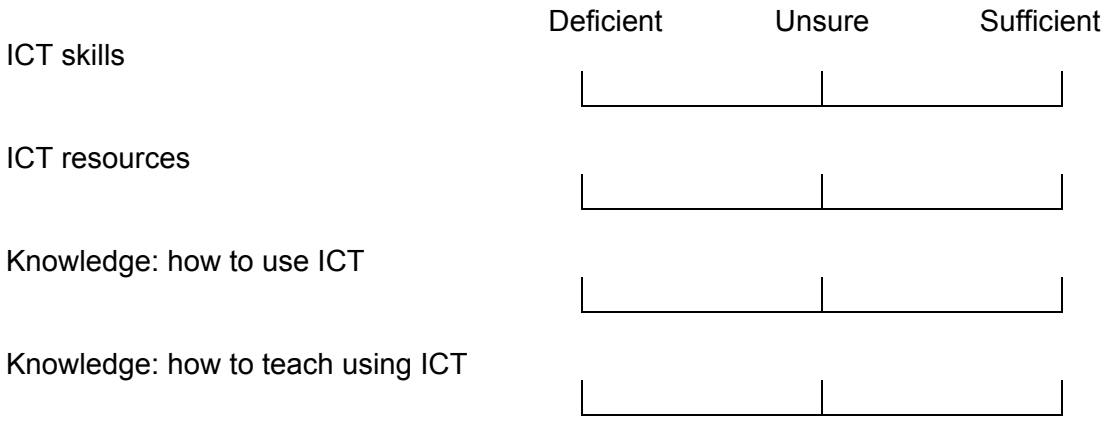
Resources, skills and knowledge and their impact on your classroom teaching

The first issue that you will need to consider, when identifying professional needs relating to ICT, is whether the main difficulty arises from the levels of sufficiency of teacher skills, ICT knowledge or ICT resources.

Figure 3 is a set of grids that has been designed for you to make judgements on your feelings about levels of sufficiency for four aspects affecting provision for ICT in teaching and learning. For each aspect, the scale used ranges from extremes of sufficiency to deficiency with a mid-point to indicate ‘unsure’. Illustrative examples are shown in Figure 4 for different cases.

Figure 3

Grids to assist making judgements on sufficiency of aspects affecting ICT provision



For each extreme on the scales in Figure 3:

- **Deficiency** means no skills, no resources to fulfil requirements, no knowledge of how to use ICT resources and no knowledge of how ICT can be used to support teaching and learning.

- **Sufficiency** means skilled to fulfil all curriculum/subject intentions using ICT, resources available and accessible to fulfill requirements, good knowledge of how to use ICT resources and good knowledge of how ICT can be used to support teaching and learning.

- **Unsure** on the scales may apply, for example, to teachers who:
  - have no aspirations of using ICT to support teaching and learning
  - know what can be done and what is available but does not know how to fulfil aspirations.

Figure 4

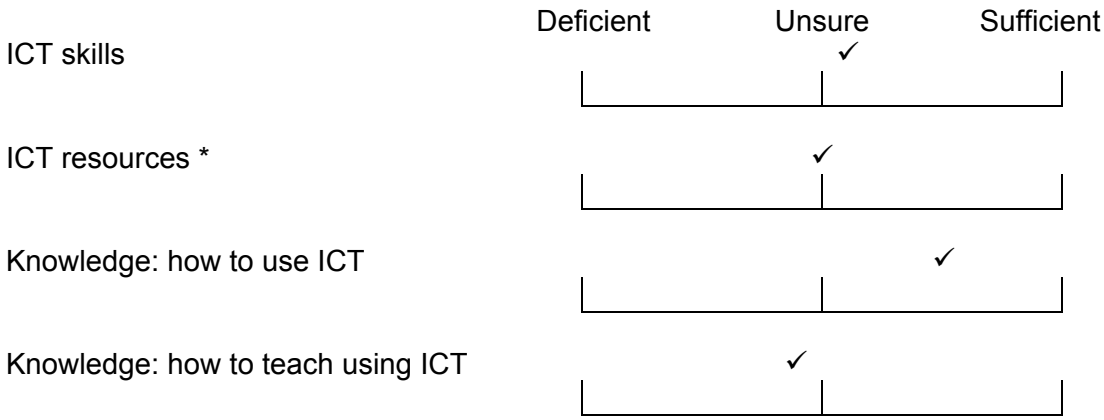
Examples of completion of grids to assist making judgements on sufficiency of aspects affecting ICT provision for different cases.

Example 1

A teacher with five years' teaching experience who feels that their personal knowledge of ICT is good and can use a computer for a range of purposes at home. The teacher has difficulty knowing how to use the resources available in school, which are not easily accessible and are older than those available at home.

Example 2

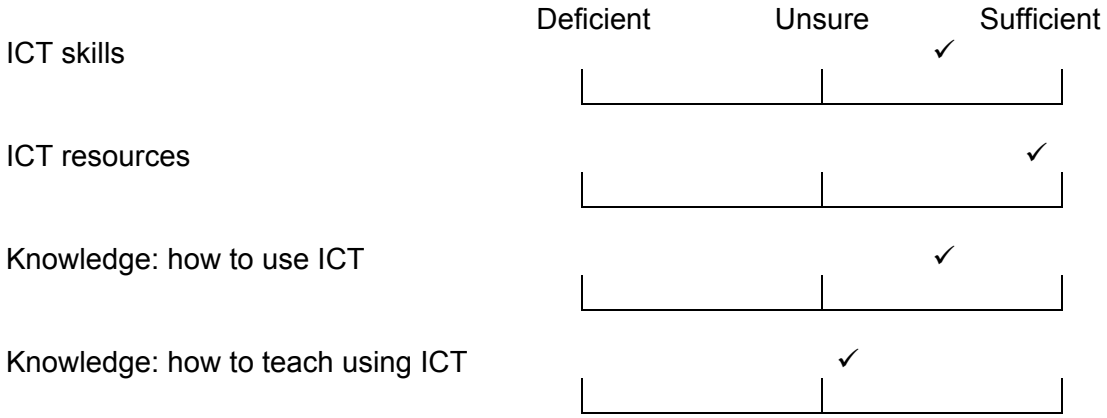
A trainee teacher who is embarking on a first teaching practice. Prior experience and knowledge is use of a computer as an undergraduate and teacher training on the opportunities for using ICT resources in the classroom.



* At the start of the teaching practice the trainee is not aware of the resources available in the school and, therefore, would have difficulty in making a judgement on the sufficiency of resources. An activity for the trainee would be to identify whether the resources exist to meet teaching aspirations.

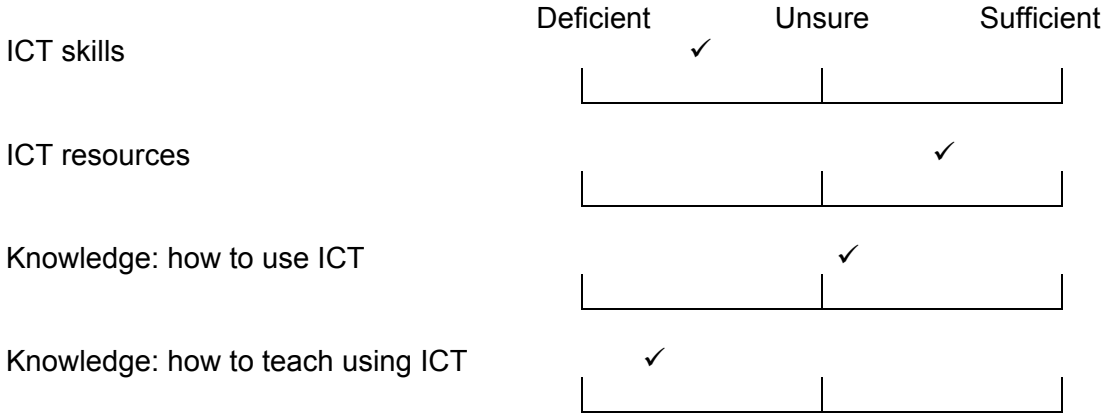
Example 3

A newly qualified teacher who is working in a school that has recently upgraded its ICT resources. The teacher has made extensive use of ICT to support learning but, nevertheless, feels that further skills could be acquired through continuing professional development, rather than from the use of own resources outside school.



Example 4

A curriculum coordinator for ICT in a school with 40 teaching staff. The coordinator is concerned that whilst most staff appear to recognise the potential for using the resources, which are continually being updated, few actually do so on a regular basis. Each member of staff has been asked to complete the set of grids in Figure 5. From the 30 grids returned, the coordinator has produced summaries, one for each department, of the responses to help identify staff perceptions and their training needs. Below is a summary for one department in the school.



Activity 5

Considering sufficiency of ICT resources, skills and knowledge in your lessons

Look again at Figures 3 and 4. Decide whether the main difficulty in integrating ICT into your lessons arises from the level of sufficiency of skills, knowledge or resources.

Complete a copy of the grids in Figure 3 to give a rough indication of your judgement for each of the aspects as they relate to you in your school situation.

You may wish to photocopy the grids for use by colleagues to in order to form a collective view. Curriculum coordinators or senior managers may find the grids helpful to identify staff perceptions of sufficiencies of skills, resources and knowledge in the school.

In Activity 5 you indicated a series of judgements about levels of sufficiency using an inexact quantitative method. These judgements need to become qualitative to help identify training needs and their priority. Activity 6 and Figure 5 will allow you to start this process by asking you to produce the evidence on which you made your judgements.

Figure 5

Template to indicate reasons for judgements on levels of sufficiency for aspects affecting ICT provision for Activity 6

Aspect	Reasons underlying judgements on sufficiency
ICT skills	
ICT resources	
Knowledge: how to use ICT	
Knowledge: how to teach using ICT	

Activity 6

Making judgements about your skills and knowledge, and the resources available to you

Whether you completed Activity 5 for individual needs or for your institution, use Figure 5 to record the reasons why the particular positions were indicated on the scales for each of the judgements made about levels of sufficiency.

If you are undertaking this activity as a curriculum coordinator to identify school or departmental needs there are some extra steps required:

- give careful consideration to staff perceptions by revisiting individual's responses; beware of making judgements based on the general rather than the specific needs;

- do not try to make judgements on behalf of others from the information they have provided in Activity 5. Either:
  - form hypotheses and test their validity with individuals, or:
  - invite each individual to complete Activity 6 and then collate the responses.

Translating professional development needs into targets

Activities 5 and 6 enabled you to take the first steps in the process of identifying your professional development needs. The next steps in the process are to analyse the judgements and their underlying reasons and to translate them into action plans containing clearly identified and achievable targets. When targets are defined it is important that they:

- are achievable as small steps forward and are capable of being realised by a set point in time;

- are written in a precise form as a clear statement of the action, the requirements, the timescale and the outcome using unambiguous language that is free of jargon;

- identify guidance and support required – which personnel will be required to help the individual or the institution;

- identify resource implications – those resources that exist already and those that will need to be obtained;

- identify the goal – the successful completion state that the target is to achieve, *ie* the outcome and its deadline.

If the above criteria are not followed then the targets will probably fail to address the needs of the individual or the institution.

To illustrate these criteria, Figure 6 contains examples of targets and a commentary on the likelihood of the intended goals being achieved. The targets for an action plan will fall into the categories of short-, medium- and long-term goals. To begin with, you do not need to concern yourself with this matter. The first task is to formulate the targets and then to prioritise them in a sequence for action, which may include their chronology.

Figure 6

Examples of targets and their likelihood of achieving their intended goals

Target	Commentary
To continue to use spreadsheets.	This is not a target because the action does not indicate developing competence or a change of position.
To develop the use of spreadsheets.	An intention is stated which suggests a target, but it is too broad. There is no indication of guidance and support, resourcing, goal, or timescale.
To develop the use of spreadsheets for recording pupils' attainment and determining their progress.	The target is clearer because a precise goal is stated. There is no indication of guidance and support, resourcing or timescale.
To identify the ICT resources required to develop the use of spreadsheets for recording pupils' attainments and determining their progress.	The target now includes consideration of resources in relation to the goal, but not the nature of guidance and support. A timescale for the goal is needed.
To identify the ICT resources required, and the guidance needed, to develop the use of spreadsheets for recording pupils' attainments and determining their progress during the next month.	This is a good target. It addresses guidance, resources, goal and timescale. It is ambitious but can be used to set an agenda that is achievable. Perhaps two targets are necessary to develop what is needed and to develop the competence.
To use the ICT resources and expertise that exist in the department to develop the use of spreadsheets for recording pupils' attainments and determining the progress during the next month.	This is also a good target because it acknowledges that the resources and supports exist to meet the goal. It is achievable.

The purpose of Activity 7 is for you to revisit your responses to Activities 1 to 6 in order to devise an action plan that:

- considers how to make use of technological advances in the teaching methods you use;
- addresses some of your concerns about sufficiency of skills and knowledge;
- uses existing resources in the first instance;

- contains short-term targets that lead to realisation of goals through being achievable and precise, and that identify the guidance, support, and resources required.

If you are:

- highly-skilled in the use of ICT to support teaching and learning then your targets could address how you will support the work of colleagues in improving their use of ICT;

- a trainee teacher then your targets should be discussed with you mentor and their goals achieved by the end of the teaching practice;

- an ICT Coordinator, Head of Department in a Secondary School, Subject Coordinator in a Primary School, or a Senior Manager then you could use this activity with staff to produce a short-term action plan to address whole school or subject needs.

In undertaking Activity 7, do not try to achieve too much at once. When the targets have been met, *ie* their goals have been achieved, reflect on the successes and build on them by repeating the process to include medium- and long-term targets.

Initially, short-term targets should use the resources that exist, but as the cycle is repeated and your confidence increases in your use of ICT, the targets should evolve to consider the goals that can be achieved if new ICT resources are forthcoming. If this happens then your capability is increasing and you should begin to recognise the potential of ICT to help teaching and learning. However, if the resources are not forthcoming then the process of improvement may stop abruptly. Action planning should be an iterative process, which, if managed carefully and sensitively, will bring about change through a series of small but significant steps.

Activity 7

Producing your action plan of short-term targets

Look back over your notes for Activities 1 to 6. Produce an action plan that contains four short-term targets. Each of your targets should be achievable within one school term, or 12 weeks, and lead to improvements in your use of ICT to support your teaching and pupil learning. Each target in your action plan should address one of:

- the teaching and learning requirements of the National Curriculum or examination syllabuses (*eg* in relation to a specific area of a programme of study in a subject you teach);
- the administrative requirements of teaching (*eg* in relation to a specific area of assessment, recording or reporting of attainment and progress);
- the preparation and planning requirements of learning experiences (*eg* in relation to producing teaching materials).

There should be at least one target from each of the above three categories.

Where to from here

In this opening chapter I have attempted to indicate why we need a manual of ICT teaching skills, by suggesting that there needs to be a considered approach to managing and promoting the development of teachers' skilful performance. This is especially so because of the increasing impact of technological advances on facets of our everyday life. The activities have offered a model for this approach by focusing on allowing teachers of all levels of experience, from trainees to Curriculum Managers, to establish the status of ICT in their teaching or their institutions and to plan for improvement in ICT provision.

So far, I have intentionally placed greater emphasis on teachers rather than pupils because initial concerns are about teachers' ICT capability. In the rest of this book the emphasis shifts to the teachers' ability to provide and support the pupils' use of ICT. This is because the greater concern is how the ICT curriculum requirements, to which pupils are entitled, can

be met. Each of the chapters that follow builds on and expands the issues introduced in this opening chapter. The activities will support you in developing your own and your learners' ICT capabilities.

In Chapter 2 the key issue discussed is that ICT capability is not ad hoc learning, but requires a pedagogy, which may not be new. Generic and proven teaching skills, which 'good' teachers use to support learning are explored and discussed in relation to how they may be applied in developing pupils' ICT capability. Emphasis is placed on developing this capability through contextual learning tasks that are *built into*, as opposed to *bolted onto*, lessons. Chapter 3 offers a short review of theories of teaching and learning in general education and their place within ICT education. Continuity and progression in pupils' ICT capability are explored in Chapter 4 through consideration of the problem of identifying what pupils already know and can do and where the learning has taken place.

The concerns that teachers frequently express about ICT resources not being available or in the wrong place when they need them is explored in Chapter 5. These concerns include the perceptions that those responsible for the resources are gatekeepers, and that whilst one computer is insufficient for teaching purposes, a room full of computers is frightening to many teachers. The issues relating to ICT resources management, access, deployment and pupil-computer ratio are discussed. This chapter also considers health and safety and ethical issues.

The discussion and activities in Chapter 6 focus on planning subject-specific activities in a whole curriculum context to cover different strands of ICT. The strands explored are modelling, measurement and control, communication and information handling. The activities and discussion concentrates, initially, on these strands outside of an ICT context and then moves onto how tasks can be developed using appropriate ICT resources. Emphasis is placed on the concept that ICT resources should not be viewed solely as physical entities to undertake menial tasks, but as metaphysical tools to assist cognition.

The final two chapters tie together the issues and concepts covered in previous chapters. Chapter 7 expands the target setting introduced in Chapter 1, and the matters explored in Chapters 2 to 6, to produce substantive action plans and school policy in relation to ICT.

The intended purpose is to assist the teaching profession in improving the quality of education provided to raise the standards of provision for ICT, especially in the quality of its teaching. Chapter 8 provides bibliographical notes on the sources used in previous chapters to assist teachers and institutions in developing their delivery of ICT.

Chapter 2

Old skills and new skills

Distinguishing knowledge, skills and understanding

This chapter deals with the skills required by teachers to use ICT resources and to teach using these resources. The first issue requiring consideration is the confusion surrounding knowledge and skills.

> "Now what I want is facts. Teach these boys and girls nothing but facts. Facts alone are wanted in life.... You can only form the minds of reasoning animals upon facts: nothing else will ever be of service to them.... Stick to Facts, sir!"
>
> **(Charles Dickens (1854), *Hard Times*, Chapter 1: 'The One Thing Needful')**

The philosophy presented by Dickens is from an era when 'to know' something meant 'to understand' or 'to be able to do something'. It is alarming to reflect and then to realise that times may not have changed and that knowing about something is too often the measure of understanding or being able to do something. It is the difference between the knowledge of, the understanding, and the ability to do something that is often considered in a confused manner.

For example:

- **whilst** progress is defined as gains in knowledge, skills and understanding;
  and attainment is defined as what pupils know, understand and can do;
  then assessments of progress and attainment are invariably made using methods designed to test, principally, what knowledge, or facts, pupils know.

- **whilst** teachers are considered to have insufficient ICT skills;
  and teacher training schedules are intended to increase ICT competence;
  then the training methods and its assessment are invariably knowledge driven.

In each of the examples above, emphasis is placed on the assessment of knowledge as a measurement of understanding, rather than the ability to do something to the required specification. In other words, the assessment of competence or of skilful performance, perhaps unwittingly, is predominantly knowledge-based. However, to be able to do something, there does need to be an underlying knowledge and understanding. If there is no knowledge about, or understanding of the task, then the result will either be an inability to start or to complete the task. The confusion between knowledge and skills in assessing competence needs further consideration. The following analogy helps illustrate the point.

An analogy

Using a computer is often likened to driving a car. Proponents of this analogy assert that a knowledge of how either one works is unimportant in being able to use it for its intended purpose. The analogy often lacks depth, in that, apart from Piagetian age dependent readiness (see p44), a baseline knowledge is required to be able to control the machine in both cases. The limit to this baseline may, however, be confined to that of the user or consumer, rather than to that of a technician or mechanic.

It is worth, however, exploring the separate cases of car driver and computer user in order to consider the breadth and depth of the knowledge that is applicable for effectiveness at various skill levels. As you read through the description of the car driver below you will detect that the line between knowledge and skills is blurred. This is intentional to illustrate that, in order to be able to perform a task (*ie* skills), then certain facts (*ie* knowledge) need to be known. In other words, you need to know how to do something before you can be sure. The problem is a ‘wicked problem’ (Rittel and Webber, 1974); how do you know what it is you need to know in order to perform a task?

In the case of the car driver, a detailed technical knowledge of how the component parts function is not essential. However, there is a baseline which is above that of no knowledge. For example, a knowledge of the function of the car's controls is essential if it is to move in a given direction and at a particular speed under the driver's control. Similarly, a knowledge of what to do in response to actions and events (*ie* road signs and conventions, road conditions and other drivers) is essential if the driver is to remain in control and avoid having an

accident The baseline knowledge relates to the control of the car under a range of conditions. Assessments of competence are based:

- on knowledge of conventions as a road user;
- skills in driving the car and application of the baseline knowledge.

Moving from the baseline, the car driver may, with experience, acquire knowledge of some of the component parts of the car. Furthermore, some gains may be made in the understanding of when and how to recognise that it is not functioning as it should. There are at least two benefits. First, the driver can obtain technical assistance before the malfunction worsens (therefore avoiding increasing maintenance costs). Second, the driver may feel sufficiently competent to attempt some routine maintenance (again avoiding maintenance costs).

As the driver gains experience, perhaps with additional instruction, the skill and knowledge levels will eventually reach a maximum. This maximum, therefore, indicates the limit of the driver's competence or capability, as user or consumer, in driving or technical proficiency. Additional instruction, which is not essential, may take the form of training in acquiring additional knowledge and skills relating to the maintenance of the vehicle, or relating to controlling the car.

Taken one step further the driver may be sufficiently motivated to train as a driving instructor, a mechanic, an engineer or a car designer. In these instances the user/consumer has made a transition to instructor, technician, maker or designer, but, at the same time, retains the former status. If this transition is not made, which is invariably the case, then, as proficiency increases, the driver becomes a more discerning user. This phenomenon may be most apparent when the driver replaces the vehicle, because the criteria used to select the replacement are that it should not have the unsatisfactory characteristics of its predecessor.

For the case of the computer user, a similar chain of argument may be followed, because to use a computer a baseline knowledge exists. Several key questions emerge for you to consider in Activity 8.

Activity 8

Developing skilful performance in using a computer system

Read back over the development of skilful performance in driving a car (above). As you read, consider the analogy for the case of learning to use a computer system. Record your responses in your file so that you can refer to them in Activities 9 and 10.

- What baseline knowledge is needed to use a computer?
- Where does the balance lie between knowing how the component parts work and knowing how to use the component parts?
- Does the computer user need to know how the programs work?
- What instruction is needed to develop the skills of proficient use to become a discerning user?

The typical computer user

As you attempted to answer the questions in Activity 8 you may have realised that there is no such person as a typical computer user, though the typification may be the 'home' user. The ambitions and aspirations may vary according to the motivation of the home user to a greater extent than a car driver. These home user variations range by the purposes for which the computer is used. For example:

- by children to help with homework;
- solely for games playing;
- in pursuit of a hobby, which may be, itself, using a computer;
- for electronic mail and Internet access;
- for administrative tasks in the home;

- for work brought home from the workplace;

- for the range of purposes in the preceding bullets points.

For each of these examples the baseline knowledge may be limited to knowing how to use the components parts rather than knowing how they work (*ie* technical knowledge). However, through developing proficiency in using the computer and its peripheral components (*ie* the whole computer system), the home user will acquire increasing knowledge of how the parts work. Therefore, technical knowledge is acquired, in part, through increasing skilful performance, because an element of self-instruction comes in to play. This element is that the home user wants the computer to do more and more. In order to achieve this the home user becomes sufficiently motivated, either to refer to the documentation that came with the computer system, or to buy one of the computer magazines available each month. Currently, the sale of computer magazines directed towards home users are amongst the highest-selling magazines, especially with the enticement of 'free' programs worth hundreds of pounds.

There is a paradox here. The user is initially confused by the complexity of the technical documentation, which is jargonised beyond normal comprehension. Many proficient home computer users, therefore, make the transition to discerning users through a process of self-directed study. This process may continue, without formal training, until the discerning user becomes either an instructor, technician, maker or designer of computer systems or their programs. It is through a similar process that much of the computer industry as it is today has been shaped, and will probably continue to do so in the future. In the field of education a large number of the most ICT literate teachers started as home computer users without formal ICT training. Arguably, of course, this may be one of the reasons why there is concern about ICT in schools.

Developing teachers' skilful performance as computer users

The key points that emerge from the analogy between car driver and computer user need to be considered further in relation to the additional case of the teacher faced with using computers in the classroom. These key points are that, in order to be effective in using ICT resources to support teaching and learning, teachers need:

- to be skilled as proficient and discerning users, and not as technicians;
- to know how to use the resources, and not how the resources work;
- to know how the use of resources can be *built into* education, and not *bolted onto* education;
- to develop teaching skills that incorporate technological advances in ICT by not discarding the old to make way for the new.

Activities 9 to 12 address each of these key points. Collectively, they are intended to help you, by developing your skills and knowledge, to start to make greater use of ICT resources in teaching and learning. You do not need to follow each activity in the sequence in which they are presented. In fact, you might study the activities first and then decide your own route through them.

Skills and knowledge relating to ICT gadgets

Earlier in this chapter the discussion focused on the problem of how do you know what it is you need to know. One possible solution may be to work to a framework from which you may derive your own checklist. An example of such a framework may be found in Figure 7, which is intended to assist you in Activity 9, to set up ICT gadgets (hardware) prior to their use. Guidance notes, which provide a commentary for Figure 7 and Activity 9, may be found in Appendix I.

Activity 9

Setting up ICT hardware

Using each point in Figure 7 identify if you have the knowledge to be able to do what is required.

As you work through Figure 7 and the guidance notes (Appendix I), produce a checklist of things you need to know (and remember) to be able to set up ICT hardware prior to use in your teaching area.

You may need to produce two checklists, for:

- ICT hardware predominantly located in computer rooms or resource areas (where the interconnections between base units and external devices are established)

- the occasions when you need to set up a system for use in your own teaching area.

Figure 7

A framework to assist identifying practical skills and knowledge relating to ICT hardware

Connecting and disconnecting a computer base unit to external devices, such as: • a monitor and/or a data projector; • a keyboard; • a pointing device such as a mouse; • a digital camera and/or scanner; • a modem; • an external storage device; • a printer and/or a plotter; • a network.
Recognising the reasons why a computer system is not working as it should, such as: • lack of power to the device or incorrect power-up sequence; • a fault within the device itself or the computer base unit; • faulty interconnecting leads; • incompatibility between the base unit and the device; • insufficient user knowledge about the device's capability; • driver software not properly installed; • environmental factors.
Knowing procedures for dealing with faults within a computer system and its external devices, such as: • reporting matters to designated personnel; • locating user documentation.

Skills and knowledge relating to ICT applications

In Activity 10, the framework used in Activity 9 is extended to include skills and knowledge in using ICT software. This may be found in Figure 8, which focuses on being able to input, process, store and output data using a computer application program (software). Guidance notes, which provide a commentary for Figure 8 and Activity 10 may be found in Appendix II.

Figure 8

Extension of the framework in figure 7 to include practical skills and knowledge relating to ICT software

Using a computer system to input data to, process data in, and output data from an application program:

- selecting appropriate hardware for a specific application program;
- using windows, icons, mice, pointers;
- installing an application package;
- loading a previously installed application program;
- retrieving a file or creating a new file;
- entering data into a file;
- saving existing and new files for later retrieval;
- printing a file;
- dealing with error messages.

Before proceeding further you need to ensure that a computer application program, such as a word processor, spreadsheet or drawing package, has either been installed or is available to be installed on the computer system that you intend to use. An activity itself may be for you to install an application program. However, you might feel, quite reasonably, that you are not sufficiently competent to install an application at this stage. If this is the case then you should work your way through Activity 10 using a pre-installed application, and then repeat the activity by installing another application program.

In many schools the task of installing software is the responsibility of designated staff, which can be counter-productive to developing teachers' ICT skills. One possible solution of overcoming this is to have computers dedicated to staff for continuing professional development purposes.

Activity 10
Using ICT Software

Use each point in Figure 8 to identify whether you have the knowledge to be able to do what is required. As you work through Figure 8 and the guidance notes (Appendix II) you need a context within which to work. This context needs to be relevant to teaching and should be undertaken on a suitable application package. The activity can be related to any application program, and could be one with which you have already have some familiarity.

Possible examples might include:

- redesigning or creating a pupil handout (activity/information sheet) using a word processor or desk top publishing (DTP) program;
- evaluating an ICT learning resource, eg a Computer Assisted Learning (CAL) program, a CD-ROM or an Internet website;
- setting up a marksheet using a spreadsheet program;
- creating a datafile, relevant to your specialist subject, using a database program.

Each of the above examples are generic in that they have relevance to all fields of study in the curriculum. A supplementary activity, in its own right, would be to apply all of the above to your teaching subject(s).

Trying it out in the classroom

I hear and I forget
I see and I remember
I do and I understand (***Anon***)

This proverb is familiar to many teachers when they are introducing new ideas. It is essential, therefore, that you now *do* something using ICT in the classroom situation. This should help you to check your *understanding* of the concepts from Activities 9 and 10.

Activity 11

Trying ICT software out in the classroom

Plan and deliver an activity in which pupils use an application program or an ICT learning resource with which you are familiar.

In your file make notes on:

- intended benefits from using the ICT resource that would not be possible using other approaches
- any problems that you encountered;
- the effectiveness of your use of ICT to support learning;
- pupils' response to the activity.

Keep your notes safe for use in Activity 12 and the activities in Chapter 6

Pedagogical problems with ICT

Activities 9 to 11 were intended to allow you to increase your own proficiency in developing procedures relating to general ICT skills that can be applied to the use of new application programs. Having completed these activities you might have given some consideration as to how you can make use of ICT resources in your teaching to create new opportunities to promote pupils' learning. The discussion, therefore, needs to move onto teaching skills, *ie* pedagogy. Specifically, we need to consider how those ICT skills needed by teachers can be linked seamlessly into existing pedagogy.

Particular pedagogical problems include:

- attempting to arrive at a consensus on what constitutes, in general, effective teaching skills and, in particular, effective ICT teaching skills;
- establishing and developing a link between general and ICT teaching skills;
- implementing the two concurrently in the learning environment.

It may be that the use of ICT in teaching and learning requires its own pedagogy. If this is so, then there is the potential danger that ICT activity becomes bolted *onto*, rather than being built *into*, learning experiences. There is a considerable body of evidence to suggest that this has already happened, reported though, for example, HMI commentaries on inspection findings.

Bolted-onto practices described as unsatisfactory include:

- allowing those pupils who finish their work first to use the computer;
- pupils' use of word processors for retrospective typing up of work.

It is essential, if ICT resources are to be used purposefully by *all* pupils, that a wide range of opportunities needs to be created within the learning experiences themselves, as a facility to assist cognitive skills. The phrase 'facility to assist cognitive skills' is used quite deliberately here to avoid confusion with 'tools for learning', which, incidentally, is an entirely different matter and one that marginalises the potential of ICT resources.

To extend the framework used for Activities 9 and 10 to include a specific set of teaching skills to promote effective learning in the use of ICT would be flawed. This is because there would be an implication that an easy-to-follow recipe offers some guarantee of success in the use of ICT in teaching and learning. Curriculum evaluators and school inspectors are aware that such recipes do not exist, because of the differences between learning institutions and their classrooms. Essentially, effective teachers adopt teaching styles and skills that promote the intended quality of learning according to the needs of the learners and the ethos of the institution.

In order to make judgements about the quality of teaching and learning, evaluators make use of pre-defined criteria, which take account of school differences. The purpose of these criteria is to identify strengths and opportunities for development in curriculum provision on an individual school basis. Central to each criterion are key questions, the answers to which describe the quality of teaching and the resultant learning. Whilst the criteria do not prescribe an essential set of skills they do offer a framework against which to 'measure' effectiveness. Figure 9 contains an example of the key questions that arise from the criteria used by Ofsted Inspectors for the purpose of inspection under Section 10 of the School Inspection Act 1998.

In Figure 9, teaching and learning are considered through four sets of key questions covering each of teaching, response, attainment and progress. These key questions can be used, beyond the inspection situation, for the purpose of considering pedagogical issues relating to curriculum development.

It is important that teaching, response, attainment and progress are considered with respect to each other. For example; good teaching facilitates positive pupil response and therefore promotes good attainment and progress.

The strongest correlation is that of pupil response to the teaching styles used. For example; if pupils are showing a positive response to the teaching, typified by an eagerness to participate through positive contributions, then both attainment and progress should be significant because the motivation to achieve exists.

Figure 9

Key questions arising from the criteria used by Ofsted Inspectors for the purpose of making judgements on the quality of teaching and learning

Quality of teaching

Does the teacher:

- have a secure knowledge and understanding of the subject?
- set high expectations to challenge pupils and deepen their knowledge and understanding?
- plan effectively, with clear objectives and how they will be achieved, taking account of differing needs?
- employ methods/organisational strategies that match lesson objectives and needs of all pupils?
- manage pupils well and achieve high standards of discipline?
- use time, learning resources and support staff effectively?
- assess pupils' work thoroughly, constructively and use assessment to inform planning and teaching?
- use homework to reinforce and/or extend what is learned in class?

Quality of learning: pupil response

Do pupils:

- show interest in their work/enthusiasm?
- work independently to generate ideas and solve problems?
- show pride in finished work and a desire to improve?
- work collaboratively when required?
- ask/answer questions, join in discussion, select and use relevant resources?
- show initiative and take responsibility?
- sustain concentration and respond to challenge?
- respect the feelings, values and beliefs of others?
- persevere when tasks are difficult?
- form constructive relationships with one another, teachers and others?
- apply themselves to the task?
- behave well, show courtesy, show respect for property?

Quality of learning: pupil attainment • What do pupils know,and understand? What can they do? • How does it compare with national curriculum requirements? • Are there variations in attainment amongst pupils of different gender, ethnicity, background or ability (including those with special needs)?
Quality of learning: pupil progress • What gains do pupils make in knowledge, skills and understanding? • Are pupils making significant progress in the lesson, and over the series of lessons? • Is progress comparable with or better than others in the school?

During their training, teachers are encouraged to develop skills as self-reflective critical practitioners. The key questions in Figure 9 provide an appropriate model upon which to provide feedback by those observing the trainee and by the trainee for self-appraisal. Without such a model, trainees, at the start of their teaching practices, and indeed observers of their lessons, tend to focus restrictedly on trainees' subject understanding and pupils' behaviour. This is understandable because the trainee is initially concerned about subject knowledge and the possibility of disruptive behaviour.

A parallel may be drawn with qualified teachers when they introduce the use of ICT into their lessons. They too will become concerned with ICT subject knowledge and how pupils will behave towards new approaches to their learning. Again, this concern is understandable and suggests that the use of ICT resources to support teaching and learning may require an approach that is conservative, which, at the extreme, may actively resist the potential for rapid change implicit in technological advance. At the other extreme is a liberal approach that advocates rapid change at the expense of discarding those teaching methods, which, by consensus, promote effective learning. A mid-point is required between the conservative and liberal extremes.

The characteristic features of this mid-point should include:

- considering the nature of pupil activities that may be enhanced by the use of ICT resources;

- incorporating existing effective general teaching skills into the use of ICT resources;

- developing specific ICT teaching skills and incorporating them into the teaching repertoire;

- analysing the learning gains from the use of ICT resources with reference to gains made from other approaches.

- reflecting on how pupil learning may be enhanced by activities that are ICT resourced.

Activity 12

Incorporating your teaching skills into the use of ICT

Before starting this activity you will need to have prior experience of using a ICT resources in your teaching. Therefore, you will have either completed Activities 9 to 11 or will have acquired similar experience elsewhere.

In this activity you will consider the characteristic features listed above in relation to your teaching, in general, and to your use of ICT, in particular, to enhance learning. The activity is designed to be undertaken through either individual or collaborative endeavour. The preferred option is to work as part of a team in which individual considerations are shared through discussion.

School co-ordinators or curriculum managers may wish to adapt the activity to form part of a whole school continuing professional development programme. The activity is intentionally detailed, but if undertaken collaboratively it should make a significant contribution to school improvement in ICT provision. This is because the focus is on developing skills in critical self-reflective practice in an area of curriculum development.

Reread the notes 'Pedagogical Problems with ICT' (see p.32) and analyse the extent to which the ICT activities that you have used in your teaching, read about, and witnessed:

- assisted the development of pupils' cognitive skills;
- were ‘bolted onto’ or were ‘built into’ the central aim of the lesson;
- required either new teaching skills or adaptation of existing ones;

- were accessible to, and achievable by, all pupils (ie of differing of ability, ethnicity, or gender);
- offered an approach that produced at least the same gains in pupils' knowledge, skills and understanding arising from the central aim of the lesson as would have been achieved by other approaches.

If your analysis focuses on the sufficiency of either your own ICT knowledge or the resources available then you will need to consider two further matters. These are to what extent was:

- prior consideration given to the level of available ICT resources?
- pupils' existing ICT capability acknowledged (this point is considered in further depth in Chapter 4)?

Share your analysis with colleagues. Note the key points from the resulting discussion for use in the activities in Chapters 5 and 6.

Summary

In this chapter the focus has been on providing guidance on the development of skilful performance in the proficiency of appropriate ICT skills and knowledge to build confidence as a computer user and in linking those skills into teaching and learning.

Activities 9 to 12 are iterative, in that by revisiting them your competence and confidence in the use of ICT should gradually increase. The activities in the following chapters will build on your increasing skills to make use of ICT resources to support teaching and learning. This will allow you to consider the issues relating to pupils' prior experience, resourcing and the breadth of ICT in a whole-curriculum context.

Chapter 3

Theories of teaching and learning and their relevance to ICT

This chapter is intended to be a short review of the place of theories of teaching (pedagogy) and learning (mathetics) within general educational practice. The activities will allow you to consider the place of these theory within ICT education. Mathetics is a term proposed by Papert (1980 and 1993) to describe the art of learning; derived from the Greek word mathematikos (disposed to learn) from which the English word polymath is derived (a person of much or varied learning).

The two branches of psychology that have been influential on pedagogy and mathetics are behaviourism and constructivism. In behaviourist theory, pupils enter school as empty vessels in which information can be deposited. In constructivist theory they arrive at school with prior experiences that can be built upon. In both theories pupils are keen and eager to learn, because learning is as essential for survival as eating and drinking.

Whatever the theory, teachers play a key role in controlling the learning that takes place. The paradox is that many pupils are unwilling to share, what they have learnt outside school and to learn in the school environment. As most teachers are aware, you can lead children to school but you cannot force them to learn. The problems may be that:

- there is a tendency to concentrate on the quality of teaching rather than the quality of learning;

- the diet of the material to be learnt is too easy (or too difficult), irrelevant or uninteresting.

Fortunately most, if not all, teachers structure their teaching to promote effective learning through strategies that are designed to motivate their pupils. They do this by basing their teaching, as experienced practitioners, on assumptions about learning. However, in the last two decades some of these assumptions seem to have become disapplied to ICT education

– a fear of new technology as a teacher substitute, and therefore the possibility of losing direct control of pupils' learning? This may because of the 'gadget factor' being used as the prime motivator and, incidentally, the prime demotivator.

Assumptions about learning

The list of assumptions about learning has been adapted from a list originated by Barth (1975). His full list described assumptions about children, learning and knowledge, which characterised 'open-education' in the 1960s and 70s. At that time, 'open-education' was viewed generally as trendy and attributed to ideology that was politically left of centre. So, with the exception of experimental initiatives, the assumptions did not have a wide influence on general educational practice in the UK. This was because there was no clear-cut evidence to suggest that the educational standards achieved improved – though there was no evidence that they did not.

However, with an emphasis, in the late 1990s on enabling pupils to learn how to learn, these assumptions are coming to the forefront. This is partly because of the impact of ICT on teaching methods, in particular, through the use of computers as tools for learning. An example of this resurgence may be found in *The National Curriculum Handbooks* (DfEE/QCA, 1999, p22) where 'thinking skills' are cited as separate but complementary to key skills.

The following list has been edited from Barth's list of 29 assumptions. Included are those that relate to learning. The assumptions have been edited from the third-person, 'children', to the first person plural - because they apply to all learners:

1 We are innately curious and display exploratory behaviour quite independent of the intervention of others.

2 Exploratory behaviour is self-perpetuating.

3 We will display natural exploratory behaviour if we are not threatened.

4 Self-confidence is highly related to capacity for learning and for making important choices affecting our learning.

5 Active exploration in a rich environment, offering a wide array of manipulative materials, facilitates learning.

6 Play is not distinguished from work as the predominant mode of learning.

7 We have both the competence and the right to make significant decisions concerning our own learning.

8 We will be likely to learn if we are given considerable choice in the selection of the materials we wish to work with and in the selection of the questions we wish to pursue with respect to those materials.

9 Given the opportunity, we will choose to engage in activities that will be of high interest to us.

10 If we are fully involved in and having fun with an activity, learning is taking place.

11 When two or more of us are interested in exploring the same problem or the same materials we will often choose to collaborate in some way.

12 When we learn something that is important to us we will wish to share it with others.

13 Concept formation proceeds very slowly.

14 We learn and develop intellectually not only at our own rate, but in our own style.

15 We pass through similar stages of intellectual development . . . each in our own way, and at our own rate and in our own time.

16 Intellectual growth and development takes place through a sequence of concrete experiences followed by abstractions.

17 Verbal abstraction should follow direct experience with objects and ideas, not precede them or substitute for them.

Activity 13

Reflecting on assumptions about learning in relation to ICT

Reread 'Assumptions about learning' (see p41).

Reflect on the possible links, in your own teaching, between the assumptions and the use of ICT to enable pupils to learn how to learn.

Behavourism

Behaviourism dates back to end of the nineteenth century and early part of the twentieth century and is based upon the beliefs of the philosopher John Locke who viewed children as 'blank slates' (*tabula rasa*) upon which messages are written through experience. The work of psychologists such as Pavlov into dogs' salivation responses to conditioning, and Skinner into rats' responses in mazes to punishment and reward, led to the concept of the learning cycle of stimulus-response-reward (SRR). The SRR concept became central to learning theory, and when Skinner applied his findings to classroom teaching he became critical of teachers for ineffective reinforcement of learning.

The characteristic feature of behaviourist theory is that learning can be broken down into discrete elements of skills and knowledge, and that through appropriate stimuli from the teacher the desired learning behaviour (*ie* the response) will be produced. A behaviourist teaching approach, therefore, is essentially based on methods of control and instruction (*ie* didactic), where the learning outcome can be easily assessed because it is either right or wrong. Teaching methods associated with behaviourism include drill and practice and rote learning. Learning is reinforced through punishment and reward, but not necessarily for every response. This is because 'conditioning' relies upon occasional punishment or reward to ensure that the skill or knowledge can be confidently and consistently demonstrated.

Constructivism

The basis of constructivism is that children are not *tabula rasa* upon which to write messages. Instead, they are active meaning makers who interact and construct meanings

from what is observed and experienced around them. Everyone is capable of learning and there are no fixed boundaries or ceilings to knowledge, except, perhaps, of age dependency.

Constructivism dates back to the first half of the twentieth century and is based upon the work of philosopher John Dewey and his concept of discovery-based learning. The work of psychologists, such as Piaget, Bruner and Vygotsky, led to a division into classical and social constructivism. Central to each of the divisions of constructivist theory is the belief that, 'what a learner can do with help to today, he or she can do independently tomorrow'.

A constructivist teaching approach, therefore, is essentially based on methods intended to provide new experiences, allowing learners to build on what they already know, understand and can do with increasing independence. There are no established right or wrong answers acting to control the pace at which learning takes place.

Classical constructivism

Classical constructivism, based on Piaget's work, was popular in the late 1960s. It was influential in the recommendations of the Plowden Report (1967) for destreaming, the abolition of the three-tier system of secondary modern, technical, and grammar schools and the selection mechanism of the 11+ examination.

Classical, or Piagetian constructivism is built on the idea that there are stages of development, which are age related. These stages are sensori motor (birth to 18 months), concrete operational (18 months to 12 years) and formal operational (from 12 years). Children must pass through each stage of development. Higher level concepts, for example those based on abstraction, cannot be understood until lower level concepts, for example those based on concrete examples, have been understood. The implication is that they are not 'ready' to learn a particular concept until they have reached the appropriate cognitive developmental stage. The key issue is that all learners, irrespective of ability, have the capability to understand higher level concepts but at different ages.

In classical constructivism, children's learning is through their exploration of the world around them as 'lone scientists' and the role of language plays a minor part in development. Communication, and therefore, dialogue and discussion are regarded as of little value in learning. The role of the teacher is to take into account each child's stage of development when planning lessons. Stimulus material is provided to practice activities, but not through discussion or dialogue.

Social constructivism

Social constructivism is based on the work of the psychologists Vygotsky in the 1930s and Bruner in the 1970s. It differs from classical constructivism in that children's active meaning making is not dependent on either cognitive developmental stages or through exploration as lone scientists. Instead learning takes place through the use of language in discussion and dialogue with more knowledgeable others.

At any stage in learning, the learner has a prior knowledge, which may be based on incomplete or wrong conceptions (schemata). By sharing this prior knowledge a clearer understanding is achieved and the learner's schema becomes modified. The concept of a 'zone of proximal development', described by Vygotsky, is the gap between what the learner already knows and understands from prior experience, and what will be known and understood from new experiences.

The role of the more knowledgeable other is, through active intervention, to determine the extent and nature of this gap and to provide a framework or scaffold from which the learner can make sense of the surrounding world. In providing this scaffold, the learner's schema should become extended, modified and corrected. This is achieved by providing stimuli that encourage active participation and that relate to the particular topic or subject being studied. An important point is that 'more knowledgeable others' does not necessarily imply the teacher in the classroom; they could be a peer or another adult by whom the child is influenced.

We need to identify the implications of these theories, for teaching and learning using ICT resources. This is the task for you to do in the next activity.

Activity 14

Identifying the implications of behavourist and constructivist theories for your classroom use of ICT

Read back over the text on behaviourism and constructivism. As you read, make a list of the implications on developing and promoting your pupils' ICT capabilities.

From your list, which of these implications form the basis of your teaching style:

- in general?
- when using ICT resources?

Can you account for any difference in your responses to the two questions above?

Which of the implications in your list do you feel you should develop to promote more effective learning when using ICT resources?

Activities 13 and 14 in this Chapter have been designed to allow you to reflect on your teaching in light of the theory. The next step is for you to consider your teaching and the theories in relation to pupils' development of ICT capability. This is the focus of the next chapter.

Chapter 4

Continuity and progression

Defining capability and technology

In this chapter the discussion moves to consider the issues relating to when, where, how and from whom ICT capability is acquired. The focus moves, in general, from the teacher to the learner. In particular, how teachers can provide opportunities for the development of their pupils' ICT capabilities to ensure continuity and progression.

Before you read on, reread the last paragraph and notice the transition from the singular 'capability' to the plural 'capabilities' - this was intentionally deliberate and provocative. There are at least four reasons for suggesting that ICT should be considered in terms of multiple capabilities:

1 The statutory curriculum entitlement for the National Curriculum for ICT in schools, describes multiple capabilities as a single capability.

2 The inclusion of 'and communication' into information technology implies that, at least, two capabilities may coexist.

3 The principles of a broad-based curriculum.

4 Pupils gain experience in the use of ICT resources in a range of environments, many of which are outside the classroom.

Before exploring each of these reasons we need to consider some definitions of both 'capability' and 'technology' when applied to education. In fact, there are semantic problems with what is meant by 'capability', 'technology' and, more essentially, with 'learning' itself. Without some attempt at defining these terms, the states of confusion and lack of consensus surrounding their usage make it a very difficult matter to consider them in relation to the theories of:

- the arts of teaching (pedagogy) and learning (mathetics);
- the methods and validation of knowledge (epistemology).

If pupils are to be supported purposefully in showing their ICT capability (capabilities) it is essential to arrive at a consensus of the meanings of ‘capability’ and ‘technology’, albeit vague, at least amongst staff at an individual institutional level. In doing so, institutions may become better placed to construct their curriculum provision for ICT.

My own 'comfortable' definition of capability is 'the ability to identify appropriate opportunities to apply or learn the skills, knowledge and understanding needed to produce intended outcomes'. This definition incorporates both the action and awareness that we should foster in our pupils.

I offer two definitions of technology with which I feel most 'comfortable'. These are the two phrases:

- Technology is knowing *how*
- Technology is making things work *better*

Even though these phrases may be open to the criticism of being trite or glib, they may be found embedded within the National Curriculum Design and Technology Orders (Des and Welsh Office, 1990 and DfE1995 versions) and their associated guidance material. However, such notions are not articulated in other subject orders even though information 'technology' pervades the whole curriculum.

Curiously, these and all other definitions disappeared in the 1999 National Curriculum. Without such metalanguage it becomes difficult to convey subject meanings succinctly to interested parties such as financial benefactors, pupils and parents. The 'importance of' statements preceding the programmes of study, whilst being aspirational, do not articulate a pithy definition to convey general understanding of what ICT actually is.

Education may have suffered from overly complex definitions of technology that have had the effects, either deliberately or otherwise, of:

- making ICT inaccessible to many teachers;
- creating an impression that it is a field of study, analogous to science, that must be taught through defined procedures or processes.

The consequence is that, inevitably, many teachers are mindful of technology in the belief that it has to be taught before it can be understood. At an extreme, this mindfulness invokes behaviours associated with panic; namely avoidance tactics in the use of technology connected with information and communication.

The main problem with the terminology is that fields of 'technology' and 'science' are nouns without a verbal form, unlike, say, the field of 'design'. For example, you can design something and you can have a design for something, but you cannot technology or science something. However, you can have a science or a technology of something. This chain of argument becomes even more problematic when applied to ICT in that you can neither ICT something, nor can you sensibly have an ICT of something. Nevertheless, technologies of information processing and of communications exist, which are fields of study outside the primary or secondary school curricula.

From these ideas we can draw two provocative conclusions:

- ICT in schools should not be perceived as a technology to be taught, but a field to assist learning.
- ICT is not a subject to be taught in its own right.

Instead, ICT in schools should be based on learners and teachers knowing *how* to use and apply ICT resources to produce *better* outcomes in the subjects being taught and studied. This should form the basis of what we mean and understand by ICT capability or capabilities. It is not the foundation of teaching pupils to ICT (*cf* teaching pupils to design in order to develop their design capability). ICT capability should be based on providing opportunities for pupils to use ICT resources across a variety of contexts through a range of subjects.

In the next activity you will explore your colleagues' understanding of 'capability' and 'technology' in an attempt to produce a briefing paper that offers a consensus view for

discussion. At a whole-school level the activity will assist with formulation of your institution's policy for developing pupils' and teachers' ICT capability.

Activity 15

Exploring colleagues' definitions of capability and technology

The methods that you use for this activity might include devising a short questionnaire circulated to staff, a discussion item on a staff meeting agenda, or a focused discussion during a staff development session. What is important is that you obtain a wide range of views that represents all the areas of study in your school's curriculum.

Using the method that you have decided upon, obtain as many views and opinions as possible of colleagues' definitions and understandings of 'capability' and 'technology' in the contexts of ICT in general education and in individual subjects.

Analyse the responses and produce a staff briefing paper (300 words maximum) summarising the implications for pupils' ICT capability. You may wish to cross-reference the key points to the definitions and notes preceding this activity. Your paper should end with a list of key questions so that you and your colleagues can consider the approaches used to allow pupils to develop and demonstrate ICT capability.

Before you circulate your briefing paper to colleagues follow the appropriate protocols in your school (for example, seeking approval from a member of the school's Senior Management). Invite responses to your paper, or arrange for it to be discussed as an agenda item at a forthcoming meeting.

Edit your briefing paper in light of the responses received to produce a short report of your findings. Circulate this to colleagues for further comment.

Keep your notes from this activity - they will be essential in Chapter 7 to assist with informing school policy, whole staff or your own personal development needs in developing pupils' ICT capabilities.

At the start of this chapter it was suggested that there are at least four reasons why ICT should be considered in terms of multiple capabilities. We now move on to explore each of these reasons in turn and to undertake some supporting activities.

IT capability in the National Curriculum

In the 1990 and 1995 versions of the National Curriculum for Information Technology there are statements about, but not definitions of, 'capability' which imply that multiple capabilities may exist. In the 1999 National Curriculum for Information and Communication Technology there are neither definitions of capability or a suggestion of multiplicity. However, the attainment target is titled 'Information and Communication Technology Capability' with statements, as attainment levels, of this non-defined capability.

This does not sufficiently help you in planning for the development and assessment of pupils' ICT capability. Therefore, it is essential that you aware of the guidance about capability in the 1990 and 1995 versions.

In the 1990 *Non-Statutory Guidance: Information Technology Capability,* Section A (NCC, paras 1.2-1.3), we are informed that:

> Information technology is concerned with storing, processing and presenting information by electronic means. Pupils need to use IT in school:
>
> - to enhance and extend learning;
> - to gain confidence and the capability to use IT in later life.
>
> Pupils who possess IT capability will have:
>
> - knowledge about applications of IT and about IT tools such as word processors, databases, spreadsheets and software for processing sound and images;
> - the skill to use appropriate IT tools effectively;
> - an understanding of the new opportunities IT provides;
> - knowledge of the effects and limitations of IT.

Significantly, though, there is reference to *capabilities* in the preface to the programmes of study for information technology *capability* (*ibid*, p51):

> In each key stage pupils should develop information technology capabilities through a range of curriculum activities which will:
>
> - develop confidence and satisfaction in the use of information technology;
> - broaden pupils' understanding of the effects of the use of information technology;
> - encourage the flexibility needed to take advantage of future developments in information technology;
> - enable pupils to take greater responsibility for their own learning, and provide opportunities for them to decide when it is appropriate to use information technology in their work.

In the *Revised National Curriculum for Information Technology* (1995, p1) the characteristics of IT capability are described:

> Information technology capability is characterised by an ability to use effectively IT tools and information sources to analyse, process and present information, and to model, measure and control external events. This involves:
>
> - using information sources and tools to solve problems;
> - using IT tools and information sources, such as computer systems and software packages to support learning in a variety of contexts;
> - understanding the implications for IT for working life and society.
>
> Pupils should be given opportunities, where appropriate, to develop and apply their IT capability in their study of National Curriculum subjects.

With the exception of Physical Education, each subject order in the 1995 National Curriculum revision, contains a page detailing Information Technology as a common requirement as a preface to the programmes of study. This deficiency has been addressed in the 1999 National Curriculum.

Putting the C into IT - The 1999 National Curriculum

The inclusion of 'and communication' into 'information technology' occurred in the late 1990s in both education and industry simultaneously. This renaming of IT to ICT represented a general recognition that one of the most significant advances in technologies associated with microelectronics was increasingly faster systems, which allowed global communication.

Whilst slower systems had been in existence for at least two decades, it was not until developments, such as the Internet, Pentium™ processors, 'user friendly' web-browsers and electronic-mail software became widely available to allow low-cost, mass-communication in real-time by electronic means.

The change of name from IT to ICT in the 1999 National Curriculum was, in fact, of little relevance to curriculum entitlement since IT had always included a communication aspect. It was merely a renaming to meet fashion. However, the relationships between communication skills, information handling skills and ICT (and, incidentally, IT) have implications for the assertion that multiple capabilities may need to be considered. There is, nevertheless, the potential for confusion with the life skills aspect of communication skills, which can mean something entirely different.

This confusion is implicitly recognised in *The National Curriculum Handbooks* (DfEE/QCA 1999) under the heading 'Promoting skills across the National Curriculum' (*Handbook for primary teachers in England*, p20; *Handbook for secondary teachers in England*, p22):

Key skills

Six skill areas are described as key skills because they help learners to improve their learning and performance in education, work and life. These key skills are embedded in the National Curriculum.

Communication[1]

The key skill of communication includes skills in speaking, listening, reading and writing. Skills in speaking and listening include the ability to speak effectively for different audiences; to listen, understand and respond appropriately to others; and to participate effectively in group discussion. Skills in reading and writing include the ability to read fluently a range of literary and non-fiction texts and to reflect critically on what is read; and the ability to write fluently for a range of purposes and audiences, including critical analysis of their own and others' writing. Opportunities for developing this key skill are provided through English in particular and through pupils' use of language across the curriculum.

Information technology[2]

The key skill of information technology includes the ability to use a range of information sources and ICT tools to find, analyse, interpret, evaluate and present information for a range of purposes. Skills include the ability to make critical and informed judgements about when and how to use ICT for maximum benefit in accessing information, in solving problems or for expressive work. The ability to use ICT information sources includes enquiry and decision-making skills, as well as information-processing and creative thinking skills, and the ability to review, modify and evaluate work with ICT. Opportunities for developing this key skill are provided explicitly through the subject of ICT and through pupils' use of ICT across the curriculum.

The other four key skills areas described are *application of number*, *working with others*, *improving own learning and performance*, and *problem solving*.

And on p22 (*Handbook for primary teachers*) and p22 (*Handbook for secondary teachers*):

Thinking skills

By using thinking skills pupils can focus on 'knowing how' as well as 'knowing what' – learning how to learn. The following thinking skills complement the key skills and are embedded in the National Curriculum.

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.

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1 *Communication* - this key skill definition makes no reference to the use of technology as a means of communicating

2 *Information technology* - this key skill definition includes the ICT abbreviation but make no reference to communication.

The other four thinking skills described are *reasoning skills*, *enquiry skills*, *creative thinking skills*, and *evaluation skills*.

The potential consequences of putting the C into IT, which must be avoided, are:

- the emergence of two fields of study, namely information technology and communication technology;
- communication skills becoming the domain of languages and information processing skills the domain of technology.

After this lengthy, but necessary, section it is now time for you to direct your energy to the next two activities. These will help you:

- consider the National Curriculum characteristics of ICT capability in relation to the subject(s) that you teach;
- identify programmes of study requirements for the subject(s) that you teach where ICT resources must be used - by either explicit statements or by implication could be used;

You should undertake these activities for the key stage (KS) most applicable to the age range that you teach. If you are:

- a primary teacher, or training to become one, then focus on KS1 if you work with Years 1, 2 and rising 5s (Reception), or KS2 if you work with Years 3 to 6;
- a secondary teacher, or training to become one, then focus on KS3 (Years 7 to 9) in preference to KS4, though you might wish to repeat the activity for KS4 at a later stage;
- an ICT teacher (or training to become one) then do not use the IT programmes of study for parts 1 and 2, but select either a subject which reflects your interests or one that you teach in addition to ICT;
- an RE teacher then you should refer to the Agreed Syllabus that is used in your school.

Activity 16

Considering characteristics of ICT capability for you own subject

Re-read 'IT capability in the National Curriculum entitlement' and 'Putting the C into IT - The 1999 National Curriculum' (see pp.51-55).

As you read, the two key questions that you should consider are:

- Which characteristics of ICT capability are also characteristics of pupil capabilities in your teaching subject(s)?
- Which characteristics of ICT capability are not supported by your teaching?

Keep a written note of your responses to these questions for use in the next activity and also for reference when you work through Chapter 6.

Your answers to the questions in Activity 16 should reveal some interesting issues, which will be referred to in Chapter 6 on the strands of ICT. Having considered the position of ICT in your own subject, the next activity is for you to identify opportunities for use of ICT resources in the National Curriculum programmes of study (or Agreed Syllabus for RE) for a subject that you teach.

Activity 17

Identifying ICT opportunities in programmes of study requirements for a subject that you teach

Make a photocopy of the National Curriculum programme of study (or Agreed Syllabus for RE) for one key stage of one of the subjects that you teach. To save paper try to reduce two pages photocopied onto one A4 sheet. If you are a primary teacher, or training to become one, you should select one subject; perhaps a core subject or the foundation subject that reflects your main area of interest. Use the same key stage that you used for Activity 16.

On your photocopy, using two different colours, highlight the programme of study statements that:

- indicate, either implicitly or explicitly, the use of ICT resources;
- could promote effective learning from the use of ICT resources with which you are familiar.

For each of the statements that you have highlighted make a note of:

- the ICT resources – software and hardware – that are needed;
- the characteristic of ICT capabilities that the statement allows pupils to develop or demonstrate;
- links to key skills and thinking skills that can be supported through use of ICT.

There is little need to 'write up' your notes. What you should do, however, is to share and discuss your findings with colleagues.

Keep your highlighted programme of study safe for use in later activities. The responses obtained from this activity will be used in Activity 18 and in Chapter 7 to assist with informing school policy, whole staff or in your own personal needs in developing pupils' ICT capabilities.

An introduction to strands of ICT capability

IT capability and its educational progression was described in the Revised National Curriculum for IT (1995) through the strands of:

- opportunities - including applications and effects (all key stages);
- communicating and handling information (all key stages);
- controlling and modelling (KS1);
- controlling, monitoring and modelling (KS2);
- controlling, measuring and modelling (KS3 and 4).

These strands are used to describe, under the respective headings, the matters to be taught through the programmes of study.

The 1999 National Curriculum programmes of study for ICT do not use this nomenclature. However, the attainment target for ICT capability makes reference to the same strands of the 1995 version in the statements describing the attainment levels. Therefore, it is essential that the teaching requirements, through the programmes of study, reflect the strands of ICT.

By taking the key words in the strands, a series of statements can be constructed, each of which describes, not an aspect or characteristic of capability, but a capability itself. For example, one capability of using ICT resources, which pupils should develop or demonstrate, is the ability to identify appropriate opportunities to apply or learn the skills, knowledge and understanding needed *to communicate information.* This phrase could be replaced by each of the phrases in the list below to describe further ICT capabilities:

- to handle information;
- to control events;
- to create models of real or imaginary situations;
- to monitor events;
- to take measurements from events.

Further capabilities exist, for example relating to the ethical issues of the use of ICT resources, or to the wider use of ICT resources in industry and commerce. For now we will restrict the discussion to the strands of ICT. However, the social, moral, spiritual and cultural implications must not be overlooked.

Activity 18

Considering the strands of ICT capability in relation to your own subject

It is important that you do not skip this activity because it acts as an essential link between Activity 17 and those that follow in Chapter 6, where you will be planning subject-specific ICT activities in a whole-curriculum context.

Re-read 'An introduction to strands of ICT capability'. Remember that each of the bullet points can be used to describe an ICT capability (see p.57). On your photocopy of the programme of study that you used for Activity 17, note the strands of ICT capability that are relevant for each of the statements you highlighted. You should also consider and include links to the values relating to ICT, such as ethical issues and the fitness of a resource for the intended purpose.

Now that you have completed Activities 17 and 18, you should have a programme of study for one key stage in a subject that you teach that shows:

- subject links to strands of ICT capability;
- ICT resources required;
- characteristics of ICT capabilities that pupils may develop or demonstrate.

So far we have considered ICT in one subject or curriculum area. However, pupils acquire their overall capability through a range of subjects and from a diversity of environments. It is this range and diversity that we shall now move onto to build the bigger picture.

Locating ICT in the School's Curriculum

The curriculum in provision in England following the 1999 National Curriculum revision is shown in Figure 10. This represents the entire curriculum entitlement. The ICT entitlement is statutory in all subjects (through key skills and learning skills). However, it is not statutory that it is delivered as a subject in its own right - the entitlement could be entirely through other subjects.

There are no statutory percentages of curriculum time laid down by the National Curriculum. However, an interpretation often used is approximately fifty percent for core subjects, forty percent for foundation subjects and ten percent for other subjects. On the basis of these approximations, it would be reasonable to expect that a curriculum entitlement for ICT should use between five to ten percent of curriculum time if pupils are to be given opportunities to develop and demonstrate the characteristics and strands of ICT capability.

Figure 10

The curriculum provision for schools in England (from August 2000)

Whole curriculum = basic curriculum + other subjects or cross-curricular themes

Basic curriculum = national curriculum + religious education

National curriculum = core subjects + non-core subjects

Core subjects:	English	Non-core subjects:	Art and Design [2]
	Mathematics		Citizenship [1, 3]
	Science		Design and Technology
			Geography [2]
			History [2]
			ICT
			Modern Foreign Languages [2]
			Music [2]
			PE

Notes [1] Key stages 3 and 4 only
[2] Not key stage 4
[3] From August 2002

In Activity 19, the first of four activities relating to curriculum auditing, you will attempt to estimate the time allocation for pupils' use of ICT resources. This is not a straightforward task. However, it should show you the difficulty in actually trying to establish what prior consideration has been given to the time allocation required to deliver ICT.

Activity 19
Finding out how much curriculum time is used for ICT in your school

For each year group in your school or college, calculate the time allocation for pupils' use of ICT resources. It is not important whether your calculation is based on use per week, per term or throughout the whole year. What is important is that you attempt to calculate the percentage of curriculum time allocated for pupils' use of ICT. Compare you answer with the figure of five to ten percent indicated in the on p59.

Now calculate the time allocation indicated on the school's timetable for the teaching of ICT skills and knowledge. Is there a difference between your two calculations? If so, what does this difference mean?

To obtain a comparison between policy and practice take a two week period and ask:

- colleagues from each subject area for each year group (or other appropriate structure for primary schools) how much time they spent using ICT resources;
- pupils from each year group how much time they spent using ICT resources in school and when they were taught the required skills and knowledge.

For each, obtain averages of the responses overall and for each year group, and turn these into percentages of curriculum time.

The two percentage averages that you have just calculated are not intended to be exact quantitative indicators. What qualitative conclusions can your draw from the percentages obtained about time for pupil entitlement in the use of ICT resources?

The Principles of an Entitlement Curriculum

The idea that ICT involves more than one capability is reinforced if we consider the principles underpinning an entitlement curriculum. The term 'entitlement' means the learning opportunities that pupils should receive by right.

The *Curriculum from 5 to 16*, (DES/HMI 1985) outlined five key principles of an entitlement curriculum. These are broad, balanced, differentiated, showing progression, and relevant to meet the needs of all pupils. DES/HMI (*ibid*) also outlined four elements of learning and nine

areas of experience (not subjects). A summary of the key principles, the elements of learning, and the areas of experience may be found in Figure 11. The National Curriculum is based, as an entitlement curriculum, on these principles, elements and areas.

Important key points are that these principles do not prescribe:

- how the curriculum should be delivered;
- the teaching methods to be used;
- what subjects are taught.

However, the National Curriculum does break a principle of entitlement by prescribing subjects. Therefore, to meet statutory requirements, the principles of an entitlement curriculum are met by a school through prescribing what subjects are taught, to what age groups but not to what percentage of curriculum time (though recommendations exist).

Figure 11

The five principles of an entitlement curriculum

Broad	Four elements of learning: attitude or values, concepts, knowledge, skills. Nine areas of experience: aesthetic and creative, ethical, linguistic and literary, mathematical, physical, scientific, social and political, spiritual, technological. An alternative, but not dissimilar, viewpoint to HMI's areas of experience is Gardner's theory of Multiple Intelligences (1983). He believes that any 'intelligent' act is the result of one or more of these intelligences. These intelligences are: bodily-kinaesthetic, existential (proposed 1998), interpersonal, intrapersonal, linguistic, logical-mathematical, musical, spatial.
Balanced	Pupils should receive an education across *all* areas of experience and elements of learning.
Differentiated	The learning needs of individual learners are identified by diagnostic assessment and through sensitive observation by the teacher.
Progression	The individual learner's development should be continuous so that good gains in progress and attainment are made.
Relevant	Individual pupil's needs are identified and opportunities are provided to meet these needs.

The exact location of ICT in the curriculum, as either a subject in its own right or as a cross-curricular dimension, poses a problem for curriculum managers, because of its status as a non-core subject and also as a requirement in all other subjects. The debate about skills being taught through ICT as a subject or through other subjects will be covered further in Chapter 6. For now, all that needs to be noted is that there is not a simple right or wrong answer as to whether ICT is taught as a subject or otherwise.

As a subject there is a parallel with English and Mathematics, in that the skills are taught through the parent subject but are required in other subjects as *literacy* and *numeracy*. To explain this to primary teachers, the DfEE/QCA (1998), in *A scheme of work for key stages 1 and 2: Information Technology a Teacher's Guide* (p19), state that: 'IT is to ICT as literacy is to books' (*sic*).

This is awkward, not only because it is phrased wrongly (reread the phrase to spot the error) but also because IT includes communication (as a strand) as part of its own definition. More sensibly the equivalent for ICT is, not one word, but phrases such as *ICT literacy* or *ICT capability*.

What is important is that pupils are given opportunities using ICT to:

- learn skills;
- demonstrate a literacy or a capability;
- be assessed appropriately.

Assessment of capability needs to be formative to identify learning needs (and teaching requirements) and summative to report progress. Such assessments should occur wherever pupils make use of ICT resources in the learning environment.

If assessments are not appropriate then:

- pupils' ICT experiences may lack rigour;
- gains made in skills, knowledge and understanding may be poor because of:
  - insufficient breadth;
  - poor differentiation of tasks to meet identified individual needs;

- activities that lack relevance.

In Activity 20 you will consider the principle of breadth of an entitlement curriculum in relation to the development of pupils' ICT capabilities.

Activity 20

Considering breadth of pupils' ICT experience in your subject

Your responses to this activity should be shared with colleagues. Better still, it could be undertaken collaboratively. If a written school policy exists for ICT then you will need a copy for reference. Indeed, it may be that the school policy itself goes most of the way to completing the activity. If this is so then you should edit and amend the policy to include additional matters that arise.

The templates in Figures 12 and 13 have been designed to help you with this activity, but you may wish to design your own. Because of the size of the pages in this book you will need to produce copies in A4 format to avoid cramped layout.

Starting with a subject that you teach and your notes from Activities 14, 15 and 16, consider:

- what ICT elements of learning are taught, extended or reinforced (fig 12);
- which of the nine areas of experience have been visited through pupils' use of ICT resources (fig 13)

In your response to the two bullet points above do not attempt to produce long lists.

If pupils have been taught to use specific software elsewhere, then you need to make a short note, indicating the relevant elements of learning or areas of experience.

Keep your notes safe until you are ready to move onto Activity 22.

Activity 21

Extension to Activity 20 - 'intelligent' ICT

As an extension to Activity 20 you may wish to attempt to identify the links to Gardner's MI theory (refer back to Figure 11). This would ambitious, but interesting undertaking and might be best attempted by considering each intelligence and its contribution to ICT capability within a subject. You may wish to design your own template based on Figure 13.

Your findings should demonstrate that 'intelligent' ICT capability arises from interaction of several intelligences. For example, the 'intelligent' act of using a computer with a graphical user interface (GUI), for whatever purpose, involves logical-mathematical (formal operation of symbols and conventions), spatial (finding your way around a GUI), and bodily-kinaesthetic (use of keyboard and mouse) intelligences. Add an ICT application such as a word-processor to produce a report for a specific audience and further intelligences are involved, namely linguistic and intrapersonal intelligences. If the resultant report is then delivered verbally, with audience interaction, then the remaining intelligences, interpersonal and existential, come into play.

Figure 12

Template to record information about elements of learning for ICT in a subject

Subject			**Key Stage/Yr Group**	
Area of study or topic	**Attitudes**	**Skills**	**Concepts**	**Knowledge**
↓	↓	↓	↓	↓

Figure 13

Template to record information about areas of experience for ICT in a subject

Subject			**Key Stage/Yr Group**	
Area of study or topic ➔ **Area of experience ⬇**				**➔**
aesthetic				**➔**
creative				**➔**
ethical				**➔**
linguistic and literary				**➔**
mathematical				**➔**
physical				**➔**
scientific				**➔**
social and political				**➔**
technological				**➔**

Curriculum mapping of ICT

Activities 19 and 20 prepared you for the task of constructing part of a curriculum map, which you will do in Activities 22 and 23. If you have omitted Activities 19 and 20 then you should backtrack before proceeding further. You should now be in a position to construct the part of a curriculum map that relates ICT entitlement and capability, initially, for one key stage or year group of a subject.

Activity 22

Constructing a curriculum map of ICT entitlement for one key stage of a subject

The template in Figure 14 has been designed to assist you with this activity. Because of the size of the pages in this book you will need to produce copies of Figure 14 in A3 format to avoid a cramped layout.

Using your responses to Activities 16 to 20 (and Activity 21 if you were brave enough) complete your copy of Figure 14 for the key stage or year group of the subject that you have been working on.

Do not feel that you must make an entry into each box of the template, especially if you are considering the ICT activities for one year group. If you find that you are making an entry for each box then you will need to question whether you are trying to cover to much in your use of ICT. One of the main points of this activity is to enable you to identify gaps in ICT provision and then to establish from elsewhere these are addressed.

Figure 14

Template to construct part of a curriculum map showing subject and ICT links

Subject		**Key Stage/Yr Group**		
area of study or topic				➔
subject programme of study links				➔
ICT activity				➔
IT programme of study links				➔
ICT resources				➔
characteristics of ICT capability				➔
strands of ICT capability				➔
elements of learning for ICT				➔
areas of experience for ICT				➔
intelligences for ICT				➔

The curriculum map that you completed in Activity 22 shows a small part of the curriculum provision for ICT in your school. The benefits of producing a map for the whole curriculum include being able to identify:

- areas of omission and areas of repetition;
- pupils' gains in skills, knowledge and understanding;
- if pupils are being given opportunities to demonstrate increasing ICT capability.

You can also use the map as a tool to focus on the issues of differentiation and relevance. Having identified and explored these issues you and your colleagues will be in a more informed position to plan for continuity and progression in pupils' ICT capability.

Activity 23

Extending the map of ICT entitlement to the whole curriculum

To produce a full map you need to consider all year groups for all subjects. This activity is difficult to undertake unless you can obtain the support and collaboration of your colleagues. This may be more difficult if you are not a Curriculum Co-ordinator or member of your school's senior management team.

If you are a trainee teacher then you should not attempt to produce a map of ICT activity for the whole curriculum. Instead you should restrict the map to the key stages in the subject for which you are training to teach.

One way to proceed may be to table your part-completed curriculum map at an appropriate meeting and to discuss the best way forward to produce a map showing ICT provision for the whole curriculum.

Keep your responses to Activities 22 and 23 safe for use in Chapters 6 and 7.

Pupils' ICT experiences outside the school environment

One of the implications that may have been in your list from Activity 14 in Chapter 3 is the need to diagnose what pupils already know and can do. Before you can do this you need to

establish from where they acquire these prior capabilities. In Activities 18 to 23 you have already done this for the ICT capabilities acquired from the school's curriculum provision.

However, to obtain the full picture you need to identify and include the breadth, depth and relevance of ICT capabilities acquired from the hidden curriculum (those experiences outside of classroom control). This will be the purpose of the next two activities, which are designed for you to:

- identify the extent to which pupils acquire ICT capabilities outside of the school environment;
- analyse pupils attitudes to ICT as a result of external influences;
- consider the implications of acquired capabilities arising from external influences in relation to your school's ICT provision.

Ideally you need to involve all pupils in your school, but this may be a practical impossibility. More realistically you might decide to focus on group or year samples, or a whole year group. If you use samples then you must ensure that they are not too small and are cross-representative to obtain valid and reliable data. Suitable sample sizes should be at least twenty-percent of year or group sizes and should be representative of ability, ethnicity, gender and special needs.

Activity 24

Identifying capabilities acquired from your pupils' use of ICT resources outside of classroom control

In this activity you will find out about pupils' attitudes towards and experiences of using computers. To do this you will need to conduct a survey in your school by using a questionnaire or through talking to pupils.

You will find an example questionnaire in Appendix III that has been used by the author to obtain data from over three thousand secondary pupils in Years 7 to 10. If you are a primary teacher, or training to become one, then you will need to modify the example questionnaire, especially for pupils below Year 6.

Before designing and conducting your survey you should refer to the guidance notes, in Appendix III, which are about analysing the data obtained. It is important that you refer to these guidance notes - it is good practice to design surveys *after* you have considered what it is that you wish to investigate.

You may, if you so wish, construct your own questionnaire or interview schedule using the example in Appendix III as a model.

You need to find out:

- ownership of, access to, and usage of computers outside school;
- type of computers used outside school (do not be surprised if pupils include games consoles, and do not discourage this);
- activities that pupils use computers for outside school;
- pupil gender;
- number of siblings and position in family;
- attitudes towards using computers.

Having carried out your survey, you will need to analyse the data which you have collected. This is the purpose of Activity 25. However, before you proceed further you should reread the guidance notes in Appendix III

Activity 25

Analysing the data from your survey of pupils' use of ICT resources

Your analysis of the data from the questionnaire should be directed to addressing key questions, which you will need to identify first.

Some examples include:

- Do more boys use or own a computer at home than girls?
- Are parents more likely to buy a home computer for boys than girls?
- What are the main uses of computers at home?
- Is there a difference between boys' and girls' use of a computer at home, at school or elsewhere?

- Does family size and position in family have some bearing on computer access and use?
- Do pupils who use a computer at home show a more positive attitude to using computers? You may need to consider this in relation to the three categories of types of computers at home, as indicated in the guidance notes for question 5 and 6 (Appendix III).
- What characteristics and strands of ICT capabilities are developed through pupils' use of computers outside of school lessons?

Summary

The discussion and activities in this chapter should have allowed you to build up a comprehensive picture of the breadth, depth and relevance of pupils' opportunities for ICT activity.

If you are:

- a trainee teacher or a qualified teacher then you will have acquired data for one year group or one key stage of a subject and associated pupils' ICT experiences;
- a Curriculum Manager or a Subject Co-ordinator then you will have considered a wider provision beyond one subject, year group or key stage.

It is now time to reflect on what you have found out from your work using the activities in this chapter. The starting point for the final activity, which is concerned with continuity and progression, is to return to the points made earlier in this chapter (p.63):

- pupils' ICT experiences may lack rigour;
- gains made in skills, knowledge and understanding may be poor because of:
  - insufficient breadth;
  - poor differentiation of tasks to meet identified individual needs, and;
  - activities that lack relevance.

Activity 26

Reflecting on continuity and progression issues

Using you responses Activities 16 to 25, identify the extent to which there is a match between pupils' ICT experiences at school and at home. Some questions that you may wish to consider include:

- Do pupils display two levels of ICT capabilities - one arising from experience outside school and the other arising from what they are taught about ICT in school?
- Do you and your colleagues acknowledge pupils' prior learning and plan for continuity and progression to cater for individual pupils' needs?
- Are pupils' ICT capabilities enhanced or restricted by opportunities at school (or home)?
- Do you and your colleagues suggest and encourage ICT activities that may be done at home?

Keep your responses to the activities in this chapter safe for use in Chapters 6 and 7.

Considering curriculum principles is all well and good if the resourcing for ICT is adequate, or if there are provisions to make it so. The next chapter focuses on resources and their management. The activities are designed to help you to use resources more effectively to support pupils' learning through their use of ICT.

Chapter 5

Resource access and deployment

In this chapter we turn to some of the problems of ICT resourcing faced by teachers in meeting curriculum requirements. Four specific areas relating to resourcing are discussed, these are:

1 The coordination of ICT,

2 The implication arising from the half-life of knowledge concept on future teaching and learning needs.

3 Health and safety risk assessment.

4 Room layout to meet teaching and learning needs.

Before moving further you will need to refer back to your responses to some previous activities:

- Activities 5 and 6, where you considered the sufficiency of the resources available to you.

- Activity 17, where you indicated the resources required to support a subject that you teach.

Activity 27

Identifying problems of ICT resourcing in your school

Read back over your notes for Activities 5, 6 and 17.

As you read, make bulleted lists of what it is that is satisfactory and unsatisfactory about the access to, and the management and deployment of ICT resources in your school.

From your lists, identify the issues over which you feel you have some control and those over which you have no control.

Four phenomena and their paradoxes

There are at least four phenomena commonly observed in the use and management of resources in schools, each of which gives rise to a paradox.

- Teachers are aware that the effort required in locating and setting up resources for classroom use can greatly outweigh the educational benefits gained from their use. Resources that have tremendous potential may not be used to benefit in the classroom. Taken to the extreme, the resources are never used.

- proposals are made for purchase of expensive ICT resources on valid educational grounds. These resources are then not used because of the efforts required to get them to the right place when needed.

- ICT resources become outdated very quickly and replacement resources are perceived as 'better'. All resources require a storage location and the security of that location is directly proportional to the 'newness' of the resource and new resources are protected to the point of restricting their use. As an aside, those of us old enough to remember the early Beta videos, RML and BBC computers in schools may remember the somewhat ridiculous lengths to keep them secure. I remember having to follow the Education Authority policy of, at the end of every school-day, storing computers in a locked cupboard in a locked upstairs room with bars on the windows. I was the only key holder to the cupboard, which housed the school's 4 BBC computer systems! Later still the policy applied to early IBM PCs, but with an addition of an alarm system to the locked

room. By then the BBCs had been rehoused more openly around the school, where they were in constant use.

- on a larger national scale the three phenomena described above become compounded. Value for money, as an oft used measure of the efficiency of effective use of learning resources, is frequently reported as poor in annual Government Agencies' reports. There is concern about the lack of use of IT resources and teachers' low skill levels after considerable investment of government funding.

The four paradoxes arising from the phenomena described above are that:

- learning gains from use of ICT resources do not happen because the resources are not used;
- proposed purchases of ICT resources are rejected, because of poor value for money from previous purchases;
- resources are used more as they become older, even though cases have been made for their replacement - this can also promote negative attitudes by pupils in their use of computers at school because they familiar with newer technology elsewhere (*eg* at home)
- lack of use of resources and low skill levels may be caused by resources being inaccessible, and not by teachers refusal or reluctance to use them.

This is intentionally controversial, but some of the above points may have rung true in your own situation as you try to make use of the ICT resources available to you. Perhaps additional phenomena and their paradoxes may have come to mind. In Activity 28 you will consider their validity in your school.

Activity 28

Considering paradoxes of ICT access and deployment

Read back over the four phenomena and their paradoxes. As you read, to what extent are these phenomena and their paradoxes true of your school?

If you consider that they are not true of your school, then you should be pleased. Be aware that at any time they could become true, and you will need strategies to prevent them from happening.

For those paradoxes that are true of your school, what can you and your colleagues do, individually or collectively, to overcome them?

In your file make a list of key points that need to be addressed to allow easier access to, and deployment of, ICT resources in your school. To prevent a somewhat negative list, consider strategies that are positive to assist you and your colleagues.

The ICT Coordinator's role

Central to the access and deployment of ICT resources in any establishment, whether educational or in industry, is a resource manager. In a school this person is usually the ICT Coordinator. We now turn, in this chapter, to consider your understanding of the role of a school's ICT Coordinator. If you are the IT Coordinator then this section and its activities will be of value to you in appraising (or re-appraising) your own role.

You may recall that, in Chapter 2, an analogy was used to compare a car driver and a computer user. This analogy was intended to make a comparison between levels of skilful performance and user (or teacher) proficiency. The discussion, which followed the analogy, concluded with a bullet list of behaviours that teachers need to develop to become skilled computer users. If you cannot recall these behaviours then, before proceeding to the next activity, you should re-read 'Developing teachers' skillful performance as computer users' (p26).

The reason for revisiting these behaviours is to consider them in light of the role of your school's ICT Coordinator in supporting your teaching and learning using ICT resources. From these behaviours some key questions emerge about the ICT coordinators *actual* and *expected* role. It is these questions that form the basis of Activity 29.

Activity 29

Considering your expectations of the role of an ICT coordinator

Some key questions that you should now consider about your expectations of the role of your school's ICT Coordinator are as follows.

Should an ICT Coordinator:

- be skilled as a technician and as a proficient user?
- know how the resources work and how to use the resources?
- know how the resources can be built into effective teaching of your subject(s)?
- facilitate the development of your teaching skills to incorporate technological advances?

If you are an ICT coordinator then use these questions to identify and re-examine your own position and competence. You should use your responses to reflect on your personal continuing professional development needs.

Before moving on to consider an ICT Coordinator's actual role in supporting your teaching, it is appropriate to look at a typical coordinator's job description. Whilst searching for source material for this book I found the job description for my appointment as a school's Head of Information Technology. A copy of this job description may be found as Figure 15. This job description was for a regraded post as a result of the school's reorganisation in 1990. Prior to this appointment, there was extensive discussion with the school's Senior Management about the pedagogic, administrative and technical aspects of an IT Coordinator in the hope of securing administrative and technical support. At the time I was already responsible for the school's computer education provision and was well aware of the demands placed on an IT Coordinator in supporting colleagues and maintaining a computer network. The headteacher had been sufficiently forward thinking to recognise computer education as a subject (Computer Studies) and as a cross-curricular theme (Information Technology) and was keen to enhance further the school's high reputation for computer education.

Unfortunately, what had been failed to be recognised was the inevitable expansion of IT in the 1990s arising from implications of:

- IT as a compulsory part of the National Curriculum (with an explicit Order as a fourth core subject, but not declared as such);
- the cost of replacement of less user-friendly micros with RISC or x86 PCs running graphic user interfaces to provide a more user-friendly resource base. [If you find this sentence too technical then you should refer to Appendix II, 1.2];
- the increased and more diverse range of gadgets that can be linked to a computer (*eg* scanners, cameras, CD drives, laser and colour printers);
- the developments in network technology and inter-network communications (*ie* intranets, the Internet and the World Wide Web (WWW).

Using Figure 15 and the notes in the paragraphs above we now turn to Activity 30, which is designed to raise awareness and understanding of the actual role of a school's ICT Coordinator. Activity 30 is essentially two-way, in that it promotes cooperation and dialogue between non-coordinators and coordinators about actual needs and roles.

Figure 15

Job Description for a Head of Information Technology (c.1990)

The post requires the successful applicant to teach pupils in the age range 13-18, with responsibilities and specialisms as follows:

1 Teach Information Technology, Computer Studies and Electronics as required across the age and ability range.

2 Prepare students for internal and external examinations in whatever form they may be cast, up to and including ‘A’ level.

3 Prepare work, set and mark students' work, such as may be necessary for the successful accomplishment of tasks 1 and 2. To report and record results.

4 Organise the Computing/IT curriculum and to plan the teaching programme within the school's overall curriculum and the National Curriculum.

5 Subject to the agreement of the Deputy Head (Curriculum) allocate the teaching personnel to classes and courses. (This anticipates expansion as student numbers rise), supervising the work of others who may work in the Department.

6 Identify and meet the school's IT needs. Advise Heads of Departments and other colleagues on the purchase of hardware and software.

7 Run the school's IT budget, ordering hardware, software, books and other equipment.

8 Keep records of the School's equipment and advise on and monitor the security of all IT equipment.

9 Arrange and implement INSET to meet the implementation of IT across the curriculum.

10 Maintain and manage the computing systems (except administrative systems), both for the teaching of IT and related work and for the Computer Assisted Teaching of other staff. Advise when outside maintenance is required.

11 Assist in the use of computer graphics as required for school publications.

12 Teach on the vocational education programme or its successor.

13 Advise the vocational education consortium on future IT developments.

14 Participate in the pastoral work of the school.

15 Operate health and safety procedures relating to computer equipment within the school's and the county's safety policies.

Activity 30

Identifying an ICT Coordinator's actual role

This activity must be done in cooperation with your school's ICT Coordinator. If you are the ICT Coordinator do the activity in cooperation with colleagues. The purpose of the activity is to produce an agenda for action, based on the coordinator's actual role in supporting, and obtaining support for, teaching and learning requirements.

Compare the example job description for a Head of IT in Figure 15 with the one for your own IT Coordinator. Make a note in your file of the similarities, differences and omissions between the two job descriptions.

Using your notes, the example in Figure 15, and the school's job description produce a draft of a revised job description for a school's ICT Coordinator.

Taking each of the responsibilities in the revised job description:

- If you are the ICT Coordinator, discuss with a group of colleagues, how they can support you and how you can support them.
- If you are not the ICT Coordinator, discuss with the Coordinator, how they can support you and how you can support them.

During your discussion you should:

- identify strengths in the school's ICT policy and the areas requiring development to improve the quality of education provided and the educational standards achieved through the use of ICT resources;
- identify any additional resources required, including training, staffing and accommodation;
- make notes in your file to indicate actions, strategies required and by whom the action is to be taken.

The ICT Coordinator's future role

The last two activities allowed you to consider your expectations and the actual role of an ICT Coordinator; either as a member of teaching staff or as a coordinator. We now move on to consider issues in preparing ICT Coordinators for their future roles. In the bullet points

before Figure 15 (p80), I suggested that the ICT coordinator's job is far from static. This is because of the pace of technological development, which has an impact on teaching and learning.

As new developments occur, teachers need to be sufficiently aware of their future educational impact. The main educational consequence here is that the 'technological gap' between resources being used in schools and those available could progressively widen. This has already been happening - pupils use more sophisticated ICT resources outside school. Therefore, many pupils can become demotivated by what they perceive as out-dated resources in school.

Ten years on from the 1990s, IT Coordinators have become very aware of the profound effect that developments have had on their workload in meeting the needs of teachers and pupils. The expansion of ICT in the last decade is set to continue at least at the same rate into the first decade of the new millennium. If this is so, then the demands facing ICT Coordinators are immense. Indeed, ICT Coordinators will have difficulty in effectively fulfilling their roles (*ie* pedagogic, technical and administrative) without support.

However, predicting the future is problematic in that predictions are invariably wrong. This is partly because of a lack of consideration of past and present developments, which can offer us signposts to plan future provision.

The half-life of knowledge

The consequence of emergent information and communication technologies and their pace of development is that each new discovery challenges what we thought we already knew. In *Future Shock*, Toffler (1970) describes the transition from an industrial economy to one based on knowledge. He predicts that:

> *'Tomorrow's schools must therefore teach not merely data, but ways to manipulate it. Students must learn how to discard old ideas, how and when to replace them. They must in short, learn how to learn …… By instructing students how to learn, unlearn and relearn, powerful new dimension can be added to education'*

Toffler goes onto cite the psychologist Gerjuoy:

> *"Tomorrow's illiterate will not be the man who can't read; he will be the man who has not learned how to learn"*

Today, these ideas can be illustrated using the concept of the half-life of knowledge. Products and processes tend to be replaced by newer ones more rapidly than before.

The two main characteristics of this concept are that, in a finite period of time:

- half of a body of knowledge becomes redundant;
- the volume of a body of knowledge is doubles.

Shapero (1989) suggested that the time period for the half-life of knowledge was five years for the fields of engineering, science, and technology. By the year 2010, this period has been predicted by Gardner (1999) to be as short as 22 months. However, the time period differs for fields of study and therefore there may be two forms of knowledge half-life (Knight, 1997): short and long half-life knowledge (SHK and LHK). A comparison of their characteristics may be found in Figure 16.

The implications from the half-life of knowledge concept are educationally significant:

- In the past, newly acquired knowledge served the individual from secondary schooling well into adulthood; the majority of that knowledge remained valid and reliable.
- Today, newly acquired knowledge may not serve the individual from secondary schooling well into adulthood.
- The teaching of prescribed bodies of knowledge (except, perhaps, literacy and numeracy) may no longer be the most expeditious use of teaching time.
- Pedagogy may need to focus more on teaching learners how to learn for themselves. For example, flexible and distance learning teaching style.

Figure 16
The characteristics of long- and short half-life knowledge (Knight, 1997)

	Long half-life knowledge	**Short half-life knowledge**
Knowledge type	Academic, basic, theoretical	Practical, vocational
Examples	Citizenship, language, logic, mathematics, reasoning, socialisation, theoretical parts of professional training,	Industrial processes, software use, specific technical and professional skills
Acquisition time	Long - months, years	Short - days, weeks
Depreciation time	Long - years, decades	Short - days, weeks, months
Economic return	Slow	Fast
Positive externalities*	High	Low
Source of finance	Families, state	workers, businesses

* '**positive externalities**' - a term used by economists to mean the economic or social benefits accruing to society and not just to the individual.

Activity 31

Considering the impact of ICT on teaching and learning

Re-read 'The ICT Coordinator's future role' and 'The half-life of knowledge' (pp.82-85). As you do so consider what your viewpoint is on the following questions:

- How do we know what knowledge is an essential core?
- What is the nature of the pedagogy that may be needed to equip children not only to learn, but also to unlearn and then to relearn for themselves?
- Are schools threatened as learning institutions?

In your file make brief notes for use in Activity 32.

Having considered ICT Coordinators' actual and expected role, the time has come to consider the impact of emergent technologies on future roles. In Activity 32 you will consider ways of maximising resource access and deployment to meet present and future teaching and learning needs.

Activity 32

Formulating ideas about future needs and roles

For this activity you will need to refer back to your notes for the activities so far in this chapter (Activities 27 to 31).

As you read your notes, formulate your ideas about the possible changes facing education through technological change. Brainstorming the issues with colleagues may help. The more you think about the issues the more worrying the matters may become - perhaps even threatening to you and your institution.

Make notes in your file of the actions that you will need to take to translate your ideas into practice – try to turn your worries and fears into positive actions. The best way to do this may be to make notes, tabulated, under a series of headings, for example:

- issue;
- action;
- resources;
- personnel;
- training;
- any other heading(s) you think suitable.

Use your notes to promote a wider debate about what is needed. This will assist you and your school in reacting positively to the technological developments that will influence teaching and learning.

So far in this chapter, we have looked at two of the main issues affecting the access and deployment of ICT resources in schools. These are the roles of staff and the potential for ICT to change teaching and learning. To summarise this discussion we can say: **if access to ICT resources is restricted to a few staff, then technological change cannot bring about educational change**.

Throughout this chapter I have not used terms such as 'gatekeeper' or 'IT guru' to describe the actions of some staff responsible for ICT in institutions. Such staff do exist – they typically restrict 'their' resources and knowledge for control purposes. If this is a problem in

your school then you and your colleagues should use your responses to the activities so far in this chapter to develop strategies to find a solution.

Health and safety

We move now to a third aspect affecting the access to and deployment of ICT resources, namely health and safety. It is not within the scope of this chapter to provide in-depth detail on statutory legislation concerning health and safety matters. However, you should be aware of the principles of the following:

- Health and Safety at Work Act (1974)
- Management of Health and Safety at Work Regulations (1992)
- Health and Safety (Regulations (1992)
- Workplace (Health, Safety and Welfare) Regulations (1992)
- Provision and Use of Work Equipment Regulations (1992)

To schools, the key principles are that governors, headteachers and staff have a responsibility:

- to provide a healthy and safe working environment for pupils and staff;
- to educate pupils to understand the importance of health and safety;
- to assess the risk to the health and safety of pupils and staff and to anyone else who may be affected by their activity.

Above all – health and safety should be viewed as everyone's responsibility.

The risk assessment of the use of ICT resources and their environments

In *Display Screen Equipment at Work: Guidance on Regulations* (HSE, 1992), guidance is given on good practice in reducing potential health and safety risks from the use of ICT workstations.

The guidance does not specifically mentioned pupils and teachers as users. Possibly because:

- since 1992, the use of ICT resources in schools has increased;
- teachers and pupils are not considered as screen display users for long periods of time each day.

Nevertheless, the use of ICT resources in schools may lead potentially to both short- and long-term health problems to both staff and pupils. This is particularly so when equipment is placed in positions that leads to discomfort for the user. In schools, it is important and essential that HSE's (Health and Safety Executive) guidance is considered if these health problems are to be avoided. Certainly it would not be socially or economically beneficial for today's pupils to develop health problems in the future, because of poor working conditions they experienced when using ICT resources at school.

You should be aware that not all potential health problems are covered by specific HSE guidance on workstations, but you would find indications elsewhere. One such example is the need for clean hands when handling foodstuffs. This should extend to equipment being shared, especially in closed communities. (When you read the rest of this paragraph you will probably never ever touch a keyboard again!) In general, hand washing, especially after certain bodily functions, is not as common a behaviour as we might desire. In schools, gastro-enteric disorders spread very quickly. The case rests here. [Press reports have cited links between enteric outbreaks and computer keyboards.]

Whilst on the subject of micro-organisms, it is time to consider another form of risk to the workstation itself – computer viruses. These are not microbial but are pieces of computer code designed to sabotage the workings of a computer. They are so named because their action mimics their microbial counterparts. The consequences of a computer virus attack are to disable the computer system and to place stress on the user (through frustration).

Many schools, in an attempt to limit the risk from computer viruses, do not allow pupils and staff to load data from disks containing work done on a home computer onto the school's workstations. This is an understandable viewpoint, but it is also counter-productive to the

progress of pupils and staff in their use of ICT. Furthermore it does not remove the possibility of virus attack, because:

- in such a regime, users will covertly download data from their discs;
- many viruses are transmitted through other means such as the Internet and from inadequately protected application installation discs.

The only way to protect workstations is through the installation and maintenance of virus checking software, which is the institutions' responsibility (not the users'). Procedures, therefore must be in place to ensure that:

- all users are trained in the use of virus protection software to protect their data and its transfer from systems;
- staff designated as systems managers regularly perform scans of all workstations to check their integrity;
- virus shields on workstations are permanently running as background programs on workstations;
- virus software is regularly updated to protect against infection of new forms of computer viruses.

In Activity 33, the first of three covering health and safety, you will reflect on your current understanding and knowledge of potential health risks from using ICT resources. Figure 17, which shows a typical workstation in an office environment, will act as a focus for this activity.

Activity 33

Increasing awareness of health and safety risks

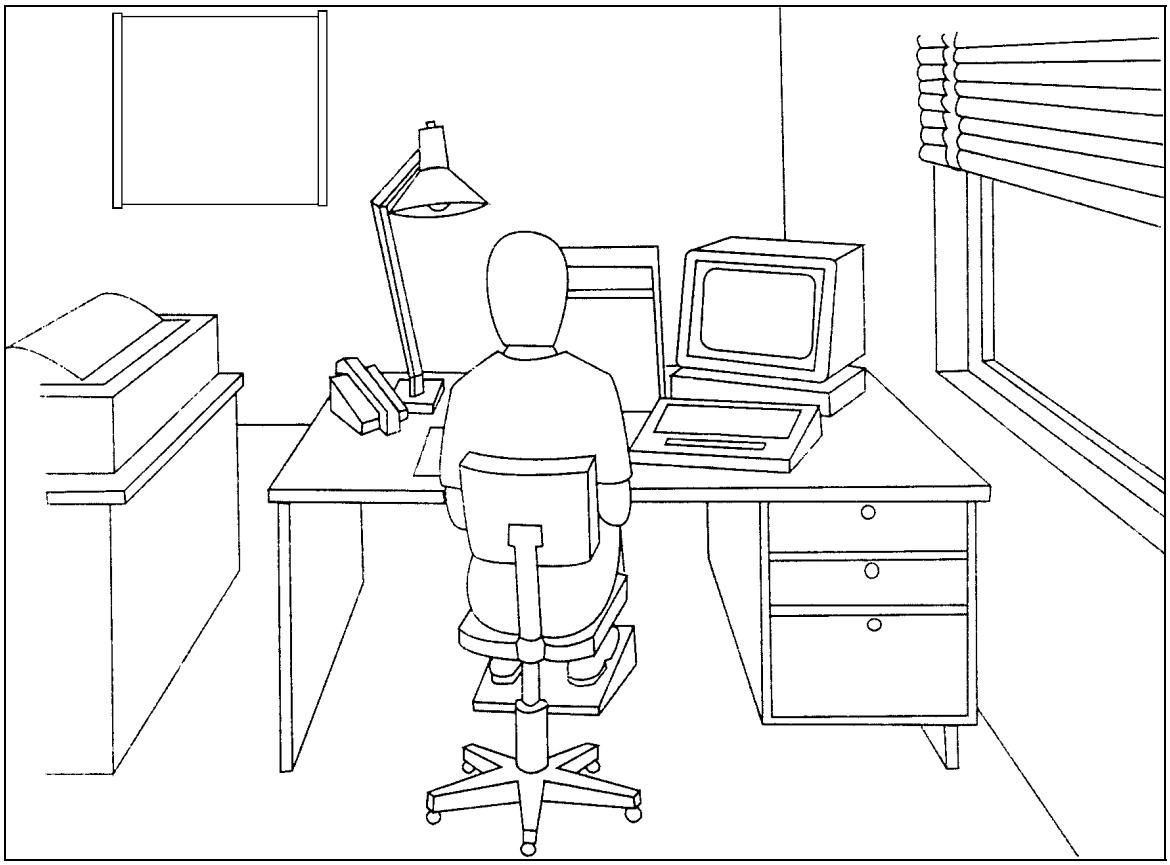
Refer to Figure 17, which shows an office situation - the factors that need to be taken into account are the same when considering workstation use in a school.

Make a list of the factors that you would need to take into account when placing a computer workstation in a classroom. When you have done this you may wish to refer to the factors identified by HSE for office use, which may be found in Figure 18 (pp94-5)

Identify the potential health and safety risks to the user which could arise if these factors are not adequately considered. Remember to include the consequences of computer viruses.

Figure 17

A typical workstation in an office environment
[Adapted from *Display Screen Equipment at Work: Guidance on Regulations* (HSE, 1992), p32]



User-centred design

In Activity 34 you will analyse pupils' use of computer workstations. Before moving on, we need to look at two fields of study that are of importance to user-centred design. These are:

- *anthropometry* - the measurements of the human body;

- *ergonomics* - the efficiency of persons in their working environment.

Unfortunately, many of the computer workstations that we use may cause discomfort to us very quickly. In other words they are organised with disregard to anthropometric or ergonomic factors (*ie* irrespective of the shape or size of the user). This is a particular problem in schools because of the size range of pupils. How can a workstation cater for the youngest (smallest) and oldest (largest) pupil?

To be comfortable in using a computer you need to be able to sit with:

- your head up;
- your shoulders relaxed;
- your back erect and supported;
- your elbows vertically below the shoulders;
- only moderate pressure at the front of the seat cushion;
- your feet firmly on the floor or on a footrest;
- your hands in line with forearms, not at an angle;
- the mouse close to the keyboard or in front of you;
- the monitor set so that the top of the screen is at eye height;
- the seat, monitor, keyboard and documents arranged so that you are looking straight ahead most of the time.

Lists such as the one above are widely used by employers as checklists for employees. However, such lists are infrequently used by teachers to check the comfort of their pupils. Indeed, poor consideration of ergonomic factors may account for some behavioural problems displayed by pupils when using ICT resources.

For example:

- inattentiveness;
- lack of concentration;
- distracting other from working;
- under-achievement.

In Activity 34, you are going to use the checklist of ergonomic considerations in the notes above to analyse the comfort of pupils and yourself.

Activity 34

Analysing the ergonomics of a workstation

For this activity you will need the help of six 'volunteer' pupils – small, middle and large size, and male and female pupils. To do this you may need to select from the youngest and eldest pupils that you teach. As an extension you may also wish to repeat the activity with a similar sample of colleagues.

During the activity, you will need to get your volunteers to engage in a task, such as keying in a few paragraphs of text into a word processor. The choice of task is up to you and will depend on your teaching subject, but should take no longer than four minutes.

Explain carefully to the volunteers the purposes of the activity:

- to check their comfort levels in efficiently using a computer workstation;
- to consider ways of improving efficient use of a computer workstation by making its use more comfortable.

For each volunteer, ask them to:

1 arrange the workstation for their own comfort;
2 complete the four minute task under your observation (so that you can identify problems of equipment layout);
3 discuss any problems with comfort and possible improvements they would make;
4 rearrange, if possible the workstation to their specification;

5 repeat the four minute task under your observation (to check if the improvements work);
6 discuss whether the task was easier as a result of any modifications;
7 rearrarrange the workstation as it was at the start.

Make notes in your file for each volunteer. When you have done the activity for all the volunteers analyse your findings:

- Did the volunteers' arrangements and rearrangements satisfy the ergonomic factors in the checklist 'User Centred Design' (p91)?
- What general recommendations would you make to colleagues about workstation layout?
- What guidance would you give to pupils about arranging their work when using a computer?
- Is it possible for a workstation to be arranged to address the needs of the size range of users in a school?

Activity 34 illustrates only a small part of the bigger picture. In schools, computer workstations may be deployed individually or severally in classrooms or resource areas. There may be one workstation in a classroom/resource area, or a suite of workstations in a dedicated computer room. Whatever their deployment the same ergonomic and anthropometric considerations should apply.

In Chapter 2, Figure 9 contained a series of questions which may be used by Ofsted Inspectors to assist making judgements on quality of teaching and learning. Figure 18 is similar in that it contains a series of questions which may be used by a Health and Safety Inspector to ascertain risks from workstations and their environments. It is these questions, in Figure 18, that you will apply in Activity 35

Figure 18

Workstation and work environment risk assessment

1	**The display**
1.1	Does the monitor swivel from side to side adequately to meet user needs?
1.2	Is the monitor sufficiently tiltable upwards and downwards sufficiently?
1.3	Is the image stable?
1.4	Is the image flicker free?
1.5	Is the information on the screen large enough to see easily
1.6	Is the information on the screen clearly defined and easy to read?
1.7	Are the brightness and contrast controls adequate and easily adjustable?
1.8	Have reflections and/or glare been eliminated?
1.9	Is the monitor regularly and adequately cleaned?
2	**Keyboard**
2.1	Is the keyboard separate from the screen (*ie* adequate movement of the keyboard)?
2.2	Can the keyboard be tilted on short legs at the rear?
2.3	Does the keyboard have a matt finish?
2.4	Are the key symbols adequately readable?
2.5	Is the keyboard regularly and adequately cleaned?
3	**Mouse**
3.1	Is a mouse mat available?
3.2	Is the mouse accessible to left or right handed users?

4	**Desk/work surface**
4.1	Is there adequate free space on the desktop for the job?
4.2	Is there adequate space in front of the keyboard to support hands and arms when not typing?
4.3	Is there adequate leg room clearance below the desktop?
4.4	Is there adequate front to back leg room under the desk?
4.5	Is the surface of the desk a matt finish?
4.6	Is the layout of the desktop equipment satisfactory for user needs?
5	**Work chair**
5.1	Does the chair have a stable five-pronged base?
5.2	Is the chair provided with castors?
5.3	Is the seat height adjustable?
5.4	Is the back rest height adjustable?
5.5	Is the back rest tilt angle adjustable?
5.6	Can all adjustments be made easily and safely from the seated position?
5.7	Is the chair comfortable?
6	**Ancillary equipment**
6.1	Is a stable and adjustable document holder available if required?
6.2	Is a footrest of appropriate size available if required?
6.3	Is an adequate task light available if required?

7	**Posture**
7.1	Have users been trained in correct posture?
7.2	Is there sufficient room at the workstation to adopt a range of different postures whilst working?
7.3	Can the workstation and its equipment be adjusted to attain a comfortable posture whilst working?
7.4	Can an adequate viewing distance form the screen be achieved?
8	**Space and room layout**
8.1	Does the layout of the immediate work area allow the work to be done satisfactorily?
8.2	Can the equipment be reached to perform tasks without excess reaching, stretching or twisting?
8.3	Have any obstructions or hazards in the work area been eliminated?
9	**Lighting**
9.1	Does the general lighting enable the screen to be viewed clearly?
9.2	Have adequate window blinds been provided where required?
9.3	Has glare on the screen caused by the finish on the walls, ceilings or fixtures been adequately eliminated?
9.4	Is the lighting suitable for other tasks when not using display screens?
9.5	Have glare/reflections on the screen been satisfactorily reduced?

10	**Noise**
10.1	Is the equipment quiet enough?
10.2	Is the room quiet enough for work to be done properly?
10.3	Can normal conversations be conducted?
11	**Heating and ventilation**
11.1	Is the ventilation adequate to prevent discomfort from excess heat/cold?
11.2	Is the ventilation adequate to avoid discomfort from dry eyes?
11.3	Have any disturbing draughts been eliminated?
12	**Other issues**
12.1	Has the position of the workstation been considered in relation to others in the room?
12.2	Has adequate training been given in how/why to operate the adjustability provided by workstation furniture?
12.3	Have the needs of users been taken into account (*ie* equal opportunities)?
12.4	Are adequate procedures in place to minimise computer viruses and their effects?

Activity 35

Risk assessment of the whole institution's ICT resources

This activity is not the mammoth task implied by its title, unless you attempt it alone. It will, however, serve at least three important purposes:

- You will find out the locations and extent of your school's ICT resource base.
- You will apply your knowledge of potential health and safety risks gained from Activities 33 and 34.
- You can consider how resources may be better arranged to improve users' comfort and their efficient use of resources.

Before undertaking this activity you should discuss the activity with several key staff in your school, including:

- a colleague from Senior Management;
- the ICT Coordinator;
- a Health and Safety representative.

You should invite them to help and support you with the activity since there are benefits to the whole school. However, before proceeding further it will be useful to be introduced to the concept of cognitive dissonance. This refers to a human behaviour in which a person resists change by taking an attitude which is incompatible with the information presented. This can lead to conflict situations. In this activity a risk assessment could be taken as having expensive financial implications, which may not be the case.

Using the questions in the schedule in Figure 18 carry out a risk assessment of the workstations in your school. If this is too big a task, then either focus on those workstations that you use on a regular basis with your pupils, or enlist the help of colleagues and pool your observations.

Make notes in your file of your observations and use these to produce a list of the problems which may lead to discomfort or inefficient use of the school's ICT resources because of their existing layout.

Through discussion with the colleagues indicated above, categorise the problems into those which may be resolved quickly and easily and those which can't. For each problem indicate the action required, when and by whom.

Room layout to meet ICT teaching and learning needs

As you worked through the activities and text in this chapter, you may have considered the position of computer workstations within a room. All classrooms have a point in the room that acts as the focal point from which whole class teaching occurs – for example, the teacher's desk, the chalk/marker board or an overhead/data projector screen. A computer workstation is becoming commonplace as the focal point from which whole-class teaching occurs. There are distinct advantages and economies in being able to present information from a computer connected to a data-projector or interactive white board.

Teachers make use of computer rooms to teach some element of their subject curriculum. In a lesson that I observed, the teacher moved the whole class, of 24 pupils, from a workshop to the computer room - their self-discipline was impeccable during this transition. However, it quickly deteriorated once in the computer room. The teacher had a clearly defined expectation of what the pupils would use the computer for - Internet search to obtain design ideas. On entering the room pupils were to sit at a workstation for a whole class briefing. A diagram of the layout of the computer room for this lesson may be found in Figure 19. The 32 workstations (of which 6 did not work) easily allowed the pupils to work individually. For each workstation, the monitor was set so that the top of the screen was at eye height. The seat, monitor and keyboard were arranged so that the pupils could look straight ahead at the screen.

Before I offer my own observations of the lesson, you should complete Activity 36, which has been designed for you to hypothesise what problems occurred in the lesson as a result of the room layout.

Activity 36

Analysing a computer room's fitness for purpose of whole class teaching

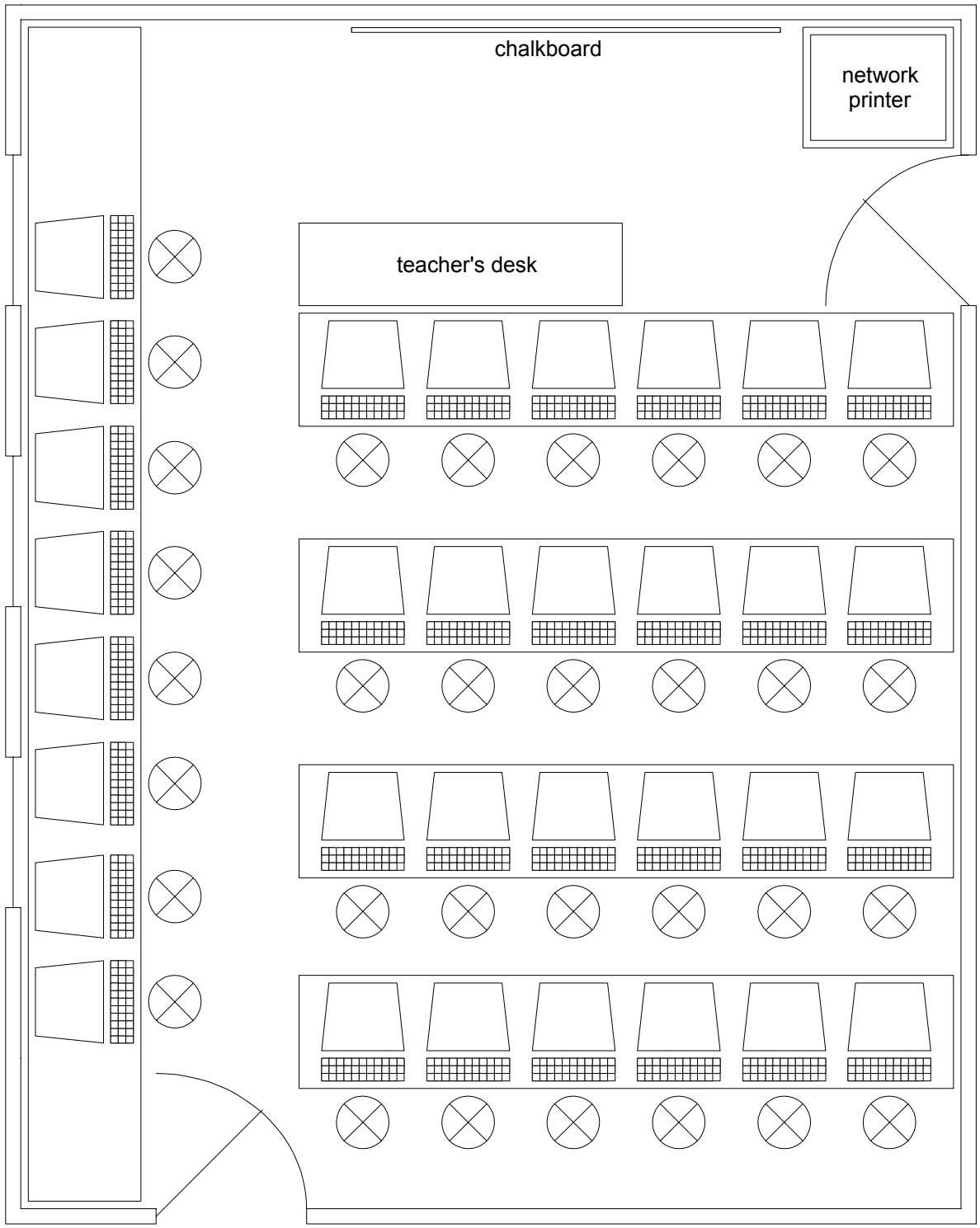
Refer back to the notes above and to Figure 19.

What problems could occur as a result of the room's layout?

Could the room be reorganised to overcome these problems? If so, then how?

Figure 19

A computer room layout



Observations of the lesson in a computer room

- Even though there is sufficient space, pupils sitting at the workstations down the side of the room make access to the rows of computers difficult.
- When briefing the whole class from the front of the room: the teacher sees the backs of 24 monitors – not the pupils' faces. These pupils cannot see the teacher - instead they see the screen, which distracts them from paying attention.
- The chalkboard can only be seen by two pupils, unless they all stand.
- There is no space for pupils' documents.

You may recall, that the pupils' task was to search the Internet for stimulus material to assist their design work. The pupils' ICT capability was very good, and their own activities included sending emails to each other, using a paint package for cartoons, searching for 'unsavoury' sites and browsing Internet shopping catalogues. It was difficult for the teacher to stop this because:

- there is only one place in the room where the teacher can observe all pupils' screens – the back left hand corner of the room (bottom right on Figure 19). It is therefore very difficult to keep checks on progress: (*ie* those on-task, and those needing help or extension tasks);
- by the time the teacher moves from one row to the next the pupils can quickly switch from the prescribed task;
- any list of suitable websites, which could have been written on the board, cannot be seen.

Clearly, for a lesson of this type, the teacher's control and discipline must be outstanding if there can be good gains in pupils' progress. Similarly, pupils' own self-discipline must be outstanding, else displacment activities will ensue. The room layout prevents whole-class teaching and makes monitoring difficult – a pedagogic rethink is required. Subject gains, therefore, in this lesson were poor

To redesign this room to cater for 24 pupils working individually, and under direct teacher control, is difficult - the room is too small. There are many pedagogic issues which need to be considered - this is the focus of the next chapter.

Chapter 6

Planning subject specific ICT activities in a whole curriculum context

The purpose of this chapter is to guide you through the planning and delivery of pupils' learning experiences through their use of ICT – at school, home and elsewhere. The key issues from previous chapters will be revisited and, through activities, translated from theory to everyday classroom practice.

Key issues raised so far

Chapter 1

- sufficient resourcing for pupils to do an activity;
- knowing how to use the resources;
- knowing how to teach using the resources.

Chapter 2

- knowing how to set up resources in the teaching environment;
- recognising when and where to obtain help if resources do not work;
- incorporating existing effective general teaching skills into the use of ICT resources;
- developing specific ICT teaching skills and incorporating them into teaching;
- understanding the difference between ICT being *built-into* and *bolted-onto*;
- assisting pupils' cognitive skills;
- considering pupil activities that may be enhanced by the use of ICT resources;
- analysing the learning gains from the use of ICT resources over other approaches.

Chapter 3

- relating assumptions about learning to ICT;
- considering features of behaviourist and constructivist theories in relation to your teaching using ICT.

Chapter 4

- defining technology and capability in the curriculum;
- avoiding confusion between pedagogic, mathetic and epistemological theories;
- clarifying the position of ICT as a technology and as a subject;
- understanding curriculum principles;
- recognising the breadth (and depth) of pupils' ICT experiences;
- identifying the contribution of ICT to a subject.

Chapter 5

- coordinating the management and use of ICT resources;
- resourcing implications from the impact of technology on the nature of knowledge;
- knowing how to assess health and safety risks relating to use of ICT resources;
- organising ICT resources to meet teaching and learning needs.

Activity 37

Checking your understanding of the key issues so far

A revision of what you have done so far is essential before you put theory into practice in the activities in this chapter.

Reread the bullet lists above. Remind yourself of what you have understood and learned. Where necessary refer back to the relevant chapter and your responses to activities.

Strands of ICT Capability Revisited

You may recall that the aspects of ICT, in a whole curriculum context, were introduced in Chapter 4. In the discussion I suggested that there were multiple ICT capabilities (p.47). In Activity 18 you identified which strands were relevant to a subject's programme of study for one key stage.

As a reminder of this discussion the strands and their capabilities, are:

- **Communicating information** developing pupils' skills to convey a message to a specific audience by presenting information in a variety of ways. For example, individually as words, pictures, numbers and sounds and collectively as multimedia.

- **Handling information** developing pupils' skills to process data into meaningful information. Processing activities include analysing, coding, collating, collecting, measuring*, monitoring*, recording, retrieving, sorting and storing.

- **Modelling** developing pupils' skills to create manipulable representations of real or imaginary situations.

- **Montrolling** developing pupils' skills to follow and create instructions to operate systems.

* In the *Revised National Curriculum for Information Technology* (DfE and Welsh Office, 1995), measuring and monitoring skills are linked, confusingly, to the modelling and control rather than to communicating and handling information strands. These two skills, in fact, are key links to inter-relationship between the four strands.

Because of interrelationships between the strands, a problem with a multiple ICT capability model is that of fragmentation. Pupils' competence could be described by the satisfactory demonstration of some, rather than all of the capabilities. Assessment, recording and monitoring of capability must be holistic – covering all strands. However, this same problem is also a strength, because by acknowledging capability in some strands incapability in others can be identified – at the levels of pupil, teacher and institution. This might sound harsh, but concern has been expressed, for example through HMI commentaries on inspection findings.

The concern is that schools have placed a greater emphasis on communicating and handling information than on measuring, monitoring and control. This emphasis has been through pupils' overuse of word-processors, for example, to retrospectively 'type-up' their work as 'reports'. Some research, which I carried out in the mid-1990s, revealed that many pupils (75 percent of a sample of 2000) perceived that word-processed work gained higher marks than hand-written work. Furthermore, some of their teachers had openly admitted this to them.

A multiple capability model, therefore, allows subject teachers and curriculum coordinators to identify more easily, first, the sufficiency of, and second, areas requiring development in existing ICT provision.

There have been several attempts by subject organisations to provide guidance to teachers as to which strands fit which subjects. Such attempts, however, tend to deal with each subject individually and do not provide a suitable overview of the collective picture. Figure 20 shows an overview of the strands relevant to the National Curriculum subjects and to RE. The information has been collated from individual subject sheets from the British Educational Communication and Technology agency (BECTa) - one of the sources to which you will refer in Activity 38. Figure 20 shows why it is that greater emphasis has been placed on the strands of communicating and handling information.

Figure 20

Overview of the relevance of ICT strands to specific subjects

	Communicating information	Handling information	Measurement and control	Modelling
Art	✓	✓		✓
Citizenship	✓	✓	✓	✓
Design and technology	✓	✓	✓	✓
English	✓	✓		
Geography	✓	✓	✓	✓
History	✓	✓		
ICT *	?	?	?	?
Mathematics	✓	✓	✓	✓
Modern foreign languages	✓	✓		
Music	✓	✓	✓	✓
Physical education	✓	✓	✓	✓
Religious education	✓	✓		✓
Science	✓	✓	✓	✓

* An interesting paradox – if ICT is taught as a subject then all strands are relevant. But in what context?

Activity 38

Accessing the Internet to find out about ICT in your teaching subject

For this activity you will need your notes from Activity 18, Figure 20, and a computer with Internet access.

If you are not sure how to access the Internet then you should learn to do so by seeking the guidance from a colleague or a pupil. Do not feel embarrassed by seeking help from a pupil – most are keen to share their ICT expertise.

Log onto the Internet and access each of the following websites

- The British Educational Communication and Technology Agency website: http://www.becta.org.uk/

- The Curriculum IT Support initiative on the National Grid for learning website: http://vtc.ngfl.gov.uk/resources/cits/

- The schemes of work for primary teachers on the Government's Department for Education and Employment's Standards website: http://www.standards.dfee.gov.uk/schemes

- Superhighway Safety: childrens' safe use of the Internet: http://vtc.ngfl.gov.uk/vtc/library/safety.html

These sites will provide you with information applicable to ICT within specific subjects.

As you browse the information you should, for a subject you teach:

- find out how ICT has been and can be used to extend pupils' capability in the different strands;
- explore links to other websites;
- make notes, in your file, of ICT activities to try out in your teaching

A useful website is the Government Information Service: http://www.open.gov.uk. This is an index to Central Government departments, organisations and agencies as well to Local Government. For example, you can access DfEE, Ofsted, TTA, QCA and your Local Education Authority. Similar websites exist for other countries – and are useful in finding out about educational developments worldwide.

As an extension to this activity, access the Ofsted database and read the IT sections of reports for your pyramid or cluster of schools.

Now that you have completed Activity 38, we can move onto planning an ICT activity within a lesson. This will be an opportunity to try out an idea of your own, or one from your web-browsing.

In Activities 39 and 40 you will apply a series of steps that link with work from previous activities in planning your ICT activity. The plan for the lesson needs to be written down. It is essential, irrespective of whether you are a trainee or an experienced teacher, that you have a method of planning your lesson, perhaps using a planning proforma. If you do not make use of an existing proforma then, at some point as you work through the activities, you should design one for use by yourself and colleagues. One advantage of such a system is that plans can be filed centrally in a house-style format. This allows colleagues, especially those responsible for ICT coordination, to quickly gain an overview of pupils' ICT experiences over a year or a National Curriculum key stage.

Ten steps to planning an ICT activity

The ten steps described in the following notes are not in a rigidly prescribed order. What is important is that, collectively, they are intended to assist you in planning ICT activities that are *built-into* rather than *bolted-onto* other activity. Having decided on the topic and its associated ICT activity, the first steps are:

Step 1 Identify the learning outcome as a development of the ICT strands and their capabilities.

Step 2 Identify the learning gains *to the subject*, and why they are more effective through the use of ICT resources.

Many of the ICT activities, especially in secondary schooling, will occur within the context of a specific subject. Therefore, it is important that the activity acknowledges that prior learning may have occurred, maybe in another subject or through extra-curricular activity – at school, home or elsewhere. Referring back to your analysis in Activity 12 of pupils' experiences will help you with this.

Step 3 Find out what prior learning has taken place (*ie* ICT strands and capability), which is relevant to the activity being planned.

Any learning experience needs to start with a concrete (familiar) experience before moving to the abstract (unfamiliar). As good teachers are aware, new experiences, which are

unfamiliar, are based on what is already familiar. If this principle is forgotten then the learners will find the work too difficult. This is not because it is too demanding, but because of the conceptual jump over the divide between what can be done already and what is to be done now (*ie* Vygotsky's 'zone of proximal development' referred to in Chapter 3). This principle is often overlooked when using ICT resources because computers may not be considered as abstract. For example, pupils may be asked to construct a spreadsheet without having constructed one away from the computer and important cognitive modelling problems may arise. Other examples exist, some of which are described in Figure 21. This leads us to steps 4, 5 and 6:

Step 4 Plan ICT experiences that are built on work that has been done without using ICT resources.

Step 5 Consider how pupils may apply conceptual understanding from previous work, to their use of ICT resources.

Step 6 Consider how the ICT activity will act as a facility to assist the development of cognitive skills (*ie* promote thinking by being a tool for learning).

Figure 21

Some examples of computer use where cognitive modelling problems may arise

Example of computer use	Conceptual problem	Cognitive modelling problem
constructing a spreadsheet	cell structure and their interrelationships	algebraic notation
drafting a document	document structure	flow of ideas between phrases, sentences, paragraphs
using a spellchecker or thesaurus	American spellings; typographical mistakes; meaning of related words	proof-reading
designing a document	use of fonts; layout of pictures and text	aesthetic use of space
information retrieval	information overload; integrity of sources	filtering and selecting
collecting data (from people and by telemetry)	sampling, accuracy, dependability and reliability	analysis of data integrity

Activity 39

Planning an ICT activity (1): Using the first six steps to forecast learning gains

This activity will provide you with the opportunity to apply the six planning steps described so far to write a forecast of the lesson's purpose. The first thing you need to do is to identify an ICT activity for a lesson, or a series of lessons, for a class that you teach.

Write in your file, or on your proforma, essential details about the class:

- subject or topic; year group (and accreditation for examination classes);
- numbers of boys and girls;
- room; lesson time; lesson duration;
- grouping (*ie,* banding or setting, age (or a combination));
- class ability profile(*ie* numbers of pupils who are below average, above average, school action, school action plus, gifted and talented)

Re-read steps 1 to 6 of 'Ten steps to planning an ICT activity' (pp107-8) and answer the following questions:

1 What is the learning outcome, to be achieved by all pupils, from their ICT use? Which ICT strands and capabilities are being developed, reinforced and extended?

2 What are the learning gains from using ICT resources? Why are they more effective through use of ICT?

3 What prior learning has taken place that is relevant to the activity being planned?

4 How does the ICT activity build on work that has been done without using ICT?

5 How can pupils apply conceptual understanding, from previous work done, to their use of ICT?

6 How will the ICT activity develop cognitive skills (*ie* promote thinking by being a tool for learning)?

Use your responses from these questions to write bullet points that describe the focus of the ICT activity within the main context of the lesson. This bullet list will also describe the aim of the ICT activity and its learning objectives as outcomes.

Keep your response safe for use in Activity 40.

Now that you have described the learning intentions of your ICT activity we will now turn, in steps 7 to 10, to teaching, resourcing, and ethical aspects:

Step 7 Identify the new skills and knowledge that will need to be taught in order to achieve the learning outcomes (remembering your response to step 3 prior experience)

Step 8 Consider what you will assess in relation to pupils' development of capabilities in the subject and in ICT.

The next step is to consider the resourcing you need. Before you do this you need to consider advantages and disadvantages of individual, paired and group work.

The main advantage of individual work is that all pupils can work at their own pace. The main disadvantage is that some pupils, irrespective of ability, can become isolated because of the absence of collaborative learning through social interaction, for example bouncing ideas off others. There are of course occasions when individual work using ICT resources are essential.

The main advantage of paired and group work is that of monitoring. There are less 'units' to monitor and more time available to extend and support the activity. The main disadvantage is that individuals can become 'passengers' within a group. Cowie and Rudduck (1988) found that teachers committed to groupwork saw benefits in five areas:

- skill and confidence in communicating;
- depth of learning and understanding;
- skill and confidence in social interaction and collaboration;
- personal development;
- life chances.

It is not always convenient to move a whole class to a computer room to allow individual work – in fact there are some psychological issues to consider if you move the pupils from the subject base:

- they could perceive the lesson as an ICT lesson;
- pupils who view themselves as technophobic, or don't like computers, may make less progress in the subject as a consequence of their disaffection to computers (this also applies to teachers);
- boys have a tendency to dominate for a variety of reasons, including a 'power' factor when given machines to use (It would be unwise to deliberately exploit this by using them as more Vygotsky's more knowledgeable others);
- the class needs settling down at least twice at the start of the lesson;
- the arrangement of most computer rooms does not cater for work away from the workstation (refer back to the key points raised from Activity 36);

The main advantage of moving a class to a computer room is that invariably there will be more workstations available. With these factors in mind:

Step 9 Identify the resources needed and their location.

Step 10 Consider how resources will be managed to avoid log-jams so that all pupils are actively engaged throughout the lesson; this includes risk assessment of health, safety and ethical issues.

Activity 40 provides you with the opportunity to apply steps seven to ten to plan the structure of your lesson. Before moving onto this it might be helpful to have a piece of paper in front of you on which, in large letters, are the words:

I am foremost a teacher of _____,
not an ICT teacher!

As all teachers are expected to be teachers of literacy and numeracy indeed all teachers are expected to be ICT teachers. However, the principal focus of your lessons is the use of ICT in your subject - and not the other way round.

Activity 40

Planning an ICT activity (2):
Using the last four steps to plan the lesson structure

Refer back to your response to Activity 39 and steps 7 to 10 of 'Ten steps to planning an ICT activity' (p.110-112). Answer the following questions (numbered in relation to the steps):

7 What ICT skills and knowledge do pupils already possess that will need to be reinforced? What new skills and knowledge will they need to be taught to do the ICT activity?

8 How will pupils' attainment and progress be monitored and assessed in the subject and in ICT? How will these assessments be recorded and reported?

9 What ICT resources are required? Where are they located? What pre-lesson preparation is required to ensure that the activity is achievable with the available resources?

10 Will pupils use the ICT resources individually or severally? If pupils are working severally at a workstation, is there sufficient challenge to occupy each pupil?
If there are insufficient workstations to do the activity concurrently, what other activities (ICT or otherwise) are part of the lesson to prevent log-jams?
Have you checked workstation layout to ensure that pupils can work comfortably and efficiently? If the activity involves using the Internet, what procedures exist to prevent pupils from gaining access to 'undesirable' information?

Using your responses to the questions above, write an outline of the lesson's structure to describe:

- the resources required and any pre-lesson preparation needed to ensure they are used most efficiently (include contingency plans in the event of some workstations being faulty); include risk assessment of workstations and ethical implications;
- the skills and knowledge to be taught, reinforced and extended for both ICT and the subject;
- the sequence of activities and how they will be managed; include logistical details such as times and group organisation;
- how the activities are extended and differentiated to allow sufficient challenge for all abilities;
- the outcomes to be assessed for both ICT capability and the subject;
- performance indicators for the attainment levels covering the ability range of the class; these should relate to ICT and subject capability.

Keep your notes with your response from Activity 39 - together they are your lesson plan for the next activity.

To reach this point you have done a lot of hard work in the last three activities, and this should now reap benefits. This is because you will have given very careful consideration of using ICT to enhance the teaching of an aspect of your subject. Planning for future ICT activities will be easier as you become more proficient – you are now past the steepest part of the learning curve.

Activity 41

Putting Your Planned ICT Activity into operation

Using your notes from Activities 39 and 40, teach the lesson for which you have planned. From the start of the lesson adopt a positive mental attitude by being enthusiastic – this is going to be an enjoyable collaborative experience for you and your pupils. If the lesson does not proceed as planned then put your contingency plans into operation – use the pupils to help with resource difficulties.

Towards the end of the lesson ask your pupils to share with each other and with you what they have learnt. To do this, use whatever teaching techniques you feel comfortable with.

After the lesson, evaluate its success. Remember that the pupils' response to the activity is a good indicator of the effectiveness of your teaching (refer back to Chapter 2).

Prior to Activity 39, I suggested that a central file for ICT activities should be initiated. If this has been taken on board then place a copy of your plan and its evaluation in the file for colleagues to refer to. If the suggestion has not been taken on board then now is a good time to initiate the file, with your plan as its first entry.

In the last activity one aspect arises to which insufficient consideration has been given, so far, in this book. This aspect is the assessment, recording and reporting of pupils' attainment and progress.

Assessment, Recording and Reporting

The assessment, recording and reporting (ARR) of pupils' attainment and progress in ICT should conform to a school's general ARR policy. All ICT activities should be planned with this in mind. In step 8 of 'Ten Steps to planning an ICT activity' (p.110) and Activity 38 you considered how attainment and progress was to be monitored and assessed and how these assessments were to be recorded and reported. You should now revisit your responses in preparation for the next activity.

The ARR of pupils' ICT endeavours can also provide important information about teachers' attainment and progress. This may appear to you as threatening, but, as indicated in previous chapters, there has been concern about low levels of ICT literacy amongst teachers during the 1980s and 1990s. This state of affairs must not continue – especially with the impact of ICT on the shift towards a knowledge-based economy. It is essential, then, that teachers' ICT progress through continuing professional development is properly assessed. If this is acknowledged then strategies to address the ICT skills' gap in teachers will be more effective than those of their predecessors.

In the opening paragraphs of Chapter 1, I suggested that centrally funded government initiatives may not be effective in training teachers to use ICT in subject teaching. Such initiatives invariably produce resources that allow teachers to identify their own continuing professional development (CPD) needs. However, these resources, alone, may not be sufficient because CPD courses are seldom based in the teachers' own classroom with pupils.

One example is the *Identification of Training Needs* (TTA, 1999) CDROM set, which provides useful examples of good practice in subjects and then asks the teacher to make responses about their own capability to replicate this in their own teaching. From the responses obtained, information is stored on a disc, which is unique to that teacher. Three main issues arise from this:

- The resource itself requires teachers to be ICT literate.
- Good practice is not readily replicable because of school differences.
- There is insufficient feedback in the 'training' process to indicate progress and attainment of both teachers and their learners.

ARR, then, is the method of providing feedback in the training loop to produce the closed system for effective development of teacher and pupil capability. Good CPD courses allow a teacher to train on the job. This is a principle that is well established in Initial Teacher Training. Teacher trainees receive ongoing feedback, from mentors and tutors, about the effectiveness of their teaching in promoting pupils' learning. Therefore, effective ICT training requires:

- peer assessment through mentoring;
- self-assessment of classroom-based practice;
- recording and reporting of teachers' and pupils' attainment and progress to identify strengths and opportunities for development.

The activities throughout this book have consistently followed the principle of training on the job by learning to use ICT in teaching through doing (remember the proverb on page 31). In the next activity you will align school policy on ARR to teacher and pupil ICT endeavours.

Activity 42

Aligning ARR of ICT to School Policy

This activity can be adapted to meet three perspectives listed below or a combination of the three. Whichever, the focus must be on effectiveness of ARR in identifying strengths and opportunities for development in teachers' and pupils' ICT capabilities. These perspectives are:

- examining existing ARR policy's implementation in ICT;
- deciding how an existing policy can be extended and implemented in ICT;
- producing a new ARR policy for implementation in ICT.

Re-read Assessment, Recording and Reporting (p114), and as you do so write an agenda for discussion with colleagues and your school's ICT Coordinator. Your agenda should focus on the key questions:

- How are (can) teachers' and pupils' ICT attainment and progress (be) monitored, assessed, recorded and reported?
- How is (can) ARR data (be) used to identify staff development and pupil needs?

Using your agenda items, carry out a literature search on assessment of ICT capability. You should include school documentation (*eg* school's ARR policy) and information obtained from the Internet (refer back to your response to Activity 37).

Cross reference your agenda items with the findings from your literature search to provide you with a clearer picture of what needs to be discussed and the actions required.

Use your agenda to write a short briefing paper summarising your perception of the status of ARR in ICT in your school. Your paper should end with a list of key questions so that you and your colleagues can consider the systems and procedures for assessing, recording and reporting ICT capability for both staff and pupils.

Before you circulate your briefing paper to colleagues, follow the appropriate protocols in your school (for example, seeking approval from a member of the school's Senior Management). Invite responses to your paper, or arrange for it to be discussed as an agenda item at a forthcoming meeting.

Edit your briefing paper in the light of the responses received to produce a short report of your findings. Circulate this to colleagues for further comment.

Keep your notes from this activity – t ey will be essential in Chapter 7 to assist with informing school policy, whole staff or your own personal development needs in developing pupils' ICT capabilities.

The work that you have done for the activities in this chapter on planning and delivering ICT activities within your subject represents a valuable resource to you and your colleagues. However, their value is only fully realised if your responses, successes or otherwise, are shared and celebrated.

In the next chapter you will tie together your responses from the activities in this and previous chapters. In doing so you will be more prepared to develop strategies and policies to allow you and your colleagues to meet the future demands and challenges facing ICT in education.

Chapter 7

ICT: The school, the teacher and the para-professional

We will now attempt to draw together the main threads of this book.

The book has consisted of two themes: one relating to teacher's continuing professional development, and one to enhancing a school's ICT provision. The themes belong together, because together they are concerned with developing pupils' use of ICT resources as tools to assist cognition, by learning how and knowing how to use computers to think with.

The two themes have been set in a common context of the developing nature of teaching skills (see Editorial p. x-xiv), and in a common theoretical context (Chapter 1). We have seen, in Chapters 2 and 3, how traditional teaching skills must adapt to new circumstances to provide methods using the new technologies.

In the Editorial we noted that the overall role of the teacher is changing. The common conception of a teacher in front of a class, delivering material in a didactic way, has to be tempered by the new view of a teacher as the director of learning. That direction operates in two different channels of activity.

The first channel is directed towards the students. The teacher directs pupil learning by acting as:

- the compiler of learning materials;
- the controller of which materials should be studied and when;
- the facilitator of that study - increasingly based on ICT learning resources;
- mentor to the learner.

The second channel is directed towards a group of adults who are progressively becoming known as para-professionals. These include all those who assist the teacher in the classroom, of whom there is now an extensive inventory:

- trained nursery nurses;
- specialist teacher assistants;
- special needs ancillaries;
- untrained ancillaries;
- technical support staff;
- initial teacher trainees;
- trainee supervisors on NVQ and other courses.

Nomenclature for these workers varies from one school to another. However, in all cases, the teacher has a management role in relation to these 'employees'. Their work has to be directed in ways which make it blend with the teacher's learning intentions and that further the understanding of the pupils.

In speculating about the future of education one has to conclude that it is likely that the use of such para-professionals will increase rather than diminish. Teachers are rather expensive to employ; the para-professional rather cheaper. There is a school of thought that sees the 'class' of the future as directed by a teacher, with a small group of para-professionals carrying out many of the chores that teachers now perform, and even some of the teaching role. The learning resource centre may be the forerunner of a more widespread use of this methodology.

This scenario may raise instant hackles among the teacher unions, yet it is not an altogether undesirable phenomenon. At the time of writing there is considerable controversy in the education press about a shortfall in the numbers of applicants presenting themselves for teacher training. In fact, there are national shortages in all subjects – at crisis levels in Design and Technology, ICT, Mathematics, Modern Languages and Science. As a result many schools are having difficulty in meeting staffing needs to deliver the full National Curriculum entitlement.

The scenario described is one answer to this problem: fewer, better equipped and better paid teachers, directing the work of a small group of para-professionals in achieving very specific learning goals which the teacher has predetermined and co-planned.

Indeed such organisation already exists in schools in more or less formal arrangements. It affects situations as varied as nursery and reception groups – run by a trained nursery teacher but supported by a team of nursery and other assistants – through to City Technology Colleges which employ graduate non-teachers to run specialist aspects of the curriculum, such as ICT or foreign language classes.

The important issue for us as teachers is not to rush in to condemn practices such as this, but to consider the learning implications which they have for pupils in Primary and Secondary Schools. Our concern should be with sustaining the quality of work done by para-professional, and, in particular, in the context of this book how we can sustain that quality through their ICT skills.

It seems clear that there are two pillars on which success will rest when teaching is organised through teaching teams consisting of a teacher-director and a group of para-professionals. The first of these is co-planning: everyone in the team has to be aware of the learning objectives of each lesson and each curriculum segment. The second is training, and whilst some of that may happen at the initial training stage for some groups of para-professionals, the burden is most likely to fall on schools and teachers to ensure that para-professionals can perform satisfactorily. But there is a sting in the tail for ICT - a statutory requirement is that initial teacher trainees must demonstrate a high level of ICT competence; at present, sometimes higher than those supervising them in schools. Here the trainee/trainer role can be reversed; a synergy exists where the trainer can benefit from the trainee's ICT skills and the trainee from the trainer's teaching-skills.

The first activity in this chapter asks you, as a teacher manager, to consider what training you would give to a para-professional in your charge and how you would give it.

Activity 43

Training the para-professionals

If you have para-professionals working with you in your classes, think through the teacher/learning tasks with which they assist.

Using the text of this manual to help you, decide what ICT teaching skills they need.

Devise an appropriate training experience for them.

Negotiate the opportunity to deliver this training.

Whole-school policy

The final activity of this book is directed towards the development of substantive actions plans and to whole-school ICT policy. The outcomes of many of the activities that you have undertaken can be extended and tied together in these directions. Perhaps, as you have been working on the activities you have been copying your responses to school managers – so you may have already made a start.

In Chapter 1 we discussed how policy development and action planning is an iterative process. Policy development is of little practical value unless it is put into practice – *ie* its contents are seen to demonstrate improvements in the quality of education provided and the educational standards achieved. In turn, to be sustainable, these improvements are themselves iterative.

Other than subject specific guidance, for example from subject organisations, there has been a paucity of literature to help teachers and schools in producing whole-school policy for ICT. What has been produced cites good practice on the assumption that it is replicable in all schools, which, of course, it is not because of school differences.

Examples of good practice are prone to rejection if they are transplanted without deference to school differences. This is because they offer models that are aspirational rather than

inspirational. If good practice was to be replicable then it would always be controlled by the lowest common denominator, which for ICT is the availability of resources (Hodgson et al, 1994). A useful document to help with school policy development, which does not centre on the good practice argument is the *Non-statutory Guidance: Information Technology* (NCC, 1990).

School policy development for ICT must not be limited by resource implications or by trying to aspire to replicating good practice from other institutions. Instead it must take the existing systems, reflect on their current efficiency, and reengineer them to become more efficient – this is the central purpose of this book.

Activity 44

Tying together your responses towards a whole-school policy

If you are not the school's ICT Coordinator then this activity should be undertaken with the co-operation of those responsible ICT coordination in your school.

If you are a trainee teacher then this activity could be used as the basis of an activity during your teaching practice.

Your responses to the following 17 activities contain information that can be used to guide school ICT policy to bring about improvement: Activities 7, 12, 15, 17, 19, 22, 23, 25, 26, 27, 28, 30, 32, 35, 41, 42, and 43.

If your school has an ICT policy, then refer back to your responses to these activities and identify aspects which are:

- not already addressed;
- inadequately addressed and are not working in practice;
- adequately addressed and are working in practice.

Discuss your findings with those responsible for the coordination of ICT in your school.

If your school does not have an ICT policy, then use your responses to these activities to write a draft policy to be tabled at a meeting with your school's senior management.

Chapter 8

Bibliography and notes on sources used in this book

This final chapter focuses on the sources cited, and also those sources not cited, which have, nevertheless, generally influenced the ideas and beliefs conveyed in this book.

This book draws on thirty years of teaching experience across different subjects, school phases and age ranges. During this period, there has been continued change in government policy towards initiatives designed to raise teacher competence and the growth of ICT in schools. To write a book that does not take the agents of change into account would be of little help, or use, to you and the teaching profession in preparation to become more adept in the use of computers.

Trying to articulate ideas that have worked, against changing political playing fields is difficult – especially when the agents of change often ignore what has worked. However, there is good reason to make ICT high on the educational/political agenda – the concern about teachers' continued low ICT capability, in general. It is important not to throw out the bath and its occupant along with the bath water. It is essential to build on what has gone before, because many of the systems are in place but not working properly – hence the need for reengineering. ICT, as IT, in UK schools is in its third decade, and in that time there have been some positive developments in the growth of this field of study – both as a subject and as a cross-curricular dimension. These positive developments are not widespread, especially in primary schools. This is through no fault of teachers who have been struggling with an over-prescribed curriculum entitlement.

Since the introduction of the first computers in UK schools we have seen every school attempt, with varying degrees of success, to make their use effective – as subjects grow these attempts are unprecedented. This is remarkable if we make a comparison with science, which took sixty years to be taught in every UK school following the recommendation of the 1902 Education Act.

Unfortunately, the rate of growth of ICT may have been so fast that there has not been time to develop a secure and replicable pedagogy. Consequently developments across schools are hit and miss. Research in the field is in its infancy and there is little evidence upon which to develop pedagogy. Teachers have been too pre-occupied with reacting to change through revisions of a National Curriculum – consequently development of pedagogy to include emergent technology has taken second place.

The activities in this book are an attempt to provide a framework for teachers and schools to develop such a pedagogy, based on educational principles which already exist, that are translatable and adaptable to ICT and that are replicable across educational institutions irrespective of their characteristics and differences. But to develop pedagogy, however, requires more than the activities and commentary in this book alone. A more arduous activity is required if the pedagogy is to be sustainable and replicable - and that activity is wider reading.

The bibliography and suggested further reading that follow are therefore intended:

- to acknowledge sources and to allow you to refer directly to them yourself;
- to help you reflect on previously published theory and practice relating to teaching and learning in general education and, specifically, to IT education;
- to assist you in continuing to develop effective ICT in your classroom and in your school.

Bibliography and Suggested Further Reading

Bame E A and Dugger WE (1990), 'Pupils' attitudes and concepts of technology', *The Technology Teacher*, Vol 49 No 8, pp10-11

Barth R (1975), 'Open Education: Assumptions about Children, Learning and Knowledge' in Golby M, Greenwood J and West R (eds), *Curriculum Design*, London: Croom Helm

Becta/DfEE (1999), *Superhighway Safety: Children's' safe use of the Internet*, Sudbury: DfEE Publications

Cowie H and Rudduck J (1988), 'Cooperative Group Work: An Overview', Volume 1 of *Learning Together, Working Together*, London: BP Educational Service

This is one of a set of readers from the Cooperative Group Work Project at Sheffield University 1985-89. Purchased by schools to assist with development of personal and social education (PSE) programmes in the late 1980s – so you might find these being used, or buried somewhere in a dark and dusty cupboard. They are still useful, especially for use with the National Curriculum 2000 guidelines/programmes of study for: personal, social and health education; citizenship; and values.

Crook C (1994), *Computers and the Collaborative Learning Experience*, London: Routledge

This book allays the fears that computers isolate the learner from peers and teachers. The author argues that computers can provide the conditions for effective collaboration and enhance the social dimension of education.

DES/HMI (1985), *The Curriculum from 5 to 16: Curriculum Matters 2: An HMI Series*, London: HMSO

A very good commentary on the principles of an entitlement curriculum and areas of experience. It is these principles upon which sound curricular provisions are built – and to which the National Curriculum aspires.

DES/HMI (1989), *Information Technology from 5 to 16: Curriculum Matters 15: An HMI Series*, London: HMSO

This commentary predates the National Curriculum for IT (ICT). It is essential reading because the messages and principles conveyed are as valid now as they were then. Somehow, somewhere and sometime these principles seem to have become overlooked (deliberately or otherwise through political expedience?) – reading this will help you sort out the wood from the trees.

DES and the Welsh Office (1990), *Technology in the National Curriculum*, London: HMSO

This document contains the first statutory provision relating to the IT attainment target (as technology attainment target 5) and programmes of study in information technology. This was replaced in 1995 by:

DFE and the Welsh Office (1995), *Information Technology in the National Curriculum*, London: HMSO

This document contains the revised attainment target and programmes of study for information technology, statutory until 31 July 2000. Of more practical use for whole curriculum IT planning is the compendium bringing together all subjects:

DFE (1995), *The National Curriculum*, London: HMSO

DfEE (1998), *Survey of Information and Communications Technology (ICT) in Schools*, London: The Stationery Office.

The annual surveys of ICT, up to 2003, may be accessed from the Internet:
DfES, *Statistical Bulletins*, http://www.dfes.gov.uk/rsgateway/DB/SBU/index.shtml, Accessed 30 Aug 2006

DfES/QCA (1998), *A Scheme of Work for Key Stages 1 and 2: Information Technology*, London: QCA

Primary schemes of work, including the 'Teachers Guides', are available through the Internet:
DfES, *Primary Schemes of Work*, http://www.standards.dfes.gov.uk/schemes, Accessed 30 Aug 2006, DfES Standards Site

DfEE/TTA (1998), *New Opportunities Fund: Lottery-Funded ICT Training Programme for serving Teachers: Specification for the Approval of Training Providers*, London: DfEE

The effectiveness of the New Opportunities Fund ICT Teacher training Programme (1999-2003) has been extensively evaluated through two major reports, available by download from the Internet:

1) Bolton E (2002), *The New Opportunities Fund (NoF): ICT training for teachers and Librarians*, http://www.tda.gov.uk/partners/quality/ict/nofreport2002, Accessed 31 Aug 2006, TDA New Opportunities Fund ICT Reports. This report focuses on the quality assurance findings in England, September 2002.
2) Preston C (2004), *Learning to Use ICT in Classrooms: teachers' and trainers' perspectives*, http://mirandanet.ac.uk/tta, Accessed 31 Aug 2006, TTA/MirandaNet: London. This report, is in three parts, (1) a summary of the evaluation of the NoF ICT teacher training programme; (2) the emergent trends from the evaluation of the NoF ICT programme for school trainers, ICT advisers and teacher educators; (3) the full evaluation.

DfEE/QCA (1999), The National Curriculum Handbook for primary Teachers in England: Key stages 1 and 2, London: QCA

DfEE/QCA (1999), *The National Curriculum Handbook for secondary Teachers in England: Key stages 3 and 4,* London: QCA

Effective from August 2000 the National Curriculum for England may be found in these two volumes and from the *National Curriculum online* web site:
National Curriculum Homepage, http://www.nc.uk.net, Accessed 30 Aug 2006, DfES/QCA

Dul J and Weerdmeester B A (1993), *Ergonomics for Beginners: A Quick Reference Guide*, London: Taylor and Francis

Gardner H (1994), 'The Theory of Multiple Intelligences', in Moon B and Shelton Mayes A (eds), *Teaching and Learning in the Secondary School*, London: Routledge

This is a useful first-hand overview of MI theory. If you wish to read more detail then you will need to refer to the original theory in:

Gardner H (1983), *Frames of Mind: The Theory of Multiple Intelligences*, London: Heinemann

Also, the following Internet site gives information from Howard Gardner about his MI theory in practice and his view on schools in the future:
Howard Gardner Topics Menu,
http://www.ed.psu.edu/insys/ESD/Gardner/menu.html, Accessed 31 Aug 2006, Educational Systems Design

Hammer M and Stanton S A (1995), *The Reengineering Revolution: The Handbook*, London: Harper Collins

HSE (1983), *Visual Display Units*, London:HMSO

HSE (1992), *Display Screen Equipment at work: Health and Safety: Guidance on Regulations*, London: HMSO

HSE (1998), Working with VDUs, Sudbury: HSE Books

This leaflet contain notes on good practice which are not compulsory but which you may find helpful in considering what you may need to do. Information about HSE's publications can be accessed from: http://www.hse.gov.uk

Hodgson A R, Mockford C D, Wormald P W, and Zanker N P (1994), 'Information Technology in Design and Technology - A Discussion Paper', *Design and Technology Teaching*, Vol. 26 No 2, pp35-39

Householder D L and Bolin B (1993), 'Technology: Its influence in the secondary school upon achievement in academic subjects and upon students' attitude toward technology', *International Journal of Technology and Design Education,* Vol 3 No 2, pp5-18

Knight P T (1997), *The Half-life of Knowledge and Structural Reform of the Education Sector for the Global Knowledge-Based Economy*, http://www.knight-moore.com/pubs/halflife.html, Accessed 31 Aug 2006, Washington: Knight-Moore

A paper prepared for the Forum on Education in the Information Age, Cartagena, Colombia, 9-11 July 1997. An excellent overview of the half-life of knowledge concept.

Lanfranco S (1998), *Distributed Learning, Education and Civil Society*, http://www.visionarios.reacciun.ve/ponencias/lanfrancosam/ponencia/index.html, Accessed 31 Aug 2006, Ponencia

This paper looks at a series of ICT related topics, including knowledge half-life and learning.

NCC (1990), *Non-statutory Guidance: Information Technology*, York: NCC

The guidance, covering key stages 1 to 4, contained within this document is still as valid today as it was for the original version of the National Curriculum - especially in relation to school policy, capability, continuity and progression, strands of IT, and staff IT responsibilities. Schools may have discarded this publication - a search of your technology department might reveal a copy lurking in a dark and dusty cupboard. Information for the 1995 National Curriculum revision may be found in SCAA (1995) below:

Norris B and Wilson J R (1995), *Childata: The Handbook of Child Measurements and Capabilities - Data for Design Safety*, London: Department of Trade and Industry

Ofsted (1995), *Framework for the Inspection of Schools*, London: HMSO

This is the framework for inspections prior to January 2000; inspections thereafter follow the framework in:

Ofsted (1999), *Inspecting Schools: The Framework,* London: The Stationery Office

Papert S (1980), *Mindstorms: Children, Computers and Powerful Ideas*, Brighton: Harvester

Especially the Introduction, 'Computers for Children'; Chapter 1, 'Computers and Computer Culture'; and Chapter 8, 'Images of the Learning Society'

Papert S (1993), *The Children's Machine: Rethinking School in the Age of the Computer*, New York; London: Harvester Wheatsheaf

Papert S (1996), *The Connected Family: Bridging the Digital Generation Gap*, Atlanta, Ga: Longstreet Press

Plowden Report (1967), *Children and their Primary Schools*, London: HMSO

Rittel H W J and Webber M M (1974), 'Wicked problems', in Cross N et al, *Man-made Futures: Readings in Society, Technology and Design*, London: Hutchinson

A description of planning type problems, *ie* wicked problems. To read more about the nature of problems and operational research there are many sources available from the Internet, for example:

Wikipedia, http://en.wikipedia.org/wiki/Half-life_of_knowledge, Accessed 31 Aug 2006), The Wikipedia Foundation Inc

This ‘Free Documentation’ encyclopedia contain some useful background information and working definitions, for example, relating to: cognition; metacognition; design; forward and backward design; problems (including 'wicked'), problem solving and theory.

Conklin J, The IBIS Manual, A Short Course in IBIS Methodology, http://www.touchstone.com/tr/whitepapers.html, Accessed 30 Aug 2006, Washington: Touchstone Consulting Group Inc

The Issue-Based Information Systems (IBIS) manual is available on this website in its entirety - the last section is concerned with identifying wicked problems. Other manuals are available, for example relating to strategic planning.

Robson C (1993), *Real World Research*, Oxford: Blackwell

This provides good guidance on designing and analysing surveys and case studies

SCAA (1995), *Key Stages 1 and 2: Information Technology: The new Requirements*, London: SCAA

SCAA (1995), *Key Stage 3: Information Technology: The new Requirements*, London: SCAA

Again you may need to search for these documents - irrespective of the key stage(s) you teach. Look at both documents to gain a better understanding of continuity and progression issues. Once found, do not destroy these documents just on the grounds of the existence of a newer version of the National Curriculum.

SCAA (1997), *Expectations in Information Technology at Key Stages 1 and 2*, London: SCAA

SCAA (1996), *Exemplification of Standards: Information Technology: Key Stage 3*: London: SCAA

These booklets, part of the Exemplification of Standards for National curriculum core and foundation subjects series, offer useful information on delivery and assessment of the strands of IT capability. The material, presented as case studies of whole class (key stage 1 and 2) and individual pupils' (key stage 3) work, helps you to cross-reference your work to your subject's programme of study requirements. Additionally, for key stages 1 and 2, the exemplar schemes of work (DfEE/QCA, 1998) will help you.

Seltzer K and Bentley T (1999), *The Creative Age: Knowledge and Skills for the New Economy*, London: Demos

This report, supported by the Design Council and the Qualifications and Curriculum Authority, looks at how the emergence of a knowledge-based economy is changing the way we live, work and learn. Through case studies, it proposes a programme of reform to ensure that learners can thrive in the new economy.

Shapero A. (1989), *Managing Professional People: Understanding Creative Performance,* London: Collier MacMillan

TTA (1999), *Identification of your Training Needs*, CDROM set, London: TTA

Thompson C and Householder D L (1995), 'Perceptions of technological competencies in elementary technology education', in Smith J S (ed), *IDATER95: International Conference on Design and Technology Educational research and Curriculum Development*, Loughborough: Loughborough University of Technology

Toffler A (1970), *Future Shock*, London: Bodley Head

Wheelock J (1992), 'Personal Computers, Gender and an Institutional Model of the Household', in Silverstone R and Hirsch E (eds), *Consuming Technologies*, London: Routledge

Wood D (1988), *How Children Think and Learn*, Oxford: Blackwell

A reader, widely used on initial teacher training courses, which explores critically and in detail conflicting view about how children think and learn.

Zanker N (1996), 'Levels of computer use and access, at home, by years 9 and 10 pupils; an initial comparison of the types of computer used in the home and school environments', in Smith J (Ed), *IDATER 96, International Conference on Design and Technology Educational Research and Curriculum Development*, 1996, pp60-66, Loughborough: Loughborough University

Appendix I

Guidance notes for Activity 9: Setting up ICT hardware

1 Connecting and disconnecting external devices to a computer base unit

1.1 The computer base unit contains the main computer circuit board (mother board), memory, disc drives (eg CDROM, floppy and hard disc drives), and circuit boards (interfaces) to control external devices (peripherals). Do not open the base unit to change interfaces or their settings; this is the domain of the designated technical expert in your institution.

1.2 Before connecting or disconnecting any parts of a computer system the power must be turned off to every part of the system. Prior to turning the power off, ensure that:

- all work is saved to disk or network drive;
- the computer is shutdown using the correct procedure (eg exit 'Windows' environment; log off networks).

1.3 When connecting and disconnecting parts of a computer system make a note of which sockets connect to which peripheral. A useful tip is to label all the sockets on the base unit and the ends of all connectors. It is actually quite difficult to connect a device to the wrong socket, but not an impossibility. Of more importance is not to force a plug into a socket because damage can be done that is difficult and costly to repair.

1.4 You cannot just simply disconnect a peripheral device from one system and connect it to another. This is because all peripheral devices require interfaces and control programs (drivers) installed in the base unit in order to work correctly. There are no hard and fast rules as to the interfaces and drivers installed in a computer's base unit.

The interfaces and their drivers are usually installed for:

- keyboards and pointing devices, such as mice;
- monitors and data projectors;
- modems (the interface only) – the driver may need to be installed from the Original Equipment Manufacturer's (OEM) discs);
- printers and plotters (the interface only) – the driver may need to be installed from the OEM's discs;
- storage devices built into the base unit (eg CDROM, floppy and hard drives);

The interfaces and their drivers are not normally installed for:

- digital cameras and scanners;
- external storage devices such as disc drives and tape streamers;
- more specialised devices such as CNC lathes and milling machines;
- networks (unless the system was purchased as part of a network).

1.5 **Summary**

If you are moving a computer system, or connecting a peripheral device to a system:

- computer systems can be moved to convenient locations;
- power down everything before connecting or disconnecting anything;
- do not assume that a peripheral device will automatically work on every computer system;
- do not interfere with settings for peripherals' interfaces and their drivers (unless you have received training and guidance to do so);
- make use of designated technical and support staff to assist with setting up a computer system in its new location, especially when installing new peripheral devices.

2 Recognising the reasons why a computer system is not working as it should

Computer systems demonstrate the law of the innate perversity of inanimate objects, otherwise known, amongst other names, as Murphy's Law. This law is most often demonstrated when a system is moved or it is just about to be used, either in a hurry, or with groups of learners. Trainee teachers are taught to try things out before they are used in the classroom, but even this is not guaranteed to circumvent this law from operating. The following notes should help to keep the computer gremlins under control.

2.1 There are power switches on the computer base unit and, with the exception of keyboards and mice, most peripheral devices. The sequence that the parts of the system is powered up may affect the working of the system. For example, scanners and external disc drives must receive power before they can be recognised by the base unit. Keyboards and mice receive their power from the base unit, but they must be connected to the base unit before it is switched on. Therefore, ensure that all peripherals are:

- connected to the base unit before switching any part of the system on;
- switched on and receiving power *before* the base unit is switched on.

2.2 If, having switched everything on, the system or its peripherals are not working correctly then shutdown the base unit by using the correct procedure (see 1.2). Turn just the base unit off, wait 10 seconds and turn it back on again. If this does not resolve the problem then, before seeking help, check that all the interconnecting leads are connected properly and to the correct socket.

2.3 If a peripheral device is being moved from another system to be connected to the base unit you are using check that the appropriate interfaces and drivers have been installed. See 3.2, for a handy hint on making this a simple procedure. If you do not possess the knowledge to do this then seek help. However, rather than just sitting back and letting the technical expert perform, do find out how to check that interfaces and drivers are installed so that next time you can make the check. As previously mentioned, do not interfere with interfaces and drivers unless authorised to do so.

2.4 Before using any part of a computer system be quite clear about the device's capability. The system may be working exactly as it should but fall short of your expectations. For example, the poor quality of the output from a printer may be the best quality obtainable. Similarly, a digital camera may not produce results equivalent to a more conventional camera. In these two examples the poor quality could also arise from numerous other factors.

It is a knowledge of these factors that you need to develop, and this is best acquired through trial and error. The starting point is to establish whether the system is actually faulty or does not meet your expectations. To help with this find out from colleagues, who are familiar with the resource, whether your expectations can be met using the technology available. You may then need to modify your expectations to meet the capability of the resources available. This is a compromise and not a reason for not using the available resources.

2.5 Environmental factors can affect how a computer system works. For example, extremes of temperature, high humidity, and high dust levels will have adverse effects. Also, there needs to be space around the system to allow air to circulate to prevent the system from overheating. A simple rule to follow is that if an environment is uncomfortable for you then it will also be uncomfortable for the computer and its peripherals. One specific problem that you need to be aware of, for safety reasons, is that of moving any electrical equipment from a cold to a warm environment because moisture will condense and form water droplets in the device. This could result in electric shock or internal short-circuiting if the equipment is switched on before it has been allowed to warm up to room temperature. At least 30 minutes should be allowed before switching on when moving electrical equipment from temperature extremes.

Examples of this in practice are:

- moving electrical devices from cold store rooms to warm classrooms;
- keeping equipment in a car boot, especially overnight (which, incidentally you must not do for insurance reasons).

2.6 **Summary**

If you suspect that part of a computer system is not working as it should:

- check that power is available to every part of the system and that you know the correct power-up sequence;
- ensure that appropriate interfaces and their drivers are installed for the peripheral devices that you intend to use;
- do not try to rectify faults yourself unless you are sure of the cause;
- ask technical experts to explain what they are doing to make something work;
- be clear that the equipment's capability matches your expectations;
- make sure that equipment is not located in adverse environments, or used too soon after being moved from different temperature environments.

3 Knowing procedures for dealing with faults within a computer system and its external devices

One phenomenon associated with Murphy's Law is that systems stop being faulty when you are trying to explain the faults to an expert, thus making you feel even more inadequate. The expert invariably forms the view that it is something that you did to the system and in extreme cases is liable to tell you so, which does nothing to boost your confidence. You cannot defeat this phenomenon entirely, but you can take steps to get the better of it by knowing and applying some basic procedures.

3.1 Establish as best you can that it is the system that is at fault and not your lack of knowledge and understanding of the system's capabilities (see 2.4, above). It is a good idea to check with a more knowledgeable colleague that the system is capable of doing what you intend it to do.

3.2 Before using ICT resources try to find out who used them last, and whether there was any problem in their use. This is not as simple as it appears but can be made easier by having log sheets associated with each system (*ie* base unit and its monitor, keyboard, mouse and printer), and each specialised peripheral (*ie* digital camera, scanner, data-projector). The use of a simple log system is essential and invaluable in tracing the history of faults in equipment used by many users. A small notebook is all that is required; it can be hole punched in the top left-hand corner and fastened with a piece of string and PVC tape to the equipment's case. A numbering system matching the equipment to the notebook helps identification should the two become separated. For base units the notebook could also contain details of the interfaces installed therein (see 2.3).

3.3 Ensure that you know to whom you should report faults, and the procedure by which those faults should be reported. Again, this is not always as simple as it appears, in large organisations it may be that more than one member of staff is responsible for maintenance of computer resources. For example, in a school, different departments have differing ICT needs and therefore the responsibility for particular peripheral devices and their maintenance may be departmental.

3.4 Do not expect that a faulty resource can be mended or replaced immediately. Invariably, it will be the case that the fault will need to be investigated and that the device may not be repairable on-site. Therefore plan for a fall-back situation.

3.5 Make use of user documentation, *ie* the manuals that are supplied with the resource. This is essential if you are to develop skilful performance in the use of ICT resources. All too often this documentation is not made readily available to the users in a multi-user organisation. Ensure that you know where user documentation is kept and how access to it may be obtained. Most resources, either hardware or software, have a 'getting started' guide. It is this guide that you should read as soon as possible, especially when you are using a resource for the first time. By studying the 'getting started' guide you will gain a greater knowledge and understanding of how to use the resource and its capability in meeting your intentions. Many getting started guides contain tutorials to help you master the basics of using the resource. Again these

are invaluable in developing skilful performance; in some cases you can use these tutorials with your students and pupils so that you learn together.

3.6 Make use of the system's on-line help facility, which should have been automatically installed as part of the software. On systems where disc space is limited, to save space, the on-line help facilities may not have been installed. If you can't find this facility then seek guidance as to whether on-line help exists and, if so, if it can be installed.

3.7 **Summary**

In developing knowledge of procedures for dealing with faults:

- check with a colleague whether a shortfall in equipment's capability is the result of a fault or your expectations being too high;
- establish and maintain systems for logging problems with ICT resources;
- ensure that you know to whom faults should be reported, bearing in mind that several staff may have responsibility for different types of ICT resources;
- prepare for a fall-back situation because it is seldom possible to resolve the problem with faulty ICT resources on the spot;
- make use of the user-documentation supplied with ICT resources, especially the 'getting started' guide and on-line help facilities.

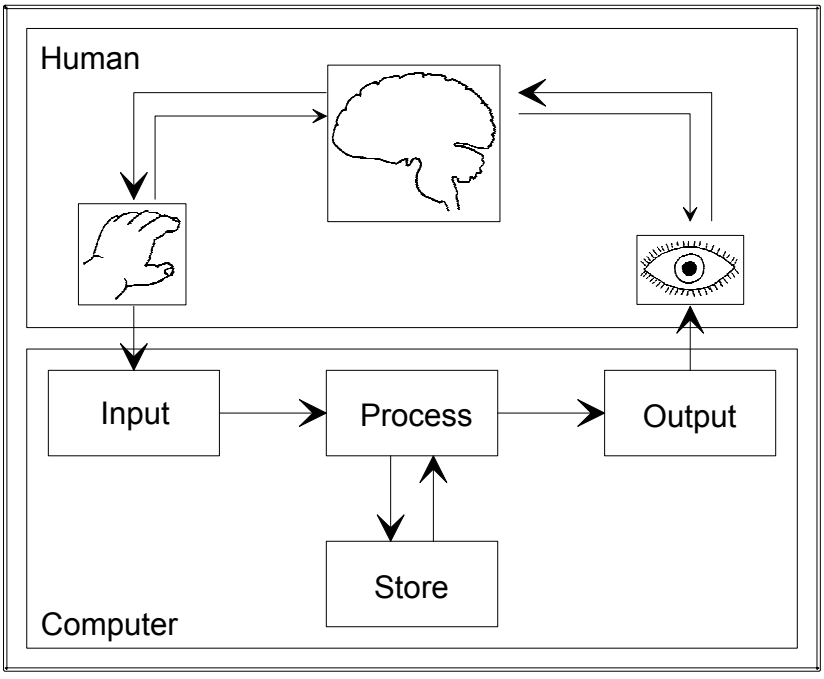
Appendix II

Guidance notes for Activity 10: Using ICT software

1 Using a computer system to input data to, process data in, and output data from an application program

1.1 Computer systems are used to perform tasks involving information (or data) processing. There are three main stages: input, process and output. This is also true of tasks undertaken by other means. A fourth stage in information processing is the storage of data during and between sessions of computer use. Whilst, at a superficial level, we may view a computer as a physical tool it is also connected to our motor, cognitive and sensory functions (*ie* at the least through our hands, brain and eyes). Therefore, a computer is an aid to assist metagcognition (ie cognitive assistance, cognitive modelling, or learning how to learn). This relationship, the human computer interface, is illustrated as a model in Figure 22.

Figure 22
The Human Computer Interface



Further discussion on the human computer interface and the concept of cognitive assistance is explored in more depth in Chapter 6. Figure 22 is intended to introduce the link between the human user and the computer machine in information processing. From the onset of using computer systems, it is important to recognise that certain motor, cognitive and sensory skills need to be developed. These include being able:

- to react appropriately to the information displayed on the screen;
- to plan and prepare the information to be entered into the computer.

If these skills are not developed then there may be the danger that the machine is in control. This is because the task to be undertaken with the assistance of the computer is insufficiently defined, The consequences of this are that the task will take longer to complete and the user may fail to recognise the advantages of using a computer. Therefore, the user will, quite correctly, question the validity of the use of the computer. This has implications for the use of ICT resources in teaching and learning, which are explored in Chapters 5 and 6.

1.2 Initial skills that you will need to develop, in relation to motor coordination, are the use of the graphical user interface (GUI), examples of which are, at the time of writing: Windows on a PC and the Desktop on an Apple Mac. Key features of GUIs are the use of windows, icons, mice and pointers as means of allowing the user to control the machine.

1.3 A program designed to assist you in performing an intended task is using ICT resources is an application program. A utility program is one that assists you in controlling the system. The program that defines the machine as a computer is called an operating system. You do not need to be concerned with the operating system function or its installation. However, you do need to be familiar with the function of utility programs, but not their installation. You need to be familiar with the function and, perhaps, the installation of application programs.

When selecting a new application program, you need to be certain that it will work on the type of computer system and its operating system that you will be using. Seek help on this matter before attempting to install any new software onto a computer system. As you become more proficient you should aim to become familiar with the system's utilities that inform the user of the type of machine and its operating system.

1.4 Prior to using an application program, it is important:

- That you check that the peripheral devices needed are connected to the computer base unit (refer back, if necessary, to Activity 9 and the accompanying guidance notes).

- That you check that the application program has been installed on the computer system.

- That you have some idea of the nature of the intended outcome and that you have undertaken the necessary planning and preparation. For example, if you are:
  - Redesigning or creating a pupil handout, using a DTP or word processing program, then you will need the original handout or the source material to be included. You should sketch out on paper the intended design and content of the proposed handout.
  - Evaluating an ICT learning resource then you should draft, as a list, the learning benefits which you hope the resource will produce.
  - Setting up a marksheet, using a spreadsheet program, then you will need to produce a draft sheet with some of the assessment data that you intend to use. On your draft sheet you will need to include the formulae to be used, for example, to calculate summative totals or grades, or arithmetic means and their standard deviations.
  - Creating a datafile, using a database program, then you will need the source data. You should produce a draft layout of the intended file and record structure.

For each of the examples above, the amount of time spent before using the computer system, which is minimal, will save time later and result in increased productivity. This is because you will have a clearer idea of what it is you intend to produce. This strategy should also be encouraged in pupils' use of ICT resources. Added benefits of this approach are better resource management in the learning environment because of reduced 'log jams' and wasted time by pupils staring at 'blank' screens.

1.5 The term used for starting a program is 'loading'. When you are loading any program watch the screen carefully for any prompts that it may give to you. If the prompt is inappropriate, for example, it asks for an installation disc or a registration number, then ignore the prompt (unless, of course you are installing the program). The easiest way of ignoring such a prompt is to press either the 'Esc' (escape) or the '↵' (Enter) key. If this produces an unexpected outcome, for example, the system stops working or the prompt reappears then make a note of the problem in the logbook kept beside the computer (see 3.2 in Appendix I). Then report the matter to the designated staff in your school.

1.6 When you are using an application program for the first time there are several strategies that can be employed to help gain familiarity. These include:

- Using the mouse and its screen pointer to browse through the menus and icons (pictorial symbols) displayed on the screen. Often, just moving the mouse over the icons will cause a text flag to appear, indicating their function. Most menu driven systems are characterised by a list of words across the top of the screen, for example 'file', 'edit', 'view' are typical menu headings. Menus are usually activated (*ie* dropped down) by moving the mouse over the heading and pressing or 'clicking' one of the mouse buttons.

- Opening and printing a sample or tutorial file. Many application programs include sample files that are installed on the system at the time of the application's original installation.

- Checking to see if there is a set of tutorial files for you to work through. It is not essential, at this stage, to work through every tutorial file. Be selective by

working through the first few files until you get the feel of the programs mode of operation.

- Making use of the program's on-line help facility, if one exists, and checking to see if a 'getting started' guide is available. (See 3.5 and 3.6 in Appendix I);

1.7 An area that often causes problems for inexperienced users is the way in which computer systems handle files. In its simplest form, a computer file may be regarded as the electronic equivalent of its paper counterpart. The document that you are working on for this activity is, therefore, the file. Specifically, the problems facing inexperienced users relate to file handling and include not knowing:

- that when an application program is exited or a computer system is powered down then files that are being worked on may be lost;
- that the changes being made to a previous file are not automatically stored;
- where (and if) a file was stored on the system last time it was used;
- that if the computer system, the application program or the operating system develops a fault or stops working (*ie* 'crashes' due to a 'bug' or a 'virus') then all unstored files may be lost.

Application program developers, in recent years, have made attempts at minimising these problems to help the least experienced user. However, such attempts are frustrated, to some extent, by the breadth and increased complexity of the systems that are available and the high cost of software development in a competitive market.

For example, the 1990s saw a rapid rise in ICT resources, in general, being released onto the market that may have been insufficiently trialled prior to their commercial release. Arguably, it is impossible to design fail-safe applications to run on the wide range of computer systems that are available, especially when the development of the system is, at best, parallel to their programs (*ie* with limited convergence during trialling). Usually the former takes precedent, and the software developer attempts either to make existing applications match new systems or to design new 'improved' versions.

1.8 Computer users transfer their favoured applications to new systems. Therefore, there is a technological gap, the consequence of which is that the problems indicated in the list in 1.7 become compounded. The implications of the technological gap, faced by education, are discussed in Chapter 5.

At this point in the discussion, the implications of the technological gap, which face you in developing skilful performance in file handling, are that:

- application programs may not have features to minimise loss of files;
- the computer systems being used by you may respond differently to the same version of the program, and different versions of the program may be installed on the systems that you use;
- files saved on newer versions may not be compatible with their predecessors because of upward and downward compatibility between versions of application programs. Usually, new versions of applications can read files generated using their predecessors.

1.9 The skills that you need to develop in relation to file handling are:

- The use of file names that can easily be remembered.

- The use a small notebook to keep a written log of your files. It is also a good idea to record the system and the application (and its version) used. An example of a suitable format may be found in Figure 23.

Figure 23

A suggested layout for a written log to record files

Filename	Date	Where	File contents	Application	System
scuba1	02/12/98	on hard disc, in *staff/myname* folder	information sheet on scuba diving	futureword, version 6	XC 1

- Knowing where a file was saved. This is important, because if you forget then trying to locate the file at a later date may be like looking for a needle in a hay stack. As you become more skilled then you will need to find out how to keep your files stored on a medium (*ie* on a disc) that is external to the system being used. Added advantages of having files on your own disc are that of portability between computer systems, and for backup copies for added security.

- Being aware that older systems, which you may still be using, insist on file names following certain conventions. For example, a maximum of eight characters comprising of letters, numbers and some symbols. Newer systems are somewhat more friendly in that they allow longer names, often to a maximum of 250 characters, but still do not allow the use of all the characters found on the computer keyboard. Because you may be using systems of different ages:
  - use short file names, which do not contain spaces or full stops (but not necessarily of less than eight characters), where the first eight characters offer an accurate mnemonic;
  - the name given to the file should make it distinguishable from other files that you have created.

- Whilst working on a file ensure that it is saved at regular intervals. If you do not do this then any editing to the file since it was last saved will be lost. Many applications, especially those on newer systems have an 'autosave' facility whose frequency can be set by the user. You need to ascertain whether this facility exists, and, if it does then set it to a frequency to suit your needs (for example, to save every ten minutes).

- When starting a new file, place a file name and the date at the bottom of your work, for example as a a footer on a word processed document. An advantage of this is that different versions of the file, especially its predecessor, are easier to identify.

- Making sure, when finishing a session using an application program, that you save the file before following the correct exit procedure for the program and the system.

1.10 The methods by which data can be entered into a computer are increasing as ICT advances. New methods are intended to free the user from the traditional keyboard,

the layout of which was designed, not for ease of use, but to minimise the jamming of the mechanism driving the keys on typewriters. Even though this technology is no longer used in typewriters, the legacy and the implications of the QWERTY keyboard remain, including:

- training in proficiency of typing skills on a word processor is required if the speed of data processing is not to be hindered by the input method;
- the QWERTY keyboard layout follows no defined pattern (even though its advocates claim that the most frequently used keys are clustered together).

Collectively, these implications act as a constraint in the flow of information in the human computer interface. This is because both the human and the machine are capable of processing data or information at speeds much greater than keyboard data entry allows. Even for the most proficient of typists this is also the case.

In education, teachers and their learners have been constrained by the use of the keyboard for entering data. The use of word processors has been the most widely used application in schools, a matter of concern reported by curriculum evaluators such as Her Majesty's Inspectorate (HMI). Pupils, especially, have spent considerable amounts of time either 'learning' how to 'type', or trying to produce 'fair copy' of project work at a much slower rate, by using word processing facilities, than if handwriting skills had been developed.

A similar chain of argument relates to the use of the mouse as a tool for drawing – a matter discussed further in Chapter 5.

1.11 In addition to entering data into a computer using the keyboard, other methods that are available include the use of:

- scanners for graphic, photographic material and optical character recognition systems for scanning typed and handwritten material directly to a word processor;
- digital cameras for photographic material;
- optical mark readers; for example, for entering attendance and assessment data.

- microphones for sound, including voice recognition systems for allowing dictation directly to a word processor;
- MIDI (Musical Instrument Digital Interface) instruments for sound;
- sensors linked to data-loggers to convert externally captured information (eg temperature, light, movement, sound) into numerical and/or control data;

As mentioned above, this list of methods increases with technological advances. In relation to Activity 10 you should develop your skills relating to methods for data entry beyond the use of the keyboard and the mouse. You should aim to do this by exploring those methods that are available to you. For those that are not, you will need to make the case to expand the data entry methods that are specifically applicable to your teaching. By doing this the two areas that should be improved are:

- increased confidence and competence in data handling in your own specialism(s);
- increased opportunities for pupils to experience the range of methods of entering data into a computer system and to select and utilise more appropriate methods than may have been previously available.

1.12 When you are using an application program for the first time you should aim to obtain output from an output device, such as a printer or plotter. By doing this you will have demonstrated the ability to use the application for the three main stages of data processing outlined in 1.1. This will help increase your confidence in that you will have achieved, albeit possibly in part, at least one of your goals relating to your targets in Activity 7.

A particular problem that you may encounter in obtaining a printout is the setting up of the printer and its driver (refer back to 1.4, 2.3 and 3.5 in Appendix I). The key points to remember are that if the printer will not respond then make a note of the problem and seek help from a colleague. Do, however, check first that it has been loaded with paper, is physically connected to the computer base unit and is switched on. To prevent you losing your work always make sure that it has been stored (saved) before printing.

1.13 Having obtained your printed or 'hard' copy of your work, examine its layout on the paper. Check that its position on the paper is where you intended (*ie* the margins are 'sensible'). You may, at this point, also check and edit other appropriate matters, such as spelling, grammar, and page structure. Finally, you should reprint the edited file and celebrate your success with both colleagues and your learners.

1.14 As you develop skilful performance in the use of ICT resources you will be hindered, on frequent occasions, by the computer gremlins. Their sole intent is to prevent you from completing the task on time. As stated earlier in these guidance notes, you cannot stop them but you can take steps to minimise their effect. Some gremlins are deliberately planted as viruses, some arise from bugs in the system, some arise from system incompatibility between hardware and software and some result from environmental factors. The first three types often forewarn the user that something nasty is about to happen, by displaying an error message on the monitor screen, but unfortunately the warning may be too late and your work will be lost. If you have followed the guidance in these notes relating to saving work then, at least, you have a previous version to fall back to.

All error messages should be taken seriously. You should:

- make a note in the logbook accompanying the computer system;
- seek help from staff designated with ICT resource responsibility;
- try to find out, from the more knowledgeable, what caused the error message so that you increase your own knowledge base on dealing with such matter.

Unless the system is clearly in distress, *ie* overheating or emitting sparks, do not panic by turning the system off. It may be possible that a recovery can be made of your work. If the system has been infected by a virus then more damage can be done by turning the system off.

1.15 Summary

When you are using a computer system to input data to, process data in, and output data from an application program, you should:

- plan and prepare the information prior to entering it into a computer system;
- develop the skills to recognise and react to the information displayed on a computer screen;
- when installing an application program, check that it is compatible with the computer and its operating system on which you are intending to install it;
- if this is your first usage of the application program:
  - browse the menus and icons, using the mouse and its pointer, to gain an overview of the program's functions;
  - open a sample file and obtain a printout (hardcopy) of it;
  - check if there are tutorial files and/or a getting started guide and work through some of the tutorial sections.
- save your work on a regular basis, using the 'autosave' if it is a function of the program;
- keep file names short, without spaces or full stops, using names that are easily remembered and recognised;
- incorporate file names into footers on documents;
- always ensure that your work is save before you send it to the printer;
- maintain a written log of your files and their location, and keep backup copies of your work on separate discs;
- explore alternative methods of data entry to the traditional QWERTY keyboard;
- maintain a written log of any error messages encountered (or irregularity in the system's operation) and report the matter to staff responsible for the ICT resource;
- if the system stops working do not turn it off, unless it is overheating or electrically unsafe, because if the cause is from a virus then more damage may be done.

Appendix 3

Example questionnaire and guidance notes for Activities 23 and 24

A Survey about Using Computers

The purpose of this questionnaire is to find out about your use of computers.

Please complete the questionnaire as accurately and quickly as you can. It is not a test and there are no right or wrong answers. Your answers will be treated with confidence and will not be used to identify you, as an individual, to anyone else.

1 Which school year are you in? ☐

2 What sex are you? Female ☐ Male ☐

3 How many brothers/sisters do you have? Brothers ☐ Sisters ☐

Are you the oldest? Yes ☐ No ☐ Are you the youngest? Yes ☐ No ☐

4 Do you use a computer at home? Yes ☐ No ☐

If you answered 'Yes' to question 4 go to question 5
If you answered 'No' to question 4 go to question 11

5 What make is it? ☐

6 What model is it? ☐

7 Whose computer is it? ☐

8 Who else uses it? Brother/sister ☐ Parent ☐ No one else ☐

9 Who bought it? ☐

Why did he/she buy it? ☐

10 In the last two weeks, how many hours did you use a computer at home?

not at all ☐ up to 2 hours ☐ 2 to 4 hours ☐

4 to 6 hours ☐ 6 to 8 hours ☐ more than 8 hours ☐

What did **you** use it for?

(Please write up to 4 uses)

1

2

3

4

11 In the last two weeks, how many hours did you use a computer at school?

not at all ☐ 1 to 2 hours ☐ 2 to 4 hours ☐

4 to 6 hours ☐ 6 to 8 hours ☐ More than 8 hours ☐

What did **you** use it for?

(Please write up to 4 uses)

1

2

3

4

12 Apart from at home or at school, have you used a computer somewhere else? Yes ☐ No ☐

If you have answered 'yes', where else?

What did **you** use it for?

(Please write up to 4 uses)

1

2

3

4

13 For each of the following statements about computers please tick one box to indicate whether you agree, disagree or not sure:

		Disagree a lot	Disagree a little	Not sure	Agree a little	Agree a lot
1	A computer is interesting to use					
2	I feel isolated when using a computer					
3	I try to avoid using a computer					
4	I don't like to be interrupted when using a computer					
5	A computer makes me work more quickly					
6	I feel tied down when using a computer					
7	I have no choice with the way I work with a computer					
8	A computer can be exciting to use					
9	Using a computer is tiring					
10	It takes a lot of skill to use a computer					
11	I get irritated when using a computer					
12	I feel relaxed when using a computer					

Please check that you have not accidentally missed out any questions.
Thank you for your time and effort in completing this survey.

Guidance notes for Activities 23 and 24

Having surveyed a sample of pupils, you need to analyse the data to deduce findings upon which to make secure judgements. Pupils' names have not been asked for. If you intend to select pupils for follow up discussions then you will need some form of identifier.

One matter concerning the use of pupils' names is compliance with the Data Protection Act (1984) and any amendments to it. If you store the data from the questionnaire then you will need to check with the member of staff with responsibility for such matters.

The following notes, relating to the example questionnaire, are intended to assist you with your survey design and its analysis:

Q1&2 School year and gender: to identify year group and gender differences.

Q3 Position in family and family size: this may have some bearing on computer access and use.

Q4 Computer at home: note that this question does not ask if pupils own a computer. A follow-up question is, 'Where, in the home, is the computer system.'

Q5&6 Make and model of computer at home: to help you produce valid conclusions from the data you will need to categorise the responses into:

- computers of the same type as those used in school;
- games consoles;
- other computers that allow pupils to obtain printout.

Q7&8 Ownership and users of the computer at home: the responses to these questions need to be analysed against the data from questions 3 and 4.

Q9 Reasons for purchase of home computer: the key issue here is the extent to which home computers are bought to assist with children's school work.

The responses from questions 5, 6 and this question should provide:

- valuable data to inform your school about the opportunities for setting homework using ICT;
- an indication of the extent to which pupils have access to resources that could extend ICT capability outside the school environment.

Q10 Hours used at home: the data from this question are not intended to provide a reliable quantitative indicator. However, it should provide an indication of none, some, or much use at home.

The more important data from this question are the uses indicated by pupils. Cross-reference the priority given to school work against responses to previous questions.

Q11 Hours used at school. as in the previous question, the data are intended to provide a qualitative indicator.

Q12 Use of a computer elsewhere: you should analyse these responses by considering the extent to which pupils acquire ICT capability from opportunities in lessons and from opportunities elsewhere.

Q13 This question is an example of a psychometric test consisting of a Likert scale of twelve statements designed to measure pupils' attitudes about their use of computers. These statements have been adapted from attitudes scales used by Raat and deVries (1985), Bame and Dugger (1990), Householder and Bolin (1993), Thompson and Householder (1995) and Zanker (1996).

Psychologists tend not to favour the use of psychometric tests based on Likert scales because of the issues of validity and reliability. Such a test must be trialled and the responses analysed to check that each statement play a contributory and discriminative part. Those statements that do not must be discarded.

It is beyond the scope of this book to detail the statistical methods used to check the discriminative power (DP) of each of the statements in question 13. However, the DP of each of the statements as contributors to measuring respondents' attitudes has been checked through extensive trialing of the questionnaire by the author.

In practice, the psychometric test used for question 13 has revealed some interesting data about computer attitudes when cross-referenced with data from the other

questions. Caution must be exercised in attempting to arrive at judgements that are not cross-referenced.

The following five statements in question 13 are designed to obtain an indication of pupils' behaviours and attitudes towards positive attributes in the use of computers:

1 A computer is tiring to use
3 I try to avoid using computers
5 A computer makes me work more quickly
8 A computer can be exciting to use
12 I feel relaxed when using a computer

Statement 3 may, at first, appear not to be a positive attribute because it is a negative statement. However, if it is reverse scored (see below) when analyzing the response, this statement is a contributory indicator of the respondent's attitude to a computer's fitness for purpose.

The other seven statements (*ie* 2, 4, 6, 7, 9, 10, 11) are designed to obtain an indication of pupils' behaviours and attitudes towards negative attributes in the use of computers. The responses to these statements contribute to overall level of enthusiasm towards computer use. They are not reverse scored during analysis. This is because respondents will show their behaviours positively due to the way in which the statement is phrased. For example, if the respondent agrees with the statement 'I don't like to be interrupted when using a computer', then they are responding positively.

For a Likert scale of twelve statements, each scored on a 5 point scale the lowest value for a respondent's score is 12 and the highest is 60, with a mid point of 36. If a respondent has omitted a response to a statement then you should not calculate the score because the scale is incomplete. Figure 24 shows the scoring for each statement.

For example, from the statements in question 13, a pupil has scored 49 out of 60: 23 out of 25 for the positive use statements: 26 out of 35 for the negative use statements. Value indicating indifference would be 36,15 and 21. Conclusions that may drawn are that the pupil regards computers as useful and appreciates the negative side to using them. Overall the pupil has a positive perception towards use

of a computer as a possible alternative to assist with tasks. Such generalisations are, as indicated above, dangerous without cross-referencing with the responses made by this pupil to other questions.

When you analyse the responses to question 13 you may prefer to keep the scores for negative use and positive use separate.

Figure 24

Score for each statement of the computer attitude psychometric test in question 13 of the survey about using computers

		Disagree a lot	Disagree a little	Not sure	Agree a little	Agree a lot
1	A computer is interesting to use	1	2	3	4	5
2	I feel isolated when using a computer	1	2	3	4	5
3	I try to avoid using a computer	5	4	3	2	1
4	I don't like to be interrupted when using a computer	1	2	3	4	5
5	A computer makes me work more quickly	1	2	3	4	5
6	I feel tied down when using a computer	1	2	3	4	5
7	I have no choice with the way I work with a computer	1	2	3	4	5
8	A computer can be exciting to use	1	2	3	4	5
9	Using a computer is tiring	1	2	3	4	5
10	It takes a lot of skill to use a computer	1	2	3	4	5
11	I get irritated when using a computer	1	2	3	4	5
12	I feel relaxed when using a computer	1	2	3	4	5

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