



Beyond Engagement

The use of ICT to enhance and transform learning at Key Stage 2 in literacy, mathematics and science



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1. Introduction

This report summarises the findings of a small-scale investigation focusing on the extent to which ICT is being used in primary schools to enhance or transform learning in literacy, mathematics and science. 21 schools were visited for a day by a DCSF School Standards Adviser. The schools were nominated by their local authorities as having at least good practice in the use of ICT and some were judged to be amongst the most effective schools in the local authority.

As well as exploring ICT developments across the whole-school, the investigation focused mainly on the capabilities and experiences of the Year 6 pupils as they reached the end of the key stage. The schools completed a self-evaluation sheet relating to the end of Key Stage 2 expectations contained in the Programme of Study for ICT (**see Annex A**).

During the school visits evidence was obtained from interviews with senior leaders, subject leaders, teachers and pupils. Teachers and pupils demonstrated specific examples of the use of ICT to enhance learning in literacy, mathematics and science. Occasionally these demonstrations involved whole-class lessons but more typically they were set up with a teacher working with a small group of pupils.

The pupils were able to explain how and why they were using ICT and also talk more generally about their use of ICT in the core

subjects. Clearly the role of the teacher in these demonstrations was crucial and it was very evident that a skilled teacher could utilise a wide range of ICT resources to good effect. Notwithstanding this, the focus remained on the type of activity and the nature of the ICT resource being used.

It is unquestionable that the appropriate use of ICT can motivate and increase the involvement and engagement of children. The purpose of this investigation was to look beyond engagement and to gain an insight into how successfully ICT is currently being used to enhance or transform learning in effective schools.



2. Current National Curriculum requirements for ICT

Schools have two key responsibilities for delivering ICT as part of the National Curriculum requirements:

- a) to teach the programme of study for ICT;
- b) to give pupils opportunities to apply and develop their ICT capability across the curriculum.

The rationale for giving pupils opportunities to apply and develop ICT capability must be firmly rooted in the desire to improve the quality of pupils' learning in the subject. The use of ICT needs to be purposeful and add real value to the subject and should not be used just for the sake of using it. It is helpful, therefore, that the new Primary Framework for Literacy and mathematics identifies a wide range of opportunities for using ICT to enhance learning. It is also important to recognise that pupils' ICT capability does not develop as though by osmosis. It can only be applied and developed in subjects if it has been taught effectively in the first place.

A distinction also needs to be made between pupils' use and teachers' use of ICT in lessons. Whilst the use of ICT by teachers (for example, demonstrating using IWB software) can stimulate interest and motivate pupils to learn, it will not, in itself, develop the pupils' ICT capabilities. Clearly there will be occasions when the teacher use and the pupil use of ICT overlap – for example, the teacher modelling

data on a spreadsheet before pupils create their own models.

Therefore the use of ICT in classrooms can be viewed as 3 interlocking dimensions:

1. The teaching of ICT capability as defined by the National Curriculum programme of study.
2. The opportunities for pupils to apply and develop their ICT capability to enhance learning in other subjects.
3. Teacher use of ICT to support teaching and learning.

This relationship is explored in further detail in **Annex B** but it is important to keep these elements in mind when planning, using and evaluating the impact of ICT.

This report focuses on the pupils applying and developing ICT capability to enhance learning in the core subjects.



3. ICT in primary schools

The investigation considered two main aspects of the organisation of ICT:

- The resources needed to support effective teaching and learning in ICT.
- The support provided for staff. This included technical support, the co-ordination of ICT across the school, continuing professional development (CPD) and support provided through schemes of work.

a) Resources to support ICT

In all the schools visited two underlying principles governed the development of resources to make effective use of ICT:

1. ICT should be used to enhance learning across the curriculum and not simply as a subject in its own right.
2. Pupils should be encouraged to make independent choices about the use of ICT and select the ICT which is most appropriate to their needs.

In almost all the schools Interactive Whiteboards (IWBs) were available for use in every classroom. In some schools, the introduction of IWBs had engaged teachers in a wider range of ICT applications and encouraged more detailed planning of lessons. There was also recognition that, particularly in the early stages of IWB implementation, some



teachers moved to a more didactic approach to their teaching. However, this has subsequently promoted a much more pedagogical approach to CPD which focused on how teaching and learning could be improved using ICT. New and emerging developments in ICT, such as classroom management software, have also provided new opportunities for sharing and reviewing pupils' work within a whole class context.

Staff had their own laptops which they often used as a link to their IWB. Digital cameras were commonly available for use by pupils, often held as a central rather than a class resource.

In contrast only a few schools were particularly well resourced with data loggers and

associated sensors. A number of schools borrowed these from secondary schools when they needed to use them.

Most schools were in the process of re-assessing their basic provision of computers for pupil use. Typically older computers were sited in small clusters in open areas to facilitate small group work. The extent to which these clusters were used varied considerably. In some cases they were well used, particularly by support staff working with individuals and small groups of pupils, in other cases it appeared that these clusters were used very infrequently. All the schools had at least one dedicated computer suite and many had two. The number of computers in the suites varied from about 15 to 34. These suites were



originally established with the teaching of the National Curriculum ICT programme of study in mind and the need to develop pupils' ICT capabilities. Typically classes were timetabled into the suites for up to two sessions per week and in a number of schools these sessions were designed to teach 'discrete ICT'. Increasingly, however, such suites were being seen as limiting the development and use of ICT as a tool for learning, with access required by pupils at the time of need.

The schools were adopting a range of approaches to reduce the potential inflexibility of their computer suites:

1. Classes were timetabled into the computer suite for a whole week each half-term. This approach enabled the use of ICT to be better integrated into weekly planning and ensured that pupils benefited from sustained periods of use.
2. Laptops supported by a wireless network were being increasingly used. Typically these were sited on a trolley and could be moved from room to room. In a small minority of the schools all the pupils in a particular year group or class had their own laptop. In one school every pupil had his or her own laptop. In some schools, however, the potential 'high maintenance' of laptops, including battery charging and breakdown, acted as a real discouragement to their use.
3. In some schools pupils were provided with individual hand held computers or Personal Digital Assistants (PDAs). In one of the schools visited these were used almost exclusively by the Year 4 pupils thus releasing time for other year groups to use the computer suite.

4. Networked computers were being included as part of the normal work space in classrooms so that each pupil would have his or her own access. In one school custom built modules had been installed in one of the classrooms. The modules provided work spaces for each pupil (in groups of 8) as well as easy individual access to a keyboard and flat screen monitor.

Across the schools there were other significant areas of development. About half the schools were actively developing a Virtual Learning Environment, usually with support from their local authority. In a few cases these were already providing extended learning opportunities for pupils from home with the added benefit of increased parental engagement in their child's work. In most schools, however, these developments were at a relatively early stage and in a minority of schools a positive decision had been made not to commit to the local VLE.



b) Supporting the development of ICT

It was clear that in all the schools a considerable amount of support was needed both to maintain and develop the school's ICT infrastructure and to provide regular support for the staff.

i) Technical support

All the schools visited benefited from some dedicated technical support for their network and computer systems. In some schools the support was full-time but more typically the support was part-time, with the technician also working with other local schools. In a significant number of schools the technician adopted a wider role and provided support for teachers in the classroom.

ii) Leading and managing ICT development

All schools had dedicated ICT leaders who were responsible for promoting and supporting development in the school. In most of the schools members of the senior leadership team, often the headteacher, took a specific interest in the development and worked very closely with the ICT leader. In one school the nature of the role was reflected in the 'e-learning co-ordinator' title given to the post.

In some schools the ICT leader had limited class teaching commitments and so was able to support colleagues by working alongside them in the classroom. More typically, ICT leaders were given a limited amount of time to fulfil this role. However, in a significant number of schools the ICT leader had no time allocated to working alongside colleagues.

Continuing professional development was given a very high priority in all schools and was used most frequently to support a long-term

view of the development of ICT. Increasingly schools as part of their CPD were taking account of pupils' ICT use at home. Typically senior leaders accepted that new approaches would take time to become embedded in every day practice and staff needed to be given time and appropriate support if progress was to be made. Consequently senior leaders did not apply undue pressure on staff to adopt new practices. Instead training and support was often 'drip feed' with regular sharing of ideas and modelling of practice. Schools had drawn upon both internal and external expertise to support developments, with many referring to the high quality support they had received from local authority leading teachers or consultants. Most of the schools included all non-teaching staff in their development work and, in particular, were very keen that learning support assistants became competent and confident users of ICT.

Many of the schools had developed a culture of regular ICT usage and new staff were quickly inducted into the school's expectations. Formal monitoring was less evident, except as part of performance management procedures. Only a minority of schools formally monitored the pupils' progress in developing ICT capabilities as defined by the National Curriculum programme of study for ICT. As a consequence of this, in some schools the pupils were not getting sufficient direct teaching or practice at certain aspects of the programme of study and this was not readily spotted. For example, in a small minority of schools the use of spreadsheets in Year 6 was spasmodic and so in these schools some of the Year 6 pupils struggled to remember how to manipulate data to produce charts.

Carr Hill Primary school – Retford, Nottinghamshire

The school was keen to find out what ICT usage the pupils were experiencing outside the classroom and, moreover, how their expertise could be harnessed in the classroom to support learning.

The school set up an after school staff meeting to find out. The staff meeting was run totally by the pupils. Groups of pupils were located around the site at various bases and members of staff circulated round the different bases. Each base had set up a demonstration of a different aspect of the ICT that pupils were

using at home or elsewhere outside the classroom. These demonstrations included social networking, message boarding, music downloads, internet-based adventure games and virtual consoles. The pupils demonstrated how to use the ICT, what they did with it and how they would like to see it incorporated as part of their learning in school.

The school is now considering the implications of this activity and in particular how they can make greater connections with such experiences and the CPD that staff need to support this development.

It was also rare to find explicit monitoring of the impact of ICT on the progress being made in the core subjects.



iii) Schemes of work

Some schools were using schemes of work developed by their local authority, and others still based their work on the Qualifications and Curriculum Authority's (QCA) sample scheme. However, in the schools visited there was a definite movement away from using the QCA scheme. The main reasons for this included:

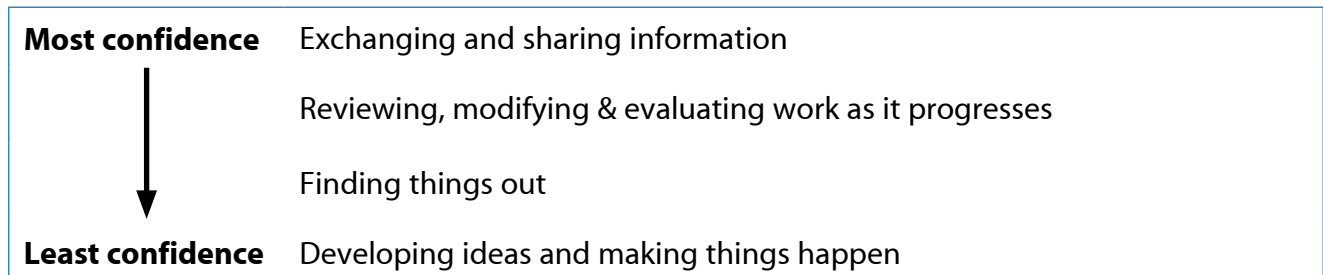
- to incorporate improvements made in the types and uses of technology;
- to integrate ICT work more closely into their teaching schemes for the core and other foundation subjects;
- to incorporate local contexts.

One school in particular had adopted the International Primary Curriculum (IPC) as a fully integrated scheme. This shift was a consequence of the teachers viewing ICT as a 'tool' for the rest of the curriculum rather than as a subject in its own right.

4. Developing ICT capabilities

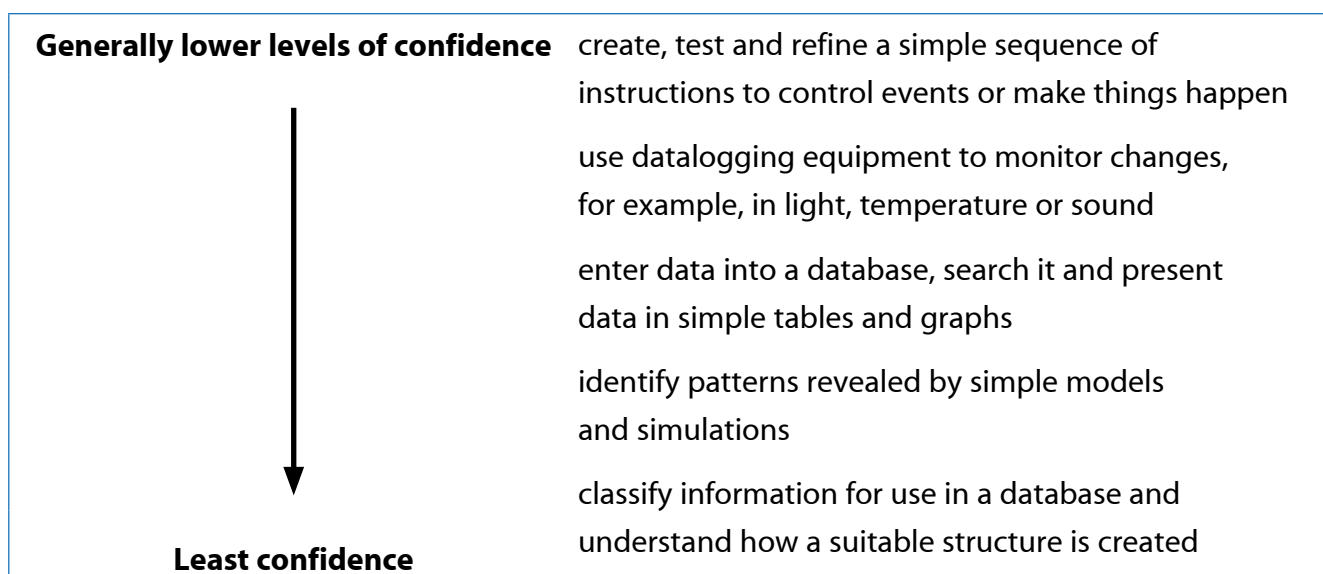
Overall, the schools' self-evaluations, made against the end of Key Stage 2 expectations, indicated high levels of confidence that 'most pupils' in Year 6 had acquired a wide range of capabilities.

In terms of the different 'strands' of the programme of study, the self-evaluations revealed the following order of confidence that expectations were being met:



In relation to the specific end of key stage capabilities, in most cases schools were confident that the expectations had been met. However, for some capabilities levels of

confidence were significantly lower than the norm. The specific capabilities where levels of confidence were the lowest included:



5. Using ICT to enhance learning

In almost all cases the pupils were clearly motivated and stimulated by the ICT approach they were demonstrating. In fewer than one in thirty of the activities demonstrated was the ICT a 'distraction' to learning and, as such, made little or no contribution to the achievement of the learning objectives in the core subject. In some cases the use of ICT achieved high levels of engagement but little beyond that; the learning objectives were achieved but the use of ICT, in itself, did not lead to deeper learning.

In about two-thirds of the activities the use of ICT provided opportunities to enhance the learning in ways that other teaching strategies probably would not have been able to do. As a consequence deeper learning was achieved. The use of ICT to enhance learning in this way, rather than just to improve engagement, was most prevalent in literacy contexts and least prevalent in the mathematics activities.

The distinction between 'engagement' and 'enhancement' activities was often partly a consequence of the type of ICT resource being used. However, what was more important was how the ICT resource was being employed by the teacher. The link with pedagogy was very strong. So, for example, software which on the face of it had very limited potential for enhancing learning was sometimes used by a teacher to create a very rich learning experience for the pupils.

In the following sections, for each core subject the differences between the engagement and enhancement 'levels' have been characterised and exemplified through the use of case studies.

a) Using ICT in literacy

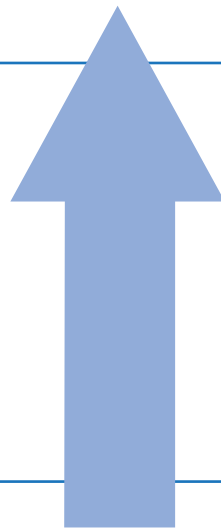
In many of the schools, pupils were able to use a range of ICT applications to present their work to a professional standard which they found highly motivating. Many pupils were able to use *MS PowerPoint* very confidently in order to present information on a previously studied topic or on a subject of their choice to the rest of the class or, occasionally, in a whole school assembly. Some schools were making effective use of visualisers to share pupils' work with the class in order to promote self and peer assessment. In all of these examples, the main purpose of the ICT was to motivate and engage pupils in their learning.

In almost eight out of every ten of the literacy activities demonstrated by the pupils the activity went *beyond engagement* and their learning was significantly enhanced. The distinctive features of the sort of activities at the engagement 'level' and those at enhancement 'level' are summarised on the next page. In addition, examples of the types of activities which significantly enhanced the pupils' learning are presented as case studies.

Enhancement

Examples of the types of activities which led to enhanced learning included:

- The use of digital cameras to create 'photo-stories', overlaid with pupils' own text and sound effects or voice recordings to capture an event, for example.
- The use of the internet to research information, such as archive footage.
- The analysis of the way information is presented in a range of websites on a similar topic to detect bias.
- The use of short films and animations to support visual literacy, for example, analysing the way the film techniques support the narrative process.
- The use of podcasts to support speaking and listening through recount and recreation of real or imagined events.
- Analysis and production of TV advertisements using multimedia approaches to support persuasive language.
- The use of *MS Word* to compose and edit writing on screen.



Engagement

Examples of the types of activities that engaged the pupils but didn't significantly enhance their learning included:

- The use of *MS Word* or *Publisher* to present work to a professional standard.
- The use of visualisers to share work with a wider audience in order to self and peer assess.
- The use of e-mail to create real contexts for writing.
- The use of *MS PowerPoint* to present information on a previously studied topic, such as World War Two.

The following case studies describe activities where pupils' learning was significantly enhanced.

Case Study 1: Creating a recount through using a photostory

Learning objectives

- To integrate words, images and sounds imaginatively for different purposes.
- To select from a wide range of ICT programs to present text effectively and communicate information and ideas.

Activity

On a school trip, pupils used digital cameras to take a range of photographs which the teacher then placed on the school website. Pupils chose the images that, for them, captured the

essence of the trip. They then wrote short, alliterative captions for each still image, e.g. 'cool, crazy caving' or 'amazingly, awesome abseiling' and overlaid them, using *Photostory*, onto the images. They also added an appropriate sound track. Each photostory lasted one minute and was shown in assembly.

Key points

- The emphasis on language skills was paramount as pupils were required to devise short alliterative captions that captured the essence of each image.
- The one-minute specification focused pupils on conveying a story using a combination of words, sound and images in a concise and economical way.



- Pupils had to use their skills of collaboration in order to select appropriate photographs for their photostory.
- The ICT allowed pupils to quickly trial and edit different combinations of photographs, alliterative captions and sound until they agreed on the most appropriate photostory.

*"We had to agree exactly what we should photograph."
(Year 6 pupil)*

*"I can select the pictures and then I can focus on the text to create the mood."
(Year 6 pupil)*



Case Study 2: Analysing and creating a TV advertisement

Learning objectives

- To use a range of oral techniques to present persuasive arguments and engaging narratives.
- To recognise rhetorical devices used to argue, persuade, mislead and sway the reader.

Activity

Pupils analysed a TV food advertisement before working in pairs to produce their own. They selected images from the internet which they overlaid with voice recordings of their own written text. They developed this further by producing a short promotional film for Greece, using a combination of words, sound and images.

Key points

- There was much emphasis on the use of appropriate and effective vocabulary which was facilitated by firstly watching a *Marks and Spencer* food advertisement without sound in order to generate persuasive vocabulary inspired by the images.
- There was a clear sense of purpose and audience leading to outcomes that were highly effective in their persuasive power.
- The use of the internet allowed pupils to quickly search, discuss and select from a huge range of instantly accessible images.



"Watching the advert without the sound really made me think of the words I needed to use."

(Year 6 pupil)

"By the end we could see what we had achieved. By looking at each other's, we could decide what made some better than others."

(Year 6 pupil)

Case Study 3: Using visual literacy to enhance the quality of writing

Learning objectives

- To understand underlying themes, causes and points of view.
- To use different narrative techniques to engage and entertain the reader.
- To select words and language drawing on their knowledge of literary features and formal and informal writing.

Activity

Pupils explored a short, animated film from one of the units in the Primary Framework. They discussed their interpretation of the characters and explored the way the camera acted as a narrator in the story. They then chose stills from the animation to produce a storyboard that included flashbacks before adding their own text to create a short story using flashbacks.

Key points

- Analysis of the way film techniques supports the storytelling process gave the pupils insights into the ways in which meaning and mood can be implied in film, for example, through the use of sound, colour, or camera angles.
- Pupils were able to transfer their understanding to written texts, both as readers and writers.



- The teacher's strong focus on the literacy objective ensured that pupils thought carefully about their vocabulary choices and sentence structures.
- The ICT gave pupils opportunities to select and extract the stills from the animation and add their own text to create their stories and go back and edit as necessary.

"It really gives you something to think about. There are many feelings and emotions in the clip."

(Year 6 pupil)

"I enjoyed writing the story – I had never used flashbacks before."

(Year 6 pupil)

Case Study 4: Making a podcast to strengthen speaking and listening skills

Learning objectives

- To use the techniques of dialogic talk to explore ideas, topics or issues.
- To use varied structures to shape and organise text coherently.
- To select from a wide range of ICT programs to present text effectively and communicate information and ideas.

Activity

As part of a unit of work on World War Two, pupils developed a podcast for a radio interview. They worked in role, either as the radio interviewer or as a character from the period, planning their questions and answers in pairs. They then imported appropriate music from other software.

Key points

- The use of podcasts supported high quality oral rehearsal of recounts.
- The podcast enabled the pupils to capture the somewhat ephemeral nature of a spoken task, facilitating peer and self review of their work.
- The use of 'podcasting' helped pupils to refine their thoughts, ensuring that their first idea (not necessarily their best one) was not always the one they chose to use.

"We had to think about speaking clearly and quite slowly. You can use the recordings to improve."

(Year 6 pupil)

"It was fun and different to do something that wasn't writing."

(Year 6 pupil)

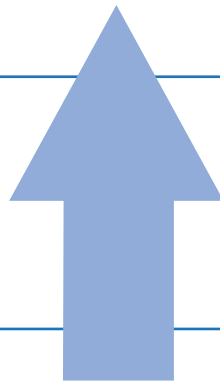
b) Using ICT in mathematics

In many of the schools ICT was used to present mathematical problems, puzzles and games. Pupils enjoyed these activities and said that the diagrams and visual representations helped them with learning and remembering the mathematics. Furthermore these activities also helped pupils to develop speed, agility and accuracy in skills such as calculating,

Enhancement

Examples of the types of activities which led to enhanced learning included:

- The use of spreadsheets to record data and produce graphs and charts to discuss and interpret.
- The use of spreadsheets to investigate a problem given in context, e.g. the cost and amount of card needed to make Christmas gift boxes of different sizes.
- The use of simple formulae within spreadsheets to perform calculations.
- The use of National Strategies Interactive Teaching Programs (ITPs) to demonstrate and model mathematical skills and concepts and to promote discussion and pupil talk.
- The use of simulations, including adventure games, to introduce investigations, explore patterns and generalisations and solve problems.
- The use of film to focus and address misconceptions and to promote discussion and articulation of methods.
- The use of dynamic geometry software to demonstrate and visualise aspects of shape and space, e.g. reflections and translations, nets and 3D shapes.
- The use of onscreen turtles to produce shapes and explore their properties.

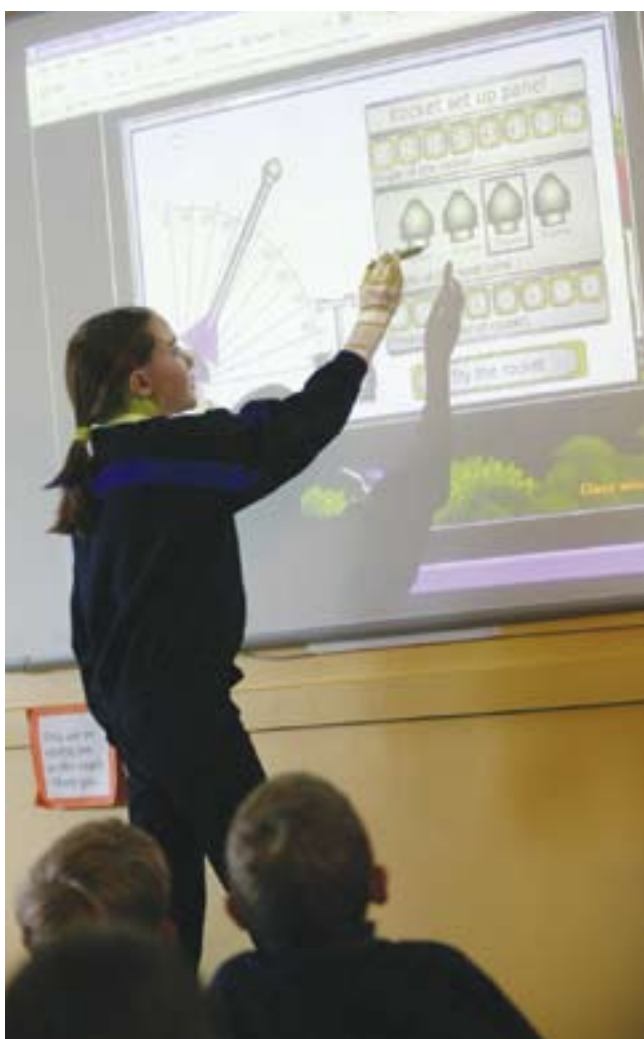


Engagement

Examples of the types of activities that engaged the pupils but didn't significantly enhance their learning included:

- The use of games, puzzles and activities (either on an interactive whiteboard or with pupils working individually or in pairs at a computer) to practise skills in calculating, estimating and problem solving.
- The use of revision websites and revision software to provide strong visual representations and structured activities to practise skills and reinforce knowledge and understanding.
- The use of onscreen tools such as protractors, rulers and calculators to provide clear demonstrations.

estimating, reading scales and recall of facts. The quick response provided by the ICT encouraged pupils to experiment and refine their answers. Pupils tended to persevere with tasks until they had achieved their goal. Several schools made use of online competitions where children competed against other pupils, sometimes from different countries. Pupils also made good use of revision materials and websites to consolidate skills and reinforce knowledge and understanding. Some schools used onscreen tools such as protractors and rulers to help pupils develop the skills of accurate measurement. Overall, pupils were motivated by using a computer but many of the activities were focused mainly on practising skills and not on supporting deeper learning.



In about half of the activities demonstrated by the pupils the activity went *beyond engagement* and provided enhanced learning. The distinctive features of the sort of activities at the engagement 'level' and those at enhancement 'level' are summarised on the previous page. In addition, examples of the types of activities which significantly enhanced the pupils' learning are presented as case studies.

The following case studies describe activities where pupils' learning was significantly enhanced.

Case study 5: Using film to focus and address misconceptions in multiplication and division

Learning objective

- To use efficient written methods to multiply and divide two-digit integers.

Activity

The teacher worked with a guided group to address some misconceptions encountered during some work on multiplication and division. Different methods were discussed and developed. Pupils worked in pairs to produce a short film (using a *digi-blue* camera) to illustrate and explain their chosen method of calculation.

Key points

- To produce the film the pupils needed to be completely confident with their chosen method. As well as recording written examples they needed to be able to explain their thinking and give a clear, accurate commentary on the method used.

- The film provided a good piece of assessment evidence and the teacher was able to revisit it, alongside other pupils' films, in subsequent lessons for whole class discussion and revision.

"As well as writing down the calculation we had to think about explaining it clearly so that other people would be able to understand it."

(Year 6 pupil)

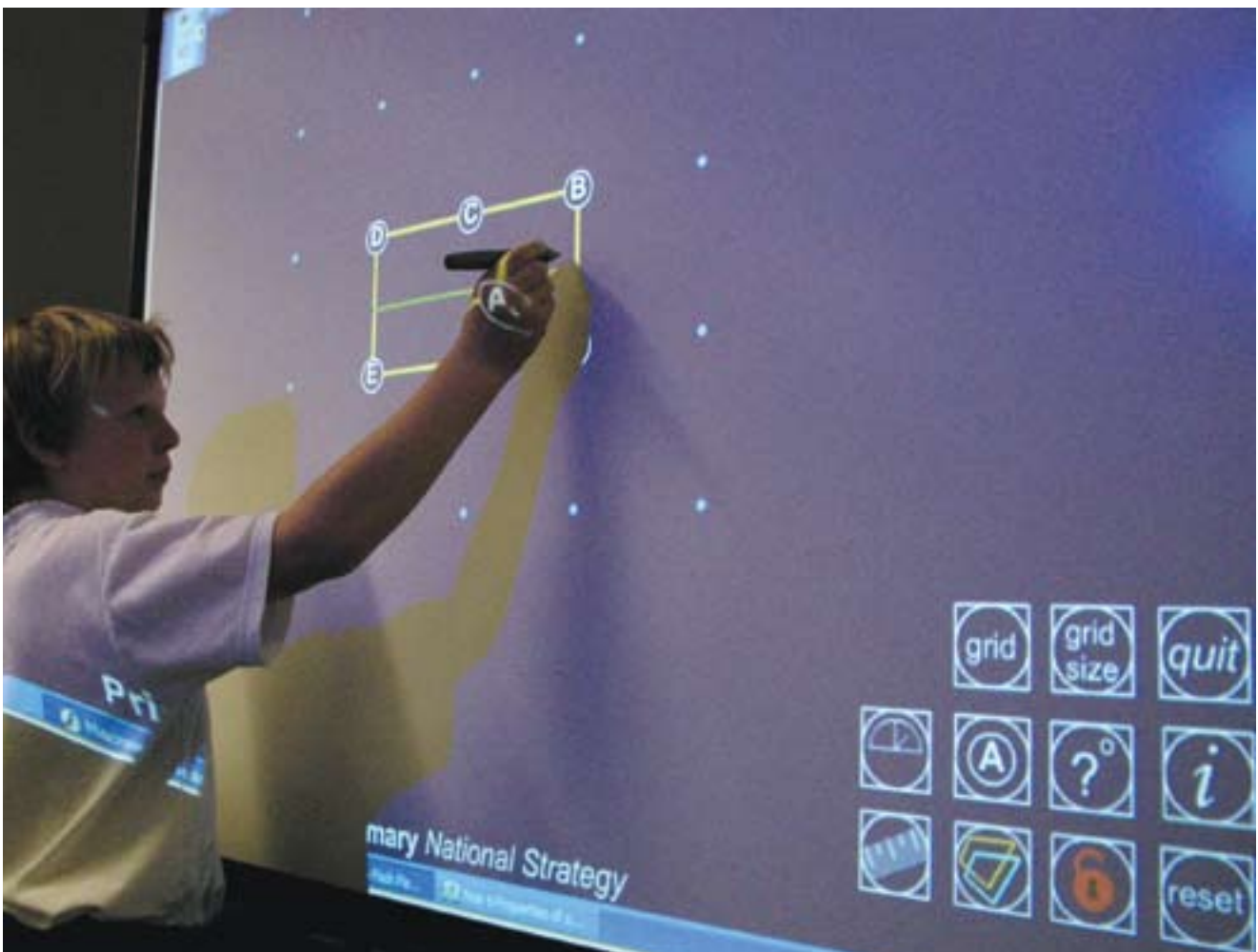
"I could even take the film home to show my parents so they could help me with the work."

(Year 6 pupil)

Case Study 6: Using an interactive teaching program (ITP) to improve graphical interpretation

Learning Objectives

- To solve problems by collecting, selecting, processing, presenting and interpreting data, using ICT where appropriate; draw conclusions and identify further questions to ask.
- To interpret information shown on line graphs.
- To describe trends and patterns shown on line graphs using key mathematical vocabulary.



Activity

The teacher projected several line graphs on the interactive whiteboard using a Primary National Strategy ITP 'Line graph'. Each graph had a title, e.g. 'Mass of an elephant' but no labels or scales on the axes were displayed. Pupils were asked to tell a story to describe each graph.

Key points

- The activity promoted pupil talk. The teacher used skilful questioning to focus the pupils on giving detailed and accurate descriptions using appropriate mathematical vocabulary.
- Groups of pupils were invited to the front of the class and used the IWB to suggest sensible scales and labels for the axes and

used these to give examples of key points on each graph.

- The teacher used the pupils' examples to discuss and clarify the differences between discrete and continuous data.
- New graphs could be displayed quickly keeping the focus on interpretation.

"We see graphs in everyday life all the time. We need to be able to think about what they show."

(Year 6 pupil)

"It's a great way of getting the pupils to focus on interpreting graphs. They like to see who can make up the best story."

(Year 6 teacher)



Case Study 7: Using a spreadsheet to explore a problem

Learning objectives

- To tabulate systematically the information in a problem or puzzle; identify and record the steps or calculations needed to solve it, using symbols where appropriate; interpret solutions in the original context and check their accuracy.
- To construct and use simple expressions and formulae in words then symbols.
- To collect, organise and represent information, interpret results and explain conclusions.

Activity

The pupils were presented with a problem: *'You have £100 to invest in a 'Christmas gift box' company. Your task is to turn your £100 into £1 000 000.'*

Pupils were given information on the price of card, the amount of card needed to make boxes of different sizes and how much the boxes could be sold for. They were asked to work out the best combination of large and small boxes to make the maximum profit. Pupils entered the data into a spreadsheet and used simple formulae to calculate costs and profit.

Key points

- Pupils were given a real context for the task and the spreadsheet provided a genuine tool for exploring the problem.
- After working out some of the calculations 'long hand' the teacher demonstrated the use of formulae in the spreadsheet. Pupils quickly realised how repetitive calculations

could be generated quickly and easily. They could also explore the effect of changing one of the variables.

- Through creating the spreadsheet the pupils were able to generate data quickly and focus on the analysis and interpretation needed to come up with the best solution to the problem.

"We don't usually learn about business but businesses all use spreadsheets so this is a skill we may need when we grow up."

(Year 6 pupil)

"It's very accurate and you can see the results really quickly."

(Year 6 pupil)

c) Using ICT in science

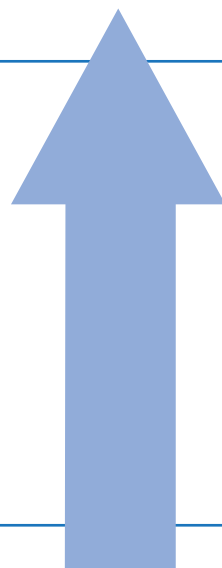
In most of the schools pupils were able to use ICT very readily to find out information about the science topic they were studying. For example, they were able to find images and incorporate them into keys or other forms of presentation. Similarly pupils could access a wide range of revision/subject consolidation websites and benefited from testing their knowledge and understanding in some interesting and sometimes competitive situations. Some pupils used electronic writing frames to help structure their work and then produced very 'polished' written reports. In all these examples pupils were motivated by the approach but the outcomes for the pupils were essentially at the level of engagement rather than enhancing learning.

However, in about two-thirds of the science activities demonstrated by the pupils the

Enhancement

Examples of the types of activities which led to enhanced learning included:

- The use of computer simulations to represent phenomena, for example the phases of the moon, which are more difficult to simulate in other ways.
- The use of film to record experimental observations which can then be re-run to compare effects and the influence of different factors.
- The use of sensors and data loggers to record and display measurements from investigations which would be hard to replicate using conventional measuring methods.
- The use of a spreadsheet to record results, produce graphs and charts in order to facilitate discussion of trends and patterns.
- The use of a digital microscope linked to an interactive whiteboard to show small objects or changes and encourage class discussion.
- The use of animated presentations, produced by film or animation software to model scientific processes, for example erosion.



Engagement

Examples of the types of activities that engaged the pupils but didn't significantly enhance their learning included:

- The use of the internet to find images and text to inform presentations and displays.
- The use of an electronic writing frame to help structure the planning and subsequent presentation of results from an investigation.
- The use of revision websites to provide interesting and visual quizzes and tests to reinforce knowledge and understanding.

activity went *beyond engagement* and their learning was significantly enhanced. The distinctive features of the sort of activities at the engagement 'level' and those at enhancement 'level' are summarised on the previous page. In addition, examples of the types of activities which significantly enhanced the pupils' learning are presented as case studies.

The following case studies describe activities where pupils' learning was significantly enhanced.

Case Study 8: Using a simulation to improve understanding of the phases of the moon

Learning objectives

- To understand the cause of the different phases of the moon.

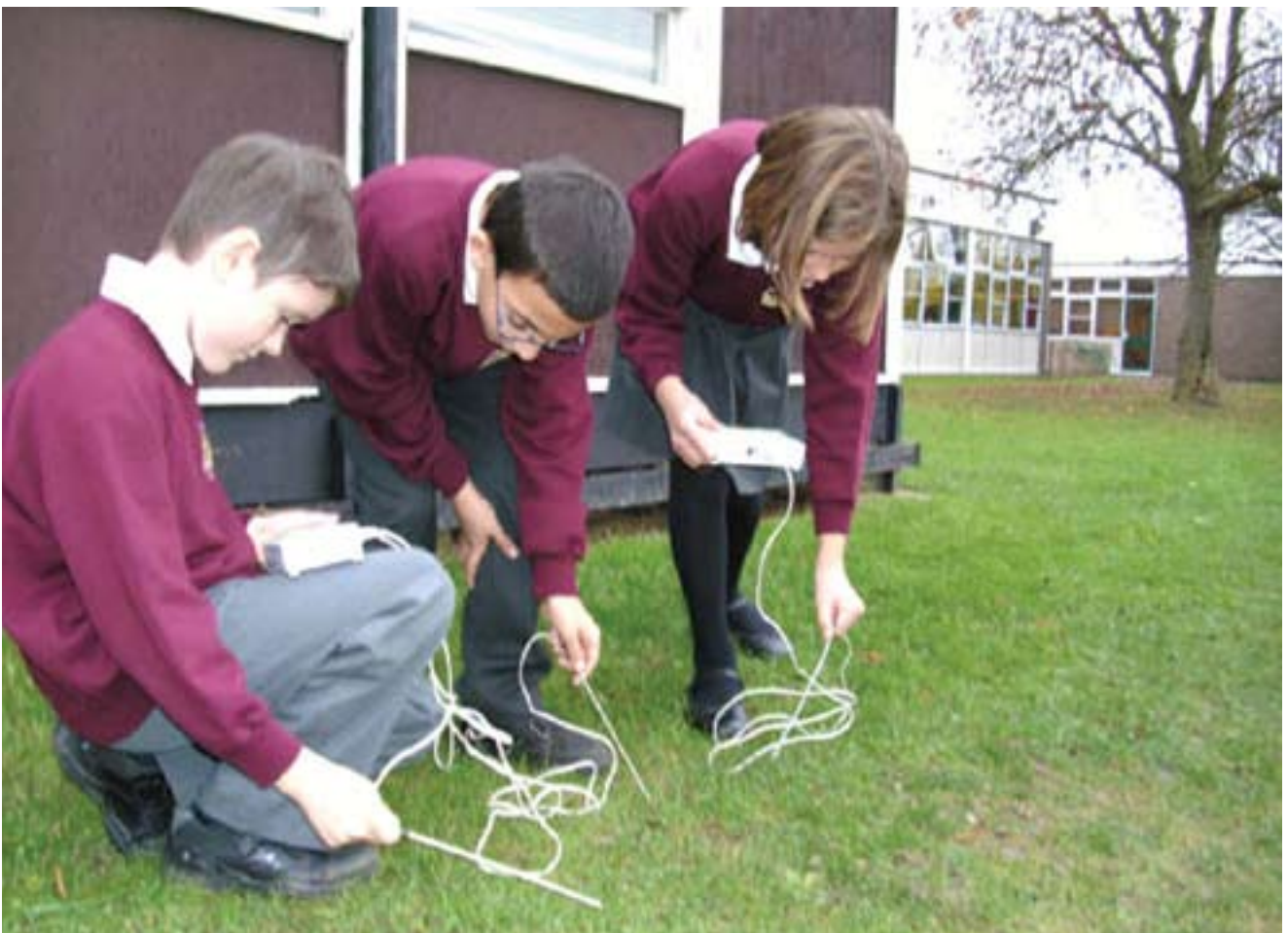
- To be able to predict the observed shape of the moon given the relative positions of the sun, earth and moon.

Activity

The teacher used a simulation of the moon orbiting the earth which showed the view of the moon as seen from the earth at different points in its orbit.

Key points

- The teacher was able to pause the simulation and ask questions about the process. Pupils were asked to predict what the moon would look like from the Earth at different points in its orbit. The teacher invited pupils to the front to control the sequence of the simulation and suggest what might happen next.





- The quality of the teacher's questioning was a key factor in creating an excellent learning experience for the pupils.
- This is a difficult concept for pupils to understand, not least because they have to imagine how the moon will look from the earth and which part of the moon will be illuminated. Modelling the situation with a 'lamp and football' approach is much less effective.

"You can really see what is going on – it makes it much clearer."
(Year 6 pupil)

"It would be difficult to follow this just from looking at diagrams in a book."
(Year 6 pupil)

Case Study 9: Using sensors and a data logger to record and display temperature changes

Learning objectives

- To record data over time, analyse it and suggest explanations.
- To understand the effect of exercise on skin temperature.

Activity

As part of an investigation into how the body changes during exercise, pupils used a temperature sensor attached to a data logger to measure skin temperature during exercise. The data logger was then used to produce a chart showing temperature against time which was displayed on an interactive white board. The class were then asked to describe the shape of the graph and offer explanations drawing on their understanding of the human body.

Key Points

- Pupils were encouraged to talk about their understanding of the effects of exercise on the body.
- The rapid production of a chart enabled discussion to focus on the pattern of the results and as a source for predictions about how the results would change if the type of exercise was varied.
- The data logger was able to take accurate readings at regular intervals – this would have been more difficult using a thermometer.

"It is a really good way of getting accurate results."

(Year 6 pupil)

"I have learnt so much about how the body changes when you exercise."

(Year 6 pupil)

Case Study 10: Using film to record observations from a series of experiments

Learning objectives

- To undertake careful observations of a chemical change and to investigate the effect of changing conditions.
- To review the procedure to check if a 'fair test' had been used.

Activity

Pupils carried out an experiment to find out the effect of changing the amount of bicarbonate of soda when it was added to some vinegar. The pupils used PDAs to film the experiments and to record their findings. After completing the set of experiments they watched the film sequences to pick up observations they had missed and to check the experiment for 'fairness'.

Key Points

- The ICT was used to support learning but did not detract from the practical nature of the experiment.
- The pupils were able to review the experiment and record observations they had missed. They were also able to check for the conditions for a fair test.
- The discussion was enriched as it was based on a visual record and not just on memory.
- The PDA also facilitated the recording of notes which could be edited at a later stage.

"I hadn't noticed that most of the bicarbonate stuck to the spoon – it wasn't a fair test."

(Year 6 pupil)

"The pupils could bring their films to me and I could see what they were puzzled about."

(Teacher)

6. Conclusions

These conclusions are based on the evidence obtained in schools judged by their local authorities to have good practice in the use of ICT.

1. In effective schools ICT is used regularly to enhance and deepen subject learning. Overall, enhanced pupil learning was evident in about two-thirds of the activities observed in the schools visited.
2. In the schools visited the use of ICT to enhance learning is most prevalent in literacy and least prevalent in mathematics. Typical examples include:
 - In literacy, animation and film are being used extensively to enhance the quality of writing; and 'podcasting' to develop speaking and listening skills.
 - In science, simulation software is often used to represent situations which can not be easily modelled in other ways.
 - In mathematics, spreadsheets are successfully utilised to produce charts and to create models and simulations.

A high proportion of ICT applications in mathematics centre round games, puzzles and revision/practice web-sites which often provide little more than the practice of basic skills. A range of software is also used regularly by teachers to demonstrate basic operations.
3. Good use of ICT is underpinned by strong pedagogical approaches including, for example:
 - a tight focus on subject learning objectives;
 - clear and precise planning;
 - effective use of questioning to initiate and support pupil self and peer review.
4. Effective practice in ICT is facilitated by achieving a good balance between developing ICT skills and capabilities and providing opportunities for pupils to apply their ICT capabilities to support learning in other subjects.
5. In schools where the development of ICT is seen as a significant priority, most Year 6 pupils are able to demonstrate the full range of the capabilities identified as end of Key Stage 2 expectations in the ICT programme of study. Within this positive picture relative weaknesses exist in:
 - classifying information for use in a database;
 - identify patterns revealed by simple models or simulations;
 - using data logging equipment to monitor changes.
6. Effective schools encourage the independent use of ICT by pupils through:

- developing a range of flexible hardware solutions, for example, computer suites, laptop trolleys and handheld devices;
 - developing access to learning on line through, for example, Virtual Learning Environments (VLEs);
 - taking account of the pupils' own ICT usage at home, including social networking and using on-line adventure games.
7. Effective schools display strong leadership in ICT. Typically this is characterised by:
- a long-term vision and development strategy;
 - active involvement by senior leaders;
 - dedicated ICT leadership.
8. Schools which are successfully using ICT to enhance pupil learning make a strong commitment to CPD which is characterised by long-term planning, is on-going and goes beyond skills training into the development of pedagogy and curriculum planning.
9. Schools which are able to harness ICT to enhance learning across the curriculum invariably have strong technical support for ICT.
10. Technical and pedagogical support provided by local authorities often plays a key part in supporting sustainable ICT development in schools.




7. Recommendations

1. To further the development of the ICT primary schools will benefit from focusing on:
 - issues of teaching and learning and not simply on the technology of the ICT application itself;
 - the potential of the ICT activities to move beyond pupil engagement to supporting enhanced and deeper learning in core and foundation subjects;
 - providing on-going CPD and support for staff in terms of collaborative working and sharing of effective practice.
2. Pupils' experiences of ICT could be extended to support deeper and enhanced learning in mathematics – rather than, for example, just isolated practice/revision programs or teacher led demonstrations – by sharing more innovative pedagogical approaches of using ICT in the subject.
3. Schools should continue to build connections between the use pupils make of ICT at home to the approaches used within school. In relation to the further development of Virtual Learning Environments (VLEs), schools need further guidance on how these can best be developed to enhance pupils' learning.
4. There is a continuing need for support for the leadership of ICT in primary schools. This support needs to encompass senior leadership as well as leadership at subject leader or co-ordinator level.
5. Providing an adequate level of dedicated technical support for ICT is a key priority. As more flexible hardware solutions are implemented, the requirement for expert support to maintain the ICT infrastructure in primary schools will become even more critical.
6. Schools could usefully develop their processes for monitoring pupils' ICT capability through the key stage so that they can:
 - identify aspects requiring further development and next steps for pupils;
 - identify potential gaps in the scheme of work;
 - be clear about the ICT that pupils should be able to apply in other subjects at each stage of the year;
 - provide meaningful transition data for secondary transfer or change of primary school to support continuity and progression.

8. Annexes

Annex A: School Self-Evaluation: End of Key Stage 2 expectations in ICT

Extent to which the expectations are met				
1 – most pupils can demonstrate this capability → 4 – only a small minority of pupils can demonstrate this capability	1	2	3	4

Finding things out

By the end of Year 6, most pupils should be able to:

1	identify the information they need to complete a simple task or solve a simple problem				
2	use simple search techniques, including indexes and lists of contents, to find information				
3	prepare information for use in a task by downloading relevant pieces or collecting them from various sources				
4	classify information for use in a database and understand how a suitable structure is created				
5	recognise different types of information such as text, numbers, graphics				
6	enter data into a database, search it and present data in simple tables and graphs				
7	check that information is accurate and reasonable				
8	discuss what might happen if information is entered into the computer incorrectly or not downloaded completely				

Developing ideas and making things happen

By the end of Year 6, most pupils should be able to:

9	combine text, graphics and sound to develop and present their ideas				
10	reorganise information for a particular task or problem				
11	create, test and refine a simple sequence of instructions to control events or make things happen				
12	use datalogging equipment to monitor changes, for example, in light, temperature or sound				
13	use simple spreadsheet models to explore the effect of changing variables and answer straightforward questions				
14	identify patterns revealed by simple models or simulations				

Exchanging and sharing information

By the end of Year 6, most pupils should be able to:

15	use e-mail				
16	use software to create stories, animations, presentations, displays and posters				
17	consider the needs of different audiences, such as parents, peer groups, younger or older pupils				
18	recognise the need for quality and accuracy in their presentations of work and ideas				
19	work in groups to solve problems and complete tasks				

Reviewing, modifying and evaluating work as it progresses

By the end of Year 6, most pupils should be able to:

20	review what they have done and consider how they might improve their work				
21	evaluate other people's work and get ideas for their own				
22	describe their use of ICT and how they might have completed a task using other methods				
23	compare their use of ICT with other people's				
24	recognise the benefits of using ICT for particular tasks				
25	describe some uses of ICT outside school and the impact it might have on people at work and at home.				

Annex B: The role of ICT in the curriculum

a) ICT capability

This involves technical and cognitive proficiency to access, use, develop, create and communicate information appropriately, using ICT tools. Pupils demonstrate this capability by applying technology purposefully. The aim is to make them discriminating in their use of information and ICT tools and review the contribution that ICT can make to their work as it progresses.

b) ICT – the subject

Pupils need explicit teaching to be able to develop their ICT capability. The focus of this teaching is defined by the National Curriculum programmes of study for ICT. This specifies the knowledge, skills and understanding required in four areas:

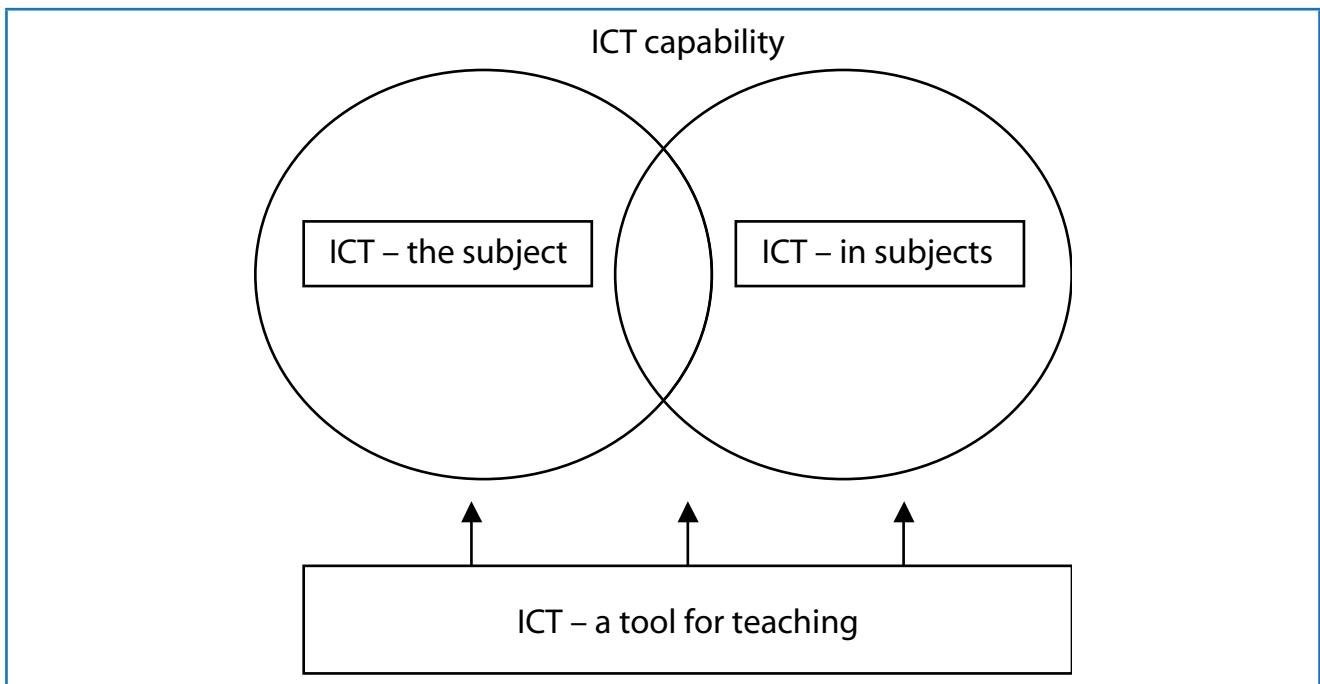
- Finding things out.
- Developing ideas and making things happen.
- Exchanging and sharing information.
- Reviewing, modifying and evaluating work as it progresses.

c) ICT – in subjects

The aim is to ensure that pupils will be able to harness their ICT capabilities and apply them in the different subjects. As the pupils become more confident they will be able to develop higher levels of ICT capability within these other subjects. Consequently there is not a simple unidirectional relationship between 'ICT – the subject' and 'ICT – in subjects', instead there is a close interaction between the two. This interaction is illustrated in the model shown below.

d) ICT as a teaching tool

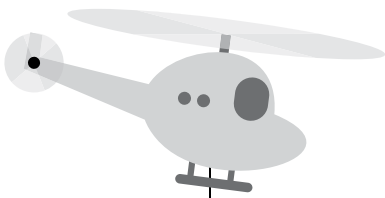
ICT teaching tools provide opportunities to add value to the teaching and learning in subjects. For example, the use of interactive whiteboards, video projection units and video presentations as teaching tools can enhance the pupils' learning.



Annex C: List of participating schools

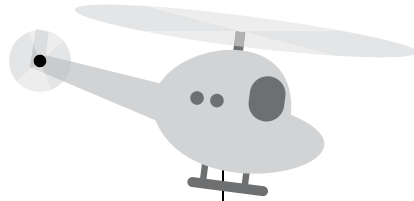
The DCSF would like to acknowledge the time and effort taken by the following schools in participating in this investigation.

Burwell Village College	Cambridgeshire
Carr Hill Primary School	Nottinghamshire
Drayton Park School	Islington
Fawcett County Primary School	Cambridgeshire
Hammond Primary School	Hertfordshire
Knutsford School	Hertfordshire
High Halden Church of England Primary School	Kent
Norbury First and Middle School	Harrow
Oldway Primary School	Torbay
Prettygate Junior School	Essex
Prince Albert Primary School	Birmingham
Robin Hood Primary School	Birmingham
Sherborne Abbey Church of England VC Primary School	Dorset
Southmead Primary School	Wandsworth
Spring Vale Primary School	Wolverhampton
Stag Lane Middle School	Harrow
St George's Primary School	Dorset
St Michael's Church of England Primary School	Wandsworth
St Teresa's Catholic Primary School	Kent
Trinity Church of England Primary School	Wolverhampton
Two Mile Hill Junior School	Bristol



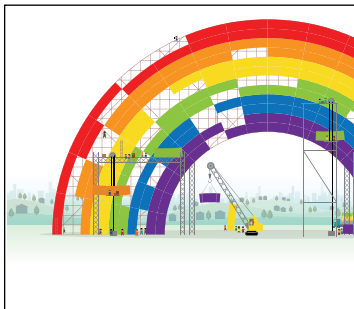
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