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The impact of broadband in schools

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Becta
ICT Research

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Foreword

Broadband connectivity is a central component of Becta's vision for a coherent, dependable and sustainable ICT architecture for education, connecting schools to a wide range of content, services, applications and institutions. In this way, broadband connectivity will support teaching and learning and facilitate easy access to, and exchange of, management and administrative data.

Becta's vision builds on work to date to develop a National Education Network (NEN), linking existing broadband infrastructure to create a national network that provides safe information and service access across education. The NEN is key to the provision of a common digital infrastructure for education – a system that unifies local, regional and national structures, providing the right technical infrastructure – as set out in the DfES' e-Strategy, Harnessing Technology: Transforming Learning and Children's Services, in March 2005 [http://www.dfes.gov.uk/publications/e-strategy/]. Although the NEN is still in development, significant progress has already been made. An important step was the initial funding for Regional Broadband Consortia (RBC) to provide safe, secure and fast managed broadband services to schools through dedicated networks – national policy with regional delivery. Further progress was made when all ten RBC networks were connected together via superJANET4 – the Joint Academic Network (JANET) backbone linking all further and higher education institutions and the research councils. Work is now under way to agree and embed a standards framework to underpin the future development of the NEN, to ensure that the already significant return on the sector's investment in broadband is maximised.

Much has been achieved: as of June 2005, 81 per cent of maintained schools in England had a broadband connection (78 per cent of primary and 99 per cent of secondary schools). These figures are rising as RBC and LEA broadband deployments continue apace.

This report underlines the crucial importance and impact of this investment, and clearly demonstrates the benefits and advantages that broadband connections can bring to schools. Of particular importance is the impact that reliable, high-performance broadband connectivity has in embedding the use of ICT within institutions, raising confidence, competence and capability. Broadband is changing the way pupils learn and construct their work, changing the way teachers organise their lessons and co-operate with one another, and changing the ways schools administer the curriculum. As a catalyst for curriculum change, broadband has widened and deepened participation in learning. As the 2006 target is reached, we believe that broadband will continue to enable a more timely and effective realisation of the benefits which flow from the embedding of ICT in education.

Dr Stephen Lucey
Executive Director - Infrastructure
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The researchers would like to acknowledge the co-operation and support of the staff and pupils of all schools whose work is the subject of this report (see Appendix for a full list of participating schools). We would also like to acknowledge the support and sponsorship of Becta (British Educational Communications and Technology Agency) Broadband team and the Regional Broadband Consortia (RBC[1]) who supplied key technical data.

[1] Regional Broadband Consortia are clusters of LEAs which were formed with the aim of acquiring cost-effective broadband provision for schools. There are ten RBCs in England.

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1. Executive summary

This report is a review of our current state of knowledge of the impact of broadband technologies on the educational process. It was commissioned by Becta (British Educational Communications and Technology Agency) and is the second in the series of reports on the impact of broadband. In the initial pilot project we drew on largely qualitative evidence from a small sample of self-selecting schools (Underwood *et al*., 2004). These schools were deemed to be best-practice schools and the goal of the study was to identify what could be achieved in a broadband-enhanced learning environment. The evidence of broadband connectivity being exploited to the full through activities such as video conferencing and through online interactions in which pupils acted as both receivers and also creators of knowledge, was impressive.

In this second study, the degree to which such activities have spread to more typical schools was explored. This study is based on sources of information such as quantitative data of broadband usage drawn from Regional Broadband Consortia (RBC) and Local Education Authorities as well as data from a more representative sample of schools. Where possible we investigated the impact of broadband on standard performance data as well as surveying staff and interviewing headteachers within the school. We also conducted a limited number of individual school case studies.

In this second, more representative, sample there were fewer instances of activities that are broadband dependent: for example, the use of video conferencing was in its infancy. This is partly explained by the fact that many of the schools were in the first year of working with the increased level of connectivity and were yet to understand its potential. However, a second and equally interesting finding emerged, and this concerned the embedding of the technology into classrooms. Throughout this and the pilot project teaching and support staff and pupils have commented on the increased reliability and capacity of a broadband supported classroom. These two characteristics jointly increase the quality and quantity of educational activities that can and are being undertaken. Such reliability has led to increased confidence in the technology for all users and in turn to widening and deepening of participation as multiple users can be connected at any one time without adversely affecting speed of access. In essence a broadband level connectivity allows technology to become embedded throughout a school, and leads to significant efficiency gains and interesting changes in working practices of both staff and pupils.

This study shows that broadband is changing the way pupils learn and construct their work, changing the ways teachers organise lessons and co-operate with colleagues, and changing the way schools administer their courses.

It also shows how broadband is presenting new challenges for schools in their allocation of resources, the training of teachers and devising of strategies to exploit new technologies.

ICT in general – and broadband technologies in particular – are increasingly seen as a catalyst for curriculum change. While the potential is there, as witnessed by the rich sources of data presented here, assessment may limit that function. Technologies present challenges to the current assessment system. How should we assess the new skills that are developing and what implications has the prominence of such new skills for more traditional educational goals? So far, the assessment system remains stubbornly resistant to change. It was one of the few areas of educational activity that showed only a marginal impact of the technology in this study.

Whilst this study provides evidence that much progress has been made, with positive developments across age phase, subject and types of activity since our pilot evaluation report, there remain barriers to effective broadband usage and also growing concerns about the sustainability of the infrastructure underpinning its successful use. Some barriers were reported in the pilot study and new barriers have also been identified. The issue of filtering internet access was problematic for many schools in the pilot project. This has decreased as schools learn ways to improve the filtering process. However, the cost of broadband and the supporting technologies remains a concern for many schools. Equally, the

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cost of providing the increased technical support needed to sustain technologically rich environments is still a worry for many schools, and particularly primary schools. Schools are required to make decisions about resource allocation that challenge their understanding of the technology and its possibilities. As a result there is some redundancy in the purchase of software titles and the adoption of some short-term approaches in the design of networks.

Please note that in the summary of outcomes presented below, reference is made to the relevant explanatory section in the main report where an expanded statement of the research findings is presented.

Outcomes

1.1 Variations in provision in level of broadband connectivity

The implementation of the Broadband Stakeholder Group's (BSG, 2001) educational broadband connectivity plan to have wired educational institutions by the end of 2006 appears to be proceeding well. There are, however, regional variations in provision. Some RBCs have already achieved a 10 Mbps level of connectivity across the educational spectrum, while others are staging implementation, first connecting at 2 Mbps but with a future goal of 10 Mbps. Again there may or may not be variations between primary and secondary provision depending on the RBC.

It would be over simplistic to say that these variations result from ease of implementation in geographically small but populous areas. While these factors are important, the level of connectivity is also dependent on each RBC's policy rather than on simple geographic factors such as the rural or urban divide (Section 3.1.1).

1.2 Broadband connectivity – meeting the need

The majority, but not all, of the primary schools in this sample are operating within the 'threshold of comfort', that is, the level of connectivity is adequate to their needs. Those primary schools testing the limits of provision are too few to establish any pattern or influencing factors (Section 3.1.2).

However, 40 per cent of secondary schools are regularly operating beyond the 'threshold of comfort'. For secondary schools this is most acute when the school has 2 Mbps connectivity. It is also more acute in urban than rural areas (Section 3.1.2).

Low use of the resource is not prevalent but where it does occur it is a feature of the primary age phase, often new recipients of the technology, or of schools with above recommended levels of connectivity.

1.3 Links between the level of broadband activity and nationally accessible performance data

At GCSE, significant differences were evident in pupils' performance on GCSE/GNVQ tests, with significantly improved performances in the year immediately following the installation of broadband. This finding should be treated with caution due to small sample size (Section 3.1.4).

No significant effects on nationally accessible performance data were found at KS2 (Section 3.1.4).

1.4 Aspects of broadband connectivity and the school environment that contribute to better outcomes for pupils and teachers

The ICT skills base for both staff and pupils continues to improve and competence and confidence in ICT usage is increasingly pervasive throughout the schools (Section 3.2.3).

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Lessons to specifically teach ICT skills are featuring less on school timetables and learning through use is becoming the norm (Section 3.2.3).

The level of management commitment to the technology is a major factor in the acceptance of ICT in the whole school (Section 3.2.5 and 4.1.3).

For secondary schools, higher levels of connectivity (minimum 2 Mbps with caching or circa 10 Mbps) enable a whole year group to conduct internet research simultaneously and with minimal delay.

Schools with the highest levels of connectivity made more use of their broadband connection for administrative purposes (Section 3.2.10).

While both primary and secondary teachers use this technology in equal measure to support teaching and preparation and, to a lesser extent, professional development, secondary teachers were more active users of the technology for administration (Section 3.2.10).

1.5 Features associated with broadband connectivity that hinder effective use

The problem of accessing ICT resources within the institution and at home is declining for staff (Section 3.2.4). For pupils, in-school access is now generally good although resourcing home–school links remains an issue despite positive action by some schools to make resources more universally available (Section 3.2.5). The conundrum here is that although resources in the home are increasing, the quality of those resources is not always sufficient to increased demands, such as using the school's VLE.

The issue of filtering internet access raised in the pilot project has decreased as schools implement ways to improve the filtering process. For example, some schools have installed their own internal filters to supplement that provided with their internet connection.

There is a growing concern about the sustainability of the infrastructure. The cost of broadband, its supporting technologies and technical support is a worry for many schools. This is particularly so for primaries.

1.6 Academic and motivational benefits associated with educational uses of this technology

The nature of teaching and learning

The enabling nature of the technology allows seemingly prosaic use to encourage the development of high-level thinking skills in the hands of a creative teacher (Section 3.2.6). Broadband technology increases the quantity, quality and efficiency of resource access, not only freeing time but providing a richer set of materials for scholarly activities.

The ability to tailor learning packages to individual pupils by provision of various learning tasks within the same classroom is being realised by many teachers (Section 3.2.2).

Multimedia and interactive content is engaging and motivating, particularly for primary pupils. Use of such material in primary and secondary institutions adds variation to lessons and helps to keep pupils focused by seamless transition from ICT to non-ICT activity, and from website to website (Section 3.2.8 and 4.1.3).

For many secondary schools broadband is enhancing learning by being an additional tool to aid research (Section 3.2.5).

A number of case studies and the questionnaire responses record enthusiasm of both staff and pupils for activities that use the technology (Section 3.2.6). Cessation of such activities is viewed as a punishment by both staff and pupils (Section 4.1.2).

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Changes in working practice

There is increasing ICT activity for teaching and learning and for support administration (Section 3.2.5 and 3.2.10).

In secondary schools ICT is starting to branch out from the core subjects, although a small but significant percentage of interviewees felt that the core curriculum subjects still had first access to the ICT facilities (Section 3.2.6 and 3.2.8).

Many teachers express awareness of resources available, and are gaining confidence to explore possibilities that such a rich resource base offers (Section 3.2.2).

Some schools are beginning to share both technical (Section 4.2.1) and pedagogical (Section 3.2.5) provision and practices externally as well as internally.

Pupils are turning increasingly to electronic production, storage and communication of their work (Section 3.2.5).

The formal school day no longer acts as the main constraint on teaching and learning activities. Where good digital home–school links have been established, pupils and teachers are able to operate within a single virtual space irrespective of their geographic location (Section 3.2.5).

1.7 Aspects of increased connectivity that contribute to better outcomes for students and teachers

As recorded in the pilot project to this more extensive study, the main advantage of broadband over previous internet connections is that it provides faster and more stable access to learning materials, and for many pupils at the same time (Section 3.2.2).

The reliability of broadband has been associated with new emerging ways of communicating including everyday administration between staff but also between staff and pupils; sharing of expertise and knowledge within and between schools; and communicating with the home and the community which is currently limited but a growing feature in many of the schools surveyed here (Section 3.2.5).

It also provides access to countless lesson ideas and materials to aid teachers in their planning, which reduces time spent on initial preparation whilst increasing time available for developing and sharing ideas with colleagues (Section 3.2.2).

The educational ‘industry’ has been very responsive to the opportunities presented by the technology, as is shown by the growth in use of subscription sites for which schools utilise their e-learning credits to gain access (Section 3.2.2).

Equally, there are numerous free access websites with educational content that schools consider valuable and often use in lessons (Section 3.2.2).

1.8 Non-technological barriers to change

While assessment in some schools is being mediated through the new technologies (Section 3.2.3) the nature of assessment, whether online or using more traditional technologies, remains unsurprisingly resistant to change. National assessment criteria are the driving force here and only through change at this level will the potential of digital technologies as assessment tools be realised (Section 3.2.6 and 4.1.1).

A small number of primary schools are still concerned that secondary schools will not have the same level of ICT activity incorporated into the curriculum that the young pupils are becoming accustomed to. This has been a long-term concern but the data collected here shows that this is a declining issue (Section 4.1.2).

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Cost is a significant non-technological barrier highlighted by many schools as they plan for future ICT provision in general and broadband in particular (Sections 4.2.1 and 4.3.1).

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2. Outline of the study

2.1 Background

The perceived significance of broadband technologies for the economic health of the developing world (see Underwood *et al*., 2004 for a fuller discussion) led the British government to create the UK Broadband Stakeholder Group (BSG). This partnership of all those involved in the internet industry was charged with helping the government to meet its stated target of having the most extensive and competitive broadband market in the G7 by 2005. Broadband technologies were prompted as an exciting and effective way to improve the quality of education and also a way of developing an economically viable IT literate society (BSG, 2003). The BSG (2003) has asserted that 'education has a crucial role to play in the realization of ‘Broadband Britain’ as the widespread and systematic use of broadband in education will be a significant driver for residential broadband demand and take-up.' (BSG, 2003, p.3).

The BSG (2001) instigated policy objectives to deliver broadband connectivity to all points of learning, with every school having a specified level of connectivity by 2006. This has been a driving force behind educational technology development in the UK. This policy complements that laid out in the eEurope 2005 Action Plan, which states that by the end of the year 2005 member states should aim to provide broadband connectivity to all schools, universities and institutions that play a part in e-learning, such as museums and libraries, to facilitate both educational and research objectives.

This report from the Broadband Evaluation Team is a follow-up report to the 'Connecting with Broadband' Literature Review and Case Studies Reports (Underwood *et al*., 2003 and 2004), which focused largely on examples of best practice within schools. This study addresses a larger sample of schools, covering a wider range of knowledge, expertise and practice when using broadband both for direct teaching and learning purposes and also for activities supporting the core educational activities.

The purpose of this evaluation was to examine the impact and added value of broadband connectivity upon teaching, learning and school improvement. The identification and assessment of the changes stimulated by broadband connectivity – the research presented here – provides evidence to adjudge the extent to which broadband is a worthwhile investment.

2.2 What is broadband connectivity?

'Broadband' is a generic term for those digital communication technologies required to provide high-speed networking services. Such services have the capacity to transmit significant amounts of data at a high rate, which facilitates the delivery of a range of digital services some or all of which can occur simultaneously.

There is no universally accepted definition of broadband and national definitions vary, but it is generally agreed that it applies to services considerably faster than Integrated Services Digital Network (ISDN). The DfES definition of such connectivity has a recommended baseline threshold speed of 2 Mbps. While we recognise that this is a low threshold, the disparity in speeds across various institutions (standard 2 Mbps in primary and 8 Mbps in secondary schools) has provided a fertile area for comparative research.

Broadband connectivity is usually a symmetrical service allowing fast in- and outbound data capacity with links between computers provided through a range of technologies including cable or through wireless technology, both of which are evolving rapidly. Connectivity may be enhanced through caching to optimise available bandwidth (Underwood *et al.,* 2004). Many schools make use of commercial caching software, which frees up their available bandwidth. Using cached resources reduces the competition for bandwidth and delays in accessing internet-based materials. Caching does not provide a symmetrical service, however, and while activities serviced by material downloaded to a school’s intranet are significantly enhanced, access to and from the outside world is not directly facilitated other than that the pipe is freed for other tasks. Where this is a high-connectivity

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pipe, again benefits accrue but caching does not improve the performance for schools on the margins of broadband connectivity (less than 2 Mbps).

There are those that argue that reliance on caching places students in the role of information receivers rather then creators in that they are active users of the resources held on the intranet but will have difficulty communicating their own work to a wider audience of peers beyond the school (S. Heppell, 2003 personal communication). The benefits of caching therefore have to be evaluated against the usage schools will make of their internet. If they will be largely focussing on bringing information into the school and classroom, a cache would be beneficial. If however they are seeking to provide information and resources beyond the school, a cache adds no benefits to the delivery. Such activities would include video conferencing or real-time data collection as in the Bird Box Project (South East Grid for Learning, 2005).

The definitions of broadband can be based on technical criteria such as the capacity of the communication link, or on functional characteristics. For example, currently schools in the Telford area of England work with a 115 Mbps communication link, but the school internet access (that is, the functional characteristic) is at 6 Mbps. Sharing a broadband link is not uncommon in our schools. This often means schools potentially have very good access levels but, as in the case of ADSL, the reality of access varies constantly and depends greatly on usage of all other parties sharing the connection (Section 4.2.2).

Despite all the hyperbole surrounding broadband, it is in effect a very mundane if highly functional technology providing fast internet access and the capacity to stream rich media content, such as video and audio, on demand. For this proposal we intended to operate within the DfES definition of such connectivity, that is a speed of 2 Mbps and above as specified in the tender document of the Broadband pilot project (page 2) which specifies 2 Mbps in primary schools and 8 Mbps in secondary schools as the recommended standard of provision to be achieved, while also recognising the importance of internal networking and caching to optimise available bandwidth (Underwood *et al*., 2004).

However, even if an RBC has established a new fast network the level of connectivity may not meet the DfES stated criterion of 2 Mbps for primary and 8 Mbps for secondary schools. The example of Telford, already cited, is a case in point with the primary schools being well endowed by the DfES criterion but the secondary schools being nominally underpowered at 6 Mbps. The technical officer for this network argues that the current level of functional connectivity is delivering, and it is refreshing to see recognition of the case for primary school children being provided with as much power as their senior peers. The LEA serving the city of Birmingham had also elected to install 512 kbps and 2 Mbps ADSL levels of connectivity supplemented with a cache in the first instance, again arguing that this was sufficient power for current educational activities. Birmingham is just beginning to embark on a roll-out programme of 10 Mbps to all of its schools.

2.3 Expectation of the impact of broadband connectivity

There is a widely held perception, supported through the literature and earlier studies (see Crabtree and Roberts, 2003; Underwood *et al*., 2003; 2004) that broadband connectivity brings increased stability and reliability of operation. This in turn, it is argued, will lead to positive effects on staff confidence to use technology in their classrooms, resulting in wider participation and in some cases more innovative teaching across an increasing range of subject areas. The expectations of the impact on education are high but are they justified in practice?

There is little doubt that new technologies have significant impact on how we operate in the world and the enhanced connectivity associated with broadband technology should be no exception to that rule. If an assumption is that the technology will have an impact, the question arises as to the nature of that impact. The overarching question becomes whether broadband makes it easier to do what we have always done, or whether it changes the way we do it. In other words, is broadband changing the very

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nature of educational practices? Many of the specific research questions outlined in Section 2.4 are founded on this overarching question.

All use of new tools starts by recapitulating current practice, but as the potential of the new tool becomes apparent, new uses emerge. This in turn leads to new patterns of behaviour as novel ways of interacting with the world arise. A simple everyday example of this in terms of broadband connectivity is the use of online shopping for the weekly groceries which, for a small but growing cohort of the population, has replaced the weekly visit to supermarket. From the schools in this study can we see equivalent changes: for example, young people and their teachers re-organising their work patterns as they manage their activities electronically rather than in physical space. It is these key changes in behaviour and the impact of those behavioural changes on learning outcomes which are the focus of this report.

However, Crabtree and Roberts (2003) in their monograph on the uptake of broadband technology across the UK commented that despite the ready availability of this technology, the impact of broadband on society is patchy – that is, unusually the demand for a technological innovation is not outstripping the available resource. The DfES has identified this lack of take-up as a significant issue and states that a persuasive argument to adopt this technology is not yet publicly available (cited in BSG, 2003. p.11).

The Broadband pilot study confirmed that even in our carefully chosen best-practice schools, the resource was in some but not all instances in excess of need. Alongside the issue of educational change, this study explores the demand–resource equation.

2.4 The research questions

Resource distribution

Are there identifiable variations in provision in level of broadband connectivity?

Is the current level of broadband connectivity adequate to needs?

The relationship between technological innovation and educational outcomes

What link, if any, exists between the level of broadband activity and a range of nationally accessible performance data?

What aspects of increased connectivity contribute to better outcomes for students and teachers?

Are there features associated with broadband connectivity that hinder effective use of this level of connectivity?

Are there identifiable academic and motivational benefits associated with educational uses of this technology?

2.5 The research design

The research design adopted a three-strand approach to provide robust quantitative baseline data (Strands 1 and 2) supported by indepth qualitative case studies (Strand 3).

Strand 1: The Baseline Activity Survey: *Exploration of the link between provision, use and national metrics of performance*

Purpose: To investigate the link between the level of broadband connectivity and usage, and nationally accessible performance data.

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Sample: All primary and secondary schools in five Local Education Authorities (LEAs) drawn from four Regional Broadband Consortia (RBCs) with representation from metropolitan, urban and rural authorities (Table 2.1).

Table 2.1: Distribution of sample schools by RBC, LEA and age phase

RBC	LEA	Primary	Secondary
RBC 1	LEA 1: metropolitan	42	11
RBC 2	LEA 2: metropolitan	364	103
RBC 3	LEA 3: urban	27	15
	LEA 4: rural	83	54
RBC 4	LEA 5: urban	76	18
TOTAL		**592**	**201**

Method: Quantitative analyses of national and regionally held data.

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Strand 2: The baseline usage survey: *Exploration of staff and pupil attitudes towards and usage of, ICT*

Purpose: To conduct inter-school (Baseline 2) and intra-school (Baseline 3) comparisons of the impact of broadband connectivity on a range of school performance indicators.

Sample: A stratified sample of 87 schools. The schools varied by age phase, type of LEA (rural v. urban authorities), level of broadband connectivity (including some pre-broadband schools), and length of implementation of broadband within the institution (Table 2.2).

Table 2.2: Distribution of sample schools by level of connectivity, age phase and location

	Primary		Secondary	
	Rural	**Urban**	**Rural**	**Urban**
Low Connectivity with some features of broadband (<2 Mbps)	1	7	1	4
Mid-Connectivity (2 to 8 Mbps)	16	12	5	12
High Connectivity (> 8 Mbps)	0	10	3	6
	17	**29**	**9**	**22**

NB: 10 schools were aware that they had been upgraded to broadband but were unable to specify the level of connectivity they were operating at.

School connectivity ranged from 128 kbps to 10 Mbps, although 2 Mbps was the most common level of connectivity across the primary and secondary phases. While this was the anticipated level of connectivity for primary, it was below the 8 Mbps target connectivity for secondary schools.

Level of connectivity was more often than not related to the current policy within the relevant LEA or RBC. For instance, Dudley is currently installing 10 Mbps in all its schools whilst Birmingham has placed 512 kbps and 2 Mbps ADSL connections in many schools, supplemented by a cache (the provision in Birmingham is fluid, as the LEA is in the initial stages of upgrading provision). This is one demonstration of the differences between LEAs and RBCs in service provision and support. While it is possible to speculate on why these variations occur given the overall target for levels of connectivity, a systematic study of this issue was not in the remit of the current study. It is, however, an important issue for further research.

The regional variations quoted here once again raise the question of what can be counted as a broadband connection.

Method: In addition to national data sets, we conducted semi-structured interviews with one key member of staff for each school (either the head or head of ICT) drawing on instruments developed under the ICT Test Bed and Broadband projects (Somekh *et al.*, 2004; Underwood *et al*., 2004). Pupil and staff questionnaires were also completed by each school.

Strand 3: The field evaluation

Purpose: To build a rich picture of the interaction of variables associated with broadband connectivity to supplement our understanding of the quantitative analyses of Strands 1 and 2.

Sample: 27 schools selected from Strand 2 with varying levels of connectivity. Some 16 of these schools took part in the pilot Broadband evaluation project (Underwood *et al*., 2004) and their inclusion in this sample provided evidence of the impact of broadband as it becomes embedded in the school. A further 11 new schools which had not previously been investigated completed the sample.

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Although every effort was made to balance the sample across age phase, type of LEA and level of connectivity, there was a measure of opportunistic sampling in this cohort.

Method: Indepth case studies through structured interviews, classroom observation and portfolios of work. Evidence was collected of the individual ways that each school deals with the challenge of broadband ICT.

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3. Detailed study findings

3.1 Levels of usage

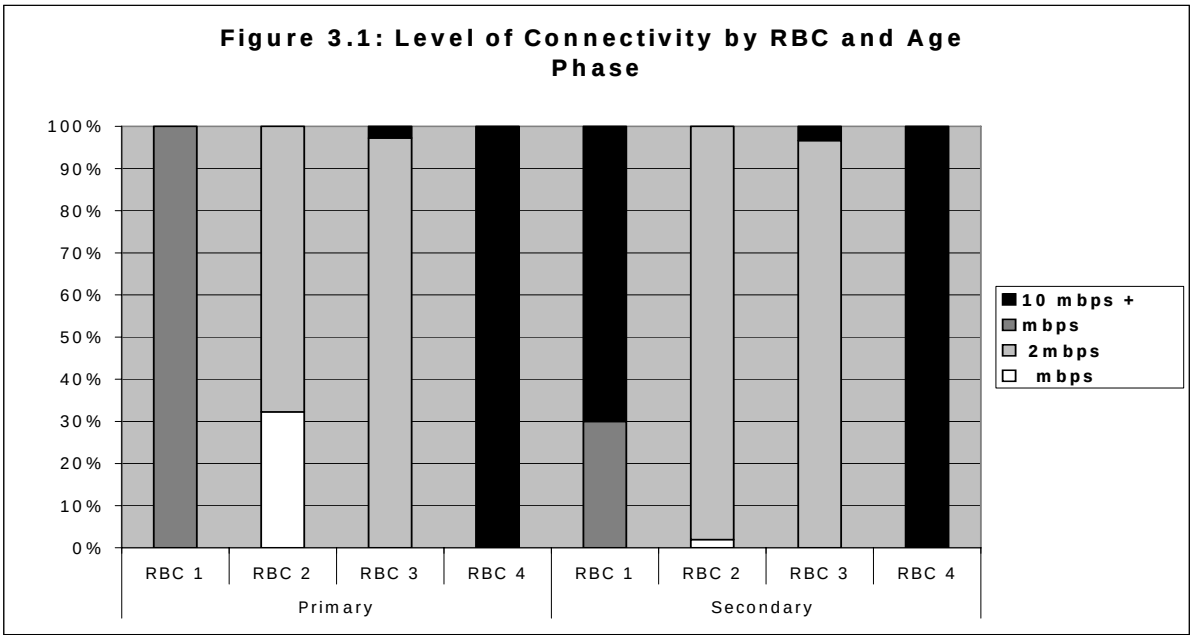
The data presented under Strand 1 of this report is interesting because the LEAs and schools forming the sample are not representative of best practice within any educational region or authority. They are more a cross-section of broadband provision and usage within England. Findings from these institutions should counter the argument that positive effects of technology are the product of 'hothouse' environments with stronger than usual support for training and pedagogic practice (Lesgold, 2000). It should also be pointed out that RBC 3 was very much at the roll-out stage as this survey was conducted, so many of these schools are in the first stages of working with the new level of connectivity.

RBCs/LEAs provided data for all their schools' level of connectivity, and their approximate average usage of the connectivity available. RBC 3 also provided data on how often each school was stretching the limits of its connectivity.

3.1.1 Current provision

The level of provision by RBC and age phase is shown in Figure 3.1.

Figure 3.1: Level of Connectivity by RBC and Age Phase



NB: While the pattern of provision supported by RBC 3 is similar for the contributing LEAs, there are major differences in patterns of connectivity for the LEAs guided by RBC 2.

- RBCs 1 and 4 have recommended or above recommended connectivity levels at primary and secondary levels.
- RBCs 2 and 3, with a few exceptions, are operating at recommended primary connectivity levels across the secondary sector but are yet to reach the 2 Mbps target for all primaries.
- In RBCs 2 (LEA 2) and 4, caching is extensively used to ameliorate bandwidth problems. These RBCs report only limited overloading problems. A small number of schools in RBC 1 also use caching in this way. It should be noted that while caching allows rapid access it does not enhance fast broadcasting of children's work beyond their school. For many schools this does not inhibit current practice, but for those schools that see interaction with external audiences and experts, this is a major issue.
- RBC 3 does not make significant use of caching.

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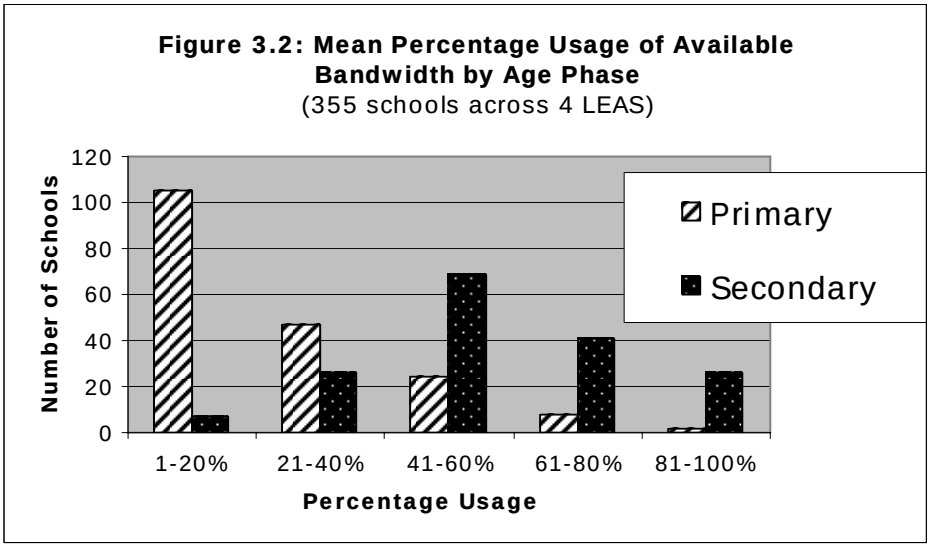
- RBCs providing the highest level of connectivity (1 and 4) are, as would be anticipated, both of the urban or metropolitan LEAs.

The three LEAs with lower levels of connectivity are less easily classified. They include one metropolitan, one urban and one rural LEA supported by two RBCs.

3.1.2 Broadband is an expensive resource – is it fully utilised?

The 'threshold of comfort' operates on the industry standard heuristic, as reported by RBC managers in interviews for this study and in Becta's National Education Network Design Document (2004), that an average connectivity usage of above 60 per cent will result in poor system performance such as slow response times and lockouts. These are the incipient problems of a system under strain.

Figure 3.2: Mean Percentage Usage of Available Bandwidth by Age Phase
(355 schools across 4 LEAS)



The threshold of comfort – 60 per cent usage

For the four LEAs (RBCs 1 to 3) that provided school level data (Figure 3.2):

- Ten per cent of primary schools are operating above the 60 per cent threshold of comfort.
- Over a third (40 per cent per cent) of secondary schools are operating above the threshold of comfort.
- A further 13 per cent of primary and 41 per cent of secondary schools are operating just below this threshold.

Data from the fifth LEA (RBC 4) surveyed, recorded all 94 primary and secondary schools as operating well within the threshold of comfort. For this compact urban authority, all schools had connectivity levels of 10 Mbps with additional caching facilities.

Data on connectivity overload from RBC 3, which provides a standard 2 Mbps connectivity for both age phases (Figure 3.3), shows a significant number of secondary schools in both the rural (52 per cent per cent) and the urban (79 per cent per cent) authority were experiencing connectivity problems.

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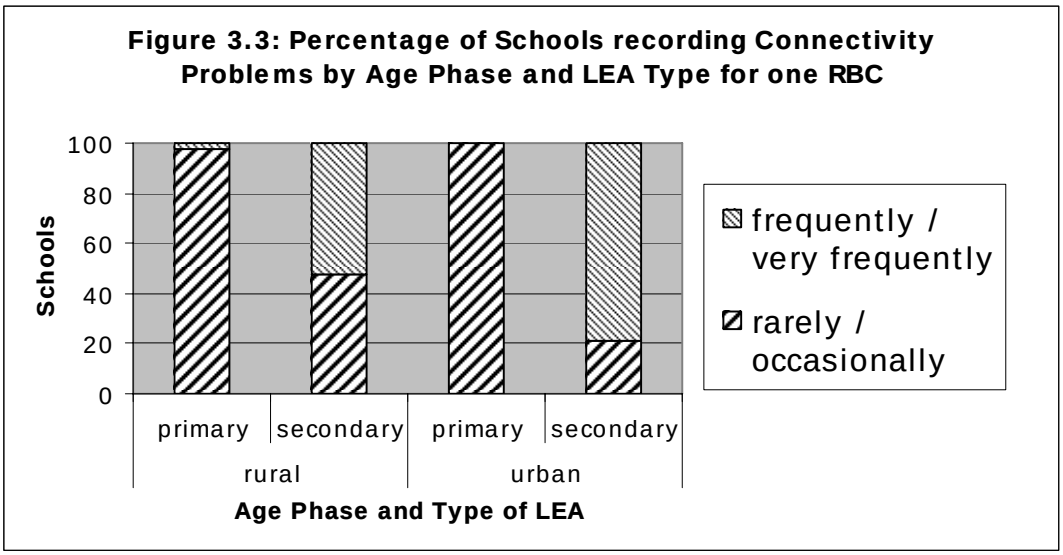
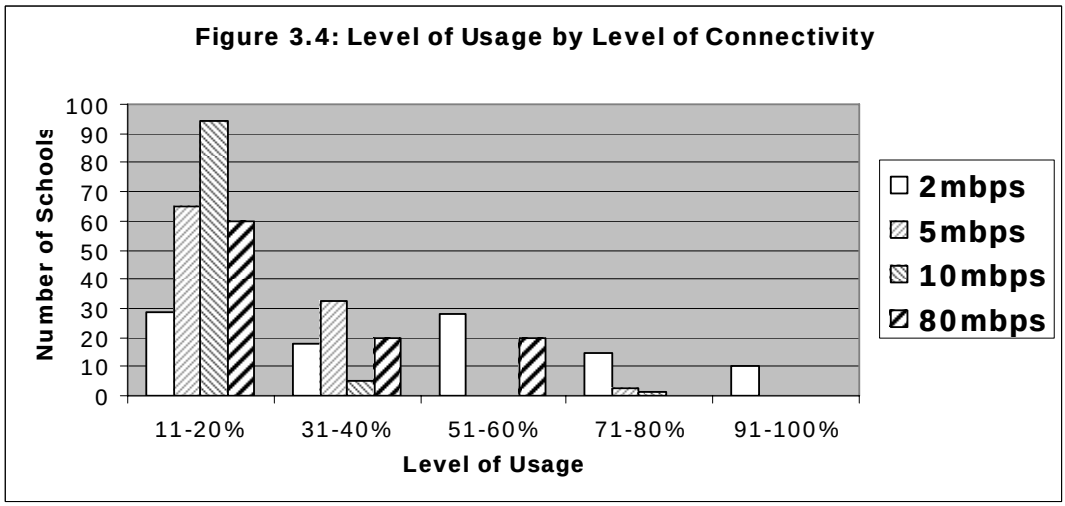


Examining level of usage by level of connectivity shows the following:

- Two thirds of the schools in this sample are operating within the comfort zone (Figure 3.4).
- Of the schools which were testing the resource beyond tolerable limits, it is those schools on 2 Mbps connectivity which are most likely to be operating on the edge or outside the comfort zone (Figure 3.4).
- These schools are mainly but not exclusively secondary schools (Figure 3.3).



Assuming that 60 per cent per cent usage (the threshold of comfort) is using the resource to its full capacity, then it can be argued that schools operating within the range of 30 per cent to 60 per cent per cent usage are comfortably but fully exploiting the resource available to them. While Table 3.4 shows that in this non-selected sample of schools two-thirds of schools are operating within the threshold of comfort, those who might be deemed as low users of the resource (20 per cent per cent usage or less) are almost exclusively primary schools plus schools with very significant levels of connectivity. For example, most, but certainly not all, schools operating above 10 Mbps have capacity to spare.

The low use of the bandwidth may be due to a low use of the resource or to an intelligent use of caching. In addition, a number of these schools are new recipients of the technology and staff have had little or no time to develop strategies to embed the opportunities offered by higher connectivity

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into their professional practice. However, within these figures there must also be some resistance to use the technology in general.

The causes of any differential response to the technology needs further exploration.

3.1.3 Effects of broadband on performance

Level of use and performance

Where possible the performance of the Strand 2 schools (n = 87) was analysed and compared to their use of broadband.

The data used was Key Stage 2 results and GCSE results (Key Stage 3 data was not available) in the two years pre and post broadband installation. It should be noted that this target year varied for individual schools and so no comparison with national annual figures could be made. No significant relationships were found.

Performance pre and post the installation of broadband

Performance data in the form of average point scores for Key Stage 2 (KS2) and GCSE national tests was gathered for a subset of the Strand 2 sample of schools.

The relevant nationally held performance data was available for only twelve primary and nine secondary schools involved in the project. Each of these schools was benchmarked against itself using data from the year prior to broadband installation and the year post broadband installation.

For the KS2 tests, improvement measures were calculated by the DfES as the aggregate of the three percentages of pupils achieving Level 4 or above in the English, Mathematics and Science tests. For the GCSE data, the improvement measure taken was the percentage of 15-year-old pupils who had achieved five or more A*-C grades at GCSE or GNVQ level for each institution.

Although tests of difference (repeated measures t-test) revealed no significant changes at KS2, at GCSE, significant differences were evident in pupils' performance on GCSE/GNVQ tests, with significantly improved performances in the year immediately following the installation of broadband.

The findings from the GCSE data are encouraging and whilst the improvement in performance at this level cannot wholly be attributed to the introduction of broadband connectivity, it would not be overly presumptuous to assume that broadband is certainly a contributory factor to schools' general improvement, especially given the findings documented throughout the rest of this report.

The gains shown within the secondary schools also reflect the greater overall usage of this enabling technology by these schools compared to their primary counterparts (see 3.1.2 above).

3.1.4 Summary

The Strand 1 data presents contrasting levels of provision and activity across the 4 RBCs sampled. The level of connectivity is very variable and is dependent on each RBC's policy rather than on simple geographic factors such as the rural or urban divide. Although primary schools tend to have lower connectivity (2 Mbps or less) this does not apply to the whole sample. Similarly, there is a trend for secondary schools to be connected at 10 Mbps but again this is not a universal finding.

The level of broadband usage is more revealing in educational terms than the connection level per se. Here we see the majority, but not all, of the primary schools in this sample operating within the threshold of comfort (the 60 per cent per cent or less usage level), that is, the level of connectivity is adequate to their needs. However, over half of secondary schools are regularly operating beyond the threshold of comfort and this is most acute when the school has 2 Mbps connectivity. It is also more acute in urban than rural areas.

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The findings from this sample vary subtly from the data collected in Strand 2, and particularly in Strand 3, in which the schools have opted to work with the project team and are representative of more active users of the technology. This, and very recent acquisition of broadband by schools in RBC 3, are key factors in explaining why, although some primary schools are heavy users of the capacity available to them, many primary schools in this sample are not fully utilising their connectivity capacity.

Coupled with the data on the impact of broadband on standard assessments of performance, a picture of high demand and increasing educational gains emerges for secondary schools. That such a pattern cannot be discerned for primary schools does not necessarily mean that broadband is having no impact on younger pupils. It may be the case that at this younger age the children are learning technological skills that will stand them in good stead later in their educational careers and so domain-specific or general cognitive skills are not the focus of their learning (see 3.2.6 for further discussion of this entry skills debate). The learning skills being developed here are not tested in the key stage tests. We return to the issue of appropriate assessment in section 4.1.1. In this sample, primary schools that tested the limits of provision were too few to establish the impact of the technology on the wider performance.

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3.2 Outcomes of strand 2 and 3 quantitative and qualitative studies

The findings are presented under the following headings:

3.2.1 Data sources

The findings presented here combine data from the staff and pupil questionnaires and interviews with staff (87 schools), teacher logs and classroom observations (27 schools) (Sections 2.5.2 and 2.5.3). Table 3.2.1 presents the distribution of returns by respondent and role.

Table 3.2.1 The Sample by respondent and function

Sample	Group of respondents	Number of complete questionnaires
Pupils	Key Stage 2	1000
	Key Stage 3	240
	Key Stage 4	165
Staff	Para-professional staff (teaching assistants, admin staff, technicians)	86
	Teaching staff	274
	TOTAL	**1765**

3.2.2 Range of uses

Broadband connectivity was seen to support a range of educational practices, which fall into two broad categories: improving traditional tasks, and extending practice.

Broadband to improve traditional school tasks

The main advantage of broadband over previous internet connectivity is that it provides not only faster but more stable access to learning materials, and for many pupils at the same time. It also provides access to countless lesson ideas and materials to aid teachers in their planning – the intention being that teachers will spend less time in initial preparation, and instead use the time to develop and share ideas. For instance, there are many subscription sites for which schools utilise their e-learning credits to gain access. Equally, there are numerous free access websites with educational content that schools consider valuable and often use in lessons.

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Broadband to extend practice

Not only does broadband facilitate access to pre-prepared resources, it offers the opportunity for teachers to create their own online resources and so tailor lessons directly to their lesson objectives, in accordance with the needs and skills of their pupils. Lessons can be more animated, more detailed or illustrated, or more exploratory, depending on pupil requirements. Whilst some of the vignettes displayed here refer to activities which can be performed on narrowband connections, the key factor is that staff report that the connection is more reliable with broadband, which increases teacher confidence to use the technology 'live' in class. The availability of broadband also reduces the potential for conflict over access with other classes or users accessing resources simultaneously.

Vignette 1: Extending practice to improve traditional tasks

> One primary school use a program that records the teacher's handwriting and plays the teacher's actions back on a looping video on the interactive whiteboard. The pupils can refer to the teacher's actions while doing their own handwriting, and check which direction to write a letter or how to join two letters, leaving the teacher free to move round the room to help individual pupils. Each week staff select what they call a star writer who does the handwriting instead of the teacher, and their photograph is displayed on the screen next to the pupil's handwriting.
>
> **Urban primary school, 2 Mbps**

Whilst this may seem a reinvention of an old task, it provides a new perspective for pupils, frees the teacher to help those who need further help, and prepares pupils for greater, more innovative uses of the technologies. The vignette is an example of how broadband is enabling pupils to take greater ownership of the technology in their classroom, as well as allowing them to be more involved in the direction of their own learning. Teachers and pupils in many schools are beginning to explore the potential of creating their own resources and allowing pupils to interact directly with the tools.

Developing new practice

As in the pilot project, new practices are emerging though the use of technology by innovative pupils and teachers.

One interpretation of the concept of schools without walls is emerging with the rise in the virtual fieldtrip.

Vignette 2: The world at your fingertips

> Use of webcams is beginning to feature more in classrooms. One instance was seen in a primary classroom to view real-time images of Greece for comparison in a project on Ancient Greece. Another instance, again in a primary classroom, used the webcam to view the weather around the world.
>
> **Two rural primary schools, 2 Mbps**

The hegemony of the word is giving way to more multimedia modes of communication and children are authoring work of increasing professional levels. Whilst producing more professional-looking work may not always increase the quality of work the pupils produce, evidence from the case studies suggests that use of the ICT and Internet facilities can and does enhance motivation and enthusiasm for learning in the classroom.

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Vignette 3: Virtual and first hand experiences

> A teacher works with a sixth form class to develop marketing portfolios using multiple modes of representation and a range of multimedia tools.
>
> **Rural technology college, 10 Mbps**

3.2.3 ICT readiness

The concept of 'ICT readiness' used here draws heavily on the widely used concept of Reading Readiness (Downing and Thackray, 1975). ICT readiness is defined as the accretion of the skills, knowledge and attitudes to allow meaningful engagement with the technology.

Skills, knowledge and attitudes

Sixty per cent of primary and 62 per cent per cent of secondary teachers acknowledge that computer skills are important to their professional role. The findings for paraprofessionals showed more variation across the age phase, with 52 per cent per cent of primary and 80 per cent per cent of secondary paraprofessionals strongly agreeing that computer skills are important for their role.

A majority of teachers agreed that their confidence in using ICT for preparation (54 per cent per cent primary; 65 per cent per cent of secondary teachers) and teaching (58 per cent per cent of primary and 60 per cent per cent of secondary) has increased over the last twelve months and many link this to the quality of technology now in their school. Paraprofessionals were equally positive, with 63 per cent per cent of primary and 54 per cent per cent of secondary staff indicating increasing ICT confidence. It is interesting to note half of secondary pupils (56 per cent per cent) felt they were better at using computers than their teachers!

There are a number of indicators of growing pupils' skills and confidence in ICT usage. Eighty-three percent of primary pupils felt that they could use a computer by themselves for most things, with 65 per cent per cent also declaring computers as easy to use. Forty-nine per cent of secondary pupils stated that they have the skills to help others to use the internet and to encourage them to experiment with new software and equipment.

Vignette 4: Fluent in ICT

> Online assessment is seen as fundamental to one primary school's approach to teaching and learning. All pupils have an Individual Education Plan, and off-site access to the school network means pupils continue their work at home. Whilst other schools have this facility, this school has no timetabled lessons as such, and home access to learning materials is pivotal to the success of individual learning environments. Despite the high level of ICT knowledge required for this method of teaching and learning, there are no specific ICT lessons. ICT is simply used as a tool across the curriculum.
>
> **Rural primary school, 2 Mbps**

The school in vignette 4 has provided off-site access to the school network for pupils and teachers via the 'home-made' e-portal. Users log in and can access the library, intranet, assignments and email on the school server. Pupils submit work via Class Server through to the e-portal for their teachers to collect. This facilitates a greater level of independent learning in pupils, whereby they select their own appropriate learning styles and schedules in line with their Individual Education Plan.

From the questionnaire data, secondary teachers self-reported greater levels of knowledge about ICT than the primary teachers on nine of the fourteen applications questioned. Those applications where primary teachers emerged the more knowledgeable included word processing, CD-Roms, searching

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the internet and using the interactive whiteboard (the latter is supported by the case study observation findings). Self-reports from both sets of teachers indicated similar levels of knowledge concerning use of email. This pattern was evident also in the responses from the paraprofessionals. Secondary staff recorded greater levels of knowledge on eleven of the fourteen applications compared to primary staff (a further two applications were responded to equally by both sector samples). Such perceptions of knowledge are a confidence facilitator, but do not guarantee levels of actual performance.

Vignette 5: Skills and confidence

> From my observations the girls make extensive use of the facilities. Keyboard and search skills were impressively high. By Year 9 around 50 per cent of the girls were approaching touch-typing levels.
>
> **Rural high school, 10 Mbps**

The ICT skills base continues to improve, and competence and confidence in ICT usage is increasingly pervasive throughout the schools.

3.2.4 Resourcing ICT skills development

Schools are actively encouraging staff ICT development by providing laptops or PCs for home use (76 per cent per cent primary; 92 per cent per cent secondary teachers) and teachers are accessing and moving files between the school and home computer (46 per cent per cent primary; 66 per cent per cent secondary teachers).

The data shows only marginal difference in the proportion of primary (46 per cent per cent) and secondary (51 per cent per cent) paraprofessionals who had received a laptop or PC from their school. Whilst it is perhaps not surprising that teachers are more likely to be offered this facility, it is promising to see that the resources are now being made available for the paraprofessionals as well.

Increased and increasing home use is also reflected in the rising numbers and levels of staff with home Internet access. Forty per cent of primary and 38 per cent per cent of secondary teachers reported having a dial-up home connection (41 per cent per cent primary; 28 per cent per cent of secondary paraprofessionals). Furthermore, the move to increased connectivity in schools is mirrored in the home, with 43 per cent per cent of primary and 50 per cent per cent of secondary teachers having a broadband home connection (44 per cent per cent primary, 34 per cent per cent of secondary paraprofessionals). It is worth mentioning that ‘home broadband’ connections usually refer to connections significantly slower than 2 Mbps. The following vignette shows, however, how some staff are able to take advantage of this higher level of home connectivity.

Vignette 6: Streamlining administration and home access

> The e-portal at one secondary school incorporates online registration, and as registration is now required for every class session this helps to reduce a large administrative burden. The e-portal also hosts daily information for staff. Pupil reports are all written by staff through the tracker system and so can be done at school or at home.
>
> **Urban secondary school, 2 Mbps**

Not surprisingly, very few pupils stated that they had a laptop or PC provided by their school (5 per cent per cent of secondary pupils). However, seventy-nine per cent of primary pupils had home access to the internet. Twenty-seven per cent of secondary pupils stated they had a dial-up connection whilst 61 per cent had broadband home internet access, leaving just 12 per cent of secondary pupils without any home internet access.

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The level of access claimed here is high when viewed against national figures. According to Oftel, 12.5 million homes had an internet connection in October 2003 with the bulk of these having dial-up access [http://www.computing.co.uk/news/1146685], while PRNewswire point out that in some parts of Britain over 30 per cent of households already have broadband. In other reviews the figure is still below 10 per cent. Most people live in areas with between 19 per cent and 28 per cent of broadband households. (LONDON, April 22 /PRNewswire/ at http://www.mysan.de/article85511.html).

Assisted by this rising statistic of home internet access, some secondary schools in this sample are encouraging pupils to submit their work by email or via the VLE.

It is evident from the case studies that schools are beginning to introduce schemes to provide pupils with hardware for use at home, either with parental help or targeting certain groups of pupils such as those with special educational needs. There are safety implications which schools have to consider when introducing such schemes, and schools are trialling various strategies to approach these issues.

3.2.5 Impact on working practices

Much of the perceived benefit of broadband connectivity in schools lies in the reliability that the equipment will work and the speed at which materials can be accessed without too much contention with other users. This benefit has facilitated staff confidence to incorporate the technologies in their daily practices. This increased confidence recorded by staff in the questionnaires and interviews is likely to be linked to high frequency of ICT use both in school and at home. Eighty-five percent of primary and 94 per cent of secondary teachers reported daily use of ICT at school. A smaller but still substantial proportion of primary (62 per cent) and secondary (63 per cent) teachers reported daily home use of ICT. Paraprofessionals are also actively engaged with the technology at school on a daily basis (76 per cent primary; 94 per cent secondary) but have a lower home usage (41 per cent primary; 54 per cent secondary) than teaching staff.

The trend of frequent use of ICT found in the staff samples was echoed in the pupil sample, with 80 per cent of secondary pupils claiming they use ICT at school either at least once a week or daily, and 86 per cent claiming the same frequency of use at home (64 per cent in the daily home use category). For primary pupils, 60 per cent stated that they often use a computer in school, with 56 per cent often using a computer at home.

Ninety-one per cent of secondary pupils thought it important to develop computer skills, with 84 per cent of secondary and 56 per cent of primary pupils of the opinion that that they produce better work when using a computer compared to using more traditional tools.

The majority of staff were convinced that they are more productive when using computers (84 per cent of primary and 81 per cent of secondary teachers; 74 per cent of primary and 97 per cent of secondary paraprofessionals) and to a slightly lesser extent that using computers has reduced their workload (65 per cent of primary and 57 per cent of secondary teachers; 50 per cent of primary and 60 per cent of secondary paraprofessionals). Vignette 6 (above) is a positive example of how broadband is helping to streamline administration and in doing so help to reduce teachers' workload.

The high proportion of pupils with home internet access has facilitated a substantial proportion of secondary pupils being able to access the school website from home (73 per cent) and just under half of the secondary pupils can access the school network to download material to their home computer. A reasonable proportion of primary pupils could also access the school website from home (53 per cent) but only 15 per cent indicated that they had downloaded, or could download, their school files at home. Establishment of such infrastructure should allow home–school links and home learning to really grow.

A number of schools are introducing schemes to boost figures of home access to ICT equipment. Some schools are making second-hand computers available to homes without computers. Others are

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introducing parental buy-in schemes to foster a sense of ownership of the technology. It is hoped this will increase chances of pupil use of the tools.

Vignette 7: Barriers to developing home–school links

> For some schools, home–school links are much harder to foster. One secondary school situated in a modern inner-city area estimates that few of its pupils have broadband access at home, and this has inhibited the development of a Virtual Learning Environment.
>
> Despite low home internet access, the broadband in school has become second nature to the staff and pupils. This is a 're-built' school that was previously closed by the LEA for poor standards. It is now an improving school. Current GCSE results are substantially above the average for the local authority if slightly below national average.
>
> In spite of this improvement, however, security of ICT equipment in the school remains an issue in an area of surrounding need.
>
> **Urban city academy, 10 Mbps**

Thirty-three per cent of secondary pupils recorded that they mostly save their work on a shared area of the school network, whilst 42 per cent tend to save work to a specific computer hard drive. The proportion of secondary pupils saving work to the Virtual Learning Environment was predictably small. Memory sticks were the main storage area for 13 per cent of the secondary pupils with floppy disks being largely viewed as outdated technology. Indeed, in one secondary school it was interesting to note that a stringed memory stick had replaced the whistle on a piece of string around the teachers' necks!

A surprising 80 per cent of primary pupils in our sample of 1,000 children stated that the computer was their main place to save work. While our observers noted that this was possibly the case in a few of the Strand 3 schools it was not apparent across the majority of schools. It would seem more plausible that the children are recording computer use or activity rather than storage *per se*.

The reliability of broadband has been associated with new emerging ways of communicating including everyday administration between staff but also between staff and pupils (75 per cent of primary and 71 per cent of secondary interviewees use email at school for work purposes); sharing of expertise and knowledge within and between schools (46 per cent of primary and 59 per cent of secondary interviewees share their resources); and communicating with the home and the community which is currently limited but a growing feature in many of the schools surveyed here. Some examples of community use within this sample of schools include emailing newsletters to parents, and providing courses for parents or the community, usually on a one-off basis. Other schemes are in developmental stages in many schools.

Vignette 8: Increasing ICT activity for teaching and learning and support administration

> Most staff readily use electronic communication although there are a few reluctant users. The fact that the senior management team reacts more quickly to electronic messages than paper communications is a major incentive to go online.
>
> **Rural high school, 10 Mbps**

Broadband technologies can of course help to overcome logistical difficulties, for example by allowing the spread of work over time and space and ready access to educational resources

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Vignette 9: Organising the working day

In this secondary school pupils are bussed in from a large catchment area and this restricts out of hours access to school facilities. However, this school has high levels of home internet access and this is being exploited though the VLE. This is seen as a key benefit of broadband in the school. The school has seen two clear benefits of this. Digital storage has produced a reduction in the instances of losing or forgetting work. Also the focus has shifted from writing a perfect piece of work from memory in the first attempt, to writing, editing and building a final article over time using an almost infinite resource base.

Urban secondary school, 10 Mbps

Broadband technologies are encouraging schools to develop contacts with other educational institutions both locally and across the world.

Vignette 10: E-mentoring to ease transition and to inculcate responsibility for others

E-mentoring, pairing Year 6 pupils about to start secondary school with Year 7 pupils, is being used to reduce problems or concerns when transferring from primary to secondary school. The provision of an online virtual tour of the new school, and the opportunity to participate in an online forum are used to ease the transition process.

Urban primary school, 512 kbps

Underwood and Dillon (2005) have shown just how significant such provision is for vulnerable groups.

Vignette 11: Accessing real world expertise

Two primary schools linked to the same theatre group have gathered information on their surrounding area to share with the partner school, in order to write a play as part of the web play project. They have contacts with, visit and are visited by the theatre group to develop and film their play, which on completion appeared on the school's website.

Urban primary school, 512 kbps

3.2.6 What activities are, or are not, being undertaken?

Exposition still dominates

Secondary pupils recorded the main uses of ICT in particular subject lessons as follows: teacher use of a computer to show and explain aspects (44 per cent in science; 45 per cent in maths) and teacher use of the interactive whiteboard to discuss topics (41 per cent in science; 50 per cent in maths). These support assertions from the staff questionnaires that uses of ICT in class – whilst varying greatly according to school, staff and pupils – are still mainly teacher led, and with limited communication outside the classroom. Problems with viruses as well as the unknown nature/agenda of chat room users are potential considerations or concerns schools may have about developing external communications. Many schools do, however, have link schools either via email or occasionally via video conferencing. Time-zone and firewall restrictions often limit the scope of some video conference communications.

Focus on core subjects

Pupil responses mirror findings from the head teacher interviews and also the case studies, that whilst ICT is branching out into new areas, it is still dominated by the core subjects and particularly maths and science. A small but significant percentage of interviewees (18 per cent primary; 24 per

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cent secondary) attributed this to access problems, with core curriculum subjects dominating ICT facilities.

Vignette 12: ICT Branching out into new subjects

> The arts had previously struggled to demonstrate a need for ICT in their curriculum, but one secondary school has fought this and introduced its Mediaonics© course as a combination of performing and visual arts with technology, to respond to gaps in graduate skills. Although the course was developed within the school and made little use initially of the school's 10 Mbps connection, this level of connectivity is now enabling them to disseminate the course to other schools within their local consortium of three secondary schools and a FE college.
>
> **Urban secondary school, 10 Mbps**

For primary pupils the most common ICT activities included internet information searches (90 per cent of pupils recorded doing this in lessons), a finding corroborated by the case study data. Paired or group work using computers (88 per cent), teachers using ICT to show and explain aspects (87 per cent), and teacher use of the interactive whiteboard to discuss topics (78 per cent) were the other main ICT activities in primary school lessons. The use of presentational devices, largely interactive whiteboards in our sample, is common in primary schools but restricted in secondary schools.

Vignette 13: Learning through interaction and enjoyment

> At one primary school a class were learning times tables on a number grid on the interactive whiteboard. As one pupil moved through the grid, blocking the correct numbers and speeding up to the pace of the encouragement from his classmates, he proceeded to block numbers at a rate quicker than the automatic 'you're right' system feedback could keep up with – which the children loved!
>
> **Rural primary school, 2 Mbps**

It is highly probable that the number of pupils in secondary versus primary schools making demands on the system necessarily has an impact on the type of internet activity that the schools' current broadband connections can support. Equally, in primary schools all teachers can use the facilities but perhaps in specified subjects. In secondary school staff, the dichotomy between users and non-users is still apparent but less evident than in earlier studies (Harrison *et al*., 2003). The drivers of ICT in secondary schools therefore develop its use within their own subject area when access allows. There is the obvious strength of this in the enthusiasm that drives a range of innovative activities.

Assessment and the digital classroom

The THINK report highlighted the issue of the degree of alignment or misalignment between the looked-for benefits of ICT on learner achievement and the demands of conventional curricula and assessment regimes (Wood, 2000). In his follow-up report 'Think Again', Wood (2003) argues that while assessment remains a contentious issue, policy-makers across Europe are raising the debate about the lack of compatibility between contemporary educational objectives and current traditions of assessment. This enlightenment has as yet to spread to the educational institutions. One area where little impact of the technology is apparent is that of assessment. Assessment appears to be the most resistant of activities. Seventy-seven per cent of primary pupils in this sample recorded pencil and paper testing as being the dominant form of assessment. This is not altogether surprising but it should be recognised that the children may have an eclectic concept of assessment. This figure reduced to 22 per cent as the main form of assessment for secondary pupils, although only 4 per cent had undergone any form of online testing. The computer-based assessments these secondary pupils are

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discussing appear to be word-processed essays or electronic presentations. However, four of our case study schools are now trialling online assessment.

Virtual learning environments

As was the case for staff and primary pupils, relatively few secondary pupils reported daily school use of internet chat rooms (6 per cent) or video conferencing (4 per cent). At home only 11 per cent of secondary pupils claimed daily use of the Virtual Learning Environment. This was also the least frequented ICT application in the staff samples, which suggests that the VLE is a limited but growing resource. Thirty-two per cent of primary and 39 per cent of secondary schools in this sample reported having a VLE. A number of institutions were either in the process of developing a VLE, or were including it in their ICT development plans.

3.2.7 Broadband promoting efficiency gains

In interviews staff were quick to comment on the efficiency of lessons delivered with and through broadband technologies. This has allowed both a widening and deepening of the curriculum. Prosaic use of the technology can lead to the development of high-level thinking skills in the hands of a creative teacher.

Vignette 14: High-level thinking skills

> In two Year 7 and 12 lessons the teachers used the technology in standard ways. The whiteboard was used to introduce the topic and the children then worked as individuals extracting resources.
>
> What did high connectivity add to these lessons? It added efficiency and a depth of resources which allowed the teachers and their pupils to cover far more ground than would be possible through paper resources only. This allowed the teachers time to focus on key skills and develop advanced organisers for the impending assessment paper. This approach meant pupils had to select key points of information, tag the address for later sessions and then organise information on to their electronic template. This all sounds ordinary but the research and writing skills being practised were at a high level. Further, the teachers' actions prevented the whole-scale pasting of retrieved information into files.
>
> **Rural high school, 10 Mbps**

Vignette 15: Developing new potentialities

> A secondary school is currently hosting the pilot to a new Edexcel vocational qualification, Diploma in Digital Applications (DiDA). This is a completely paperless qualification. Samples of students' project work within the expressive arts – producing short films using iMac technologies – and covering a range of subject areas illustrates how the school is developing multiple skills across the curriculum. Broadband is essential to course delivery owing to the use of multimedia, Macromedia Flash, and video-editing resources. Staff and pupils display a commitment and enthusiasm for both the concept of online learning and the development of independent learning. The school's focus on developing an understanding of their pupils' learning needs and exploring ways to enrich that experience has in turn enriched the teaching experience too. It is hoped that this course will be available to all schools from September 2005.
>
> **Urban technology college, 10 Mbps**

This example can be considered an efficiency as it supports streamlined administration and assessment; encourages independent, self-regulated learning; provides resources on hand when

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needed; offers an effective combination and understanding of learning needs and course delivery and tutoring. It is also a new mode of working which has resonance with working practices in the wider community as we move to the use of multiple modes of presentation in the targeted paper-less office.

3.2.8 Culture change

The tip-over point

Schools have a 'tip-over point' where they evolve from ICT-accepters to ICT-enthusiasts. The aim (and often the case) is that once staff confidence using the technology increases, combined with confidence that the technology will be reliable in class, use levels increase and usage becomes more varied. For some this tip-over comes with the introduction of interactive whiteboards serviced by broadband. ICT drivers in institutions are often a means of filtering use of the technology throughout year groups and the curriculum. By this route, however, use of ICT can take a while to branch out from its original source.

Vignettes 16 to 18 show evidence of broadband as a part of the ICT system, rather than focusing specifically on what is being done with broadband. For many schools, having broadband means new equipment is either purchased or better understood, and so moulded to current educational requirements and practices. Although the vignette below may seem prosaic, without broadband this shift in attitudes and ensuing work pattern changes would not have occurred.

Vignette 16: Beginning to embrace ICT in the core subjects

> Whilst not a new potentiality for many schools, a previous hesitancy amongst Maths teachers to embrace ICT has been replaced by enthusiasm after the arrival of interactive whiteboards into the department.
>
> **Rural middle school, 2 Mbps**

Which technologies?

The use of broadband technology is as much about the additional equipment used to access to the internet as the level of connectivity itself. While many of the sample schools have chosen to place interactive whiteboards in teaching areas, others have chosen to provide tablet PCs to children. In the case of one school (see vignette 18) this is being done on a one-to-one ratio. This raises issues of funding the resource base and for many schools the whiteboard option will prove to be less expensive.

Vignette 17: Culture change with interactive whiteboards

> One of the schools observed had only had interactive whiteboards two terms previously and they had only been introduced because they had a windfall grant for that specific purpose. Teachers already said they could not imagine working without them and it was changing the way the pupils learnt and the way that teachers co-operated with each other. A major culture change was taking place in the school that was noticeable and welcome to the staff.
>
> **Rural primary school, 2 Mbps**

Many schools mentioned useful materials for the interactive whiteboards drawn from the National Whiteboard Network, as well as those from various subscription sites. Some schools were also beginning to create their own materials, as well as using the tool as a screen to display pupils' work.

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Vignette 18: Alternatives to the interactive whiteboard

A City Technology Academy is currently building a new lower school and, interestingly, the planning does not include interactive whiteboards. The school values the laptop and the tablet PC over the electronic whiteboard. The new school will provide tablets on a 1:1 ratio in classes and no interactive whiteboards. The ICT co-ordinator argues that laptops and tablets will revolutionise teaching and liberate teachers from the board, of whatever type. He suggested the laptops will change the role of the teacher from "the sage on the stage to the guide on the side".

Urban city academy, 10 Mbps

3.2.9 Opportunities for personal development

In a school system that currently prizes academic skills above most others, there is an issue in finding ways for all pupils to succeed. One middle school showed how it could make a virtue of its funding problems by developing skills in pupils. With extensive ICT equipment but limited access to technical support, the school trained some pupils to be 'web-wizards', to do basic technical maintenance and also have manager rights on the VLE. This school also used the same technique in its ecology projects to allow pupils to adopt responsible roles.

In terms of staff personal development, a secondary school has been approached by 'Teachers' TV' (a new digital TV channel aimed at teachers and others involved in education) which has expressed an interest in filming the school's ICT use. The programme was made aware of the school's use of ICT via the pilot report to this project. Nothing has been finalised as yet, but the school is considering the offer.

3.2.10 Usage of broadband

Two teachers from the 27 Strand 3 schools logged their weekly use of broadband (for a four-week period) in four categories: teaching, preparation, administration and professional development (CPD). Only those teachers using a broadband connection at home for such work have included out-of-school use. It is possible that sampling variation may have occurred in our data, due to the weeks in which teachers selected to record their broadband activity.

Usage can be defined as a proportion of actual usage time – a percentage based on the amount of time teachers recorded using broadband for over the week, and total possible usage time – a percentage based on total time available in the week, Monday to Sunday, morning through to evening.

Table 3.2.10: Usage of broadband as a proportion of actual usage and total possible usage, by category and age phase

	Teaching		Preparation		Administration		CPD	
Proportion of…	Actual usage	Possible usage	Actual usage	Possible usage	Actual usage	Possible usage	Actual usage	Possible usage
Primary teachers	46	11	33	8	8	2	14	3
Secondary teachers	42	26	21	13	24	15	13	8

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The data from this survey is presented in Figures 3.6 and 3.8 (figures 3.5 and 3.7 represent comparable data from the pilot study). Of the four categories, broadband was predominantly used to support teaching (for primary teachers, 46 per cent of their actual usage time and 11 per cent of total possible usage time; for secondary teachers actual usage time was 42 per cent, 26 per cent of total possible usage time) and this took place largely within the standard school day and week. Where before- and after-school teaching with broadband did occur, it was more a feature for secondary than primary teachers.

The second most extensive use of broadband for primary teachers was preparation (33 per cent of actual usage time). Secondary teachers were active users of the technology for both preparation – 21 per cent – and administration – 24 per cent. In contrast to use for teaching, use for preparation peaked before school with a slightly smaller peak in the evening. Similar to use of broadband for teaching, primary teachers' use of broadband for preparation was greater on weekdays than at the weekend. This was also evident in secondary teachers with use of broadband for preparation greatest on Mondays and gradually declining through the week through to Sunday. Secondary teachers' use for preparation was, however, more evenly spread over the week than in the primary teachers.

Secondary teachers used broadband for administration more than preparation, with a large peak before school and a lesser one after school (declining again in the evening). As with secondary teachers' use of broadband for preparation, use for administration was highest at the start of the week, lessening by midweek and lowest at the weekend. These two patterns suggest that broadband for secondary school administration occurred predominantly on-site.

Primary teachers' use of broadband for administration was lower than all other categories of use cited (8 per cent of actual usage time), and there was little fluctuation in usage through the day or week. Administration in primary schools is focused on the class with limited referral across the school. In such circumstances the benefit of electronic record keeping may not be immediately obvious to the class teacher.

In a statistical test of difference, secondary teachers used broadband significantly more than primary teachers for administration ($F_{(1,25)} = 10.70$, $p < 0.01$; primary mean = 2.37; secondary mean = 15.00). Secondary teachers also used broadband significantly more than primary teachers across the four categories of use ($F_{(1,25)} = 6.04$, $p < 0.05$; primary mean = 34.90; secondary mean = 59.50).

In addition to difference by age phase, a significant difference was found for use of broadband for administration by schools' connectivity level ($F(2,20) = 6.36$ $p < 0.01$; 512 kbps mean = 2.67; 2 Mbps mean = 1.08; 10 Mbps mean = 16.429), whereby schools with highest levels of connectivity made more use of their broadband connection for administrative purposes.

Whilst use of broadband for CPD was limited in this sample of teachers (14 per cent of actual usage time for primary, 13 per cent for secondary teachers), it was focussed before or after school (though not generally into the evening) and on weekdays rather than at the weekend. This suggests that use of broadband for CPD occurred largely at school rather than at home.

Overall, whilst use of broadband in the majority of tasks in the four defined categories seemed to occur during the school day (if slightly extended at either end), preparation with broadband appeared to be the only use which significantly entered the home environment and time. This home preparation with broadband was mainly a feature of the primary teachers.

3.2.11 Comparison of pilot and main study usage

3.2.11.1 Usage as a proportion of actual usage

The graphs (3.5 and 3.6) below show subtle but interesting changes over the twelve months between surveys, which while not directly comparable, do have overlapping samples. It should also be remembered that the schools surveyed in the pilot project were best practice schools. Whilst some schools in this main survey fit this description many fall outside the category of ICT hotspots.

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The rise in the use of broadband supported systems for administration and CPD is most noteworthy. As these are proportions the increase in these activities do not signal a decline in teaching or preparation rather the data are indicative of teachers, and institutions' recognition of the wider uses of the technology.

Figure 3.5 - Broadband Use as a Percentage of Actual Use, by Age Phase - pilot study

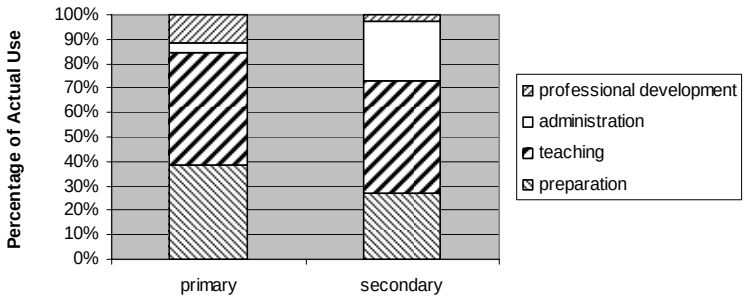
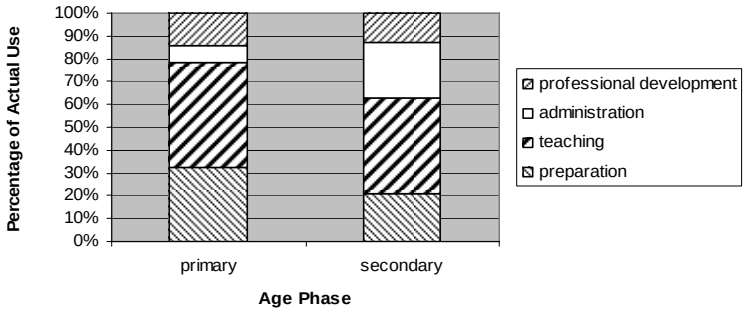


Figure 3.6: Broadband Use as a Percentage of Actual Use, by Age Phase - 2005 study



3.2.11.2 Usage as a proportion of total possible usage

Differences in patterns of usage between the pilot and current study became notable when comparing usage as a percentage of total possible usage (i.e. the whole week). The graphs below (3.7 and 3.8) show secondary teachers in the current study were using the broadband facilities far more than they were one year previously (with secondary teachers' usage rising from 41 per cent use to 62 per cent spread across the four categories). This is particularly significant as the current schools are not necessarily best practice schools.

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Figure 3.7 - Broadband Use as a Percentage of Total Possible Use, by Age Phase - pilot study

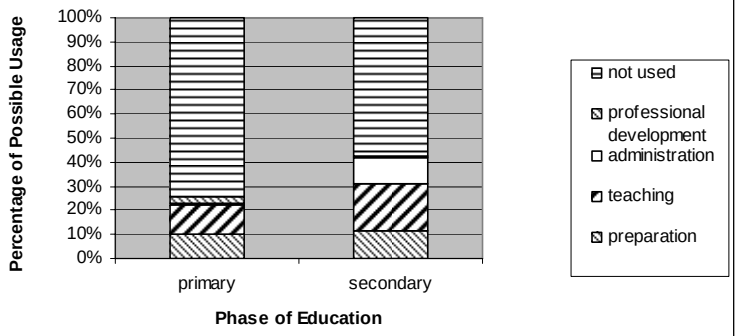
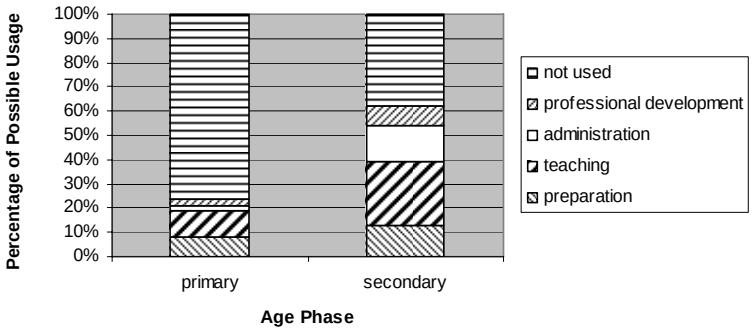


Figure 3.8: Broadband Use as a Percentage of Total Possible Use, by Age Phase - 2005 study



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4. Issues

4.1 Learning issues

4.1.1 Assessment

In 1858, academics from Cambridge visited a selection of Durham schools and observed how the pupils were being taught. They devised tests to match the teaching and learning that was taking place. The examinations they created led to the formation of the first examination board that is still in existence today and is the controlling company of OCR. The techniques for external examination are largely the same today even though the style of teaching and learning has moved on dramatically.

In our observation of schools we noted that broadband access encourages a different style of working. Previously students would prepare notes and then write a final piece, produce the final picture, etc. Now they draft and edit. At no time do students complete the final piece in one short limited period of time. This style of working develops a different style of thinking and writing which no longer matches examination assessment. We are now asking pupils to complete an entirely novel task when they are assessed. The development of ICT driven by broadband is now driving a revision of assessment techniques. Just as the Cambridge academics in 1858 recognised the need to assess what was being taught, the education system needs to provide a modern match between learning and assessment.

We have already referred to issues of assessment under 3.2.3 and 3.2.6. Although there are some moves both commercially and locally within the schools to change assessment practices, this is not widespread. It will remain a barrier to progress until policy-makers take affirmative action showing that they not only want to develop a digitally literal society but also that they are willing to consider slaying some sacred educational cows to achieve the goal.

4.1.2 Technology inversion

The technology is developing from the grassroots of the educational system upwards. Pupils at Key Stage 2 are doing tasks as a matter of course that senior academics have no idea about. The greatest use of the broadband potential is observed in primary schools and middle schools that move beyond the general internet search to show how broadband brings added value to the curriculum.

Vignette 19: Pupil control

> A Year 6 literacy session involved pupils in parallel classes writing shared reports about the Antarctic on the interactive whiteboard. When each class had prepared their report, there was a tick-box on their half of the split screen for them to register they were ready to exchange files with the parallel class. They then received, marked and returned the other class's report. The pupils commented that their teachers were beginning to let them use the whiteboards now, since the teachers had become more confident themselves.
>
> **Urban primary school, 2 Mbps**

As these children progress through the school system they are in danger of becoming de-motivated if the secondary and tertiary sectors cannot build on the sophisticated skills they have developed. The strength of the motivating effects of the technology is readily apparent. A number of case studies and the questionnaire responses record enthusiasm of both staff and students for activities that use the technology. Cessation or withdrawal of such activities is viewed as a punishment.

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4.1.3 Making more from less

Schools with a confident ICT strategy and ICT knowledge can obtain a lot of added value from limited investment. One primary school concentrates on having a technologically rich environment that is easy to use and standard throughout the school. There are limited sources and limited software. The focus is on making the software deliver rather than buying ever more sophisticated titles.

Vignette 20: Making full use of what is there

> At an urban primary school, technology is integrated with the curriculum. It is part of most lessons but does not intrude. It is used to drive the educational objectives of the school so it is harnessed to teaching objectives rather than driving them. The system is relatively simple and is uniform throughout the school. All classrooms have interactive whiteboards and children use computers from the nursery upwards. There are relatively few peripherals such as cameras, and printing is done through a small number of large networked laser printers. The technology is part of the way the school works. Staff commented in the classroom that they could not imagine working at a school without this technical facility.
>
> **Urban primary school, 5 Mbps**

4.1.4 Responsible use of information

One of the dangers of using the internet for research is the temptation to simply cut and paste. The important aspect here is whether teachers use this as an opportunity to introduce the significance of plagiarism and the importance of acknowledging sources of information. However when teachers use this as an opportunity to introduce the significance of plagiarism and the importance of acknowledging sources of information then this can be a worthwhile learning experience. This does not obviate the need for children to re-structure information in their own words.

Is it time, at least in the secondary schools, to be making children aware of intellectual property rights (see 3.2.7 above) and etiquette of information use? Staff and pupil attitudes toward this issue vary greatly both within and between schools in the current sample.

4.2 Continuing professional development

4.2.1 Staff training

While a small number of schools report compulsory training for all staff, training was patchier than in the best-practice schools from the pilot project, reflecting the level of use across staff in general. Schools were very aware of the need for further training but some schools cited cost and low level of support from local agencies as a limitation to what they could achieve.

One weakness is the reliance of some schools on one person. This reliance has potential consequences if that person leaves. Whilst these schools may well have policies for strategic leadership and development of ICT, growth of technology in the curriculum often occurs in isolated areas. In this sense, schools vary in terms of whether their ICT developments are predominantly led by staff or management. Vignettes 8 and 20 are two prime examples of management leading the drive to integrate ICT into school life, which staff have accepted and indeed embraced!

4.2.2 Strange understandings

One of the responses to this technology, as other technologies, is that users develop limited understandings and pragmatic rules for making it work. The way some teachers talk about the technology borders on superstition and the way some systems are set up is reminiscent of Heath Robinson contraptions. This is not a problem when things go well. It is also not an issue in schools, and we have robust and credible examples here, where well trained technical teams are available

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operating a just-in-time policy of support. However, when things go wrong and that expert support is not available, this lack of understanding can inhibit resolution of problems. For example, one of the teachers interviewed thought that the accidental removal of a plug, which leads to an immediate system failure, was continuing to have long-lasting effects and was the cause of continuing problems with the video conferencing system.

4.2.3 Widening access

Although there are several schools in our sample that are actively using the technology to forge links with the wider community, this is not standard practice for the majority of our schools.

Closer liaison with the home is better developed although again only a limited number of schools have a fully developed VLE. The benefits of having a VLE are very much intertwined with levels of pupil and staff home internet access, and thus vary by institution. Whilst encouraging school and home internet access is a strong step forward to realising Broadband Britain, for many schools this is not a viable option at present.

4.2.4 Teaching / technology balance

Balancing the educational and technological demands of a modern classroom is an essential skill for teachers but this balance is affected by:

- missing skills: teachers may not be able to deal with minor technical problems
- keeping it simple: some schools have opted for a limited range of software and hardware to ensure staff can and will use the technology effectively. As a starter policy this can be very effective although it does lead to plateau effects and limits more innovative activities.
- creating websites: school websites are commonly authored by teachers, more so than in the best practice schools in the pilot survey (Underwood et al., 2004). Design and maintenance of such sites is a very real concern for schools and raises issues of the effective deployment of teacher time.

4.3 Resource issues

4.3.1 Costs of the technology

Some schools have concerns over the costs of installing the equipment. This concern has been used as at best a valid reason, or at worst an excuse, for not embracing broadband technologies. Other schools have been experimental in their desire to incorporate the technologies with the curriculum.

Vignette 21: Finding ways that work

> One primary school has tried and tested a number of modes of ICT in the classroom. They have trialled and rejected e-beams (projection facility), which they had hoped would be a cheaper way of having interactive whiteboards. Whilst they appreciate they did not utilise a number of the functionalities of this technology as they were not useful in the primary school environment, they felt the e-beams were not particularly successful when used with children (moving near or bumping into the projector, or teachers' hands getting in the way of the signal from the board pen to the e-beam). The cheaper option was in the end not

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the best and they have now invested in interactive whiteboards in every classroom, but this shows the school and staff are keen to try to push their use of ICT forwards.

Rural primary school, 2 Mbps

Other schools are beginning to share resources and practice both within and beyond their school, which is helping to alleviate some costs and save time. At one rural primary school better co-operation between schools in the area has helped to resolve technical issues by the sharing of technical support and expertise.

4.3.2 Resource sharing

Sharing a broadband link is not uncommon in the sample schools. This often means schools potentially have very good access levels but, as in the case of ADSL, the reality of access varies constantly and depends greatly on usage of all other parties sharing the connection. We were informed of one method of 'saving space' in some of our sample schools with their own 2 Mbps connection. If they were about to undertake a bandwidth-hungry activity, such as video conferencing, they could inform their broadband provider of their plans, who ensures that this activity takes priority over their portion of available access; while all other usage of the link will be slowed, it will not impede the performance of the scheduled usage.

One of the more technically advanced schools in our sample pointed out that even in well-endowed areas such as the Yorkshire and Humberside RBC, where the mean connectivity level is 10 Mbps, if several schools instigate resource-hungry activities then other schools will lose capacity. This RBC is negotiating raising the overall level of connectivity to 100 Mbps in the foreseeable future.

4.3.3 Technical support

Some schools are able to have successful ICT and broadband provisions with only limited technical expertise within the staff. One observed school was unable to say where the broadband link came from or how anything worked. As long as it worked, they were happy not to know anything about it. In some ways it might be that having some technical expertise would be a hindrance because whatever knowledge they had would be patchy and might lull them into a sense of false security about technical competence.

Provision of on-site technical support tends to be a feature of schools actively exploring the opportunities provided by broadband. School funding to provide this support is often limited, particularly in primary schools, which may prevent schools from taking advantage of, and even being aware of, the potential added value- with broadband. Conversely, one primary school within our sample has a full time network manager and a technician, and has implemented a total immersion ICT policy with interactive whiteboards fully integrated within each classroom environment. Not only is the technology available and supported, the teachers have adopted it into their teaching and learning pedagogy, and management emphasise its importance within school policies.

Such provision is more apparent at secondary level with a number of the schools in this survey having an ICT team including teachers, technicians and the ICT manager. Such schools often act as the ICT hub for surrounding primary, and less often, other secondary schools.

4.3.4 Security

A number of schools expressed concerns about the security of this very expensive resource.

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4.4 Technical issues

4.4.1 Filtering and blocking

Two schools within 20 miles of each other illustrate radically different approaches to policing the internet. Both schools receive their broadband from the same source. One recognises that children will occasionally come across inappropriate material and deal with this by encouraging them to use the internet responsibly. They teach the pupils to click away from unwanted sites and to tell the teacher. The other school polices the pupils' use of the internet and has many concerns about inadvertent access to inappropriate sites. The ICT co-ordinator said that she keeps a close eye on all the screens.

There is little doubt that head teachers and teachers realise that the increased speed and content accessible via broadband has negatives as well as positives, such as in the ability – intentionally or otherwise – to access unwanted material.

Vignette 22: Controlling information access

> One secondary school, as with many others, has introduced its own filter in addition to that provided with their broadband connection. The advantage of this was demonstrated during our visit, as a parent had alerted the school to some images their son had accessed on a school computer which she deemed inappropriate. Due to the presence of the school's internal filter they were able to deny access to this site immediately – this would have been a process of request and wait for response which would have taken at least two days if they had had to wait for the external filter to deny access to this site. Whilst permitting access to currently denied sites is more time-consuming as requests still have to be approved by the provider, the ability to respond in this manner to denying access was very impressive, both to the visitor and the parent involved.
>
> **Urban secondary school, 2 Mbps**

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5. Implications of the key findings

5.1

The reliability and speed of broadband is the key to many of the changes noted here. Reliability, especially in the standard whole-class situation, has widened and deepened the use of ICT in schools. However, the data presented here shows that while a number of schools are operating within the threshold of comfort, many secondary and some primary schools are beginning to stretch the resource available to them. As more innovative uses of the technology become the norm rather than the prerogative of a few, this problem will increase.

5.2

The issue of what constitutes high connectivity, alluded to at the start of this report (section 2.1), remains with us. Caching does reduce waiting times for frequently accessed data such as a favourite site or the school's home page, and by freeing the pipe it can increase connectivity to the outside world. However, in accessing the outside world it cannot compensate for low bandwidths. A partnership of genuine broadband connectivity (2 Mbps or above) and caching may prove to be the ideal scenario for many schools, with 10 Mbps and caching required by those schools whose teaching and learning goals require ready access and interaction with the outside world.

5.3

While the new technology tools offer great potential they should not be viewed as a replacement but rather a facilitating agent for good teaching and effective learning practices.

5.4

Comparison of data from the pilot to this extended study shows increased understanding of the potential of broadband to affect the everyday practice. This has resulted in efficiency gains and enrichment of the curriculum by staff. It has also led to a more active and changing role for learners, as teachers extend the range of activities and modes of working now available through the technology. Such activities and practices are enhanced by broadband. Broadband dependent activities such as video conferencing and real-time data capture are only just beginning to have an impact on schools across the board.

5.5

There is limited community use of school ICT resources. Given the problems of access to computers at home for about half of all school children and their parents, there is clearly work to be done here. As many schools are only open during the school day for some 40 weeks a year it could be argued that significant funds are supporting an underused resource. The development of community resources in, for example, libraries with preferential access for schools during term time is one alternative funding model. Alternatively, greater community access to school facilities may be required. Indeed, a number in our sample schools have chosen unilaterally to implement such a policy. There are numerous other factors which schools have to take into account when considering community use of the facilities. These issues themselves are worthy of further investigation.

5.6

The role of broadband in Academies and Building the School of the Future should be addressed, both in the creation and further development of the institutions. It is interesting to note the equality of access, in that no separate funding has been allocated for the internet/broadband connection within budgets for these initiatives. The institutions will therefore receive a level of connectivity according to the local RBC/LEA agenda.

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5.7

E-learning credits, while an excellent response to the e-learning initiative, are no longer serving this function. Schools feel that there are insufficient good resources available and our schools report that there have been many redundant purchases made to use up the credits. The problems over spending e-learning credits suggest that there needs to be an active policy to ensure the development of current software and of the next generation of quality software. A more radical use of these credits would be to allow the funds to be used for ICT-specific training. School-tailored CPD has proved very successful in the ICT Test Bed schools (see Somekh *et al*., 2004).

5.8

Implications and impacts of broadband on assessment are largely still to be realised. This will require a re-evaluation of learning and teaching styles and techniques, in order that learning and assessment styles and methods correspond.

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6. Recommendations

6.1 Data from the RBCs

In this project we anticipated that the RBCs would be the source of a rich vein of data. This has proved to be so but the disparate nature of the data collected has been problematic. A co-ordinating organisation needs to be established to co-ordinate data from the RBCs to provide a national and regional picture of the level of usage of broadband connectivity. Work currently under way between Becta and the RBCs should facilitate this goal. Important data to be collected would include: schools' level of connectivity; average usage of the connectivity over the day, week and month; peak usage; and frequency of hitting the peak usage. This would outline to providers whether the connectivity provision is being utilised and when activity mainly occurs, inform future revisions and upgrades of broadband provision policy, and also provide evidence to support any plans for community use of the facilities.

6.2 Level of connectivity

A technical assessment of the effectiveness of different combinations of connectivity level and caching to support a range of future learning environments needs to be undertaken. In view of the fact that caching tends to facilitate faster inbound internet access, with little effect on outgoing data transfer, the decision of whether or not to install a cache must take into account what broadcasting or information providing the school is doing or planning to do. This is particularly important when data to be transferred is time-dependent, such as real-time recording of natural events or synchronous collaborative activities at a distance.

The size of the school, type of use and type and amount of technology connecting to the internet all need to be taken into consideration when assessing any school's broadband resource needs. In addition, the pedagogic and learning models – for example whether the school perceives the learner as just an information receiver or as information receiver and provider – will have implications for resource usage.

From these analyses Becta should be encouraged to produce scenarios for relevant stakeholders, which show what they might achieve with different levels and configurations of this enhancing technology. This would allow schools and LEAs to buy in to broadband at an appropriate level.

6.3 Agendas for provision

There were many differences between service provision and support in the LEAs and RBCs, including the level of connectivity being installed in schools. A systematic study of this issue was not in the remit of the current study, but it is an area worthy of further research.

6.4 Quality resources, e-learning credits and CPD

A re-evaluation of e-learning credits was called for by many schools, and in two main ways. Staff called for provision or means of increasing awareness of new software to allow them to utilise the credits in their currently intended way. Conversely some staff felt that they now had sufficient software for their needs, and so stated that new ways to spend the credits would be most beneficial, such as in ICT-specific training to enable them to make better use of the resources they currently have.

6.5 Patterns of response to the technology

The causes of any differential response to the technology need further exploration. Does use of broadband need to be compatible with existing practices, or does it engender new practices?

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6.6 Pupil response and the use of broadband

We have extensively interviewed staff and managers but not pupils. The focus now should be on how styles of working and modes of thinking are changing in a generation of learners brought up in technological environments. As we examine the way technology affects the way they think and communicate, we should ask ourselves what assessments should we be devising to capture these new cognitive and social skills?

In some schools we are seeing a move from the pupil as information receiver to pupil as author or creator of information, now that they have been provided with the tools to operate in this role. To what extent is the pupil being given/taking responsibility, ownership and autonomy for his/her own learning (see Hargreaves 2004)?

6.7 Whose information?

There needs to be a review of teacher and pupil understanding of, and attitudes to, issues surrounding the nature of information. This includes an evaluation of the quality of information and information sources. This in turn relates to staff and pupils' understanding of, and attitudes towards, intellectual property rights.

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7. References

Bardi, A-M and Berard, J-M, "L'ecole et les reseaux numeriques", Inspection General De L'EducationNationale, Julliet, 2002: no. 2002-035

Becta (2004). *National Education Network Design*. http://getconnected.ngfl.gov.uk/docs/complete_design_document.pdf Accessed May 10 2005

Broadband Stakeholder Group, (2001). *Report and Strategic Recommendations*, http://www.broadbanduk.org/reports/BSG_Report1.pdf Accessed October 24 2003

Broadband Stakeholder Group, (2003). *Opportunities and Barriers to the Use of Broadband in Education.* Broadband Stakeholder Group, Report and Strategic Recommendations. http://www.broadbanduk.org/reports/BSG_%20Education_%20Report_03.pdf Accessed October 24 2003.

Crabtree, J. and Roberts, S. (2003). *Fat Pipes, Connected People Rethinking Broadband Britain*. London: iSociety. http://www.theworkfoundation.com/pdf/fat_pipes.pdf Accessed November 5 2003

Downing, J,. and Thackray, D. V. (1975). *Reading Readiness*. London: Hodder

Hargreaves, D. (2004). *Personalised Learning – 2: Student Voice and Assessment for Learning*. Specialist Schools Trust 2004. http://www.schoolsnetwork.org.uk/content/articles/3625/chapt1studentvoice.pdf Accessed May 10 2005.

Harrison, C., Comber, C., Fisher, T., Haw K., Lewin, C., Lunzer, E., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B., Watling, R. (2003). *ImpaCT2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*. http://www.cfy.org/BECTA_exec-sum.pdf Accessed May 5 2005

Lesgold, A. (2000*). Determining the Effects of Technology in Complex School Environments*. http://www.publishers.org.uk Accessed June 15 2001.

Somekh, B.,Underwood,J., Convery, A., Dillon, G., Lewin, C., Mavers, D. and Saxon, D. (2004). *Evaluation of the DfES ICT Test Bed Project.* First Annual Report to the Department for Education and Skills.

South East Grid for Learning (2005). The Bird Box Project. http://www.segfl.org.uk/birdbox/about/ Accessed May 17 2005

Underwood, J., Ault, A., Banyard, P., Durbin, C., Hayes, M., Selwood, I., Somekh, B., Twining, P. and Woodrow, D. (2003). *Connecting with Broadband: The Literature Review.* Final project report for Becta, Coventry.

Underwood, J., Ault, A., Banyard, P., Dillon, G., Durbin, C., Golland, D., Hayes, M., Selwood, I., Somekh, B., Twining, P. and Woodrow, D. (2004). *Connecting with Broadband: Evidence from the Field.* Final project report for Becta, Coventry.

Underwood, J. and Dillon, G. (2005). A Pilot Investigation of the Transition of Children on the Autistic Spectrum from the Primary to Secondary Mainstream Education Sectors. End of project report for the Baily Foundation, London.

Wood, D. (2000). *THINK Report.* European Schools Network (EUN), Rue to Treves, Brussels, Belgium

Wood, D. (2003) *THINK AGAIN: Hindsight, Insight and Foresight on ICT in Schools:* European Schools Network (EUN), Rue to Treves, Brussels, Belgium.

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8. Appendices

8.1 Contributing RBCs and LEAs

East Midlands Broadband Consortium

Lincolnshire County LEA

Nottingham City LEA

Birmingham LEA

Tameside LEA

Westminster LEA

8.2 Contributing schools, strand 2

Abraham Moss High School, Manchester

Anglesey Primary School, Birmingham

Ashfield Comprehensive School, Nottinghamshire

Bartley Green Technology College, Birmingham

Bassingbourn Village College, Hertfordshire

Beaufort School, Birmingham

Betley CofE VC Primary School, Cheshire

Blakenhale Junior School, Birmingham

Brewood CofE Middle School, Stafford

Buildwas Primary School, Shropshire

Calthorpe School and Sports College, Birmingham

Cherry Oak School, Birmingham

Cheveley CofE Primary School, Newmarket

Colley Lane Primary School, Halesowen

Dudley Wood Primary School, Dudley

Easthampstead Park School, Bracknell

Gorsemoor Primary School, Staffordshire

Grange Technology College, Bradford

King David Junior School, Manchester

Lightwoods Primary School, West Midlands

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Lionel Walden Primary School, Cambridgeshire

Lincoln Christ's Hospital School, Lincoln

Little Thetford CofE VC Primary School, Cambridgeshire

Manor Primary School, Tamworth

Meade Hill School, Manchester

Meadowgate School, Cambridgeshire

Morley Memorial Primary School, Cambridge

Newall Green High School, Manchester

Newall Green Junior School, Manchester

Paget High School, Staffordshire

Pens Meadow School, West Midlands

Ravensdale Junior School, Derby

Rees Thomas Special School, Cambridge

Robert Wilkinson Primary School, York

Roundwood School, Manchester

Russells Hall Primary School, Dudley

St Agnes CofE Primary School, Manchester

St Cuthbert's RC Junior and Infant School, Birmingham

Saint Francis of Assisi Catholic Primary School, Notting Hill

St James's CofE Primary School, West Midlands

St Luke's CofE Primary School, Cambridge

St Mary's CofE Primary School, Shropshire

St Mary's CofE VC Primary School, Dudley

Temple Primary School, Manchester

The Benjamin Britten High School, Suffolk

The Grove School, Nottinghamshire

Thomas Alleyne's High School, Staffordshire

Thomas Barnes Primary School, Tamworth

Waverley School, Birmingham

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Whalley Range 11-18 High School, Manchester

William Shrewsbury Primary School, Staffordshire

Wilson Stuart School, Birmingham

Yearsley Grove Primary School, York

Yorke Mead Primary School, Hertfordshire

8.3 Contributing schools, strand 2 & 3

Avondale Park Primary School, London

Beverley High School, East Riding of Yorkshire

Bisham CofE Primary School, Buckinghamshire

Bournville Junior School, Birmingham

Broadclyst Community Primary School, Exeter

Castle Vale School and Specialist Performing Arts College, Birmingham

Cherry Orchard Primary School, Birmingham

Chyngton School, East Sussex

Clifton Without Junior School, York

Djanogly City Academy Nottingham

Jeff Joseph Sale Moor Technology College, Cheshire

Jessie Younghusband Primary School, Chichester

King Edward VI Camp Hill School for Boys, Birmingham

Leasowes Community College, Halesowen

Mere Green Combined School, Sutton Coldfield

Monkston Combined School, Milton Keynes

Priestsic Primary and Nursery School, Nottinghamshire

Prince Albert Junior and Infant School, Birmingham

Rainford High Technology College, St Helens

Robert Arkenstall Primary School, Cambridgeshire

Royds Hall High School, Huddersfield

Saxmundham Middle School, Suffolk

Saint Benedict Catholic School, Derby

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St Paul's CofE VA Primary School, Cambridge

Stoke Damerel Community College, Plymouth

Thomas Eaton Primary School, Cambridgeshire

Wilmslow High School, Cheshire

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