Evaluation

Evaluation of the DfES ICT Test Bed Project

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Executive Summary

Introduction

The ICT Test Bed Project

The ICT Test Bed Project (2002-06) was set up by the Department for Education and Skills to explore how ICT can be used to support the Government's wider agenda for education reform. The independent evaluation is managed by Becta's Evidence and Evaluation Directorate. It is overseen by a Steering Group comprising DfES, QCA, NCSL, LSDA, Ofsted, NESTAFuturelab, CfBT, GTCE, TTA and leading researchers. The project is taking a holistic approach to ICT implementation in three ICT Test Bed areas of social disadvantage (two within inner cities and one in a rural area). The level of investment over four years is £34 million. This has given the 28 ICT Test Bed schools and three colleges access to very high levels of ICT hardware and appropriate software, as well as support to make the most effective use of this investment. ICT Test Bed work is focused on using ICT to:

- raise standards and performance, especially in the areas of school and college improvement, student attainment and raising the quality of teaching and learning

- enable more effective leadership and management in schools and colleges

- help teachers to concentrate their time on their core task of teaching

- enable more effective collaboration between schools and with their local colleges

- provide wider learning opportunities to pupils, their families and the wider community in a home environment.

Aims of the evaluation

The purpose of the evaluation is to assess the effectiveness of the ICT Test Bed project in terms of its five key foci. It incorporates external and internal strands which are inter-related to maximise formative impact on the project.

- The external evaluation is assessing whether, to what extent and how the objectives of the ICT Test Bed policy have been met, identifying challenges encountered and lessons learnt. There is an emphasis on measuring change against benchmarks (using quantitative methods) and developing explanatory theories about the development and implementation of good practice (using qualitative methods).

- The internal evaluation, in partnership with teachers, school and college leaders, is using an action research approach to support the development of good practice and its dissemination. The evaluation team provides guidance and mentoring for teachers and school/FE leaders in carrying out research, including support materials for carrying out data collection, analysis and publication.

Research design

The evaluation has adopted a mixed methods approach, incorporating both quantitative and qualitative strands. The quantitative strand contains three elements:

- Tracking change in staff and student attitudes, self-assessments and perceptions in ICT Test Bed schools and colleges against base-line data collected between October 2002 and September 2003.

- Tracking progress of Benchmarking ICT Test Bed schools/colleges in terms of student attainment and other measures available in the public domain against up to four comparator institutions.

- Maturity Modelling[1] of ICT Test Bed schools/colleges: using a framework on six dimensions for assessing changes in school and college maturity annually. The dimensions which incorporate the five ICT Test Bed themes are: technological, curriculum, leadership/management, workforce, intra/inter-institutional linkage and external linkage.

The qualitative strand contains two elements:

- An external, independent element based on a range of data collected by the evaluators

- An internal element comprising action research studies undertaken by participants from ICT Test Bed institutions.

Overview of the report

This report summarises the preliminary outcomes of the evaluation based on the first two years' work. It is divided into four sections:

- 1: Background

- 2: Progress against the Base-Line: a comparison of the perceptions and attitudes of ICT Test Bed participants between years 1 and 2. (Note: outcomes from the first comparative Benchmarking data and Maturity Modelling[1] data will not be available until March 2005.)

- 3: Indicative evidence of Change: preliminary findings of the external qualitative evaluation

  - Teaching and Learning

  - Leadership and Management

  - Workforce Development

  - Collaboration between Cluster Institutions

  - Home and Community Links

- 4: ICT Test Bed from the Inside: evidence from action research carried out by teachers and para-professionals.

Summary of findings

Progress against the base-line questionnaire data

Of the three kinds of quantitative data used in the evaluation design, only one had been collected twice by the time of writing this report, enabling comparison against the base-line of staff, pupil and parent self-reported attitudes and perceptions, between 2002-03[2] and March 2004.

The results of this comparison are encouraging, recording increased use of ICT in teaching and learning across all phases, with some indications of more varied teaching approaches. Pupils in all sectors recorded a significant increase in the use of presentational software and there is some evidence of greater use of email and school intranets.

All respondents (including parents) reported greater confidence and competence in ICT usage. ICT-enhanced links between home and community are beginning to be established. At Key Stage 2, children reported an increase in the school's support for their use of ICT at home and parents overall reported a 6% increase of home ownership of computer facilities to 85%.

Staff reported a significant increase in computers supplied by their institution for home use. This appears to be linked to the significant increase in their reported levels of competence and confidence. They reported that a large part of their ICT training had been in the form of informal training from a friend or colleague, suggesting the growth of an ICT-friendly culture.

Indicative evidence of change: preliminary findings of the external qualitative evaluation

Teaching and Learning

The use of ICT to improve the quality and efficiency of teaching and learning is the most important of the ICT Test Bed themes, to which all the other themes are related, since this is education's core business. This report focuses in particular on the use of whole-class teaching technologies since all three clusters have made very significant investments in these, placing them in every classroom in many schools. The rate of development of ICT use varies significantly between schools and teachers within schools, but this report focuses on 24 classrooms selected by senior managers: it, therefore, reflects some of the best practice in ICT Test Bed.

Whole-class technologies, with their large screens, and interactive facilities, have changed the ambiance of the classroom significantly. The evaluators observed the use of: content-rich web-based materials such as drill and practice 'games', materials created by teachers (a presentation on histograms, for example, and downloaded images and scanned texts) and exercises designed with standard office programs such as mathematics activities using spreadsheets. The clarity of teachers' presentations is greatly improved and students frequently show high levels of attention, both of which make it easier for teachers to explain complex skills and/or concepts. One teacher said:

> 'I know for a fact that [without the large screen] I wouldn't be teaching them as much […] and I know that they wouldn't be learning as much because they'd be looking around […] It's made it a lot easier because they're looking at it and it's clear to them, it's on a big scale.'

In two of the clusters, schools have installed interactive whiteboards which combine computer facilities with data projectors and touch-sensitive screens; schools in the third cluster have installed specialist suites of a large screen, data projector, computer, visualiser and graphics tablet. In this report both alternatives are referred to as 'whole-class technologies'. Projected electronic resources can be dynamic, allowing rapid editing and movement (video clips, animation) which opens up exciting possibilities for teaching and learning.

A large screen taking up a sizeable area of classroom wall space is significant as a focus of attention. For example, a reception class teacher said:

> 'They were sitting quietly through the whole lesson and they are only five. If I was using the [traditional] whiteboard it would not have held their attention so well.'

Some institutions were using voting systems whereby pupils respond to multi-choice questions and the responses are displayed as a graph, and this was clearly enjoyed by pupils. Pupils could also produce video clips using Digital Blue cameras for display on the large screen, for example for peer teaching or as a stimulus for self-evaluation and critical feed-back from peers. The immediate availability of sound is also useful, for example using the children's own voices to present facts and questions.

The whole-class technologies have proved reliable because of good technical support, but in some schools there have been problems with visibility necessitating blinds (notably in secondary schools where large numbers of classrooms have been equipped and less attention may have been paid to detail during procurement). It is important to position projectors so that they do not shine directly into teachers' eyes as this is a potentially serious health hazard.

Teachers are producing or acquiring resources for use with whole-class technologies and sharing these as well as storing them for future re-use. The evaluators observed some very creative uses of presentation software. Pace is significantly increased when a range of resources have been assembled in advance: teachers often 'called up' these pre-prepared resources with a touch of the pen or mouse as they moved from one section of the lesson to the next. One teacher commented that initially she used too much PowerPoint and came to realise that although the children enjoyed it, they were passive. She had started to adapt the resources to build in more student activities. In much of the best presentation, the pupils themselves wrote on the board and responded to the displayed material.

Whole-class technologies fit well with existing whole-class teaching approaches. Lessons in primary schools tended to follow fixed formats, with individual tasks rather than collaborative or interactive work set in the middle stage. The evaluators observed some individualised activities in all sectors, but in many instances whole-class technologies remained didactic tools, improving classroom ambiance rather than learner autonomy.

In classrooms with 8-foot screens, a computer, data projector and wireless tablet together offer similar functionality to a whiteboard and can be used with similar software, enabling teachers and pupils to move letters around the screen, highlight text and annotate material as well as interact with any program. Where visualisers are used they are not in themselves 'interactive', but pupils can use them to demonstrate their completed work and teachers can project and magnify whatever is being done under the camera – demonstrating wiring a plug or dissecting a flower. The advantage of both the visualiser and wireless tablet for pupils is that they are writing in a plane they are used to (that is, horizontal like a desk, not upright) and use natural sized handwriting which is blown up on the large screen. In many schools these resources have been introduced in phases and therefore teachers' expertise and confidence with the various elements is currently more variable.

Almost all lessons with an interactive whiteboard observed in schools took place in a classroom rather than a computer suite, but this was not the case in the FE colleges. Laptop or desktop computers were available in primary school classrooms as a resource for individual or group work and in one exceptional Year 6 classroom we saw pupils move easily and quickly from the IWB session to using their own personal laptops. By contrast, a similar transfer to laptops took twenty minutes in one of the FE classrooms.

It is clear that whole-class technologies have the potential to transform classrooms and, in some cases, are already doing so. However, questions remain to be studied as the ICT Test Bed project moves into its third year.

Teaching and learning – questions remaining to be answered

- What is really innovative when using whole-class technologies? Will it be sufficient if we see an accelerated curriculum but not an enriched curriculum as a result of this investment?

- How can whole-class technologies be used effectively to ensure differentiation? Do whole-class technologies work against the policy drive for personalised learning?

- What is the actual state of teacher development across all ICT Test Bed classrooms (as opposed to a selected group) in terms of skills to use whole-class technologies?

- There is a huge perceived need to develop, manage and store resources for use with whole-class technologies. How can teachers best be assisted in doing this?

- Does the investment represent value for money? Some FE teachers we interviewed were not convinced it was, and responses in secondary schools, where levels of equipment often still vary significantly between departments, were less wholly enthusiastic than in primary schools.

Summary of findings

Leadership and management

The ICT Test Bed Project poses major challenges for leadership and management at all levels: classrooms, departments, institutions and, in the case of the schools, the local education authorities (LEAs). Through hard work and commitment considerable progress has been made in meeting these challenges. Each phase of development has required a different kind of support and there have been problems in keeping educational vision at the forefront at the same time as coping with the imperatives of organising installation and solving logistical problems.

This report focuses on the planning and installation phase of ICT Test Bed in the colleges between October 2002 and March 2004. Future reports will focus on leadership in the colleges and across the whole cluster in the main implementation and consolidation phases.

All three LEAs welcomed the project and perceived its purposes as being focused on teaching and learning and school improvement. All three found it easy to engage with ICT Test Bed's aims because the project was perceived to fit in well with existing policies. The three clusters set up very different management structures. In one, ICT Test Bed was managed directly by the heads of the cluster schools, with the secondary head (later replaced by a primary head) chairing management meetings. This LEA appointed a Link Officer to liaise between the cluster and LEA officers. The other two LEAs appointed ICT Test Bed Managers who chaired meetings with heads and ICT co-ordinators. One set up a management structure which separated decision-making between capital expenditure (the Executive Board chaired by the Chief Inspector) and revenue expenditure and implementation (the Management Board made up of heads). The other, partly because of its small size, decided against a formal management structure. In both, decision-making was made by heads on the basis of information and advice provided by the ICT Test Bed Manager. A significant difference between the school-led and LEA-managed approaches was the number of meetings attended by heads, which were weekly in the former and never more frequent than monthly in the latter.

The Action Planning process carried out during the first six months served to orientate heads and staff to the possibilities and challenges of ICT Test Bed. However, it was unhelpful that initially plans had to be drawn up separately from existing plans such as school development plans. In two of the LEAs the ICT Test Bed plans were later integrated with school development plans to produce an implementation plan which proved to be much more valuable. In future, such planning should be embedded in existing plans from the start. Another problem was that delays in procurement and installation were not anticipated, although they should have been from the experience of previous large-scale ICT projects.

Delay was frustrating and also stressful as heads, college managers and their staff felt under pressure to produce measurable improvements in children's national test scores and examination results within a year, and this was clearly impossible. Stress levels were increased because in most cases heads had seriously underestimated the amount of time that would be needed for management. Heads found it very difficult, even with plenty of professional advice, to develop a vision for ICT in their school, because they had no prior experience to draw upon. The visit of the heads in one of the clusters to an innovative primary school in another LEA was a good example of the kind of vision-building training that can build mental models of what is possible.

Successes of leadership and management include the following:

- ICT has been embedded in teaching and learning in almost all primary classrooms and many secondary and FE classrooms through the use of whole-class technologies such as interactive whiteboards.

- Change management consultancy provided by the national remodelling team in the second year was greatly appreciated and had a noticeable impact in many schools.

- Home and community links proved difficult to establish within budget, but all three clusters are now making significant progress.

- In one cluster, ICT Test Bed provided the funding to develop, trial and implement a custom-built suite of whole-class teaching technologies with the support of a well-established commercial provider. This may well be attractive to other LEAs.

Many problems were encountered and addressed with commitment and resilience:

- The sheer scale of the initiative made implementation difficult, requiring phased development over time.

- Procurement of complex, networked software packages such as virtual learning environments and management information systems proved to be very time consuming. In all three clusters, it took approximately two years before these systems were installed and beginning to be used in schools.

- In one of the clusters, there was a large number of thefts of ICT equipment that disrupted teaching and caused frustration, as well as leading to considerable unforeseen costs in strengthening security provision.

- Long-term sustainability is seen by all heads and their staff as a very significant problem. Expectations of staff, pupils and parents have been raised by ICT Test Bed but it will not be possible to meet those expectations in the long term without funds to replace out-of-date equipment and provide necessary support staff such as technicians and technical managers.

- Ofsted inspections have disrupted development work for periods as long as three months in many schools subject to inspection.

Workforce development

ICT Test Bed provides the opportunity to see if ICT can be used to improve the efficiency of workforce deployment and, as a result, improve the working conditions of teachers and the educational service provided to pupils. Matters of particular interest to policy makers are the potential for ICT to:

- reduce teachers' workloads

- enable teachers to share resources and re-use them

- enable staff with different roles to work more flexibly together

- increase the efficiency of record keeping and retrieval of records.

This is a developing area of ICT Test Bed work which has depended on the installation of new resources, such as management information systems with better functionality than previous MIS, and the development of new working practices. The examples of good practice in this report suggest that considerable gains are likely to be achieved over the next two years.

A large number of teachers and some classroom assistants have been given a laptop for their own personal use and find that this makes it easier to prepare lessons and carry out administrative tasks efficiently. Staff also find 'memory sticks' (sometimes called 'thumb drives') are an easy way of transferring files between home and school.

The technology-rich schools and colleges in ICT Test Bed have an increased need for good technical support, because once it is the norm to conduct lessons using ICT, any breakdown in the equipment or the network is extremely disruptive. In-house technical support has therefore proved to be essential, so that technicians can solve technical problems quickly and easily.

Considerable time savings have already been made in those schools where teachers are able to store and access information directly on the school server. Where a teacher's computer is also linked to whole-class technologies this information can be collected communally, for example during registration, and pupils can easily be given reminders. Pupils also find it very helpful when information and 'reminders' are displayed on interactive whiteboards. In one school which had moved to electronic lesson planning, the head had surveyed staff and found evidence that it reduced their workload.

Teachers are investing considerable energy in creating resources for teaching. In the study of teaching with whole-class technologies (see Teaching and Learning above) the evaluators observed teachers with very high skill levels in finding, creating, putting together and manipulating web-based resources,

digital and scanned images, sound etc. It was often difficult to distinguish between these resources and commercial products. Given many teachers' expressed lack of knowledge and experience with ICT prior to the start of ICT Test Bed, their confidence and competence with technology is remarkable. Teachers justify their time investment in producing resources because such resources can be shared and also stored for future use.

The selection of resources from the increasing body of material available on the internet or school and college intranets is posing a growing problem. This is time consuming for individuals and some form of critical appraisal and annotation is essential, but it is not easy, particularly as teachers work in different ways, with very different pupils and have different needs. In some ICT Test Bed institutions, subject co-ordinators or departmental or college ICT champions are taking on some of these responsibilities.

A case study was carried out of technicians' work in one cluster where newly-appointed ICT Test Bed technicians had been required to attend a classroom assistant training course to broaden their role. This was a particularly interesting initiative although it was not possible to identify any clear outcomes. One thing learnt was that when providing such training it is important to make explicit links between the broad support role and technicians' primary role of ensuring the functionality of equipment. Technicians in our study were proud of their technical expertise and conscious of having a heavy workload, hence they did not express much interest in carrying out learning support work. Several heads also expressed reservations about any widening of the technicians' role. Nevertheless, some technicians said they enjoyed assisting teachers in their use of new software and equipment, and in practice, whatever their expressed opinions, they all described taking part in a range of activities in which they supported learners who were using ICT equipment.

Another case study was carried out involving two schools in which learning support assistants had been given laptop computers for their use both at work and at home. The changes which this brought about in their working practices and ICT skills were generally positive and suggest that this work should be extended and/or better embedded. In one school, where the work was focused on a clearly defined team supporting children from minority ethnic families, considerable gains were achieved in efficiency (particularly in storing and accessing pupils' individual records) and motivation. In the other school, where laptops were given to all LSPs, the need to introduce new procedures and provide training for such a large, diffuse group was challenging and only limited progress was made in the first year. There are some health and safety issues to be addressed in relation to both the weight of laptops and vulnerability to attack and theft. Some LSPs preferred to use a memory stick to transfer files between their laptop at school and computer at home.

Summary of findings

Collaboration between cluster institutions

The first of two cluster-wide ICT Test Bed themes is the use of ICT to develop more effective collaboration between schools and their linked college. This is an important part of Government policy to provide pupils with more continuity and coherence of educational experience as they move from primary to secondary schools and into further or higher education.

The formal meetings and informal discussions that have taken place over the first two years, in order to plan and take decisions, have provided an ideal basis for beginning to share resources and undertake joint projects. ICT Test Bed schools and colleges have excellent electronic networking which makes communications easier once habits of use are established. The installation of virtual learning environments in two of the clusters provides a repository for teaching resources to enable sharing but the process of assembling these resources is only at an early stage.

The colleges are independent organisations which are not, like the schools, under the governance of an LEA. The establishment of links between the three colleges and their cluster schools was, therefore, not easy, and they have developed at different rates. In one cluster the college is a very active partner and has organised training days for school staff and taken a lead on developing home and community links. In another, as a result of major college re-structuring and a change in the ICT Test Bed manager, collaboration has progressed much more slowly. In the third, which has also had a change in the ICT Test Bed manager, collaboration is now developing well, for example through a college-based workshop to develop e-learning resources.

In a study of the use of whole-class technologies in 24 classrooms, the evaluators saw evidence of collaboration in the development of resources between school subject co-ordinators across the cluster. The college in one cluster has established a content-development workshop to support teachers in developing e-learning materials. This supports more effective use of the college's VLE by college tutors, but is also a resource for use by staff from cluster schools. School and college staff can use the well-resourced workshop to develop materials with the help of three full-time materials' developers. The logistics of school staff travelling to the college to make use of this facility have proved difficult. Video-conferencing links are planned but are not yet in use. Nevertheless, schools perceive college staff as friendly and supportive and there are some cases where interactive resources have been collaboratively developed.

The evaluators carried out a case study of a collaborative project in one cluster, using Apple Macintosh computers and professional standard digital cameras and software. The original aims were to establish a pool of specialist equipment at the college for use by schools, to develop vocationally-appropriate skills in school and college students, and to create a public website to enhance pupils' motivation for carrying out assessed course work. The logistics of sharing equipment proved complex and somewhat limited the possibilities for independent work and creativity. It also proved difficult for school pupils to visit the college because of the need for them to be accompanied by a member of staff. Use of the professional digital equipment enabled pupils to generate ideas rapidly and produce new forms of outcomes, giving them a better chance of realising their potential. However, the digital medium also encouraged a way of working that involved taking – and discarding – many more pictures and did not fit well with the assumptions of an external assessment process designed for traditional media where each step in the process of production could easily be collected and displayed in a portfolio.

Home and Community Links

The second of the cluster-wide ICT Test Bed themes is the use of ICT to improve communications with parents and wider community, and provide pupils with access to computer-based learning materials from home to help raise educational standards.

This theme caught the imagination of all the participating schools and colleges from the beginning. However, implementation proved very challenging for two of the clusters that started with the assumption of providing a computer in every home. In the third cluster, initial aims were more varied and, perhaps, more realistic. Although in all three clusters this aspect of ICT Test Bed work was a lower priority than others, work in one cluster commenced more quickly because it did not involve major procurement decisions. This report provides an overview of progress in this cluster (Cluster A) and case studies of the roll-out of new computers to homes for all schools in Cluster B and a vertical group of three schools in Cluster C. This took place in the summer of 2004, after a lengthy process of decision-making and procurement.

In Cluster A there was evidence of good progress in strengthening informal contacts with parents by networking ICT-equipped community rooms to primary schools. In this rural environment, education is not easily available to the whole community. The college was successful in encouraging adults back into education through equipping outreach centres with ICT and running taster courses in digital photography. It also used ICT to link with students and employers during placements. Connectivity in this rural area is problematic and this was a factor in the decision not to attempt to link large numbers of homes with schools electronically. One primary school greatly increased the ICT skills of Year 6 pupils of average ability by providing them with laptops for their sole use for a whole year. Similar initiatives in other schools, loaning laptops and digital cameras for shorter periods, greatly increased pupils' motivation and established closer links with parents. College technicians supported the two secondary schools (one a special school) in placing reconditioned computers in pupils' homes and achieved very positive results.

In Cluster B the allocation of computers to all pupils' homes created a strong feel-good factor. However, providing connectivity so that homes and schools are electronically linked has proved to be problematic and this is not yet in place. The key aim was to allow pupils to engage in out-of-school learning by giving them access from home to integrated learning software (ILS), curriculum resources and instructions about homework. There was considerable optimism that this would raise standards of attainment for pupils in this area of socio-economic deprivation. The intention is to provide a wide range of learning materials through the VLE. The intention is also to provide learning opportunities for parents and encourage children and their parents to work more closely together on schoolwork. There may also be administrative advantages in parents having electronic links with the school. Electronic access to information and services would also fit with Neighbourhood Renewal objectives. It is too early to provide evidence of impact, but early indications are very positive. The procurement and roll-out of the computers was a huge and time-consuming administrative task, but the whole process was meticulously planned over a long period of time and very well managed. Some challenges remain, however:

- It has not yet been possible to find the additional funding necessary to provide homes with connectivity (the hope is to provide them with broadband) or appoint the personnel needed to manage this extended initiative. The intention is to establish a virtual learning environment from which resources can be downloaded to homes but at present children are being issued with CD-Roms with resources for use at home.

- Once the VLE is established there will be a considerable need for professional development for teachers to enable them to produce appropriate resources.

- Recovering and re-issuing computers, as children and their parents move on, is likely to become a considerable problem in this very mobile community.

- All schools are concerned about how to sustain this initiative in the long term as equipment ages.

In Cluster C the original intention had been to place computers in all homes and establish network connections between homes and schools. In an urban environment with good broadband connectivity widely available this seemed feasible at first. However, costs proved to be prohibitive, particularly as the composition of the cluster, with three secondary schools, meant that many more families would have been involved than in Cluster B. However, one of the secondary schools retained the original vision and new computers were placed in homes of pupils in a 'vertical' mini-cluster of this school and its ICT Test Bed feeder junior and infants' schools. The origin of the initiative in the secondary school meant that the other two schools were only included at a late stage in the planning and, probably as a result, communications with parents and other administrative matters became logistically complex and confusing. As in Cluster B, the whole process was very time consuming. Nevertheless, all concerned remained enthusiastic about the potential of the initiative to raise pupils' standards of attainment. The experience of these schools clearly shows the complexities of communicating with parents and the importance of doing so effectively even when offering something that the school assumes will be greeted with enthusiasm.

Summary of findings

ICT Test Bed from the inside – evidence from action research carried out by teachers and para-professionals

This section of the report is based on a cross-case analysis of 23 action research studies of innovative ICT Test Bed work carried out by teachers and para-professionals. These studies make two major contributions:

- 'Insiders' provide unique knowledge and insights of the experience of participating in the ICT Test Bed project which would otherwise be inaccessible to the evaluators

- The process of carrying out action research provides a powerful incentive to engage more fully with the ICT Test Bed Project's aims, and constitutes a significant form of continuous professional development.

The process of reading the reports in the light of one another, including systematic mapping of contents, cross-checking of themes and meta-analysis to look for trends and gaps, generates more reliable knowledge than can be produced by a single action research study. References are given throughout to the action research reports on the ICT Test Bed Evaluation website **www.evaluation.icttestbed.org.uk**

What interests teachers most about ICT Test Bed

Teachers' main interest in ICT Test Bed, as indicated by their choice of research areas, is the use of ICT for teaching and learning: the 23 studies cover almost all the main areas of policy in curriculum and learning (for example the literacy and numeracy strategies and special educational needs). The majority of studies also provide insights into teachers' professional development in ICT.

The leadership and management theme is not addressed directly, but it is clear that these studies have been carried out in institutions where there is a developmental, risk-taking approach to using ICT, and this has implications for understanding the impact of leadership styles and philosophies on institutional cultures and openness to experimentation and change.

A few teachers used statistical data to illustrate general trends, but at this early stage no real evidence could be presented of children's improved attainment as a result of ICT use.

Teaching and Learning

Most studies of primary teaching and learning centred on teachers' use of the IWB or large screen and visualiser. These technologies allowed teachers to present complex concepts with greater clarity and engaged learners' attention much better than traditional whole-class presentations. Learners appear to be highly motivated by IWBs. However, the emphasis in these studies was on improved presentations by the teacher, rather than on using the IWBs to stimulate pupils' social interaction. This trend in these studies fits with the evidence from the external evaluators' observation study that these technologies may not be immediately supportive of personalised learning or differentiation. Three studies explored the impact of using ICT for writing on pupils' motivation to attend to matters of grammar, punctuation and spelling, but there was no commonality of view between them.

FE teachers described very different ways of using IWBs from primary teachers. Two studies focused on using ActiVote to improve the confidence of low-achieving 16–19-year-olds. Both suggest that participation of this kind improves students' confidence and one shows high levels of motivation when researching subject-knowledge to create quizzes for other students.

Most of the studies, across all sections, suggest that the use of technology of all kinds raises learners' self-perception and confidence. Two show radical improvements in the concentration spans of children with special needs such as autism. A third study shows considerable gains for an FE student with a stammer through developing an electronic portfolio. In another FE study students stated a strong preference for interactive teaching of technical matters, declaring that they strongly disliked the normal practice of being asked to learn ICT skills by completing individualised worksheets.

Across all sectors, these studies suggest that problem-solving, creativity and critical thinking are most in evidence when individuals or groups have direct 'hands on' access to technology such as laptops, CAD, and digital video and animation. With direct access there appears to be an increase in students' ability to initiate activities. Group work with technology also appears, from these studies, to improve students' social and collaborative skills.

Continuing Professional Development

These studies show teachers' commitment to exploring the possibilities of ICT. There is excitement about what has been achieved but no complacency: many studies end with questions for further research.

Of particular note is the evidence of teachers' greatly increased skills in using ICT, especially whole-class technologies and digital imaging/animation resources. Many describe adapting software to meet learners' needs. There is no mention of skills acquisition having been problematic. Teachers appear to be attracted by the opportunity for creativity or developing a distinctive identity for themselves within their school or college. They seem to find that ICT helps to improve their status and some are explicit in saying that they want to avoid being 'left behind'.

The studies suggest that for some teachers, ICT Test Bed has helped re-create the primary rewards of teaching arising from successfully meeting learners' needs. Thus learners' improved confidence and self-image is mirrored in teachers' improved self-esteem. Many of the studies record teachers' satisfaction in developing resources with ICT.

Overall, the studies suggest that ICT is helping teachers to make radical improvements to traditional methods of teaching and learning, but only a very few show evidence that ICT has resulted in a move to new kinds of pedagogy with more emphasis on personalised learning and creativity. However, it is clear from the studies that IWBs are helping some teachers to be very creative in producing new teaching materials. These studies suggest that ICT is having a major impact on relationships in the classroom, but little impact on roles: the roles of teachers and learners are reinforced but the ambiance of the classroom is radically changed.

Workforce remodelling

The two research studies carried out by para-professionals illustrate how ICT has allowed them to develop new roles, providing new kinds of support for teachers and learners. In one case, exploration of literacy and numeracy software packages improved a classroom assistant's understanding of assessment and enabled her to talk to teachers and the head with greater confidence and enhanced professionalism. In the other case, a web designer found that in-depth support for FE teachers in developing digital portfolios greatly decreased their need for support in the longer term.

1: Background

The ICT Test Bed Project is a large-scale initiative which potentially involves the participating schools and colleges in major changes to all aspects of their work. The commitment and enthusiasm of a very large number of staff, senior managers, pupils and parents has been extremely impressive.

Funding during the first year was allocated to the schools in two phases: each cluster received £1 million as an initial investment plan in November 2002 and across all three clusters a further £13 million was allocated in March 2003 after the DfES had accepted their action plans (the exact sum varying according to number and size of schools). Colleges received £850,000 each in year one, allocated in March 2003. The deadlines for spending were very tight (July 31 for schools and August 31 for colleges) leading to some underspends being carried over to the next year. Funding for subsequent years, after the main procurement phase was completed was (and will be) at lower levels (for schools and colleges combined approximately £6.5 million for 2003-04; £3 million for 2004-05; and £2 million for 2005-06).

The implementation of a project of this scale takes a considerable period of time and the work has fallen into distinct phases:

- The first 11 months' work (October 2002 – August 2003) was a time of planning, procurement and the installation of ICT infrastructure, a time during which heads and their staff faced a major challenge of management and organisation, assisted in various ways and in varying degrees by their LEAs, as well as by the Becta Implementation Team. Spending the money wisely, to deadlines, was a major responsibility for all concerned.

- By September 2003 most of the equipment was in place and contractors (suppliers, electricians, carpenters, plasterers etc.) had left the buildings. The period of disruption was over and staff were able to turn their full attention to how best to use the new ICT resources.

- By December 2003, considerable progress had been made with the integration of ICT into teaching and learning through the use of interactive whiteboards or specially tailored suites of large screens, data projectors, computers, visualisers and graphics tablets.

- During 2004, schools and colleges turned their attention to the installation of a second wave of technologies – laptop computers linked to wireless networks, virtual learning environments and management information systems – some of which were delayed because of lengthy procurement processes of up to a year. In some schools there was also a special focus on digital imaging, including video-recording and animation work using specialist hardware and software, and in two clusters the colleges played a leading role in supporting this work.

- Collaboration between the cluster schools and their partner college developed at different rates over the two years as a result of major restructuring in one college and changes in ICT Test Bed management in two colleges. By December 2004 this was very well established in two of the clusters and developing in the third cluster.

- The three clusters took different approaches to using ICT to link with pupils' homes and the community but where this involved installing computers in homes, the main thrust of the work took place in the summer term of 2004.

- From September 2004 the level of support for ICT Test Bed from Becta was scaled down as schools and colleges moved out of the implementation phase into the main phase of consolidation and maximising outcomes.

- By December 2004 almost all the equipment was in place and in use, with the exception of one cluster which had still not installed its planned video-conferencing equipment. However, considerable work still remained to be done in all three clusters to make complex new facilities such as management information systems and virtual learning environments fully operational, since they require the development of new procedures and materials.

2: Progress against the base-line: a comparison of the perceptions and attitudes of ICT Test Bed participants between years 1 and 2

This section of the report is based on self-reported assessments and perceptions. As with all such data, there are some question marks over the equivalence of responses across the sample. It should also be noted that the composition of the sample will necessarily differ over the lifetime of the evaluation as pupils and staff leave the ICT Test Bed institutions. However, drawing the sample from equivalent groups each year ensures that the comparative nature of the data is maintained. The data is presented by educational phase for pupils, but globally for teaching staff, non-teaching staff and parents. Where significant differences appear by phase in these latter groups, they are clearly indicated in the report. Here we are reporting both trends and statistically significant differences, and the latter are also clearly indicated throughout the document.

Key Stage 1 Pupils

The Key Stage 1 findings are based on a sample of 617 pupils in 2002–03 and 675 pupils in 2003–04 from nineteen schools, including the one special school in the project. The questionnaire for these, the youngest, pupils was considerably shorter than that used with other groups, resulting in a reduced data set.

- Significant decreases in the use of CD-Roms, printer, scanners and email were reported by children in the mainstream schools. All other aspects of ICT use showed gains, although none reached statistical significance which indicates that whilst the use of ICT has increased at Key Stage 1, it has not done so substantially.

- Children at the special school reported a significant increase in positive attitudes towards those lessons that incorporated ICT. They also reported significant increases in their use of computers for game playing, but a decrease in their use of drawing software packages.

Key Stage 2 Pupils

The Key Stage 2 findings here are based on a sample of 1002 pupils in 2002–03 and 1519 pupils in 2003–04 from nineteen schools including the special school.

Attitudes:

- The overwhelming majority of pupils report using ICT in their learning, which is a significant increase on the first year. This increased activity is not confined to the classroom: another significant change is that the extent of use of computers at home and school is now similar.

- There is also a statistically significant increase in positive attitudes towards computer use. This enjoyment in using computers is linked to a trend in increasing competence with computers, reflected in the children reporting a 40% reduction in seeking help. When they do need help, asking teachers still remains the first option for this group. The special school pupils also reported a rise in confidence (65% compared with 39% in 2002–03), although this difference was not statistically significant owing to the very small sample size.

Usage:

- At school, children reported that their use of presentation software and digital cameras had increased significantly. By contrast, there was a significant decline in the use of CD-Roms and drawing/painting packages. This may be indicative of a shift from resource collection to more creative uses of ICT. Activities at school are mirrored by activities at home, with significant positive correlations between home and school use.

- The special school pupils also reported using more presentation software and scanners whilst proportionally their use of databases, CD-Roms and word processors all decreased. Their home use of ICT similarly showed a decline in the use of CD-Roms, drawing/painting applications and a marginal decrease in use of the scanner and the internet at home. (In neither case were these changes statistically significant, however.)

- There was a significant increase in the numbers of pupils reporting that the schools were supporting and encouraging their use of ICT at home, with many more children reporting that they were reading school emails at home and were completing school work online. There was also a surprising increase in the numbers of pupils stating that expert help was available at home from parents.

- Children reported considerable changes in the use of ICT in lessons. This covered all aspects of use, but particularly increases in the use of electronic presentation equipment (whiteboards and visualisers) both by teachers and pupils themselves, email and the internet, and teachers using a computer to explain things.

2: Progress against the base-line: a comparison of the perceptions and attitudes of ICT Test Bed participants between years 1 and 2

Secondary Pupils

The secondary pupil findings are based on a sample of 1540 in 2002–03 and 1305 in 2003–04 from five secondary schools.

Attitudes:

- Although in general attitudes to school and class work were positive, there were significantly more negative responses to school as a whole in this the second year of the project. This might be a sample issue or it could be a loss of the 'halo' effect for ICT, so that the second year's responses reflect a more normal distribution of largely positive pupils alongside a small but significant group of disaffected pupils.

- On a more positive note, secondary pupils reported a significant increase in confidence levels when working with ICT. This was coupled with a statistically significant increase in the number of pupils that reported using a computer at home on a daily basis from 50% in 2002–03 to 93% in 2003–04.

- There were significant increases in pupil satisfaction with the hardware and software that is available to them in school. Equity of access also appeared to have improved, with fewer pupils stating that they require easier access to a computer at home or school to encourage them to engage with ICT on a more regular basis. The cost of internet access was also perceived as being significantly less problematic this year, with fewer pupils indicating that this was a potential barrier to their use of computers.

Usage:

- As in Key Stage 2, use of presentational software has significantly increased in the last year and there have also been marginal but significant increases in the use of virtual learning environments, digital cameras and scanners both at home and school.

- The proportional shift from word processing and other standard applications to an emphasis on the use of the internet found at KS2 was also reported at secondary level. There was a significant reduction in basic tool use both at home and school.

- There was very encouraging evidence that ICT is now becoming more embedded in the curriculum, with pupils reporting a greater range of teaching methods as a result of ICT usage. This was found across the curriculum, although some curriculum areas are more advanced than others. Pupils reported the biggest changes in science, followed by English and then art, all of which demonstrated significantly higher uses than last year. There was the least change in modern foreign languages, although even here pupils reported significant gains in their answers to four of the ten questions relating to teaching style and ICT.

FE Students

The FE findings reported are based on a sample of 262 students in 2002–03 and 197 students in 2003–04 from three FE colleges. These students were drawn predominantly from those courses which have received ICT Test Bed funding, but other students are also included since all three colleges have invested in cross-college ICT facilities such as virtual learning environments and management information systems.

- An overwhelming majority of FE students indicated that they enjoyed attending college and completing coursework and there were statistically significant increases in the number of students reporting higher levels of confidence and experience of using ICT. One of the largest changes was in the number of FE students reporting the need to learn to use a computer.

- The numbers of students reporting daily or frequent uses of a computer both at college and at home has increased significantly: the largest increases were in the daily use of college computers, although daily use at home is still the favoured option.

- FE students reported no preference in searching for information from paper or digital resources.

- Students reported increases in the use of most ICT applications both at college and at home, with significant increases in college use of presentation software, communication software, basic tools such as word processing and use of virtual learning environments. The FE students' home and college use of a computer were highly correlated, indicating that they use the computer for similar activities at both home and college.

- FE students reported a more even balance between the use of expository teaching methods and more active and engaging methods enabled through ICT than the secondary students. However, they reported that little support was available to them from the college for ICT use in the home environment. For example, institutional software or hardware was not reported as being available for use at home and access was not generally provided to the institution's network from a home computer. Access to institutional websites from home was the only kind of college support available to the majority of students.

- The main perceived barriers to internet use related to the cost of computer hardware and software as well as internet access at home. Time constraints and the students' own computer skills were of much less concern, although all possible sources of concern were rated much higher by FE students than secondary pupils. There were no significant differences found between FE students' attitudes to internet use in 2002–03 and 2003–04.

Parents

The findings reported here are based on a sample of 1081 parents in 2002–03 and 1273 parents in 2003–04 with children in both the primary and secondary sectors. Parents of FE students are not included in the sample.

- Parents reported a small but significant increase in the use of electronic communication with schools, although the most common method of schools contacting parents continued to be sending a letter home with the child. Electronic communications largely took the form of email messaging and providing access to pupils' progress reports on the Web. Interestingly, parents also reported a significant decrease in contacting schools by telephone. They tended to be satisfied with the schools' attempts to keep them informed.

- Parental awareness of the ICT facilities available in school was high, with a majority considering the facilities to be either 'good' or 'very good'.

- 85% of parents reported having access to some form of computing facility at home. This is a significant increase of 6% since the first year. There was also a significant gain in parents' perceptions of how well they were equipped to assist with their child's computer use at home, although competence levels are still quite varied. The most common response in terms of providing help for their children when using computers was that they felt they were able to encourage their children to use a variety of programs. However, there was still a sizeable number of parents who said they encouraged their children to use computers independently at home.

- Parents reported using computers themselves at home or in the workplace; very few used them in public libraries. The location of ICT facilities in the home is split between public spaces (living room) and more private spaces (a bedroom). Interestingly there was a definite trend for parents to make more use of computers in the living room, and for children to make more use of computers in bedrooms. Whilst this trend was slightly visible last year, it has become more apparent owing to the general increase in levels of computer use.

- Children's use of a computer at home was regularly monitored and as a result of this, parental concern about dangers was generally low. However, there was a small but statistically significant increase in parents' concerns about the websites their children look at and the activities they use a computer for.

- Parents said that cheaper or free internet access would encourage them to use the internet more often, as would having more free time. This finding is similar to that emerging from the FE student data and is unchanged from last year.

Staff

The findings reported here are based on two sets of questionnaire responses: those designed for teaching staff and those designed for non-teaching staff from across all three phases. The total number of teaching staff completing the questionnaires in 2002–03 was 802, and in 2003–04 was 482. Support staff figures mirrored these totals, with totals of 447 in 2002–03 and 225 in 2003–04. This is a disappointing return and we would not want to see any further erosion of the sample in year three of the evaluation.

As with the previous questionnaires, tests of difference were applied to this data to establish where significant changes in responses had taken place between the first and second years. It was necessary to include all sectors in one analysis as there are very small numbers of staff in the nursery and special school and there was a small response rate for the FE sector. The vast majority of questions for both staff types reflected significant positive changes between the two years and for this reason we have not indicated for each question that the change was significant. Rather, those questions for which there was no statistical significant difference have been clearly marked in the following text.

Skills and competencies

- Staff across all sectors reported increased confidence when using ICT and a significant increase in skill levels. They also reported an increase in the amount and quality of training they had received. It appears to be the case that improved access to high-quality training has resulted in increasingly positive attitudes towards ICT use, even amongst the most reticent of users. All staff reported enjoying working on computers and felt that they help to improve productivity and reduce workloads.

- Positive attitudes have resulted in a significant increase in the number of staff reporting regular use of a computer; for example, the number of FE support staff reporting daily use of a computer has risen from 63% to 90%.

- There have been significant increases in the number of staff reporting institutional provision of ICT for use at home, although non-teaching staff across all sectors report slightly lower levels of provision than teaching staff.

- Staff reported the highest level of ICT competencies for applications such as word processing or using the internet or email. FE staff reported far higher levels of use of email than the parents or any of the student groups, and knowledge and use of email was marginally higher for teaching than support staff in FE. The only question in this section not to show a statistically significant gain between the first and second years was teaching staff knowledge of multimedia applications across all sectors.

- FE support staff generally spent more time using ICT for supporting learning and whole-college activities than for other tasks. The FE teaching staff allocated most of their time using ICT to working directly with students, which was also true of the primary teaching staff. Secondary teachers reported using ICT predominantly for supporting learning closely followed by working directly with students, which was the same pattern as for the primary support staff. ICT use for general administration tasks was the primary use of ICT for secondary support staff.

2: Progress against the base-line: a comparison of the perceptions and attitudes of ICT Test Bed participants between years 1 and 2

ICT access and support

- Daily use was much higher for primary and secondary teachers than support staff, both at school and at home. Access to ICT was largely in the home or school for both support staff and teaching staff and there was little use of facilities in other locations such as libraries. Levels of ICT hardware and software in the schools and colleges were reported as satisfactory for the needs of both teaching and support staff.

- Informal training such as help from a friend or colleague formed a large part of the training received by staff, particularly the support staff. More formal training was less frequent, and minimal training had been provided for authoring software, content management software (VLEs) and management information systems (MIS).

- Half to three quarters of all primary and secondary teachers and support staff were able to access help when using ICT. Help at home was less frequently available than help at school. Provision of ICT for home use was generally in the form of the school issuing laptops. Teaching staff were the main beneficiaries of such provision.

ICT as a motivator for students

- Staff from both primary and secondary sectors were agreed that ICT motivates students to learn; and teachers from all sectors, but particularly primary teachers, felt that taking more pride in their work is the main motivator for pupils when using ICT in learning rather than grades and competition. However, FE teaching staff held a wider range of views about the role of ICT in motivating students.

- The main uses of ICT in FE teaching were reported as teachers using ICT to present information and prepare resources, and teachers engaging students in discussion, explanation and demonstration possibly using an interactive whiteboard.

- The majority of FE teaching staff indicated that their students predominantly used ICT to help them learn about a topic, recall and report information.

- Teachers' reports of students using internet and email in class time, either within or outside the classroom, across all sectors were relatively low in general. FE teachers reported higher levels of these activities than either primary or secondary teachers, although all sectors had increased their use from last year.

- Teachers in schools and colleges also reported an increase in collaboration between students using ICT in lessons.

Views and attitudes

- Both teaching and support staff at primary and secondary level reported positive perceptions on their quality of life. There was a more mixed response from staff in FE. While staff were generally positive about working in college, responses in the 'agree' and 'strongly agree' categories were at least 11% higher from support staff. However, support staff views on the amount of free time they have, feeling valued and enjoying work showed no statistically significant differences.

- Views on institutional leadership and management and the schools as organisations were encouraging; with staff generally indicating satisfaction with the school's direction and leadership. Collaboration between staff was reported to be better for primary schools than for secondary. In the two colleges which completed this section of the questionnaire, college management and leadership styles were also on the whole regarded in a positive manner. Positive responses were, however, lower for college support staff's views on clarity of aims and collaboration within staff, and college teaching staff's views on leadership and support for staff.

- Roughly half of the respondents from schools agreed that their school's management of resources was satisfactory in terms of appropriate class sizes and use of ICT in managing resources. Primary support and teaching staff were more positive about their schools having a well-designed timetable than the secondary staff, although the secondary staff were not unduly negative.

- In the two colleges which answered this section, decision-making procedures attracted mixed responses from support staff and negative responses from teaching staff. However, teaching staff gave more positive than negative responses in relation to joint planning between teachers and classroom/learning assistants, which was in agreement with the responses from support staff.

Note: One college requested the removal of section 4 from their staff questionnaires. This section covers issues of institutional leadership and management and staff quality of life.

In summary

What has changed?

The overall findings from the year two surveys of staff, student and parent attitudes are encouraging.

They record increased activity in teaching and learning with ICT and a widening of participation across institutions and phases, and suggest some indication of more varied teaching and learning styles. Pupils recorded a significant increase in the use of presentational software in all sectors and there is some evidence of a shift to greater use of email and the school's intranet.

Confidence and competence in ICT usage is growing steadily across all participants in our survey, including parents.

There was a significant increase in the number of FE students reporting the need to learn to use a computer.

Although these are early days, the establishment of home–school links is promising for future development. At Key Stage 2, more children reported that the school was supporting their use of ICT at home. This may represent the homes of younger children 'catching up' with the facilities already available to secondary pupils. The parent data showed a significant increase in access to computer facilities at home, from 79% in 2003 to 85% in 2004.

There is also a significant increase in the number of staff who have computers at home provided by their institution, but this shows a bias towards teaching staff rather than support staff. Staff, in particular support staff, reported that a large part of their ICT training had been in the form of informal help from a friend or a colleague rather than formal training.

What has stayed the same?

Use of basic tools such as word processors, databases and spreadsheets has generally remained static for all user groups except FE students, where there has been a slight increase in usage. All groups report frequent use of these tools with a majority of users reporting daily or at least weekly usage in years one and two of the project.

Children at Key Stage 2 (including those who answered this questionnaire at the special school) report no change in their attitudes towards attending school or enjoyment of using computers, with moderate to high levels of enjoyment being reported in both years.

There has been no significant shift in the locations where ICT is accessed. The main locations of use remain, perhaps unsurprisingly, at the institutions and at home. All groups are reporting very little use of computers or ICT in other locations such as public libraries.

The use of video-conferencing facilities by students at the three colleges also remained static this year, with low levels of reported use of this technology.

Schools are continuing to contact parents mainly through traditional methods such as sending letters home with pupils, despite the small but significant increase in electronic communication between schools and home.

All staff report very similar methods and types of training being delivered during years one and two of the project. Given that there have been increases in reported skill levels and satisfaction with the training staff have received, this is an encouraging finding which suggests that the training has been appropriately designed and delivered.

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

Teaching and Learning

The implications of the ICT Test Bed Project for teaching and learning are at the heart of the project's purposes. This is the central area of the schools' and colleges' core business, to which all the other ICT Test Bed themes contribute. The project's investment in a range of technologies for use by teachers and pupils, in classrooms and at home, is very extensive. Since it is impossible to deal in detail with the full range, in this report the focus is on the impact on teaching and learning of the use of one key resource: whole-class interactive technologies.

Classrooms in the ICT Test Bed schools have been provided with either an interactive whiteboard linked to a computer and data projector (the schools of two clusters) or a visualiser and interactive tablet linked to a computer and data projector (the schools of one cluster). The ICT Test Bed curriculum areas in the further education (FE) colleges have invested in similar resources. The huge investment made in these whole-class technologies, the time and effort given to professional development, implications for pedagogical philosophy and vision have the potential for a major impact on learning.

A study was carried out involving observations and interviews with teachers and pupils in 24 classrooms across all phases in the three clusters in the autumn of 2004, at the beginning of the third full academic year of the ICT Test Bed project. Most classes had been equipped with whole-class technologies for between one year and 18 months, though in some FE classes the time was shorter as installation had been delayed.

It is important to note that schools, and individual teachers within schools, are progressing at different rates and this study of 24 classrooms, selected by ICT Test Bed managers in selected schools and the colleges, did not focus on the least advanced.

Six key themes emerged from the research: resources, pedagogy, shaping of the lesson, interactivity, skills and attitudes.

Resources

It is clear that whole-class electronic resources provide a new ambiance in the classroom. Across the clusters, the evaluators saw a range of electronic resources used in whole-class teaching: content-rich web-based materials (drill and practice 'games', for example), materials created by teachers (such as an electronic talking book, a presentation on histograms, downloaded images and scanned texts) and exercises designed with standard office programs (for example, mathematics activities using spreadsheets). The quality of teacher presentation is significantly improved, not just in terms of colour and imagery but also in the clarity of text. Pupils can now read the board much more easily than before. The ease with which text can be highlighted and changed can lead to increased pupil involvement and more pupil control over the process. One teacher said:

> 'I know for a fact that [without the large screen] I wouldn't be teaching them as much […] and I know that they wouldn't be learning as much because they'd be looking around […] It's made it a lot easier because they're looking at it and it's clear to them, it's on a big scale.'

Projected electronic resources have the potential to change curriculum materials from the static to the dynamic. That which is displayed can be changed rapidly (from screen to screen), is provisional (can be added to and deleted) and can move (video clips, animation). Very different from paper-based materials, this opens up possibilities for teaching (which resources can be displayed) and learning (expanded modes of representation), and hence has implications for pedagogy (interactivity).

The presence of a large screen taking up a sizeable area of classroom wall space is in itself significant. A number of teachers spoke of the attraction and focus that this draws from the pupils. For example, a reception class teacher said:

> They were sitting quietly through the whole lesson and they are only five. If I was using the [traditional] whiteboard it would not have held their attention so well. Varying things like showing a mince pie instead of a burger [in a numeracy lesson] makes things different so they look at it.

It also allows the teacher in some cases to stand or sit to one side and gives more opportunity for them to observe and concentrate on assessing the pupils' reactions. This was especially true when using the teacher's computer to manage the image or by using the ActivSlate which enabled management and changes to the screen to be carried out from anywhere in the classroom. The obvious involvement of the pupils and the pleasure of the teacher in the attractions of display technologies did on occasions encourage the teacher to spend longer on plenary questioning rather than on pupils carrying out their own enquiries.

The whole-class technologies have built-in or associated tools such as pens or similar pointing devices. These certainly, in our observations, often encourage and enable more pupil control of, and involvement with, the proceedings. It was interesting to see children who had been in school for less than four weeks handling the pen and changing pages on the board with confidence and skill. The ActivSlate has some advantages but is perhaps less intuitive to use, and in addition was introduced at a later stage of the implementation phase. As a consequence it is not yet being used uniformly across all classrooms, particularly in secondary schools. When children have not had experience of the ActivSlate, for example in the Early Years, teachers feel it is more appropriate to stage its introduction to ensure that pupils develop the required skills.

The visibility of a large screen was clearly an improvement on a small computer screen and teaching manipulative processes such as Excel program management, as well as loading programs and web-based resources and managing files, were considerably easier for students to follow. Simple techniques such as placing a square grid over a shape to explore area, moving elements of compound shapes around the board and simply drawing bar-charts and other graphs were certainly helpful pedagogic tools, and ones (at least not so readily) possible non-electronically. There are also a number of other functions built in to the software used with the classroom technologies, for example the ability to highlight words and to use colour to help structure the work. The 'spotlight' tool was also useful to enhance the pupils' understanding of elements of the text.

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

Of other ancillary equipment the voting systems (ActiVote, for example) used in some schools seemed to impress teachers and pupils by their possibilities. These are tools whereby pupils respond to multi-choice questions much as audiences vote in game shows. Use of a voting system needs careful preparation if the questioning is to be anything but merely checking knowledge of facts and in order to contribute to meaningful diagnostic assessment. Research over recent years suggests that formative assessment – especially formative self-assessment – could be highly beneficial in raising attainment, especially of lower achievers. It will be interesting to continue to monitor the degree to which teachers do use the results from ICT assessment tools to inform their subsequent practice, and improve learners' experiences. Although the teacher can actually see what each child has answered, the pupils still feel a comforting degree of apparent anonymity in the process, and the social context of the assessment is found attractive.

Another item of clear value was the Digital Blue video camera. Evidence was seen of pupil-produced video-clips, displayed on the large screen, providing useful peer teaching for other pupils. It also motivated the pupils (even those with autism) to review their spoken and visual communication skills. Images taken around the school and at school events are obviously valuable stimuli for discussion.

The immediate availability of sound is also useful: using the children's own voices to present facts and questions, or enabling the questions in the presentation to be asked in their teacher's voice, or even just presenting further stimuli to acknowledge right or wrong answers. It also helps, of course, in the seamless presentation of video-clips as part of the lesson presentation in subjects such as RE, PSHE and geography. Many children's television programmes and electronic games are very noisy (or sound rich) and young people are used to having such stimuli as background to concentration. In this way whole-class technologies do help to provide multi-modal (text, sound, still and moving images) opportunities in the classroom which can support learning in different ways. It is this variety which probably accounts for the increased attention and concentration which teachers report in their pupils.

Whole-class interactive technologies were reported to have been very reliable. This is in part due to the investment in technician support which ICT Test Bed funding resourced and partly the well-founded technology that appears to be embedded in the resource. Teachers, too, are now largely confident and competent with the resources so that difficulties no longer become problems. This appears to be particularly true of many primary schools. Whilst still true of many secondary teachers, the situation in this phase of education seems to be more variable. The researchers noted some problems resulting from the introduction of whole-class electronic resources into every classroom in secondary schools, which amounted to a large-scale system change. For example, there can be a problem with visibility, particularly on sunny days; blinds are costly and there was at least one observed session where the blinds were broken. Shadows can be cast if people stand in particular positions in relation to the projector and there is a clear health and safety issue from the projector shining in eyes. In most classrooms, however, these were not regular problems and experience has led to better positioning through ceiling-mounted projectors.

Teacher Resources

In all the observed lessons the teachers had resources already placed in the system before the lesson began, either through pre-prepared PowerPoint presentations or by placing links or pages ready for recall as the lesson progressed. In this sense teacher lesson preparation is possibly more thorough when using the whole-class technologies. It is also proving useful for supply teachers, since the teaching resources are ready for the lesson, and continuity of curriculum is better ensured. The quality of computer-based materials is generally excellent and many teachers have adopted a simple data storage system of storing files and web-pages in folders which makes it very much easier to find the appropriate file or image for display.

The PowerPoint presentations observed by the evaluators were of themselves evidence of teacher creativity. They were generally of high quality, often involving animations and sound. How they were used pedagogically, however, varied within and between lessons. Teachers were attracted to PowerPoint because they could prepare pages for display before the lesson took place, with low levels of reported use of this technology. They could include a variety of images and the ability to move through the pages easily facilitated lesson management. They are easy to adapt and modify, both before and during the lessons. Finally, they are easy to place on the school's VLE or to pass on and share with fellow teachers.

Many of the teachers in the sample had created PowerPoint presentations as lesson starters, increasing the range and scope of texts used in introductions. They were used to illustrate book stories (teacher-made e-books) and to recapture information presented in an earlier lesson. It was felt that in presenting the information via PowerPoint the students could be provided with a structure and there was clear evidence to pupils of teacher planning. The starter activity and/or objectives provided a focus when students walked into the room and all the presentations could be made available on the school/college intranet so that students who had not taken adequate notes or who had missed a lesson for some reason could access the notes. Where appropriate, teachers took the opportunity to use pen tools to write additional notes and to highlight features of pre-prepared materials. This enabled them to demonstrate, to explain more fully, to respond to perceived need according to student response, and to respond to student questioning. This use of the adaptability of the technologies was essential to stimulate student interaction with the lesson. There were occasions when PowerPoint was used merely to present notes and information which the teacher often read to the class and this kind of use often resulted in boredom and information overload.

Good PowerPoint handout notes were attractive, with white space inviting supplementary commentary from the audience, but poor ones were merely full of words. There is always a question as to whether to offer the prepared handouts beforehand for students to annotate during the session or to annotate the handouts from student discussion during the session before printing them. There were occasions on which the quantity of PowerPoint slides was misjudged and on occasions apparently good pages failed to maintain pupil attention owing to other classroom 'events'. One teacher commented that she was so enthusiastic about PowerPoint in the first year that her presentations were too PowerPoint heavy.

She realised that the children were mostly enjoying it but they were passive. She was beginning to adapt the resources she had already created and build in more activities for the students to do. In much of the best presentation the pupils themselves wrote on the board and responded to the pages as they were presented.

Preparing electronic resources has implications for teacher workload with regard to advance planning and preparation, even though practice has speeded up the process of resource creation. Finding images on the internet or scanning them in from books takes time. Many teachers highlighted the advantages of being able to create presentations at home and transfer them to school via memory sticks, CDs and discs. Teachers said that they were willing to invest the time because it is a resource for future use. Many teachers indicated the advantages of being able to use and adapt materials prepared the year before and all seemed to have well organised filing systems.

It was noticeable in our observations that we saw comparatively little use of web-based resources. Teachers did have some bookmarks in their files to useful pages but few brought forward web-based games, for example, preferring to use self-created resources. Nor did we see much evidence of the overt use of search engines in the classroom. The issue of copyright, the security of access to materials in personal files, as well as a desire to encourage personalised resources means that most VLE materials will be 'home-created' and may mean that teachers will in future make less use of what are sometimes excellent web-based resources. It may, of course, be primarily a consequence of the limited number of observations.

Pedagogy

There is no doubt that many teachers in ICT Test Bed schools and colleges have become very skilful and accomplished. Teachers selected programs and files, adjusted screen displays, moved between resources and used tools with ease and without hesitancy or uncertainty. In all of the observed lessons, the display technology was embedded as a mediating 'tool' for subject teaching and learning. There is a sense in which whole-class technologies are bound to have an impact on pedagogy and observers, teachers and pupils agree that they increase pace and interactivity. Nevertheless, they can also fit easily into existing patterns of classroom interaction, and in some ways their efficiency reinforces presentational approaches and teacher dominance which reinforces traditional methods. The teachers set the learning objectives, presented planned and prepared materials, and asked 'teacherly' questions which largely had short right/wrong answers with limited extended discussion. It should be noted, however, that by focusing the enquiry on whole-class technologies it would inevitably lead to observing such situations, and individualised learning contexts were less likely to be seen. What is clear is that pupils appreciate the clarity of teachers' presentations:

> *'It's better because you can see what you have to do... Before, you had to get all in a mess and then you kept getting everything wrong because you didn't have the interactive whiteboard to help you with what to do.'*

There was some evidence that individualised activities took place in upper KS2, secondary and FE contexts and there was some evidence that the ICT Test Bed investment in laptops for upper primary classrooms was generating more pupil-centred activities. In FE too there were examples of individual research-based enquiry by students. In many instances, however, it would still be true to say that whole-class technologies remained didactic tools, improving classroom ambiance rather than learner autonomy. Teachers allowed students to manage the board, but the context was entirely theirs and they retained control over the content and the questions. Whole-class technologies do not of themselves empower moves towards more individual and differentiated teaching. The national primary strategies have worked against such development, with standard lessons and standard targets, and whilst there was evidence of some differentiation within some primary lessons, it was limited. Few of the observed secondary lessons, where students are more likely to be placed in 'ability' groups, showed evidence of individualisation. Different subjects probably differ in their assumptions about individual as opposed to class learning but the whole-class technologies, with the strong central focus, encouraged more class-based contexts. There was little overt sign of individualised learning plans in FE lessons where classes were often as small as 10 or 11 students, though it was evident that some tutors did make use of the VLE, and by implication there was a strong expectation that students would utilise this resource. It could well be that formal classes form a smaller part of the FE curriculum and that individualised activity is more likely to be student self-study.

All parts of lessons where whole-class technologies were used took place in classrooms rather than computer suites, except in some FE sessions. The lesson format in primary literacy and numeracy lessons largely cohered with the now 'traditional' three-part structures, that is, whole-class starter, group/individual activities and whole-class plenary.

In early primary classrooms there was good use of the traditional gathering space (often 'the carpet') at the front of the classroom round the board. The KS1 children then moved back to their tables for related group or individual work and groups also used banks of computers located in the classroom as well as the IWB. This group work was often clearly differentiated for the different groups or individuals, using either different worksheets, different computer programs or 'fast finisher' activities. The confidence and competence with which these pupils, even four-year-olds, approached using the computers was impressive.

Differentiation in the whole-class sessions was more difficult to monitor without knowing the children, although it was clear that the teachers asked some children to undertake less demanding tasks at the IWB and their questioning was differentiated, as it would be without the IWB. There was some indicative evidence that well constructed use of a voting system could provide a stimulus for differentiation, as the pupils' responses were so readily available for the teacher. There is much development work needed, however, for this to be a widespread activity.

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

In upper primary, secondary and some FE classrooms, students remained at their tables which were set out in various (but largely fixed) layouts. These sessions were clearly targeted at one subject and generally followed quite traditional patterns. The teachers generally conducted often lengthy question and answer sessions to start the lesson which were then often followed by individual tasks for the students to carry out. One FE lecturer used games to enliven the initial question and answer session. In another FE session, the teacher used a mind-mapping program on a tablet to structure students' recall of the previous session. The display technologies certainly helped to focus this activity, and in good sessions stimulated good discussion. In some lessons, however, this introduction was rather extensive with students' attention and computer structuring giving a sense of purpose which might not always reflect learning.

The availability of desktop computers or laptops for pupils' use seemed more variable in secondary and FE contexts, and clearly depended upon the subject areas. Most primary classrooms in two of the clusters contained a group of computers; in the third cluster there were usually just one or two, and a number of upper primary classes already had (or were just introducing) sets of wireless networked laptops. Secondary technology departments were well supplied but not all the other subject areas were so fortunate, making computer-based instruction problematic except where departments made widespread use of the school's computer rooms. In one FE context, some students took up to 20 minutes to move from the IWB session to using the laptops, whereas in a Year 6 classroom where the pupils each had their own laptop (available to take home) the transition took only the time it took for the computers to boot up. This might create some issues when the primary pupils who are used to taking notes and writing with their laptop emerge into a less well supplied secondary context. The teacher of this Year 6 class, using Word tracking procedures, commented on compositions uploaded to her file by the pupils and they then downloaded the comments for action. It was rare to see homework presented and assessed electronically in secondary schools.

Interactivity

Interactive whiteboards provide a shared pedagogical space where teachers and pupils can interact with curriculum content and one another. Not only does it focus the individual pupils on the learning resource but it also provides a communal image and space and encourages socially supported learning. In most KS1 classrooms pupils were not only invited to write on the board but were encouraged to manage its functions.

Key Stage 2 classrooms were more formally laid out, though some did have a gathering space at the front. Nevertheless, it was common for pupils to be asked to come forward and either write on the boards or type into the computer to move the lesson forward. The interactivity was also implicit in the questioning and discussion that took place, often stimulated by the images presented using the classroom technologies. Using the ActivSlate meant that the teacher could stand anywhere in the room (often at the back, ensuring that the children were totally focused on the screen) and also that the children could interact with the resource without moving from their seats, which made it quicker.

Interactivity does, of course, vary with the phase of schooling. Teachers of primary pupils generally reported that pupils were attentive during the parts of the lesson when the interactive whiteboard is being used, and are keen to 'have a turn'. This may be to do with having an audience. For some older Key Stage 2 children, writing on the interactive whiteboard in front of the whole class opens them up to public viewing, which some pupils do not enjoy ('I was dead nervous, man'), but in many classes it was a normal and accepted activity. By contrast, using the ActivSlate meant that pupils in Key Stage 2 were able to remain in their own seats, where the teacher felt they were more comfortable. A secondary teacher, however, commented that, although Key Stage 3 students like to go up to the interactive whiteboard and use the pens, Year 10 and 11 students don't want to do this because 'they're a bit more grown up'. This would seem, however, not the universal experience.

In some classrooms an even larger screen, a computer, data projector and wireless tablet together offer similar functionality to a whiteboard and can be used with similar software, enabling teachers and pupils to move letters around the screen, highlight text and annotate material as well as interact with any program. Where visualisers are used they are not in themselves 'interactive' but pupils do use them to demonstrate their work (writing on a sheet of paper or filling in the answers to a workbook) instead of writing on a whiteboard. Visualisers can also be used to project and magnify whatever is being done under the camera – demonstrating wiring a plug or dissecting a flower, for example. The pupils also like putting their own completed (handwritten work) on the visualiser so that they can share it with the rest of the class. The advantage of both the visualiser and wireless tablet is that they are writing in a plane they are used to (they are horizontal like a desk, not upright) and use natural sized handwriting which is then blown up on the large screen. The pupils do, however, have the complication of having to interact with two surfaces at once, the tablet on which they are writing and the screen on which it appears, and some pupils do not initially find this easy. In many schools these resources have been introduced in phases and therefore teacher expertise and confidence with all the elements of the classroom technology are currently more variable.

In secondary schools and in FE the interactivity was generally built in through questioning and discussion, and also through individual written activities in the handouts that were interspersed throughout the lesson. In well conducted lessons, the whole-class technologies proved an aid to stimulating discussion and participation. Some secondary lessons did, however, involve student interaction using the board and in some FE sessions, with a small number of students, the board was used as a working area where students were fully involved with the various activities. In one FE session in particular it was recognised as a focus to encourage students to talk more to each other, and to share, and the IWB appeared to work well.

Questions that remain to be answered

This research suggests many positive consequences of the investment in whole-class technologies. Questions still remain, however, about whether the classrooms have significantly changed in terms of children's learning and whether the technologies have helped develop the pedagogic skills of teachers.

- Whole-class technologies change the ambiance of the classroom. There is the dominating effect of a large bright screen, the tactile nature of the interaction, the teacher as entertainer/performer, and the novelty effect. This has significant potential for pedagogy, which some teachers claim to be exploring in innovative ways. It often appears, however, that the significance only lies in the way that display technologies make it easier to integrate the various types of media and present materials attractively. Where this is the case, whilst the technologies are valuable they are not necessarily innovative. In our limited observations it was in the imaginative use of the IWB in KS1, the use of classroom-made videos, and potentially the use of new assessment and administrative tools, which was truly innovative.

- The practitioners observed in these 24 lessons were competent users of classroom technologies. This is evidence of improved technical skills. Evidence from other visits suggests that other individuals and teams have developed at different rates. So are we seeing different levels of technical and pedagogical skills? What produces good skill/pedagogic development and what causes the differences? Is it a result of sharing of skills/practice within departments? Between schools? Is it pressure from learners or colleagues? More exploration is needed to ascertain the significant factors in teachers' ICT development.

- Individuals are building up banks of resources, and resources are being shared within schools and colleges, particularly within primary year groups or secondary school/FE departments. This was regarded positively by most staff involved in this research. Some critical analysis of the quality of resources is needed. Is the technical support of a team of experts, commissioning and payment for content to be made available one way forward or do teachers need to 'own' the resource? In the FE sector, there is a large bank of highly interactive online materials – centrally developed using a learning object approach, created by commercial multimedia companies at high cost (£20M). The use of the materials in the sector is so far generally below expectations. ICT Test Bed colleges are looking at how the materials can be used but no use was observed or mentioned in the lessons. Critically assessing available content takes time and teachers perhaps feel that creating their own resources is more productive, more attuned to their pupils' needs and it is easier to recall what it can do. In the development of the VLEs it will be interesting to monitor the way in which they are utilised.

- There are notable differences in observed levels of maturity of classroom technology use (including pupil interaction with technology). Is this a function of the types of technology or the method of introduction? It is clear that installing a visualiser and interactive tablet linked to a computer and data projector, as opposed to an interactive whiteboard, allowed teachers to adopt the individual technologies one at a time over a longer period of time, with the result that wireless tablets and even visualisers were not yet in regular use in all classrooms where they had been installed by the autumn of 2004. On the other hand, it may be that a staged introduction will lead to a more gradual maturity compared to a large and sudden injection of technology which leads to too rapid development (in the sense that it might satiate the learner). The key question is which approach will give most pedagogic change in the long term?

- Teachers have taken specific interests in particular new resources that fit with their curriculum needs or meet individual preferences. Do we have real evidence of change in teaching style or is this a matter of individual teacher attitude and style? Are teachers merely extending what they have always done when using the new technologies? Genuinely innovative work was evident in some classrooms: for example, where pupils' use of video cameras was linked with whole-class technologies, and in one Year 6 class where all pupils had been given their own wireless laptop computers and link their use to the interactive whiteboard. Providing different sets of computer-based learning activities, linked with the use of whole-class technologies, improved differentiation in an innovative way. However, this level of innovation was not general across the 24 classrooms.

- The classroom technologies have had a positive impact on structure and pace within a lesson, largely because resources are ready prepared but can still be easily adapted or annotated during the lesson. This has meant that material is covered more efficiently, opening up space for more repetition or further discussion. It is interesting to ask whether the curriculum is being enriched, or merely accelerated, as a consequence. Both alternatives clearly have important benefits. Positive effects were noted on learner skills perhaps owing to increased practice time as a result of speedier initial delivery by the teacher.

- In the FE colleges the lessons using whole-class technology provided little evidence of differentiated learning taking place. This is a matter of concern since classes with an over reliance on whole-class teaching are not well regarded by inspectors. It may be that the presence of the whole-class technologies reinforces the ease of whole-class teaching so that teachers get caught up in the technology and interactive learning takes second place. This may be of less concern in schools where there has been an explicit policy requirement for teachers to engage in more whole-class teaching. However, the new policy emphasis on personalised learning indicates that schools, too, need to take more account of the need for learner interactivity.

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

- There may be a danger of overuse of PowerPoint. The 'bullet point' metaphor, which suggests that learners are the target of teacher-prepared information, is not insignificant. The researchers saw some innovative use of PowerPoint, but in some classrooms it seems that teachers spend too much time reading slides aloud to classes. Is there is a shortage of pedagogic skills in using PowerPoint to create effective learning activities? How could this be developed?

- In view of current policy initiatives to encourage personalised learning from primary schools through to learners of all ages, it is important to ask how the increasing use of whole-class technologies could help with progressing learners' Individual Learning Plans. If the new emphasis on personalised learning indicates a move away from regarding whole-class teaching as the preferred norm, does this have implications for high levels of investment in technologies which specifically support and encourage whole-class teaching?

- In some FE classrooms there was no clear acceptance that the IWB was 'worth the investment'. There is a feeling that what the whiteboard adds to a lesson is not very significant over what can be done using a data projector and an ordinary whiteboard (technology that has been in use in colleges for maybe 4–5 years – although certainly not in all curriculum areas). Whilst this is far from a universally held view, the advantages need to be systematically considered and the investment weighed against these gains. The active participation of younger pupils would certainly support the IWB at that stage of schooling, and the management of the images seen in mathematics lessons and text manipulation seen in KS2 would be strong incentives for the investment. Evidence of effective use in some subjects at secondary level, (modern foreign language lessons, for example) also supports further investment in IWBs, but the value in some other subjects may be more questionable.

Leadership and Management

The ICT Test Bed Project poses major challenges for leadership and management at all levels: classrooms, departments, institutions and, in the case of the schools, the local education authorities (LEAs). Through hard work and commitment considerable progress has been made in meeting these challenges. In this report we focus specifically on leadership and management of the ICT Test Bed project in the three clusters of schools during the crucial stages of planning, procurement, installation and early implementation of innovation, between September 2002 and March 2004. The management of the ICT Test Bed Project in the three colleges is not dealt with in this report. Future reports will focus on leadership in the colleges, and on leadership at all levels during the main stage of full implementation, including development and improvement, consolidation and embedding of innovation.

The parameters for change were set by the DfES in contractual negotiations with all partners. Each of the LEAs signed a contract with the DfES which specified their obligations, the amount of money they would receive and other legal matters. The three colleges signed similar agreements. The project budget comes from the Standards Fund of the DfES which clearly locates the project within the school improvement agenda. Exceptionally, this also applies to the colleges, all of whose other funding comes from the Learning and Skills Council (LSC). The obligations of LEAs included selecting schools according to specified criteria, working with project staff from Becta and the Regional Broadband Consortium to provide broadband connectivity to the schools, employing (using an agreed proportion of the ICT Test Bed funds) a project support officer (PSO), producing an annual project plan, and agreeing plans for expenditure in advance with the DfES.

The aim of this report is to examine the formal and informal management structures, procurement procedures and relationships between the LEAs and schools and the initial planning process within the schools. It sets out to provide some insights into the challenges that the schools and LEAs have experienced, their achievements in overcoming these challenges, and what has been learnt. This is with the purpose of informing other schools and LEAs which may in the future be involved in managing similar large-scale ICT initiatives.

The introduction of the ICT Test Bed Project in the three clusters

The early plans for the ICT Test Bed Project were developed by the DfES in consultation with the headteacher of a large secondary school in what was to become one of the three participating LEAs. All three LEAs were approached by the DfES and invited to join the project. In one case involvement of a particular secondary school and some of its feeder primary schools was assumed; in the other two cases, choice of schools was limited by the criteria specified by the DfES. ICT Test Bed schools in effect received 'an offer they could not refuse', which they greeted with enthusiasm because of the large sums of money involved. However, it was significant that only one cluster of schools had come into the project by their own choice through the kind of bidding procedures that were normal practice. The three colleges were invited because of their proximity to the cluster schools.

All three LEAs welcomed the project and perceived its purposes as being focused on teaching and learning and school improvement. All three found it easy to engage with ICT Test Bed's aims because the project was perceived to fit in well with existing policies.

The management structures for the clusters were set up by the LEAs. The colleges, whose governance as independent organisations was very different, were only loosely linked in the clusters. The style and structures of management set up in the three clusters were very different, in each case suiting the LEA's established patterns of relationships with its schools:

- One set up a committee structure which separated responsibility for decision-making on large-scale procurement (Executive Board) from cluster strategy and revenue expenditure (Management Board), with the most senior inspector chairing the former committee and the ICT Test Bed Manager (also an inspector) chairing the latter, whose membership was the school heads and college manager. This was, nevertheless, a flat management structure which gave heads control over the development of ICT Test Bed in their school, within a strong framework of advice from the ICT Test Bed Manager and the LEA's specialist ICT service. The Heads' Management Board met once a month in the secondary school.

- Another set up a committee structure which vested decision-making in the management group of headteachers, chaired by one of its members, subject to LEA procedures. This LEA appointed a Link Officer with a pivotal liaison role between the cluster schools and the LEA departments and responsible officers, rather than an ICT Test Bed Manager. Both heads and school ICT co-ordinators met weekly at the secondary schools to drive the work forward. The college manager was a member of both groups but did not attend all meetings.

- The third appointed a former team adviser as ICT Test Bed Manager, who held meetings as required either with heads or school representatives, depending on the issues involved, and invited them to make decisions collaboratively on the basis of detailed information and advice. The college manager attended meetings and took part in decision-making. This LEA did not set up a project committee structure. School ICT co-ordinators had regular meetings with the ICT Test Bed Manager at the LEA's ICT Centre.

Different kinds of expertise were available in each LEA to support ICT Test Bed planning and procurement. In one case there was a very high level of Council expertise in procurement as well as expert support available from a central IT support service. In another, considerable technical expertise was available and the small size of the LEA considerably simplified the lines of communication and decision-making. In all three LEAs the ICT Test Bed Manager or Link Officer brought specialist expertise from previous experience of ICT-related projects.

The action planning process in ICT Test Bed schools and colleges

Production of detailed Action Plans by each school and college during the autumn of 2002 comprised the first major phase of ICT Test Bed Project work. Heads of schools were supported by their LEAs, and Becta staff provided further support to both schools and colleges. The completed Action Plans were summarised by a member of Becta staff and presented to the DfES for Ministerial approval during the early months of 2003. The value of this planning process was investigated through telephone interviews with 17 volunteer heads and college managers in the summer of 2003.

Action planning was seen as useful because it immersed heads of schools and college managers in the project, helping them to clarify their thinking and begin to understand the scale of the undertaking. Nevertheless, for many the production of the plans had been a time-consuming and frustrating process (in many cases involving much re-writing) and the resulting documents were seen as too long, too vague (several new managers coming into ICT Test Bed institutions said they were not able to understand what was required from reading them), and more suited to the purposes of the DfES than the schools themselves. A major difficulty was that the ICT Test Bed action planning process had to be carried out quite separately from the existing School Development Plans, using an electronic template which was described as 'tricky' to use. In two of the LEAs, once the plans had been submitted to the DfES, schools undertook the important task of integrating them with other existing plans (SDPs and specialist school proposals) to produce an implementation plan, and these were described as being of much greater value.

There was also the problem that plans did not allow for delays in the procurement and installation of equipment, many of which could have been predicted on the basis of the experience of previous large-scale ICT initiatives, such as the National Grid for Learning. The frustrations of delay became additionally stressful as a result of the impression gained by heads, college managers and their staff that the DfES was looking for measurable improvements in children's national test scores and examination results within as short a time frame as a single year.

Action planning for such a large-scale ICT-based project aimed at whole-school improvements also proved to be extraordinarily difficult for the majority of heads and their staff (and college department heads and staff) because they were unable to imagine what was possible and lacked basic knowledge of available hardware and software. Advice from third parties, such as that given by Becta, was only of limited help. As one head said:

'The action planning was done at a very early stage and perhaps before we had a clear idea of where we were going. It's only now that we know what an ICT-rich school might look like. So it was quite a flawed process at the start. We know now – it's developed – we've put the vision into place afterwards. It was a strange way of going about something – but as a group we were pulled together for something we hadn't planned for.'

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

Theories drawn from socio-cultural psychology (for example, Cole, 1999, p.91) point to the need for people to develop interior cognitive artefacts of new tools such as ICT devices before they are able to use them. These mental models allow people to imagine the possibilities for use and they are more important than the acquisition of ICT skills because the latter are easily acquired once the mental model is in place and has given purpose, and hence high levels of motivation, to using ICT. Thus the development of vision requires time and the kind of training that is focused on building individuals' mental models. The visit of the heads in one of the clusters to an innovative primary school in Birmingham in the autumn of 2002 was a good example of this kind of vision-building training and had clear beneficial outcomes.

Integrally linked to this difficulty in developing vision was the difficulty in foreseeing the workload which would be involved in implementing ICT Test Bed. Almost all heads underestimated the demands it would make on managers and it was clear that those schools which had chosen to appoint a full-time ICT Test Bed manager were able to implement the work of the project much more quickly. In one LEA many heads felt they had made a mistake in not doing this from the start. Where the major management responsibility was retained by the heads rather than being vested in an LEA ICT Test Bed Manager, the project continued to make considerable demands on their time throughout the whole of the first eighteen months.

Procurement and installation of complex networked software systems

In all three LEAs procurement of complex networked software systems proved very challenging and time-consuming. Two purchased new management information systems (MIS) and the third took the decision to upgrade the existing system. Two purchased virtual learning environments (VLEs) to provide a shared resource for all ICT Test Bed schools. In all cases the procurement process for VLEs or MIS took many months.

The choice of VLEs was complicated by the fact that the purchase involves the supplier 'supporting you to develop' it by 'customising it and reflecting the needs of the institution wherever they are placed.' It is not a simple matter of purchasing a completed product. The decision requires a fine balance between going for a system which appears to be 'visionary / out of the box' or one which demonstrates 'concreteness' and appears more likely to be reliable. In one LEA negotiations spanning many months broke down when the contractor failed to provide the promised evidence of the system in use in a secondary school. This meant that negotiations had to begin again with a new contractor: the order was eventually placed in March 2004 and the system installed on school servers in July 2004. The second LEA did not have the same problem of a contractor failing to supply but still only managed to install the VLE and start a pilot project in its use in March 2004. Thus, these complex systems were not in place for teachers to begin experimental use until almost half way through the funded period of the ICT Test Bed Project. This is a factor that must be kept in mind when evaluating the impact of such systems in terms of the ICT Test Bed aims.

The choice of an MIS was if anything even more difficult and complicated. All three LEAs had an existing MIS in use by all schools, which acted as a conduit of information, including financial information, between schools and the LEA. However, these systems did not have the functionality required to meet the needs of the ICT Test Bed home-community links theme. The ICT Test Bed vision was for parents to be able to access information on the school's server, such as their child's records, from home. Some new products recently developed offered a much greater degree of functionality than their existing systems. However, in the two LEAs where the ICT Test Bed schools opted to purchase a new system there were problems in transferring schools' financial information onto it. Financial information has to be totally secure at all times, and Council financial services are set up to deal with all schools using the same system, not to work with different systems for different sub-sets of schools.

In the procurement of MIS the decision-making processes in ICT Test Bed illustrates very well the problems of large-scale system change in which the level of prior investment centrally in the 'old' ICT system – and its embedding over several years in the larger infrastructure (procedures, jobs specifications, quality procedures) – makes it extremely difficult for those who operate the system centrally to introduce a change even if the local users perceive that they need improved facilities. When such a change is made there is an inevitable period of disruption while new infrastructures are introduced to accommodate it. In the case of ICT Test Bed this was evident in the decision in one LEA to keep schools' financial information on the old system and operate this alongside the new MIS; and in the decision in the other LEA to transfer only a small number of schools to the financial system while requiring them to maintain the old system as well for a considerable period of time. Meanwhile, the LEA that decided to upgrade its old MIS so that it incorporated the same facilities as the competitor product was kept waiting for many months by the contractor who proved unable for whatever reason to deliver the upgrade to the agreed time-scale.

Successes which points to good leadership and management

Successful embedding of many aspects of ICT Test Bed work

The first two years of ICT Test Bed provide evidence of the high levels of engagement and enthusiasm of a very large number of staff, students and children. Close links have been established between the clusters of schools and productive working relationships with the college are excellent in one LEA and good in a second. The work is well co-ordinated in all three clusters and is increasingly being integrated with other policy initiatives – particularly since the integration of planning across various initiatives has been a high priority for schools.

Change management consultancy

The change management consultancy provided by the National Remodelling Team during the first half of 2004 was particularly successful and there are many examples of the NRT tools being used to provide structure and direction for planning and implementation of new aspects of ICT Test Bed work.

Home–community links

Although subject to considerable delay, the various initiatives in the three clusters to use ICT to strengthen links between schools, home and community have generated good will and enthusiasm. In the case of one cluster, additional funding was secured to supplement ICT Test Bed funds and enable a computer to be given to every home with software to support children's learning. It is also the intention to establish electronic links in the near future. This initiative has been greeted by parents with great enthusiasm and resulted in many visiting the school and establishing contact with teachers for the first time.

Development of an innovative whole-class teaching resource

In one LEA, ICT Test Bed has provided the opportunity to develop a suite of specialist equipment for whole-class, interactive teaching. This is seen by this LEA as a better classroom resource than the interactive whiteboard. The two phases of funding in the first year enabled the LEA to develop and trial a pilot version of the equipment. The large-scale nature of the initiative then attracted the attention of a major commercial provider who undertook to produce an improved suite of equipment and make it available to all schools in the LEA at a very competitive price. This is a clear case where substantial government investment has led to the development of an ICT resource which would not otherwise have become available to schools.

LEA support or school autonomy – a continuum?

Where they were in place, it was clear that an LEA with well-established structures and procedures, as well as stable relationships with schools, could take on a strong leadership role and provide very high levels of support. ICT Test Bed showed that at best this role builds on existing practices and there is no one right approach. Where an LEA is in a more transitional phase without good existing infrastructures (electronic and otherwise) it is more difficult to provide strong leadership of this kind. On the other hand, ICT Test Bed provides evidence that schools can benefit from having the opportunity to work together in ways that are more autonomous. Comparing the long-term effects of these different approaches will be particularly interesting, although ICT Test Bed will only be able to provide indicative evidence rather than reaching a definitive judgement on relative benefits.

Good procurement practices

ICT Test Bed provided the opportunity to compare different approaches to procurement. In two of the LEAs, prospective suppliers were required to go through a tender process, following initiations to tender, in one case only to suppliers from the government's approved list. At its best this worked well and one LEA could point to savings of £200,000 as a result of this process. In the third LEA, a formal tender process was unnecessary except in the case of procuring very specialist equipment (such as a VLE) because the Council operates a three-year rolling programme of tendering and approval under the European Union Tender Protocol. A choice of approved suppliers was available and purchases could be made very rapidly with obvious benefits to the schools. The element of competition retained by having more than one approved supplier also ensured very good value for money. Two LEAs reported on the importance of specifying needs very precisely on a classroom by classroom basis to ensure that equipment was installed in just the right place. One LEA also said that it had proved important to have one contractor supplying both equipment and electrical infrastructure to minimise potential misunderstandings and disruption.

Challenging issues

Fairness and equity

The allocation of such large funding to some, but not all, schools in an LEA raised issues of equity and fairness. This was particularly difficult in the case of one LEA where the cluster had already received substantial funding for another initiative. In two LEAs the ICT Test Bed schools' share of other available funds was re-allocated to other schools by the LEA to reduce the gap. One LEA ensured a benefit for all schools by specifying in contractual agreements that agreed prices would apply for purchases by all schools, not just ICT Test Bed schools.

The scale of the challenge

The huge scale of the project made it difficult for heads, particularly in the secondary schools, to manage both the challenge of dealing with planning and procurement and the need to keep staff informed and develop a sense of shared ownership. One secondary head perceives that it was fortunate that delivery of much of the equipment was delayed. It would have been impossible to deal with it all arriving at one time, 'whereas what happened in practice was that, because there were delays, people got the kit in small parts and they became proficient with it.'

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

Underestimates of costs for the home–community links theme

There was a problem for all the LEAs in meeting the benchmarks laid down by the DfES for the home and community links theme (in supplying computers to children's homes, for example). The cost of connectivity for all children's homes in addition to the costs of supplying computers proved to be well in excess of the allocated funding. This problem was exacerbated in one cluster which had three secondary schools, rather than one as in the other clusters, and consequently 5,000 rather than 2,000 homes needing to be equipped. This meant that the LEA had no option but to 'disregard the benchmark' and let schools decide on their own approach 'with a common theme of support in the community.'

Sustainability

Sustainability will clearly be a problem as ICT Test Bed comes to an end. It will not be possible for schools to renew equipment and maintain the same level of activity without a continuation of funding at a higher-than-normal level. The pressure to renew equipment will have three causes: the acknowledged three-year life-span for ICT equipment; the constant use of data projection equipment which is likely to come to the end of its life in three years through 'wear and tear'; and 'people's expectations of technology' which always rise over time. However, the perception of some participants is that if ICT Test Bed demonstrates significant gains in children's learning, a way should be found to extend this level of funding in the future – both for ICT Test Bed and other schools.

Over-zealous network security

In one school over-zealous network security is creating a serious barrier to staff use of the system (in terms of both email and access to software of their choice). There is a similar negative impact on students' use. When controls become too draconian 'it degrades performance of the system.'

An apparent negative impact of Ofsted inspections

Ofsted inspections have had a clear negative impact on ICT Test Bed's work in one of the LEAs, preventing staff from attending meetings and causing them to put project work, including action research commitments, on hold. In one case two schools missed a workshop run by the National Remodelling Team which was described by those who attended as 'fantastic, very motivational' and was said to have 'led to sustained use of the NRT tool set' by all those who attended. It is hard to measure this negative impact precisely but it is likely to be reflected across many areas of the schools' ICT Test Bed work.

Problems arising from dependence on external network providers

The LEAs are all dependent on the connectivity infrastructure in their local area. In one rural cluster the costs of connectivity were, until recently, prohibitively high but the Council has now negotiated its own terms with a broadband provider and opted out of the regional broadband consortium. Costs of providing connectivity to homes is still prohibitive, however. In a second cluster the Council infrastructure for connectivity, including email, was poor at the start of ICT Test Bed and this caused major difficulties in implementing some aspects of the work. In the third cluster connectivity inside the LEA is good, but externally is not always so good. 'When you rely on a broadband provider for your connectivity from the internet, you are obviously out of control.' The LEA has experimented with 'a very big content management box' and using it to cache content by communicating automatically with the proxy server and provider but this proved problematic at least initially.

Additional costs arising from security problems with ICT equipment

There have been major problems with theft of equipment from schools, particularly in one inner-city cluster. This is a serious additional cost in terms of security systems (CCTV, strengthened locks and bars, for example), security marking and increased insurance costs. In consultation with the police and the Council's security experts, the best solution is now clear: 'Get all the equipment security marked and then proactively market that' with brightly coloured notices that can be seen easily inside and outside buildings, advertisements in the local paper etc. These additional costs need to be included in calculations of the total cost of ownership. The costs, however, are not the main concern. Rather, it is the disruption, particularly in relation to teaching and learning, that is brought about by the damage to windows and classrooms, removal of the equipment and time taken for the scene to be investigated by the crime squad, often preventing access to equipment for numbers of weeks.

Achieving the right balance between usability and affordability

There were difficulties for schools in taking procurement decisions which struck the right balance between usability and affordability. In one school the cost of upgrading the existing wireless network to enable very flexible use of laptops in all teaching spaces was expensive so an initial decision was made to experiment with using the existing 11Mb system where 50 or 60 wireless links were required, rather than 19 before the start of ICT Test Bed. Although this reduced costs very significantly it proved to be an unworkable solution because the time taken to establish the link between each laptop and the system was unacceptably long. A 54Mb link has proved to be essential. This higher bandwidth has the advantage of being much less vulnerable to unauthorised access from hackers,

since it does not permeate many structures and is unlikely to be accessible through classroom walls. Nevertheless, this has been a difficult decision to make for the school because it has meant diverting funds that had been allocated for other things. A similar difficult decision had to be taken in another LEA where the very large display screens to be installed in assembly halls would be extremely expensive if they had the recommended quality of data projectors and associated sound systems. Reduction in quality might, however, considerably reduce visibility and lead to problems with sound. The difficulty of taking this decision led to its being delayed for many months.

Delay caused by asbestos clearance

During the installation phase, one LEA had to overcome problems resulting from the presence of asbestos in some of the school buildings. This was dealt with efficiently by the Council's specialist asbestos unit within building services. It did, however, cause some significant delays.

The need for a dual system of financial management

In two LEAs it proved impossible to maintain up-to-date financial statements for ICT Test Bed using the Council's standard financial system. This was because of a delay, sometimes of as much as two months, between the commitment of funds and deduction of these sums from the financial statement. The solution in both LEAs has been to set up a dual financial system so that records of ICT Test Bed budgets are kept locally as well as centrally. This is an additional cost which may, in time, be overcome by better management information systems.

Workforce Development

The workforce development theme of ICT Test Bed is concerned with changes in the working practices of teachers, managers and support staff which may result from the use of ICT. Matters of particular interest to policy makers are the potential for ICT to:

- reduce teachers' workloads by giving teachers laptops, providing good technical support and simplifying administrative tasks

- introduce new equipment and software that will make it easier for teachers to share resources with each other as well as re-using them on future occasions, perhaps after some small revisions

- enable staff to work more flexibly, assisting one another and sharing tasks between them rather than keeping their roles strongly demarcated

- increase the efficiency of record keeping and retrieval and thereby give individual children a better service.

A range of work has been carried out during the first two years of ICT Test Bed to carry this theme forward. In this report we focus on these areas of policy interest. The final section, which reports on the impact of giving laptops to support staff, indicates that some ICT Test Bed schools are at the forefront in exploring possibilities to implement policy aspirations (see PricewaterhouseCoopers, 2004).

Reducing teachers' workloads

The use of ICT to reduce teaches' workloads is still a developing area of ICT Test Bed work, partly because all participants wanted to focus first on teaching and learning, but largely because many of these gains depend on the installation of complex networked software such as management information systems with enhanced functionality. We report here on some examples of good practice which suggest very positive gains are likely to be achieved in the next two years.

All teachers in one cluster and many in other clusters have been given either a workstation or a laptop for their own personal use. This has greatly assisted with lesson preparation and eased administrative tasks. Many schools have also given teachers 'memory sticks' (sometimes called 'thumb drives') and these are highly valued because they enable files to be transferred easily between home and school.

Good technical support has proved to be essential since, without it, teachers have the worry of trying to cope with technical problems at the same time as teaching a class. Once ICT is widely used for teaching and learning, across the curriculum, every classroom becomes technology-dependent. The ICT Test Bed project has shown clearly that this makes in-house technical support essential, since where schools have to wait for technicians to come from another school or support service teaching cannot proceed as planned.

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Beyond specific curriculum teaching and learning, whole-class technologies are being used for organisational, management and extra-curricular purposes. Increasingly the interactive whiteboards are used for registration and as a vehicle for inter-class communications and, through video conferencing, inter-school communications. In particular the information can be collected by the central school office and absences, and even assessment results, can be centrally collated, analysed and action taken. Efficiency gains of this kind are already in place in some of the schools. Pupils reported finding visual resources such as reminders, daily timetables and team points both helpful and an enjoyable mode of presentation. In one school senior managers reported that ICT had enabled them to put systems in place to reduce teachers' workloads, in particular lesson planning:

When we got questionnaires back there weren't hours and hours of planning. That was the first thing that surprised us. Because we have got the planning [software], it's done electronically and shared.

One secondary school has made a number of changes to staffing, designed to give teachers better support to make effective use of ICT: it has appointed a classroom technologies technician who was previously an adult trainer and relates well to teachers; it has also appointed a permanent database administrator since temporary staff could no longer cope with the work; and key staff with ICT Test Bed management responsibilities have had their non-teaching hours increased. It seems likely that the noticeable reduction in staff turnover in this school is related to these changes. A junior school has provided a range of new services direct from teachers' desktop computers, including networked photocopying facilities and a system for reporting technical faults. The latter can be accessed from a web page on the school intranet developed by the IT technician. At this school a number of staff who were classed by colleagues as 'technophobes' are reported to have left.

Development and sharing of resources for teaching

Many ICT Test Bed teachers are spending considerable amounts of time and energy on the production of resources for use with whole-class technologies. This is seen as a good use of time in the short term in order to achieve long-term gains, since these materials can be stored for future use (and easy editing) or shared with colleagues, for example across a whole department.

In the study of 24 classrooms (see the section on Teaching and Learning above) the content of teacher-prepared materials for whole-class use (such as Smart Notebook materials and the use of sound and images in PowerPoint presentations) provided evidence of teachers' skills in finding, creating, putting together and manipulating web-based resources, digital and scanned images, sound etc. It was indeed often difficult to distinguish between commercial programs and those created by the teachers themselves. Given many teachers' expressed lack of knowledge and experience with ICT prior to the start of ICT Test Bed, their confidence and competence in using computers and other resources is remarkable.

It is clear that staff now need to start differentiating between what they do and do not use. This has implications for time, and is ongoing. As resources grow they will need to be annotated and some form of critical appraisal attempted. The increasing range of resources in all sectors will need careful assessment and validation, not an easy task when a resource which works well with one teacher or group of learners may not resonate with another. Nor is it easy to incorporate effective methodology with the electronic resource. Here, perhaps, is a particular role for the school subject co-ordinators and departmental or college ICT champions in providing critical support for their colleagues in relation to the available resources.

More flexible use of support staff and increased efficiency of record-keeping

Under the national workforce agreement between the Government and some teachers' unions, drawn up during 2003–04, there is an expectation that support staff will take over some of the administrative tasks formerly carried out by teachers. There are also possibilities for support staff to work more flexibly, as part of a teaching team, using ICT to assist the teacher with a wide range of learner-support and record-keeping activities.

Giving technicians a wider role

In all three clusters, the ICT Test Bed project requires a high level of technical support. To explore the possibilities for flexible use of staff, one of the LEAs built into a Service Level Agreement with the Council's IT Support Service the expectation that technicians would contribute an element of learning support in schools as appropriate. ICT Test Bed technicians were provided with hardware and software training including the installation and maintenance of new packages. There was also a short Classroom Assistant Training course to enable technicians to develop the capacity to provide assistance with learning as well as ICT skills. The training provided for the ICT Test Bed technicians was also made available to existing technicians in the ICT Test Bed schools. Some of the specialist technical training was identified by the existing experienced technicians as especially valuable for career development.

An interview study was conducted after the first year to monitor progress in diversifying the role of technicians.

The classroom assistant training was not in itself valued by the technicians as the course was not ICT-oriented and did not make recognisable links with ICT developments. The two technicians attending (non ICT Test Bed technicians elected not to attend) appreciated that it had attempted to show the importance of helping children to learn rather than be instructed. However, neither believed that they had drawn on this course in their work so far. It also became clear that the heads of some schools did not regard this extension of the role of technicians as important in the early stages of ICT Test Bed. The ideal of technicians displaying flexible learning support skills remained a long-term intention, but the heads' immediate priority was for technicians to facilitate teachers' use of ICT. In relation to learning support, at this current stage of ICT implementation, the heads' prime requirement was for technicians to ensure that learners could access the ICT rather than becoming directly involved in supervising their use of the equipment.

Nevertheless, the demands of ICT Test Bed itself and the excellent working relationships that developed between technicians and teachers led to some clear successes in widening the role of technicians.

All technicians were very conscious of the importance of ICT functioning correctly to ensure teachers could use it confidently in the classroom. They recognised that it was important for them to familiarise themselves with new software as teachers often relied upon them to troubleshoot. One technician explained that, in his view, teachers sometimes felt overloaded with information received during training, and welcomed initial classroom support to explore how the equipment could best be used in their particular teaching situation. He gave the example of a supplier of interactive whiteboards who had provided very good technical helplines but in technical language. The supplier provided good demonstrations which anticipated teachers' needs, but the technicians were important to respond to problems that arose in the classroom. For example, in one school when a whiteboard screen display was unintentionally inverted, the technician was able to show the teacher how to return it to normal. Teachers were keen to master the interactive whiteboard software themselves; one technician explained that he saw his role as initially providing support and then reducing the level of support as teachers became increasingly proficient.

All technicians explained how they supported learning in the classroom. This support covered a range of informal and responsive activities including helping teachers to log learners on and off in ICT lessons; helping individual learners navigate menus etc. when problems arose; and providing problem-solving technical advice (how to unjam printers etc.) in After School Clubs.

Some technicians were also involved in more organised learning support activities, such as supervising small groups of children taking reading assessments at 20-minute intervals, supervising children with internet proficiency, and helping groups of pupils to learn how to use the Apple animation equipment.

The introduction of a 'classroom assistant' aspect to the technician role created a degree of tension in some technicians. Whilst all technicians were keen to share their technical knowledge, and engage in problem-solving activities to get software and equipment operating either for individuals or for whole classes, several explained that their scheduling into managing groups of pupils engaged in activities would interfere with their responsive technician role. One pointed out that he did provide support and assistance in an after-school club, and enjoyed helping a particular learner with difficulties, but he was uncomfortable with the idea of having responsibility for a group of learners. However, those who had been given responsibility for management of small groups of pupils found they actually coped quite well. Another enjoyed the responsibility of managing pupils engaged in animation activities and took pride in praising the children's work he had assisted.

All the technicians indicated that over time, as the equipment was in frequent use and the level of need for technical assistance reduced, they were likely to spend more time providing the children with support as directed by the classroom teacher. This would be in line with the role suggested in the classroom assistant training course they had attended.

General points emerging from this study of technicians' working practices in one cluster include the following:

- If technicians are given additional classroom assistants' training it is important to make the links explicit between this wider role and their role as technicians, since otherwise they may under-rate its importance.

- Technicians are proud of their expertise and value specialist technical training highly. This tends to make them want to retain their 'separateness' from other support teachers. During the initial stages of installing new technology infrastructure they are also anxious not to increase their workload which is already heavy.

- All technicians are very conscious of the importance of ICT functioning correctly so that lessons are not disrupted; this is their first priority.

- Some technicians in our study took particular pleasure in assisting teachers in their use of new software and equipment following initial training.

- All technicians in our study were involved in supporting learners in ways ranging from helping them to log on to or off the network to supervising small groups using the internet or learning to use new equipment.

Giving laptops to learning support practitioners

In one LEA, schools experimented with giving laptop computers to learning support practitioners (LSPs) to enable them to extend their role and work more efficiently. A case study of work in two of the schools, carried out in the summer of 2004, provided indicative evidence of progress and possibilities. In one school, laptops were used by LSPs responsible for Ethnic Minority Achievement Grant (EMAG) provision to develop and use administrative tools. In the other, LSPs used laptops more generally to assist them in carrying out a variety of tasks.

School one: specialist support for children from ethnic minorities

This school has a highly multilingual intake; 90% of the children are from ethnic minority families and at the last count 28 different languages were spoken by pupils. Recent immigrant and refugee children can be highly proficient in subjects such as mathematics and science but are held back by their level of language proficiency. The EMAG LSPs have a role in assisting children to overcome this language barrier.

The provision of laptops to the EMAG LSPs has led to new developments and benefits:

- The school has developed electronic records. This ICT-based system has been enthusiastically received and used by the EMAG team particularly because it speeds up record keeping and makes it much easier to retrieve records. Electronic versions of individual language plans (ILPs), tick-lists for tracking linguistic progress, and target sheets for children with language needs have been particularly useful.

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- Benefits for all staff include: greater ease in sharing documentation; a reduction in the amount of paper used; and time saved on tasks such as photocopying paper-based records.

- Benefits for the EMAG LSPs include: more efficient use of their time; greatly improved ICT skill levels; greatly improved access to computers for the full range of their work (including preparing teaching materials).

- Staff development strategies have included more than 20 hours of basic skills training for each EMAG LSP, often in twilight sessions alongside teachers, and ongoing support from the ICT Test Bed co-ordinator on a one-to-one basis.

- The high level of collaboration between teachers and EMAG LSPs has further developed the culture of professionalism and mutual respect which already existed in the school.

School two: exploring possibilities for more flexible working

This school faces considerable challenges in terms of language provision, special educational needs and working with refugee children. There has been a substantial increase in the number of LSPs over the past three years with the result that there are now more LSPs than teaching staff. This raises issues for senior managers around LSP deployment, working practices and management. Prior to ICT Test Bed, they decided to develop the role by giving LSPs greater ownership of the work they do with the children, so that they operate more as partners rather than being solely teacher directed. Teams of two LSPs (at levels 3 and 4) work together in leading specified groups of around 12 children for daily literacy and numeracy lessons. In conjunction with the teacher, they have a teaching role in planning, delivering, marking and assessing their group's work. LSPs also work one-to-one with children who have specific educational needs including physical disabilities.

The LSPs use their laptops for a range of purposes including lesson planning, the production of learning resources and everyday learning and teaching. The portability of the laptops offers convenience, information is available immediately and records can be easily printed. One LSP with previous ICT experience outside education has taken on the role of supporting ICT use across the school.

The use of laptops by LSPs has led to some clear perceived benefits:

- LSPs find laptops motivating.

- The easy access to laptop use ('just having it to hand') gives the LSPs flexibility to use them in spare hours at school, or at home, which has greatly increased efficiency.

- Using the laptops at home has greatly increased the ICT skills and confidence of some LSPs, as a result of exploring and experimenting with software.

- Some LSPs report that the laptop ownership makes them feel more valued and respected.

However, there have also been some problems in implementing such a challenging innovation. The LSPs were highly motivated to use laptops and software which would provide children with low language skills with a more visual environment, but there have been problems of software compatibility which have prevented this. The anticipated benefits in terms of efficiency of record keeping have not yet been achieved because so far there has not been time to transfer the processes to the laptops.

The levels of LSPs' proficiency in use of the laptops are very uneven. While some reported using them extensively at home and gaining considerable skills, others felt they had not received sufficient training and reported very low skill levels. Training had been offered but for various reasons not taken up. This pattern of uneven skills' acquisition is often seen in ICT initiatives and reflects the varied learning styles and home circumstances of the LSPs. There were concerns about sustainability of the initiative and the implications for changing LSP roles and responsibilities within the school. On the other hand, some LSPs said that they would now find it very difficult to manage without their laptops.

General points emerging from the work of these two schools

The changes in LSP's working practices and ICT skills resulting from giving them laptops have been generally positive. In the school which has focused on one specific area of work (EMAG provision) there have been considerable gains in efficiency and staff motivation; in the other school, the use of laptops to support a much larger group of LSPs across a wider range of activities has taken longer to establish. New procedures need to be introduced and established across all staff, and training in use of software and equipment for such a large group is challenging. Nevertheless, the potential for very significant efficiency gains is clear.

There are some health and safety issues which need to be addressed. Some LSPs felt vulnerable to attack carrying their laptop on public transport and some commented on their weight. As a result some prefer to leave their laptop at school and transfer files between home and school on a memory stick. Some LSPs felt that owning a laptop was a huge responsibility and felt vulnerable to theft from home or the car travelling to and from school. The cost of replacement was one issue. The fear of children's personal records being stolen was another. Insurance was raised as an issue.

Collaboration between Cluster Institutions

The ICT Test Bed project includes two themes which focus on work across the cluster rather than in individual institutions. The first of these is collaboration between the cluster schools, and between them and the college. This is of particular importance because of recent policy initiatives focused on improving the continuity and coherence of pupils' learning as they move from primary school to secondary school (the Key Stage 3 strategies, for example) and from secondary schools to sixth form college or further education college (the 14–19 agenda).

From the start the project was established as a collaborative initiative within each cluster. ICT co-ordinators from each school have had regular meetings and heads have met weekly in one cluster, monthly in another, and as required in the third. All major decisions have been taken collaboratively, although in all three clusters individual schools have had the freedom to make their own different choices when appropriate. The ICT Test Bed managers in each college have attended cluster meetings and participated in decision-making. The colleges have not received the same level of funding as the schools in relation to their total funding and their work is, therefore, focused on three selected subject areas rather than whole-college development. However, each college has also introduced specialist networked software such as MIS and VLE systems and the latter is an area which invites collaboration across the whole of the college and with the schools.

The collaborative nature of decision-making in ICT Test Bed and the frequent meetings that this has entailed have established strong bonds between the institutions and created the conditions for shared initiatives. The electronic networks established by ICT Test Bed have also made it much easier for teachers to communicate with one another, and innovatory networked software, such as virtual learning environments, have made it easier to share resources for teaching. Nevertheless, compared with the pressing needs to procure and install equipment, provide staff with training in its use, and implement innovatory practices, there has been less immediate pressure to develop collaborative projects across the institutions. Travel time between institutions, the logistics of time-tabling and safety issues relating to the need to supervise pupils make such projects complex to manage.

In this report we focus on four aspects of ICT Test Bed collaboration:

- General progress in collaboration between the colleges and the schools

- The production, sharing of, and access to, resources for use with whole-class technologies

- A cluster content-development workshop

- A collaborative project between secondary schools and the college in one of the clusters.

General progress in collaboration between the colleges and the schools

The colleges are independent organisations which had no formal links with the clusters of schools prior to the commencement of ICT Test Bed. Indeed, in all cases they are unavoidably in competition with local secondary schools over recruitment of students to some courses. During the first two years of the project the nature and extent of their partnership with schools has developed in very different ways.

In one cluster the college is a very active partner. It has taken responsibility for organising and hosting training days for school staff and welcomed staff and children to come and use college facilities. It has also played a leading role in the development of links with children's homes and the community, for example by hosting outreach centres and establishing a virtual learning environment to support learning in rural communities, and by undertaking the repairing and upgrading of second-hand computers supplied by the secondary schools to go into homes. Work in another college has progressed much more slowly, mainly as a result of major re-structuring in the college during the first year and a change in the college's ICT Test Bed Manager during the second year. In the third college there was also a change in the ICT Test Bed Manager during the first year, but collaboration is now developing well, for example in relation to a content development facility located in the college for the use of both college and school staff (see below).

Sharing resources for use with whole-class technologies

In the observation study of whole-class technologies in 24 classrooms across the three ICT Test Bed clusters, the evaluators looked for evidence of collaboration. Teachers shared their resources with colleagues in their school and in some cases were beginning to share resources with teachers in other schools in the cluster. Whole-class technologies such as IWBs demand the development of more resources than teachers may have previously needed, but once developed they are available for use in the future and can be easily edited. One teacher who had changed year groups from Year 6 to Year 3 had the transition considerably eased by the availability of resources already assembled for teaching that year group. In one cluster, science co-ordinators developed a portfolio of resources in science that form the basis of a major element in a newly established VLE. One outcome of ICT Test Bed has been the development of strong links through the clusters enabling such sharing of expertise. The potential to access other school and web-based resources rapidly opens up expanded possibilities beyond those previously available to teachers, and enables them to respond to children's needs as they arise.

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This is a particularly effective context for primary teachers, where all the teachers in the institution, and in other institutions in the cluster, share the same concerns. The primary teacher's task to teach across all subjects is huge and, although there are differences between year group teachers, it is still in many ways a common task so that mutual support is natural and traditional. In secondary schools and in FE the situation is much more complex. A subject area will contain only a few teachers and the need to develop expertise is therefore much more an individual issue. It is not surprising therefore that development of shared resources in secondary schools and the FE colleges was found to be more patchy.

A cluster content-development workshop

In one cluster, it was decided that the college would establish a content development workshop with ICT Test Bed funding at the same time as it installed a VLE. This new facility to produce and organise e-learning resources, and make them widely available through the VLE, was important in enabling e-learning to have a much wider impact in the college than would otherwise have been possible. The facility was also made available to teachers in cluster schools.

The workshop employs three full-time materials developers to work with teachers to transform and enhance their existing materials and create new materials. It has the facility to create interactive materials and has worked with teachers from cluster schools to produce a range of materials including interactive presentations, digital video and project work in various subjects including science, geography and history.

The workshop offers a number of other services to the ICT Test Bed cluster, including offering a well-resourced space for staff from cluster schools and the college to come in and work with the team to develop their own materials. There have been some notable successes in the collaboration but generally it has proved difficult to get school staff to come into the workshop even when extended opening hours were offered. This seems to be as a result of the difficulties of travelling from the schools to the cluster through heavy traffic, either taking time out of teaching or working late in the evenings. It is discouraging for workshop staff, however. The workshop has the capability to use video conferencing to talk with teachers in the schools without them leaving their school but the necessary equipment has not yet been installed in the schools. The workshop team produces a newsletter which goes into all the cluster schools but sometimes there can be a bottleneck and the newsletter does not reach the individual teachers in the schools. Workshop staff meet with teachers in schools and attend management meetings where they generally get a good response. As one developer said,

> 'On Friday we had a general meeting with the entire staff, very good response there. We obviously made new contacts, people coming forward with ideas for learning resources. People see [what we can do]. What I normally do is show them examples of what is possible with e-learning, show them my past work, show them examples of how to use video to teach.'

The resources offered by the content workshop have been used by one of the infants' schools. The staff commissioned short animations of a character called Dogum that can be used to start lessons and stimulate discussion. A member of staff from the content workshop visited the school three times and the school ICT Test Bed co-ordinator visited the college once. The development of this kind of resource can, therefore, be seen to be time consuming. Staff at the college are perceived to be friendly and helpful and also advised the school on the development of websites and resources. At one of the junior schools the content workshop team helped the ICT Test Bed co-ordinator to put five films of an assembly together with one sound track. The co-ordinator learnt from the experience and would be happy to do it himself in future. One of the secondary schools organised a presentation from the content workshop team in the autumn of 2004. This made staff aware of the service and created a buzz of excitement and interest. It has led to further meetings with the college and the English department are particularly keen to develop some resources. Some staff in these schools, however, said they would prefer to develop their own resources, although they recognise that they do not have the time to do so.

A collaborative project between secondary schools and a college in one cluster

The Digital Imaging for Creative Industries Project was conceived to meet the ICT Test Bed requirement that Further Education colleges should allocate some funding to support collaborative projects with their cluster schools. The initial focus, Art, was suggested by the heads and the project co-ordinators in the cluster. The project was outlined in the action plan produced by the college in February 2003. Prior to finalising the plans, college staff consulted with staff from the three cluster secondary schools (heads of Art and ICT Test Bed project co-ordinators) in order to identify areas of interest and needs. School staff identified a need to provide pupils with experience of Apple Macintosh computers, professional standard digital cameras and Photoshop (industry standard equipment and software) through whole-class teaching in order to strengthen vocational elements and opportunities to develop industrial awareness.

The original aims were to:

- establish a pool of transportable high-spec digital imaging equipment, cameras and laptops for whole-class delivery within each of the cluster group institutions.

- develop vocationally appropriate ICT skills in industry-standard software (Dreamweaver, Flash and Photoshop) and printing outputs.

- create a website for displaying students' project work which can be accessed by students, their parents and potential employers and to act as a motivator for assessed coursework projects.

- enable teachers and college lecturers to collaborate on digital imaging assignments and hence to share good practice and skills.

The focus was on creating modules for A/S art and A/S photography as well as embedding technology in photography courses in the college's Multimedia departments. The modules were designed to be delivered by school staff in their own classrooms, but teachers could arrange for their students to visit the college to use the professional photography studio. Because of the time needed to travel between the schools and the college, specialist equipment was lent to the schools for three-week periods in rotation.

The project is a good example of the complexities of collaboration between four institutions. The fact that one was an FE college and the other three were secondary schools was an additional complicating factor. Staff of both the schools and the college started work on the project with enthusiasm but a number of problems arose that proved difficult to overcome. By the end of the project, all continued to agree that the approach had huge potential. Next time round it would be possible to make changes which would overcome some of the problems.

Collaboration between staff from different institutions

Collaboration between staff from different institutions proved to be challenging. There were a number of confusions about what was expected, and different assumptions across the two sectors, which made it difficult to work under pressure. Part of the problem was in expecting people to collaborate who scarcely knew one another at the outset. Future initiatives should allow more time for planning and inter-institution networking. Additionally leadership, roles and responsibilities, team structure and resource ownership should be clarified from the outset and communicated at all levels from senior management to teaching staff and technical support.

Focused use rather than inclusive of all schools/phases of education

The emphasis on industrial awareness and vocational experience was intended to address a need not being met within A/S level courses in the secondary schools. When the need to collaborate with *all* schools in the cluster was raised as a possibility it contradicted the direction that college staff responsible for implementing the project had been given. At that stage the college staff felt that the vocational elements and use of professional standard equipment did not lend itself to use in primary schools. However, the staff hoped that they might be able to adapt the project or allow primary schools to access the equipment at some point in the future. There seems to be a tension between responsibility for maintaining professional (and expensive) equipment and concerns about the risks involved in allowing younger (and older) children to have access to this kind of equipment. Clear external direction of this project and fuller lines of communication would have ensured that all objectives were met. There is a need to explore new models of facilitating students' access to expensive equipment. Often young people, with adequate supervision, can be very responsible.

Differences in ICT expertise

In one school, lack of prior experience of Photoshop (both students and staff) proved to be an additional challenge. Staff at the college provided welcome technical support through the staff and student workshops, a 'user manual' and site visits. This was acknowledged as being very helpful and professional, but time constraints did not allow for first-time users (staff and students) to develop a good grasp of how to use Photoshop. This meant that students spent a disproportionate amount of time trying to work out how to achieve particular affects or solve technical problems, because they did not have time to develop an appropriate level of expertise in Photoshop. The teacher concerned commented that there was 'no scope for discussion about the artistic qualities of the work they were doing because they were up against technical problems that neither they nor I could solve.' This created an additional strain on the pressure of covering all that was required for the A/S module. There were issues relating to finding mutually convenient times for the technician from the college to visit the schools, matching availability to lesson times for example. Students referred to a need for more extensive training or greater levels of support. They were, however, happy to learn through experimentation and offered support to each other and the teacher concerned. The teacher felt that this had shifted her role in the classroom as she was no longer the expert but learning how to use Photoshop alongside her students. However, she was not comfortable with the feeling that she was 'deskilled' or not equipped to support her students in the way that she wanted to. It proved important to cater for very varied levels of prior skills among participants (in image manipulation, for example). Both staff and students without prior experience require opportunities to develop the appropriate skills outside timetabled lessons as this requires a significant investment of time.

Logistical issues

The logistics of sharing equipment proved to be challenging, particularly in relation to the timely return of the equipment to the college which was frustrating for all concerned. College staff wanted to ensure that all schools had fair access to the equipment but that the equipment was also available for their own students to use. School staff found the three-week period to be constraining when it always seemed to be raining or the class was timetabled in the late afternoon when it became too dark to take photographs outside. In addition, school staff had to stop what they were doing to make the most of the equipment when it was their turn, interrupting other units of work. The key message from school staff was that more flexibility was desirable.

'If you could actually sort of say well 'we always start this unit on this date, could we have the equipment then?' it would have been easier. And also our exam is really early so they have had to stop unit two, do their exam, now they're going back to it without the equipment because the college now has the equipment.' Art teacher, comprehensive school, March 2004

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

The equipment provided by the college was very expensive and so school staff were asked to follow strict guidelines concerning, for example, insurance and how the cameras could be used. This meant that students were only able to use the cameras when supervised and largely used them in the school grounds rather than taking them off site. This limited creativity and choice. In some cases, students used their own digital cameras to take photographs at the weekend but the quality of the images was not satisfactory and so they only used the images taken with the professional standard equipment for their final pieces.

To increase flexibility those concerned decided that next time round it would be important to redeploy some equipment, particularly cameras, to the schools on a permanent basis and possibly to install Photoshop on school networks rather than relying on the Apple iBooks. This would increase flexibility and enable teachers to 'use [the equipment] more seamlessly'.

Owing to the distances between the schools and the college it was not possible to undertake a visit in a single lesson. School staff were asked to accompany their students on any visits to the college, which meant they had to find the time when they could be out of school for a day or a morning as well as the students. In addition, there were issues about arranging for students to be off timetable in relation to time to study their other subjects. In one school for example, sixth-form students were only allowed to be off timetable once per half-term in order not to affect other subjects being studied.

Impact on practice

Using technology was perceived to be a way of working that enabled ideas to be generated rapidly as well as new forms of outcomes to be produced. In relation to the GCSE and A/S Photography courses, digital cameras were perceived by the teacher concerned to accelerate learning because the process was much faster. The use of digital cameras gave many students the opportunity to realise their potential. Photographs could be seen straight away and taken again if the camera settings and lighting were not quite right. The students appreciated that using digital cameras was modern and represented professional practices, as well as being easier and quicker than traditional equipment.

The digital medium also encouraged a way of working that did not fit in with the assumptions of an external assessment process designed for traditional media. For example, the increase in the number of photographs taken and their easy manipulation did not encourage students to establish a paper trail of progress. Consequently, they often did not record the process of image manipulation sufficiently carefully, and new approaches to recording process need to be investigated. It would also be helpful if moderators could be better informed about the nature of digital imaging so that the contribution of this approach could be appreciated.

The flexible approach adopted in one school offered the best of both worlds: exposure to digital imaging, professional equipment and industrial practices, without constraining the final exam piece through the exclusive use of a single media form which some students clearly did not feel comfortable with.

Home and Community Links

The second of the cluster themes in the ICT Test Bed Project is home and community links. The aim is to use ICT to improve communications with parents and provide pupils with access to computer-based learning materials from home, thereby raising educational standards as well as strengthening links between the cluster schools and the local community.

This theme caught the imagination of all the participating schools and colleges from the beginning, but it proved difficult to put into operation. In two clusters, where the initial plans were to provide every pupil with a home computer, early enquiries suggested that costs would be prohibitively high, and this resulted in a decision to get work in other areas established before taking decisions on home–community links. In these clusters, decisions were finally made and computers issued to homes in the summer of 2004 (in one third of schools only in one cluster).

In the third cluster, where the varied approaches across the college and the schools were perhaps more realistic, some heads saw this theme initially as a lower priority. However, others put initiatives into place extremely quickly.

In this report we focus on three aspects of the ICT Test Bed Home and Community Links work:

- A varied approach adopted in Cluster A

- The roll-out of computers to all pupils' homes in Cluster B

- The roll-out of computers to all pupils' homes in a vertical group of high school, junior school and infants' school in Cluster C.

A varied approach adopted in Cluster A

In this cluster some schools started work on the home and community links theme very early in the lifetime of the ICT Test Bed Project. Their approach was varied, suiting the needs of the local communities and building on existing provision wherever possible. For example, several schools refurbished existing community rooms with ICT equipment for community use, either attached to the school or in the local village. In one case this took the form of a new parents' room built onto a nursery school as part of major building work. The college also refurbished and re-equipped some of its former outreach computer learning centres across the cluster and re-launched them as Community Learning Centres, which quickly became highly attractive to learners by offering short taster courses in digital photography.

The college strengthened its links with local businesses through students and staff using ICT on placements and employers coming in to college to video-record training materials. The VLE, established in several departments of the college before the installation of the cluster VLE, provided very welcome e-learning opportunities for rural learners who found travel to college difficult in the winter. The intention was that, following the installation of the VLE in schools during the summer of 2004, it would be developed to allow children and parents to access it from home. It is too early to report on the extent to which this has proved possible.

One school provided all pupils in Year 6 with a personal laptop which they used both at school and at home for the whole year, 2003–04. During an interview in March 2004 the head was very enthusiastic about the impact this had had, saying:

'The level of expertise in these kids is just amazing – their class teacher and I are amazed. I am so excited and we've had lots of comments from parents. These are children who are not high achievers and it's made an incredible difference to their work.'

Other schools also provided pupils with laptops for use in school and to take home for short-terms loans. One head commented that this had had a knock-on effect in 'bringing parents into schools who never have been before'. None of the schools had any problems in loaning laptops to children to take home, which they saw as the result of putting a clear process in place. One school had purchased digital cameras which it loaned to children in Years 1–3 to take home. It also welcomed parents to come in on Mondays after school to work on the computers with their children. All of these initiatives were highly motivating for pupils and were establishing demonstrably closer links with parents.

The college also supported the secondary and special schools in providing 100 computers for pupils' homes. The schools provided second-hand computers which a college technician repaired and upgraded before their installation in homes. In the six months after installation the college technician also made more than 150 visits to provide home support to repair, upgrade and personalise computers which, in some cases, were supporting pupils with special educational needs. The college has been particularly imaginative in using contacts with members of the community – both in their homes and the outreach centres – as the first step in supporting adults back into education, for example to enrol in literacy programmes.

General points emerging from the varied approach in this cluster

There are a number of ways in which ICT can strengthen links between schools, pupils' homes and the community. Work in this cluster provided evidence of good progress in:

- strengthening informal contacts through establishing parents' or community rooms with ICT equipment attached to primary schools

- encouraging adults back into education by equipping college outreach centres with ICT equipment and offering taster courses in digital photography

- strengthening links with local employers by using ICT links between the college and students on placement

- greatly increasing the ICT skills of primary-aged children of average ability by providing them with laptops for their sole use at home and at school. Similar initiatives to loan laptops and other equipment such as digital cameras for shorter periods of time were highly motivating for pupils and established closer links with parents.

- providing home computers for secondary (including special needs) pupils who previously had no such resource, through the use of the technical expertise of college technicians to re-condition second-hand computers and provide follow-up technical support.

The roll-out of computers to all pupils' homes in Cluster B

A key aim in this cluster is to maximise the potential for pupils' out-of-school learning by giving them access from home to integrated learning software (ILS), curriculum resources and instructions about homework. Another aim is that the VLE will enable the delivery of targeted work assignments to disparate groups or individuals. Although initial demands to create content are expected to be heavy, year on year, resources will be reviewed, adapted and supplemented rather than recreated. A third aim is that the home computer initiative will provide learning opportunities for parents and encourage children and their parents to work more closely together on schoolwork. Electronic access to information and services also coincides with Neighbourhood Renewal objectives. Fourthly, administrative benefits are envisaged. Communication with parents through email, the portal and the school website will provide up-to-date information on attendance and progress (password protected) as well as more general notification relating to the school calendar. Not only will this reduce paperwork, but it will also open up new possibilities such as the potential to create, distribute and analyse questionnaires electronically.

These are the aspirations. Implementation of the initiative started during May, 2004, with the roll-out of equipment to homes. All families with children aged 5–18 (Reception to Year 13) who attend ICT Test Bed schools were eligible to participate in a long-term computer loan scheme. The offer was open to all families, regardless of whether they already had a PC at home or not. There was a high percentage take-up across the cluster (for example, 95.6% take-up at the secondary school), and around 1,600 machines were issued in total. The bulk of the expenditure came from the ICT Test Bed budget with some additional funding from another funding source linked with the LEA. This is a major investment of funding for computers in homes in one of the most deprived wards in the country.

The process of roll-out

The roll-out of computers was described as 'an absolutely mammoth task', the workload 'tremendous' and forward planning 'immense'. Procurement and roll-out made huge demands on key people with regard to management, co-ordination and organisation.

Essential paperwork for the initiative and agreed procedures such as proof of identification, the signing of the agreement and the recording of serial numbers were standardised across the cluster, as was a primary CD of starter resources compiled by the Project Co-ordinator team and the LEA Link Officer. A particular benefit of the roll-out was the opportunity to meet with parents who rarely or never come into school. Gathering details of families and their contact numbers became an excellent auditing opportunity. The schools were able to record accurate family and contact details which in some cases had not previously been available.

3: Indicative evidence of change – preliminary findings of the external qualitative evaluation

For the Project Co-ordinators, the National Remodelling Tools proved useful in the collaborative process of planning and reflection on roll-out. Roll-out sessions in each school included presentations on the philosophy behind putting computers into homes, the loan system, expectations, setting up the computer, resources currently available, disposal boxes and opportunities for questions. Representatives from the FE college provided information and advice for families on ICT training for lifelong or vocational learning.

Response from families

The response from families was extremely positive. Children were excited at the prospect of having a computer at home for weeks in advance of roll-out. The initiative was enthusiastically received by parents. Despite language barriers, the number of parents not turning up to take possession of their computer was minimal.

Support mechanisms

A cluster helpline was set up in order to respond to parents' queries. This service was available on each school day between 8.00 am and 4.30 pm (4.00 on a Friday). Based at the City Learning Centre which is located in the secondary school grounds, this centralised cluster resource was a good way of recording the number and nature of queries. It also protected teaching and administrative staff for whom an overload of questions would have been overwhelming. The helpline has been well used and has been appreciated by parents. Some 39 calls had been made to the helpline by 19 May, with the bulk during the first week after roll-out.

Potential impact on practice

Provision of home computers promises to raise the status of homework in a context where non-completion has generally prevailed. Across the primary schools there is an expectation that children will log on to the Learning Gateway for a certain number of hours per week and an anticipation that continuation of classwork at home with continuity of resources will promote a smoother flow of learning between sites. The teachers of Years 3 and 4 in one primary school were delighted at the children's response to electronic homework (for example, writing a persuasive letter). As yet, it is too early to evaluate impacts on learning. Nevertheless, there is some preliminary, indicative evidence. One Key Stage 1 child from the same school reported having been able to answer a SATs problem as a consequence of 'playing on Toyshop on my computer' (software provided on the cluster CD). At a relatively low cost, one school had provided online access to 'Education City' in time for the 2004 summer holidays. A senior manager commented, 'I don't think it's going to change the world in terms of attainment but it's going to get the children interested and motivated.' In this school, teachers are beginning to plan electronic homework which is transferred between home and school on a disc. They are also setting homework which requires internet research, such as two opposing arguments on animal rights issues.

Even if only a few children come into school with printed information, this is enough 'to start the ball rolling', as one senior manager commented. It was reported by another respondent that Year 2 children who had used their computers at home during the summer holiday had returned in September with higher reading ability and greater enthusiasm and confidence to want to read. Greater improvement in general ICT navigation skills and use of word processing and presentation software in those pupils using home computers, compared with peers not taking up the opportunity was also reported by this teacher.

Challenges that remain

The roll-out went extremely well but development of the initiative since that time has posed some problems.

Expanded learning opportunities at home will entail extensive professional development to give staff an understanding of the VLE, the development of resources (set homework prepared in advance) and the flexibility to respond to ongoing class work.

Related to the learning gateway and content development is the issue of connectivity. Since the home computer roll-out in May 2004, only stand-alone resources have been offered by the schools. Feedback from the parents suggests that the software supplied on the CD has been enthusiastically received by the children. Taking advantage of special offers on internet connections, some families have gone online independently 'because they just got so excited by the whole thing'. The cluster is looking to provide broadband connectivity which will entail upgrading some lines to ADSL. A managed Learning Gateway will ensure that costs are not charged to homes and will provide the anti-virus and content filtering facilities. Through the schools' servers, it will also connect with the management information systems and thereby provide information on progress and attendance. The possibility of wireless access is currently being investigated. There are issues for a number of families who do not have landlines (one fifth of families in one school), as well as others who subscribe to a number of different companies, and those who have moved on to television connectivity. Cost and installation implications have yet to be negotiated and settled. The initial source of funding for this purpose has not been forthcoming. Similarly, the funding for a home–school links manager and home–community liaison workers, as originally envisaged, is no longer available.

Another issue may be recovering and reissuing computers. There will be a need for ongoing accurate records. Procedures have been put into place for recalling computers when pupils leave ICT Test Bed schools (in Years 6, 11 and 13) or move from the primary to the secondary phase. In a community where there is a lot of mobility, there will be issues around tracking the significant number of refugee and asylum seeker children because they move on so quickly. Plans will be needed for balancing larger incoming than outgoing intakes. Insurance of machines was too costly, hence the installation of 'computrace', a system that assists the police in tracking computers that have been stolen.

A final and critical issue is sustainability. How will the initiative be sustained throughout the life of the ICT Test Bed project and beyond? This was a matter of concern for interviewees, and one with no easy answers.

Afterword

The initiative was said to have created a strong feel-good factor about the whole ICT Test Bed project. A positive outcome is that the 'excellent teamwork' entailed in planning and roll-out has brought the cluster closer together. The Project Co-ordinators were pleased with the appropriateness of the training and information they had supplied. Cluster staff, and one administrator in particular, would be in a strong position to advise other schools embarking on such an initiative.

The roll-out of computers to all pupils' homes in a vertical group of high school, junior school and infants' school in Cluster C

In this cluster, the home-computer roll-out took place in the summer term for one vertical group of a secondary, junior and infant school. Procurement was supported by the LEA and its ICT Test Bed Manager. The eventual choice of product was made because the price and servicing arrangements were good. The unit included a 17" flat screen monitor, a Gold level service agreement (3 years' onsite warranty, 3 years' access to a 24-hour helpline), Microsoft Office and Encarta (which was given free of charge), and anti-virus software. The secondary school units had some content for KS3 and KS4 pre-installed, as well as direct links to the school intranet on the desktop. The units were all badged with the Dell help-line number. Originally the schools were looking to procure 1000 units but lack of interest meant that the numbers were lower in the end. The schools requested that the units were pre-installed with an Internet Service Provider but unfortunately this did not take place. The secondary school provided AOL CD-Roms while the primary schools handed out CD-Roms from Tesco. The expectation from all schools was that parents would pay the connection costs (1p per minute at the time).

The idea originated with the secondary school, which originally envisaged working alone on this initiative. The junior and infants schools joined in later. The relative size of the secondary school meant that most decisions were taken to suit its needs. For example, when the two primary schools negotiated a different image (design of the user interface and choice of icons on the desktop) for the machines for their children they had to pay extra to the supplier. Busy staff in the secondary schools did not always keep primary staff informed about decisions which in some cases proved to be more important than had at first appeared.

The three schools worked together to ensure that families with children at more than one school (or about to move schools) were only provided with one computer. This was essential to reduce costs, although there were concerns about sharing a single computer between two or more siblings in relation to equity. Collecting and cross-checking the data on families between the three schools proved to be rather time-consuming since they did not manage to set up a common system.

Parents were told about the initiative at information evenings. The secondary school did a survey of home computer access by talking to parents on Achievement Days (when attendance was the highest). Then they targeted individual families by inviting them to information evenings. The primary schools faced problems owing to parents' assumptions and expectations. Parents had to be telephoned at home to remind them about the meetings and take-up in the junior school was disappointingly low since only 44 homes actually took delivery from an estimated 100 that would have been entitled to receive a home computer. The secondary school used the word 'loan' as the equipment was technically owned by them, but this acted as a deterrent as some parents associated this with weekly repayments and debt. Other pupils and parents thought that it would be outdated technology and not worth having. All schools found that many parents did not realise what was on offer. Some parents were suspicious and wanted to know what the catch was. In the secondary school word of mouth eventually had an impact as pupils began to approach staff and ask for application forms.

In the event, fewer parents took delivery of their computers than had originally expressed an interest and surplus units were distributed to pupils coming into the secondary school in September 2004 from non-ICT Test Bed schools.

Once the computers were allocated, there was further work to be done in installing them in homes and providing basic instructions on use and technical support. The contract with the provider included delivery and support through the Gold level service agreement but owing to delays and difficulties in making arrangements for deliveries, many problems came back to the schools to be dealt with.

Maintaining software on the machines (such as Windows updates and the virus software which does not update automatically) was not included in the service agreement and remained a worry. At the secondary school, parents initially rang the school for help; the member of staff responsible for the project redirected them to the supplier but in some cases, particularly where parents did not speak much English, helped them directly. There was also the issue of parent training. The secondary school organised training sessions from a commercial provider who also offered a free printer to the first 150 parents to sign up. The junior and infants schools were not part of this deal but planned to make alternative arrangements.

Points emerging from this study

The organisation of this project from start to completion of the roll-out was very time consuming, particularly the amount of time required to chase up parents who qualified but had not attended meetings, or who had changed their contact details between applying and taking delivery of the machines. The administrative burden on key staff was substantial but it was not deemed to be appropriate for admin staff to undertake, although they did help at times with telephoning.

The benefits of placing computers in pupils' homes are likely to be considerable, far outweighing the difficulties that staff have encountered in procurement and the roll-out to homes. However, the problems encountered illustrate very well that such large-scale collaborative initiatives involving three schools from different phases need to be planned in collaboration from the start. Almost all the problems resulted from the fact that an initiative planned originally by the secondary school alone was enlarged at the last minute to include two primary schools. The experience of these three schools also shows the complexities of communicating with parents and the importance of doing so effectively even when offering something that the school assumes will be greeted with enthusiasm.

4: ICT Test Bed from the inside – evidence from action research carried out by teachers and para-professionals

By December 2004, teachers and para-professionals from the ICT Test Bed Project institutions, working in partnership with the external team as participant evaluators, had completed 23 action research studies of their innovative work with ICT.

Action Research carried out by teachers, support staff and managers in the ICT Test Bed schools and colleges makes two significant contributions to the ICT Test Bed Evaluation:

- As 'insiders' experiencing the ICT Test Bed project in their work on a daily basis, the action researchers provide knowledge and insights which would otherwise be inaccessible to the evaluation team.

- The process of carrying out action research provides a powerful incentive to engage more deeply with the work of the ICT Test Bed project, enabling teachers, support staff and managers to explore the purposes of the innovation more fully and try out new approaches with the support of a link researcher from the evaluation team. Involvement in research in this way is well known to be a successful strategy for continuing professional development.

The action research reports were written for a wide-ranging audience of teachers, parents, policy-makers and the evaluation team. They are the outcome of research undertaken into innovative work being carried out within the ICT Test Bed project as part of their authors' full-time posts. In carrying out this work they were assisted by a link researcher from the evaluation team, but this support was necessarily low level.

The emphasis in these reports is on 'first person narratives' that can give the reader what anthropologists call the experience of 'being there'. In recognition of the complexity of the ICT Test Bed project's challenges, the evaluators have encouraged practitioners to write reports which raise questions for further research as well as identifying what has been learnt from this particular study. In many cases the process of writing these reports has already led their authors into follow-up action research.

4: ICT Test Bed from the inside – evidence from action research carried out by teachers and para-professionals

The role of cross-case analysis in contributing to the evaluation

These reports are grounded in practitioners' understanding of carrying out innovatory work with ICT as part of their day-to-day practice. They provide the evaluation team with insights which would otherwise be inaccessible. An analysis of this accumulating body of studies, in a process called cross-case analysis, is the basis for this section of the report. This reading of the reports in the light of one another, including systematic mapping of contents, cross-checking of themes and meta-analysis to look for trends and gaps, generates more reliable knowledge about the process of ICT innovation than can be produced by a single action research study. References to the full action research reports which can be found on the ICT Test Bed Evaluation website are included throughout, and readers are recommended to read them in full on **www.evaluation.icttestbed.org.uk**

The role of the single study

Studies of individuals' practice can make a significant contribution to an understanding of an educational phenomenon. Yin's (2003) explanation of the strength of case study is particularly appropriate in the ICT Test Bed context. He suggests that case study:

> investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clearly evident. (Yin, 2003:13)

It is certainly apparent in the ICT Test Bed situation that boundaries between the innovation and the established context of school and classroom are difficult to draw. For example, teachers might claim that effective teaching using ICT is based upon an existing student-centred approach. However, the very act of giving all children a laptop (phenomenon) inevitably creates a more student-centred classroom (context). In a similar vein, several heads expressed concern that the benefits from long-term improvement strategies which they had developed in their institutions before the ICT Test Bed Project might now be subsumed into by-products of ICT Test Bed – so that all the developing features of the successful existing context might become attributed to the latest ICT (ICT Test Bed) phenomenon.

Individual practitioners' case studies can provide powerful understandings of local situations (Stenhouse, 1975; Rudduck, 1985; Elliott, 1991; Yin, 2003), but they have been criticised for being located in unique situations, where the findings are neither generalisable to other settings, nor capable of being replicated and tested for reliability. The traditional response (for example, Bassey, 1985) is that such studies are not meant to be reliable, but may well be relatable; that is, a reader could identify certain features of the individual researcher's context that are pertinent to the reader's own experience, thus allowing the reader to exercise informed professional judgement as a result of the intelligence presented in the individual study. For example, an ICT Test Bed teacher working with an atypically high proportion of EAL children in Sandwell has redesigned and modified software to meet the appropriate literacy levels for her class. A teacher in Durham (with no EAL children in the school) may still identify with and draw upon the Sandwell teacher's experience to help him or her adapt use of the software to make it relevant to a different context.

Teachers' research case studies are immediately valuable in reaching a deeper understanding of the ICT Test Bed Project because of the complexity of introducing ICT into the classroom. This complexity can perhaps be characterised as a 'distinctive situation in which there will be many more variables of interest than data points ' (Yin, 2003:13). Case study is needed, not only because all variables cannot always be easily controlled (indeed such controlled situations could only be achieved by disrupting classroom practice inappropriately) but also because case study can actually help researchers to identify the variables; individual teachers' studies can move us beyond the search for answers to given questions, and help us frame other pertinent questions which may have been unforeseen by researchers coming in from outside. Case studies attend to the ' how' and 'why' questions that traditional surveys and experiments cannot address, and aim to provide insights that help us inform decision-making in other complex and uncertain situations.

The role of cross-case analysis

Stake (1995, p. 25) suggests that it is helpful to draw up a topical outline of the questions to be answered before commencing multi-site case study work, so that this can later be used for cross-case analysis. The five themes which make up the focus of development work in the ICT Test Bed Project, broken down into the sub-sections which are being used as a check-list for qualitative data collection by the 'external' researchers, have provided a broad topical outline. Within this framework, it has been of particular interest for the evaluators to observe the kinds of questions that teachers have chosen to address. This provides a clear indication of what they see as valuable and researchable. Cross-case analysis has thus enabled us to explore the underpinning motivations of teachers engaged in the ICT Test Bed project.

Stenhouse, writing of the importance of teachers engaging in research to deepen their understanding of the process of teaching and learning, had a vision of teacher-researchers and professional researchers working together to develop educational theories as the basis for the improvement of teaching and learning (Stenhouse, 1975, pp. 142–165). Yin (2003) strongly advocates cross-case analysis as a means of enabling case study research to generate knowledge that can be generalised more easily to other cases. This is, however, only a small part of our intention here. Stenhouse urged the importance of teachers' research studies being written up and published to provide a core of professional knowledge. He compared the accumulation of teachers' reports of their own work with the accumulated knowledge from case studies in medicine. These reports would provide a unique core of knowledge to assist 'professional researchers' in developing explanatory theories:

> Professional research workers will have to master this material and scrutinize it for general trends. It is out of this synthetic task that general propositional theory can be developed. (Stenhouse, 1975, p. 157)

The evaluators' aim over the life of the ICT Test Bed Evaluation is to follow Stenhouse's advice and use the action research studies as a core element in developing theories. What follows is a preliminary analysis drawing on the action research reports completed so far. Here they are dealt with separately from the other strands of the research, to highlight and clarify their contribution to the evaluation as a whole. The process of cross-case analysis will continue over the final two years of the project and emerging theories, grounded in the insights from individual cases, will be integrated with the outcomes from other strands in the final report.

Cross-cases analysis of the ICT Test Bed action research

The first step has been to analyse the contents of the action research reports in relation to the ICT Test Bed themes (see Appendix 1). This provides an overview of the work that has been carried out as a starting point for analysis. The matrix quickly identifies that the studies all focus upon aspects of using ICT for teaching and learning, and that between them they cover all the priority areas of current policy for teaching and learning, with the exception (owing to the very small number of studies carried out in the secondary schools) of the Key Stage 3 strategy. CPD, within the workforce theme is also a significant secondary focus for all but five of the 23 studies. The grid also identifies that the leadership and management and cluster links themes have not been directly addressed by any of the action research studies. However, closer consideration of the actual studies does provide indirect intelligence relating to leadership and management, in that action research tends to have been carried out (though not exclusively) in establishments where a developmental, risk-taking approach to ICT was encouraged by management, and this has implications for our understanding of leadership philosophies. Similarly, support staff are only likely to undertake research in an empowering environment, and the capacity of a classroom assistant to consult a head about modifying assessment approaches is strong evidence of a collaborative ethos in which support staff have a sense of working as full partners with teachers (Oliver, 2005).

The lack of action research relating to collaboration within clusters may reflect the lower priority given to this theme by teachers during the first year of ICT Test Bed. On the other hand, such studies would need to be carried out by groups rather than individuals and this is likely to have been more complicated to organise for novice researchers. Similarly, reports which refer to community links tend to be initiated by FE teachers with a tradition of reaching out to (and operating within) the wider community (Postma, 2005; Skinner, A., 2005). This has clearly not been a chosen priority for primary school teachers.

Further analysis of the contents of the action research studies reveals that they provide a rich source of information on teachers' conceptualisations of a wide range of issues such as classroom management, pupil learning, creativity, problem-solving and the role of ICT. This second level of content analysis is summarised in the matrix in Appendix 2.

Teaching and Learning

The studies of teaching and learning carried out by teachers in ICT Test Bed primary schools draw frequently upon activities based around the interactive whiteboard or visualiser (9 out of 13). Many of these involve illustrations of work in numeracy (measuring objects by drag and drop) (Leonard, 2005), or literacy (highlighting appropriate text) (Bailey, 2005). The studies indicate that technology allows teachers the facility to present new or alternative ways of conceptualising, and thus many of the teachers claim to be reaching some learners for the first time (in EAL numeracy and literacy, letter formation, etc.) and reinforcing understanding in others (Pinner, 2005; Bailey, 2005; Varnom, 2005; Skinner, L., 2005). This was noticeable in both reports about work with children with special needs involving the use of IWBs (Seymour, 2005; Dobinson, 2005). Where comments were made about particular learners rather than whole-class response, they related to individual special needs pupils successfully accessing the curriculum, in ways that previously would have been rare if not impossible (see for example Bailey, 2005).

In the primary action research studies to date (and this may well change as skills develop and confidence builds through the project) the prevailing model of IWB use is for the teacher to prepare materials and then lead and manage whole-group activities, with the emphasis being on learners internalising new representations of concepts (art, numeracy, literacy). There is little explicit reference, in most of these reports of IWB use in primary schools, of stimulating social interaction between pupils (pupil/pupil interaction), or references to problem-solving involved pupils addressing problems on the teacher-managed screens (teacher/pupil interaction), though traditional follow-up exercises were mentioned. Almost all of the IWB studies refer to learners being stimulated and motivated by ICT (its bright colours, and moving images, for example). The IWB is thus portrayed in these studies as improving children's capacity to learn (children learn as a result of additional multi-sensory stimulation and of being presented with new representations of concepts) and also their disposition towards learning.

4: ICT Test Bed from the inside – evidence from action research carried out by teachers and para-professionals

Other action research studies carried out in the ICT Test Bed primary schools involved pupil use of a laptop/PC for literacy, art and animation. In these the focus was on individuals engaged on personal or group tasks, rather than teacher-led tasks. In one, a classroom assistant writes about helping five learners work through self-assessment literacy and numeracy packages, and describes how she arrives at a fresh understanding of 'assessment for learning' and the importance of positive feedback and self-evaluation (Oliver, 2005). Two other studies into group activities (narrative writing and animation) focus upon creativity and self-evaluation (Ashton, 2005; Jayes, 2005). The use of ICT for creative purposes emerges more strongly in action research carried out in these settings where pupils themselves have control of the ICT. In these activities, teachers noted children's capacity for constructive self-evaluation as they refined their stories or animations.

A comparative study of Year 6 children's report writing skills (Tootill, 2005) concluded that the motivational power of laptops must not distract teachers from other important considerations: such work needs to be closely monitored to ensure that superficial satisfactions – producing ornate work, for example – do not distract children from the purpose of their work and the need to aim for high quality. This study was neatly complemented by Jeyes' (2005) Year 5 study which indicated that pupils collaboratively evaluating word-processed text could concentrate upon the quality of their vocabulary rather than on grammatical mistakes which spell- and grammar-checking corrected. In yet another study, the collaborative progress made by a Year 3 group working on an animation might indicate that a particularly high level of creativity can be stimulated by working with ICT in a group (Ashton, 2005).

Action research by teachers in the Childcare Dept of a further education college suggests that FE teachers tend to use the IWB in different ways from primary school teachers. Two teachers used the IWB for ActiVote activities that were primarily aimed at developing classroom confidence in academically low-achieving 16–19-year-old Childcare students (Hall, 2005; Bone, 2005). Although the lessons' focus was nominally upon testing subject content, the teachers tried to create immediate, whole-class activities with all students participating. The activity using the latest technology was claimed to have improved 16–19-year-olds' self-perception regarding their capacity to contribute in an academic environment. Although it was noted that some students felt embarrassed by the possibility of others viewing their incorrect scores, overall it was claimed that participating in ICT activities improved students' self-esteem and confidence in relation to their abilities in both Childcare and ICT. The outcome of the action research in both cases was that these students should take increasing control of the ActiVote experience by researching subject knowledge and devising their own quizzes, thus using the IWB as a stimulus to the learning process, and building upon the improved motivation that the experience had engendered.

It should be noted that most action research studies across all sectors suggest that learners' educational self-perception has improved through the students' or teachers' use of ICT. These claims relate to learners' confidence both with the technology and sometimes beyond the ICT environment. Some of these claims are evidenced by detailed observations of children's general behaviour (several identifying changes in named individuals including two children with autism and a child with a stammer – Seymour (2005); Dobinson (2005); Hall (2005)), with most studies mentioning the teacher's perception of the overall improved classroom atmosphere. It may be the case that ICT stimulus is more inclusive of children who would have difficulty engaging in a non-ICT lesson, and with a noticeable reduction in disruptions the teacher finds the experience of teaching unusually rewarding. Atypically, the carefully structured secondary study focused upon four low-achievers and noted their provisional response to CADCAM (Webley, 2005). However, this approach and findings are not reflected across the studies.

In an FE session which involved use of the IWB, teacher and students used the board with a laptop to practise emailing (Mattinson, 2005). This study focused on students' responses to teaching methods and concluded that for effective learning about ICT, childcare students prefer collaborative exploration of ICT, rather than the established ICT instruction method in that institution of individuals working through structured worksheets. Since much ICT skills teaching is conducted using structured worksheets this is a finding which other teachers should investigate further.

From primary to FE, these action research studies indicate that evidence of problem-solving, creativity and critical thinking, was most apparent when individuals or groups had direct access to the technology (laptops, CAD, animation or digital video) (see for example Gordon, 2005; Tootill, 2005; Webley, 2005; Ashton, 2005). Where learners did have direct access, their potential to initiate activities was also apparent. Such opportunities also encouraged the demonstration of improved social and collaborative skills, (which may in part result from some lower-achieving students working in a new medium where they are not disadvantaged by literacy constraints). Some notable creative work took place in small groups owing to equipment constraints (animation, for example), and the need for technical support (digital portfolio-building) but whole-group, individual and collaborative creativity and problem-solving was also apparent in action research studies of work with Years 5, 6 and 7.

In these studies, teachers occasionally used statistical data to illustrate general trends, but as expected at this early stage in the project, there were only provisional claims made about the relationship between use of ICT and improved attainment in a particular context.

In conclusion

- In the studies of whole-class technologies, teachers present concepts in new ways and this communicates very effectively with learners, including those with special educational needs.

  - The emphasis in using whole-class technologies is on improved presentation rather than stimulating social interactions or problem-solving.

  - Whole-class technologies appear to improve learners' motivation and their capacity to learn.

- All the studies of using laptops/PCs for literacy, art and animation focus on personal or group tasks.

  - Creativity seems more likely to occur when pupils themselves have control of the ICT.

  - One study warns that the motivational powers of ICT may focus pupils' attention on superficial matters of presentation.

  - Two other studies suggest that pupils can spend more time on the quality and creativity of their work when the computer provides help with grammar and spelling.

- FE teachers tend to use the IWB in different ways from primary teachers.

  - Two studies focus on using ActiVote to improve the confidence of low-achieving 16–19-year-olds.

  - They suggest that participation with the group through ActiVote increases students' self-confidence.

  - They describe how students are strongly motivated to learn when they research subject-knowledge and devise their own quizzes.

- Most studies, across all sectors, suggest that learners' self-perception and confidence improve with both whole-class and student-led uses of ICT.

  - Two studies suggest that the IWB radically improves the concentration span of children with special needs such as autism.

  - A third study shows considerable gains for an FE student with a stammer through developing an electronic portfolio.

- In one FE study students declare a strong preference for interactive instruction with the IWB rather than individualised learning from worksheets.

- Across all sectors, these studies suggest that problem-solving, creativity and critical thinking are most in evidence when individuals or groups have direct 'hands on' access to technology (laptops, CAD, digital video, animation).

  - With direct access there appears to be an increase in students' ability to initiate activities.

  - Group work with technology has the potential to improve their social and collaborative skills.

Continuing professional development

Although CPD is not referenced as the central focus of any of these action research studies, the accumulated reports provide significant insight into how teachers learn about ICT and how they incorporate it into their pedagogical approach. Across all sectors, most of the teachers' studies acknowledge their development of ICT skills to use new technology, especially IWBs and animation. Having been supported in their own learning about the hardware and software, teachers have used and adapted the software to meet their learners' needs. Apart from the e-mentoring project and CADCAM experience – both of which revealed that the integration of ICT into the learning context was not as unproblematic as anticipated – all accounts describe the relatively successful adoption of technology into their teaching. (This positive bias is perhaps made more likely by the voluntary nature of the action research.)

In these reports, the teachers demonstrate a commitment to ICT development for a variety of reasons. For some experienced teachers, this ICT initiative may represent a creative opportunity: the injection of new technology has revived latent creative instincts to prepare imaginative and attractive resources, and refresh the excitement of the classroom (Skinner, L., 2005). Younger teachers may particularly appreciate the opportunity to exploit their more recent ICT training and develop their ICT expertise to define their distinctive identity within the established roles and relationships of the school (Ashton, 2005; Jeyes, 2005). Other teachers describe a concern about needing to be involved rather than to be ' left behind'. The potential for career development – or for those in less secure employment to become established – may also have an effect. Whatever the motivation to become involved in ICT development, these teachers' action research reports make a statement about their improved professional status.

Accounts from all sectors describe teachers' awareness of the need to use ICT to serve learners' needs and the excitement of such challenge (from redesigning software for EAL reception, through to organising taster sessions for passers-by at a learning centre). The ICT Test Bed experience helps recreate the primary rewards of teaching, from creating a 'wow' factor in the reception (Pinner, 2005) or secondary classroom (Webley, 2005), through to seeing apprehensive adults become delighted after mastering the digital camera (Skinner, A., 2005). The improved self-perception of learners is mirrored by teachers' improved self-esteem. The satisfactions of developing resources – and, occasionally, personalised resources – are mentioned in many of these studies, from primary school to FE college (see, for example Hutchinson, 2005).

However, at this early stage of the project, the action research studies appear to suggest that ICT endorses – and can dramatically improve – current practice, rather than significantly changing teachers' pedagogical approaches. It does not appear as if the potential for ICT to allow greater learner autonomy and freedom from close teacher direction is as yet being exploited to the full. Perhaps understandably, there is a tendency for teachers to describe how using ICT confirms their established pedagogical practice – albeit transformed in terms of presentation, efficiency and the ability to command learners' attention. For example, the studies of work in the FE outreach centres stress the importance of teachers creating supportive environments for adults to develop ICT confidence,

4: ICT Test Bed from the inside – evidence from action research carried out by teachers and para-professionals

and thus foreground the welcoming ethos of the FE college rather than the emancipating effects of ICT experience. Similarly, a number of teachers in the schools describe using the IWB to transmit information more effectively. Even in examples where individuals have been given laptops, cameras etc., they are directed towards a product, often under close supervision, so opportunities for creativity are highly structured. While the use of ICT equipment is a novelty, this kind of task is clearly highly engaging. It could be argued that reports of pupils' satisfactions in these activities can be traced to the fascination and novelty of the carefully constructed ICT experience. Art and CADCAM interventions demonstrated children mastering ICT to produce quality products (Gordon, 2005; Webley, 2005), but later action research studies may be able to trace development from these first, important steps to more open-ended creative engagement.

Although the indirect claims of many of these studies is that ICT is making a unique contribution to the value of learner experience (in that this technology adds something that couldn't be added as effectively in other ways), there is little evidence that the ICT is significantly changing roles in the classroom. What it is changing, however, appears to be relationships. The ambiance of the classroom is different with higher levels of attention from pupils and teachers' renewed enthusiasm for preparing resources and using them in their teaching. These studies provide some examples of changing approaches to teaching and learning (such as pupils collaboratively evaluating their writing and student e-mentoring between years). It seems reasonable to conclude that following the initial phase when CPD has been focused on teachers' needs to acquire skills to use new hardware and software, and find ways of using it that support teaching of the National Curriculum, ICT use in ICT Test Bed schools will progress beyond an enriched teacher-led experience into a transformed experience with pupils engaging in more independent activities.

In conclusion

One of the clearest messages from these action research reports is teachers' commitment to discovering the possibilities offered by ICT. In many of the studies there is excitement about what has been achieved, but in none is there complacency or even a sense that all the ends of the inquiry have been tied up. Many reports conclude on progress made to this point and potential that lies ahead.

- The studies provide evidence of successful development of skills to use ICT, especially IWBs and animation.
  - Teachers have used and adapted software to meet their learners' needs
  - Acquisition of most skills appeared to be unproblematic
- The studies reflect teachers' motivation to use ICT and their sense of improved professional status when they are successful.
  - Some teachers are attracted by the opportunity for creativity
  - Young teachers are able to build on the expertise they acquired during training and define a distinctive identity in the school
  - Some teachers simply want to avoid being 'left behind'
- The studies all show teachers' primary focus on using ICT to serve learners' needs.
  - For some teachers, ICT Test Bed has helped re-create the primary rewards of teaching: improved self-perception of learners is mirrored in teachers' improved self-esteem
  - Many of the studies record teachers' satisfaction in developing resources with ICT
- The studies suggest that ICT endorses – and can dramatically improve – current practice rather than changing pedagogy.
  - The potential for ICT to allow greater autonomy from the teacher is not addressed in many of these studies
  - Pupils' very positive response to whole-class technologies may be partly due to their novelty as well as their appreciation of the clarity of presentations
- These studies suggest that ICT is having a major impact on relationships in the classroom, but little impact on roles: the roles of teachers and learners are reinforced but the ambiance of the classroom is radically changed.

Workforce remodelling

Two support staff have carried out action research studies and written reports. In one study, a classroom assistant evaluated her role in supporting learners with literacy and numeracy software packages (Oliver, 2005). This improved her understanding of the potential of the packages, her understanding of the assessment process, and her communication with teachers and the head. This is likely to influence the degree of responsibility that she can exercise in future and has implications for workforce remodelling, in that her development of ICT skills helped her provide better support for the learners without raising concerns about teacher substitution. Her engagement with the research process seemed to improve self-perception and confidence about contributing to the staff-meetings as well as the wider ICT debate.

In another study, a web designer provided significant support – and much encouragement – to FE staff to build digital portfolios (Hutchinson, 2005). Her experience led her to conclude that considerable investment of time with staff initially ensures that future demands will be much reduced, as staff confident in the use of ICT do not require the same degree of attendance for security purposes.

In conclusion

- These two action research studies by para-professionals illustrate how ICT has allowed them to develop new roles, providing new kinds of support for teachers and learners.

  - In one case, exploration of literacy and numeracy software packages improved a classroom assistant's understanding of assessment and enabled her to talk to teachers and the head with greater confidence and enhanced professionalism.

  - In the other case, a web designer found that in-depth support for FE teachers in developing digital portfolios greatly decreased their need for support in the longer term.

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APPENDIX 1: Content analysis of action research reports by ICT Test Bed theme

Theme	CP1	CP2	CP3	LS	YS	RD	LJ	CA	VB	SG	CV	LO	JT	KW	LH	SH	AS	MP	PB	SH2	EM	EM2
T & L																						
IWB/Vis	●	●	●	●	●	●			●		●			●						●	●	
Animation			●					●														
T/P Interaction	●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	●	●	●	●
Literacy	●	●		●		●	●	●	●			●	●									
Numeracy			●						●													
ESOL	●	●	●																			
Disaffection					●											●						
KS3																						
Creativity							●	●		●			●	●	●	●						
Critical thinking							●			●	●											
L & M																						
Man/Procurement																						
Implementation																						
Content Dev'																						
IMS																						
Philosophy																						
NRT Workshop																						
Workforce																						
Laptops staff																						
Technicians												●			●	●						
CPD	●	●	●	●	●	●	●	●	●	●	●	●			●	●			●	●	●	
T reports/admin																						
Cluster links																						
Video conferincing																						
Content sharing																						
14-19 curriculum																						
Transition																						
Home/Community																						
Kit roll-out																						
General collab																		●		●	●	●
Extending day																						
School websites																					●	●
Commn' parents																						
Glyn Owen																●	●					

APPENDIX 2: Content analysis of Action Research – teachers' conceptualisations

Theme	CP1	CP2	CP3	LS	YS	RD	LJ	CA	VB	SG	CV	LO	JT	KW	LH	SH	AS	MP	PB	SH2	EM1	EM2	EM3
Teacher development																							
Develops creativity	●	●	●	●	●				●	●				●		●						●	
Develops ICT skills	●	●							●	●	●	●				●			●	●	●		
Develops pedagogy				●	●	●	●			●		●		●					●	●	●	●	
Develops resources	●	●	●		●				●	●	●		●	●	●				●	●	●	●	
Teacher Management																							
Teacher leads	●	●	●	●	●	●		●	●	●	●						●	●	●	●	●		
Teacher manages	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	
Generalised activity	●	●	●	●			●		●	●	●		●	●		●	●	●	●	●	●	●	●
Specific learner/s				●	●	●		●	●			●	●	●		●						●	●
Classroom managment	●	●	●			●			●			●	●			●			●	●			
Pupil activity																							
Responsive to teacher	●	●	●	●					●	●	●	●				●	●	●	●	●	●		
Responds to technology	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Initiates activities using ICT		●					●			●				●		●						●	
Teacher's theory of learning																							
Stimulated by ICT	●	●	●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●		
Social interaction			●			●	●	●						●		●	●	●	●		●		
Problem-solving		●	●				●	●		●		●		●			●						
New representations	●	●	●	●	●	●			●	●	●												
Following teacher model				●							●												
Accesses external theory					●											●			●				
Research methods																							
CA feedback	●	●	●	●		●	●	●															
Reflection	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pupil feedback				●				●	●			●	●	●	●	●	●		●	●	●	●	●
Peer feedback	●	●			●	●			●	●			●		●	●							
Stats		●	●						●					●				●				●	
ICT endorses teacher's style	●	●	●	●	●	●	●	●	●	●	●		●			●	●	●	●	●	●	●	●
Unique contribution of ICT in teacher's schema	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
Improved learners' self-perception	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Creativity							●	●		●					●	●							
Problem-solving	●	●						●		●					●	●							
Citizenship			●				●	●		●				●		●	●				●	●	●	●
Metacognition							●	●												●	●	●	●
Attainment	●	●	●									●	●			●						●	

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