



ICT Test Bed action research reports cross-case analysis

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This analysis is based upon research conducted by the following participants. The evaluation team is extremely grateful to the researchers and their institutions for their invaluable contributions to improving our understanding of how ICT can impact upon our classrooms, schools, colleges and communities, and influence our learning lives and relationships.

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Full details and all their reports, together with sector and thematic links, can be found on www.evaluation.icctestbed.org.uk/research

Introduction to the “cross-case analysis” of action research studies in the ICT Test Bed project

This report emanates from our attempts as an evaluation team to introduce practitioners’ action research into the evaluation of a national ICT project. The ICT Test Bed project was a four year project (2002-06) commissioned by the DfES. Three clusters of schools and further education (FE) colleges from Barking, Sandwell and rural Durham were “saturated” with high levels of ICT equipment and related funding to ensure appropriate management, classroom and technical support for the technology. To evaluate the project, DfES invited evaluation tenders that would include an action research approach to ensure that maximum benefits flowed through to teaching, learning and management. Teams from Manchester Metropolitan University and Nottingham Trent University collaborated to design the successful tender, which had three strands:

- 1 A quantitative strand gathering baseline and benchmarking data for the 28 schools and three colleges.
- 2 An external qualitative strand conducting focused studies of aspects of Test Bed work (eg use of interactive whiteboards across the sectors in all three clusters).
- 3 An internal action research strand in which teachers, leaders and support staff were encouraged to conduct voluntary research into their use of ICT. Teachers were supported in producing short accounts of how ICT Test Bed has changed their experiences. These reports were published on the ICT Test Bed website and in the evaluation team annual reports.

The Test Bed evaluation team reasoned that action research provided a unique opportunity to gain privileged access to practitioners’ insights of the ICT experience. Through action research, the team hoped that teachers and other educational stakeholders were not only going to provide answers to questions, but were going to frame questions that were central to thinking about educational ICT use. The team believed that studies of individuals’ practice could make a significant contribution to an understanding of an educational phenomenon. From a research perspective, the team hoped that the practitioners’ case studies would attend to those “how” and “why” questions that the quantitative evaluation strand could not address, and provide additional insights that would help inform our observations and interpretations in our large scale qualitative studies. The intention was that action research could corroborate, illuminate, challenge and extend the working assumptions of the evaluation team, already fed by the intelligence arising from the traditional external quantitative and qualitative approaches.

In this final “internal action research” strand, by August 2006, teachers, leaders and para-professionals had completed 116 action research reports of their Test Bed experiences. A student and parent also wrote studies. Of these, 67 reports were from primary, two from secondary and 47 from the FE sector. This “cross-case analysis” summary represents our attempt to identify

themes across the range of individuals' experiences. (A more detailed discussion of the methodological approach and consequent challenges can be found in the final chapter of this report). Reports covering the quantitative and qualitative strands can be found at www.evaluation.icctestbed.org.uk.

Action research studies: thematic breakdown

Reports covered all five themes – teaching and learning; leadership; workforce; cluster links, and home and community – although the emphasis was on teaching and learning, with 54 primary, both secondary and 38 FE participants focusing upon this theme. Some reports related to more than one theme. Five reports by headteachers and a deputy concerned the leadership of ICT in schools. Thirteen studies centred around workforce innovations (the 11 studies by assistants, support workers and technicians in schools and the 10 teaching support staff in colleges also represent contributions to the workforce theme, although they may well have had a primary focus upon another theme such as teaching and learning, or home and community links). Four studies from primary looked at cluster links, and seven from FE. Nine studies from primary and 16 from further education researched links with home and community.

<i>Theme</i>	<i>Primary</i>	<i>Secondary</i>	<i>FE</i>
Teaching and learning	54	2	38
Leadership	5		
Workforce	11		2
Cluster links	4		7
Home and community	9		16

2 To what extent does ICT transform teaching and learning?

Key findings

- The action research studies frequently indicate an underlying trend of how use of ICT has led to learners developing an improved academic identity and experiencing higher social and self-esteem in school and colleges. This has been evident from nursery learners using ICT to improve their communication skills (through their use of a whiteboard), through to mature adults (many with negative school experiences and no qualifications) re-entering the community learning centre and being supported to take pride in their new-found abilities that have recognised currency in the labour market. Such social success is evident throughout school and college life, in a significant number of studies which reflect learner (and teacher) surprise and delight at tapping their hidden potential.

However, it is very difficult from these action research studies to judge the extent to which learners' improved attitude to academic participation in ICT related activities has fundamentally changed their understanding of themselves as learners, and of their role in the wider teaching, learning and assessment processes.

- Across all sectors, action research studies suggest that problem-solving, creativity and critical thinking are most in evidence when individuals or groups have direct 'hands on' access to technology (eg interactive whiteboards, laptops, cameras, video etc) across a spectrum of electronic writing, art, photography, video, music and science activities. In settings where pupils themselves had control of the ICT, teachers frequently noted children's capacity for constructive self-evaluation as they refined their work in progress.

Background to this analysis of the studies

We were keen to explore whether ICT could help engender significant and enduring improvements in learners and in our initial action research "planning packs" we asked researchers to consider the following questions in planning their research activities:

- Will this new approach encourage reflection on learning (learning about learning)?
- Will using ICT lead to more creative learning?

- Will the learners be using ICT to engage with 'powerful ideas' – ie really thinking for themselves?
- Will it enable the learners to exercise more responsibility, take decisions and behave more independently?

It might be useful to consider the degree to which these intentions have been realised, as evidenced by the studies.

Has ICT use led to improved reflection on the learning process?

At one level, there is obvious development of learning capacity and awareness, as nearly all Test Bed learners from infants to adults and including all teaching staff, have developed confidence and competence in a range of ICT applications. This will generally be accepted as a necessary precondition for learners being confident to extend their learning choices. Increasingly, many aspects of technology are available beyond the Test Bed institutions (in homes, etc) and ICT competence will provide greater opportunities to enable learners to fulfil their learning potential. However, it is not always possible to estimate from the studies how far some learners are given the opportunities to apply new learning skills to a wider range of personal learning initiatives, beyond the directed tasks in classrooms governed by a national curriculum.

The action research studies also frequently indicate an underlying trend of how use of ICT has led to learners developing an improved academic identity and experiencing higher social and self-esteem in school and colleges. This has been evident from nursery learners using ICT to improve their communication skills (through use of a whiteboard), through to mature adults (many with negative school experiences and no qualifications) re-entering the community learning centre and being supported to take pride in their new-found abilities that have recognised currency in the labour market. This social success is evident through school and college life, in a significant number of studies which reflect learner (and teacher) surprise and delight at tapping their hidden potential.

To some extent, improved academic identity in schools involves the removal of inhibiting negative identities assumed through inability to achieve in a dominant textual world; many learners achieve unusual success by engaging with appropriate software and also with ICT imagery tools such as digital cameras, videos and microscopes. In many cases, teachers suggest that learners who have poor literacy and/or listening skills ("children who struggle to concentrate and listen in lessons") can achieve success by communicating without writing. To some extent, using ICT enables participants to feel more involved and valued and have been helped to construct an improved identity within school. Such learner use of technology has been most beneficial to those who are disadvantaged: the disaffected, autistic, unmotivated, lower-achievers and special educational needs (SEN). Reports remark that these individuals have become more expressive, participative and successful.

Technology has helped them establish an improved social identity within school.

However, it is difficult to know whether these are sustained or temporary and conditional transformations. Often, the negative identity may have been reinforced (unintentionally) in part by the school culture and community, and the ICT recovery experience may be short-term – from the limited action research studies, we do not know whether learners are encouraged to retain significant ICT to use as a consistent support to aid increasing skilled and confident participation in the textually-privileged world, or whether the ICT is an occasional treat and used as an extrinsic reward for greater effort in the text-based world. Inevitably, even with the generous Test Bed investment, ICT is governed by a school culture that has carefully managed limited resources, and one teacher in our subsequent consultation exercise noted how SEN learners get “fair access to the resources”.

Inducting learners into critical appreciation

Burkett describes how she used handheld computers (or PDAs) to create a guide for students to Dulwich Art Gallery. The A-level students found this gave them unusual confidence to access the otherwise intimidating world of the art gallery. Discussions with students noted significant improvements in confidence in relation to A-level art and also influenced their self-perception as art students capable of participating in formal art discussions. The non-threatening questioning and stimulation from a personal handheld computer enabled learners to develop and share a critical appreciation of the art gallery. In subsequent discussion, the students acknowledged what they had learnt, and two had even used their new critical confidence to visit another art gallery in their own time. Burkett noted that the handheld computers seemed to enable students to take control over their learning and become actively involved in their learning – having the confidence to ask questions, search for answers and to appreciate that there are a variety of valid interpretations in art. They can discuss ideas, share their thoughts and observations with each other and with the adults around them or they can work alone if they chose.

A gallery educator noted that the use of this technology produced more pertinent questions and individual discussion than would ever be possible in the normal gallery talk setting and concluded that this was because students quickly overcome their shyness and feel confident in their responses. They feel free to discuss answers and issues or work alone if they chose.

Burkett suggests that the technology helped make a passive experience more active, and changed their expectations of their role in the art appreciation experience.

There is evidence that learners' improved self-esteem derives from their own evaluation of a "product" (eg a photo, video, graphics display or word-processed story) and their reflection on the process, rather than from external assessment of the individual. Teachers and outside observers describe children's delight at having their work (eg animation) recognised by others, although children interviewed tend to recall the social and creative enjoyment of the process. Such intrinsic satisfactions (rather than external approval) would accord with Dweck's (2003) description of children developing desirable "learning goals" rather than "performance goals".

Reflection on learning in the primary setting

One of the most striking benefits of ICT use across Test Bed was where learners used technology to create, explore and modify their operations to gain a sense of achievement. There was personal recognition of progress across a spectrum of electronic writing, art, photography, video, music and science activities. The use of ICT for creative purposes emerges more strongly in action research carried out in settings where pupils themselves had control of the ICT. In these activities, teachers noted children's capacity for constructive self-evaluation as they refined their work in progress. The opportunities which ICT presents for self-evaluation may be crucial in developing an awareness of, and control over, learning.

To some extent, any ICT intervention which improves learners' capacity to improve in a school-based activity has a value in that it changes the learners' conception of learning a topic. They begin to appreciate that intelligence and subject competence is not fixed, but changeable, and therefore even "closed" assessments in programmed instruction enables learners to appreciate that alternative tools and strategies can improve subject ability. However, for such experience to be meaningful, and to help them adapt these new strategies, learners need to be stimulated by access to subsequent developmental activities, and not limited to learning that they achieve only in closely-managed activities.

Other possibilities for improving understanding of learning included pupils reflecting on feedback from classroom voting system activities. However, did the classroom voting system feedback indicate *why* they had made mistakes and thus suggest constructive actions they could take to remedy identified mistakes? Occasionally, where learners were given teachers' support for their self-assessments, they engaged in useful discussions about their problem areas, and youngest learners especially were given opportunities to use the interactive whiteboard (IWB) to improve their self-awareness and confidence in the strange world of the school. Encouraging pupils to direct activities on the IWB does change the traditional classroom culture, but much will depend upon the subsequent valuation of the new ways in which such knowledge is used. Studies in art and music showed how electronic representations could build learner understanding of, and confidence with, potentially embarrassing performance activities, which were subsequently attempted with greater enthusiasm by all learners.

In the above, reports indicate how ICT can contribute to learners improving their appreciation of their learning, yet progress depends upon a continuing programme of challenging opportunities and support.

Reflection on learning in the FE setting

A key theme of the FE teachers' studies is learners' improved perception of their learning environment and capacity. Many FE learners have had negative school experiences, have not enjoyed previous academic success and are not following the esteemed academic route through the higher status sixth form colleges. Consequently, several studies focus on changing learners' perceptions of college itself, through activities in local learning centres. The rewards of ICT are made accessible through courses such as "computing for the terrified", so that learners' personal and academic self-concept is protected in sympathetic environments. Similarly four reports from an entry-level childcare course emphasise the need for learners to work in teams on IWB activities, as they help learners to address the assessment system. These activities show how using ICT to change students' identity in relation to their learning environment is considered to be very important by tutors.

Nine FE studies identify how meeting learners' social and emotional needs and overcoming their negative academic self-images borne out of previous experience have been a fundamental prerequisite to them joining ICT courses. Once initial registration barriers have been overcome, the ICT experience has then often been successful, leading to subsequent enrolment on (usually) ICT courses.

In all these studies across sectors, further research would be invaluable in understanding the extent to which the satisfactions of engaging with ICT and producing quality ICT outcomes provide an appropriate response to problems caused by prior negative educational experiences. There is a concern in FE that teachers and 'fragile' learners might try to preserve the enjoyable relationships that have been created in a protective environment. Consequently, in some situations, learners have progressed through a series of discrete ICT qualifications with guardian tutors, possibly to the detriment of adopting more challenging and personally useful literacy and numeracy and vocationally-focused alternative qualifications.

Increased participation in an enjoyable FE environment may be a first step towards learners gaining greater understanding and control over their learning, but such learning confidence may only be temporary if learning does not empower the learner and move them towards a reduction in dependence on the supportive context.

Did using ICT lead to greater learner creativity?

Primary

Studies which focused on creativity were most apparent in Foundation and Key Stage 1, where there is a culture of exploration and play. Often creativity was linked to collaborative and open problem-solving, and usually linked to

digital imagery and forms of self-expression. ICT does not make classrooms creative, but in those institutions where creativity is encouraged, the creative element using ICT – desktop publishing, art, animation, digital imagery and word processing – is enhanced, as learners can experiment and modify their evolving productions. In conjunction with this, teachers are more willing to allow learners to work independently (and interdependently) when physically focused on programmes. This provides the preconditions for creative exploration of programmes, providing teachers design a structured framework for such exploration.

For learners with SEN in relation to text, and those with low confidence in art and music, ICT stimulated creative expression by removing inhibitors. Work with learners with SEN in the early stages appeared to allow self and group expression that was not tied to rigid assessment outcomes. Beyond Foundation and Key Stage 1, the best studies used creative activities as a stimulus for engaging learners in more formal pursuits – eg the use of animation software to stimulate vocabulary discussions. Productive tasks appeared to have a focus rather than a definite outcome, for example, a time-constrained animation or video ensured that creative organisation could retain a focus. Where low-tech cameras and voice recorders were sent home, children and parents seemed to enjoy high levels of interest and involvement, but one study of home-use of laptops was comparatively disappointing – they seemed to be used instrumentally to achieve homework tasks, rather than playfully and imaginatively. Outside of the curriculum constraints, an after-school animation club for Key Stage 2 learners encouraged exploration and experimentation.

Further education

With set curricula and frequently assessed vocational qualifications, opportunities for creativity in FE settings seemed more limited. However, the production of electronic portfolios was one type of open-ended, creative task in evidence. In an innovative FE collaboration, disadvantaged parents were encouraged to incorporate minimal ICT as they worked on an integrated art and textile project aimed at supporting children's literacy. The video-conferencing experience stimulated the teacher to build in web-quests (open-ended web-initiated research projects) to ensure that biology students were more active in their learning. One chemistry teacher explored 'morphing' software and adapted spreadsheets to compute chemical formulae; both had limited success, but were developmental for the learners engaged with the initiative.

Did ICT use lead to learners' improved capacity to engage with problems?

In this focus, we were looking beyond the use of computers merely to help learners to solve given problems, but rather to explore learners' capacity to use technology to "reframe" problems, possibly using ICT in unanticipated

ways. This aim was inextricably interlinked with the associated themes of creativity, reflection and independence and interdependence as a learner.

Independent problem-solving was most closely linked to creativity where open problems were set (eg in literacy and art), which required a creative response. Indeed, all creative tasks are essentially open-ended problems. Where the problems were traditional classroom challenges – for example, collaborative writing or science exploration – there appeared to be a spirit of exploration in addressing these familiar tasks with new equipment and gaining new, highly polished outcomes.

From the studies, perhaps there was more opportunity for thinking ‘outside the box’ at Foundation and Key Stage 1, where creativity was encouraged and there were fewer constraints on pupils following the ‘rules’ of ICT use.

Fisher, a nursery teacher, appreciated the virtues of rule-breaking as creative exploration, celebrating transgression as a developmental stimulus:

“Some children will spend ages alone or in groups, using programmes showing each other what to do and clearly enjoying the whole process, even if it’s not what the software designer wanted them to do – eg two children dressing teddy, hugely enjoying it, saying ‘now you put his sock on his head, etc’.”

This demonstrated a concern that ICT must not be a constraint, but rather a tool for teacher-enabled integrated education, where teachers can use their professional expertise to deploy ICT as they think fit in the interests of children.

A small number of FE studies focused upon using ICT through problem-solving activities; to some extent, ICT was used to improve assignments and “research” was to this end essentially electronic information retrieval to consolidate assignments necessary to achieve accredited outcomes. Problems to be solved by learners were essentially often closed problems, subject specific challenges where the software could produce the answers. However, in one FE setting, the production of electronic portfolios by learners with very limited academic achievement were one example of the more open-ended, creative possibilities available in FE settings.

Did learners develop improved interdependence and social responsibility (citizenship skills) through use of ICT?

Primary

In the primary setting, developing the social skills and awareness linked with 'citizenship' can be traced in three strands:

- 1 Developing the social integration of severely disadvantaged children, often with autism. Such studies often focused on one child, and showed how the teacher had invested heavily to encourage the learner to participate in mainstream activities. These studies show limited success with integration, but considerable success in terms of the learner engaging with carefully designed and organised materials, thus improving communicative potential, though still not demonstrating it in practice. At times, the concern was raised that the technology could become a substitute for, rather than a stepping stone towards, greater social integration. One comparative study indicated that ICT might only help teachers accommodate severely disadvantaged learners in their care.
- 2 Technology being used to support children with special needs. A number of studies explored how less confident children (often noted as SEN or having "communication difficulties") had been helped to collaborate and integrate through the support of their digital audio visual productions. This involved pupils taking photos and "talking books" home, being given opportunities to lead with the whiteboard; demonstrating equipment to others, and being given video-filming responsibilities, etc. These studies often noted the teacher's delight at the progress and promise the individual had made, but subsequent data was rarely gathered beyond the immediate experience studied.
- 3 There were a number of studies of improved social communication and individual responsibility. Use of a discussion board in two primary classrooms enabled teachers to gain insights into children's otherwise unarticulated thinking. Freed from having to speak in front of the class, these voices illustrated relatively mature concerns about their learning situations. Video-conferencing encouraged communication, but this was often closely managed rather than freely responsive communication. Two studies explored how disadvantaged parents developed greater confidence in school settings when attempting to support their children.

Further Education

Although social skills resulting from ICT activities fit well into established primary culture, many FE studies also developed the theme of how ICT contributed to learners recovering social and self-esteem and greater social

mobility in supportive learning environments where ICT was used. This included A-level groups making composite videos on a topic; carefully organised teams responding to IWB games; low-level learners making promotional electronic records of achievement, and English for speakers of other languages (ESOL) students working on collaborative games or Wiki pages. These shared ICT-based activities often stimulated a strong sense of social responsibility; writers comment upon students both working together and enjoying assisting less confident members with their new-found skills. A key comparator is the use of classroom voting systems; in schools' reports there was usually an emphasis on whole-class subject progress together with the capacity to note individual achievement, whereas in colleges, the classroom voting systems activities were based on team exercises designed to protect individual learners from embarrassment, whilst collectively exploring subject knowledge. Often, as mentioned earlier, ICT exercises were socially supportive, designed to repair the damage inflicted by older learners' negative school environments.

Interestingly, one very detailed and reflective study of the virtual learning environment (VLE), which unusually had gathered a range of students' responses, cautioned that the VLE had not as yet generated the intended social constructivist approaches to learning that had been anticipated.

Conclusion

To some extent, the action research studies have endorsed the potential of ICT to enhance the learners' experience, with some studies illustrating how ICT can contribute to making learners' experiences more engaging and more creatively rewarding as learners develop an appreciation of increased control over their learning environment. Often curriculum constraints and institutional cultures have inhibited the degree to which creative autonomy could be attempted. One possible reason for that, is that ICT resources were implemented through school management systems, and that although the schools were "saturated" with technology, learners were often permitted limited access to technology, within a culture where established roles and relationships informed practice. Consequently, although learners have become skilled in using technology, hopes that technology might trigger more fundamental and widespread changes in learners' school and college practices have not been realised.

However, as we shall see in the subsequent section outlining teachers' professional development, we may see that if technology had not transformed learning, it may have had significant effects on teaching.

It could be claimed from the evidence of the action research studies that those learners who had embraced technology to become most creative in re-framing and solving problems in school, to begin working more effectively, and to adopt a new confidence in learning through technology, were the teachers themselves.

Teachers had full access to technology and often responded by integrating it fully and creatively into their practices (although often it did not change the teacher's established pedagogical approach to any great degree).

3 Integrating technology into teaching and learning

Key findings

Whole class technologies

- With whole-class technologies, it is the teacher's management of, and interaction with the learners that makes lessons engaging (rather than the impact of the large images on the screen).
- Further education studies of the interactive whiteboard (IWB) emphasise social activities focused around the IWB as fundamental to subsequent knowledge transfer.

Digital imagery

- The ease of collaboratively manipulating and negotiating a high quality digital product has enabled unusually rich opportunities for children to evaluate – and improve – their work.
- Digital imagery activities often stimulate rich language work. Low-achievers develop improved communicative confidence and assume greater responsibility in the classroom.
- Digital imagery can help compensate for the disadvantages of having low levels of literacy, and improvements are often marked in the least able children, who are able to illustrate work and record achievement even if unable to draw or write.
- Complex editing and production equipment is counter-productive in achieving learning goals – the simplest imagery equipment is most often very effective.

Laptops/personal computers (PCs)

- As the laptop/PC offers a structured and focused experience, teachers are confident enough to allow a range of learners to work more independently on laptop/PC activities (even in nursery and reception classes).
- A range of software programmes enabled learners to build knowledge and understanding of practical subjects (art, music, science) eventually leading to more confident encounters with the activities.

From technology to learning – changes in practitioners’ concerns

Over the lifetime of the project, there has been a change in the analytical focus. For the first analysis, the reference points were inevitably types of technology – the IWB, laptops, digital cameras. By the end of the project, the analysis moves from categorising the types of tools to considering how tools have been deployed to support and ‘scaffold’ learning. In stimulating desirable learning, the pedagogical approach has become more critical than the deployment of specific technology through the lifetime of the project. A range of technologies – the IWB, the visualiser, laptops, digital cameras and videos, editing equipment, talking photograph albums, personal computers (PCs), microscopes, personal digital assistants (PDAs) for example – have all been deployed by teachers to allow learners to construct, deconstruct and reconstruct learning events as they experimented with and explored their capacity to interact with new content.

Perhaps initially, there was a crude (but necessary) focus on “what works” (or what could be made to work). However, as the project continued, and technology was assimilated into institutional cultures and practices, the action research studies were significant both in giving insider insight into the cultural constraints guiding and inhibiting the deployment of technologies, and were also illuminating in that they represented examples of attempts to extend, or overcome, cultural traditions and educational norms. Although the evaluation frequently discovered that technology was accommodated into, rather than dramatically changed the prevailing cultures in schools and colleges, it must be remembered that cultures are not static but constantly evolving, and the action research opportunities provided individual practitioners with a forum for exploration that both effected and reflected greater change in some of the institutions with more responsive leadership.

In celebrating the success of certain significantly developmental approaches in the use of technology, it would be too easy to devise polarities and typologies of ‘teacher-centred’ versus ‘learner-centred’ approaches; ‘open’ versus ‘closed’ activities; ‘classroom management’ versus ‘learning’ priorities. Such simplifications can seem a reductive description of committed professionals who successfully and pragmatically must negotiate institutional and social challenges that were especially evident in these selected clusters. What is interesting is where in difficult circumstances, bound by a range of constraints, practitioners and leaders have used technology to challenge received opinions about technology and schools.

Changes in the focus of teachers' reports about technology use

Tracking action research reports about IWBs shows how in 2004 we arrived at interim conclusions:

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. (2004:49)

This appeared to contrast with use of other technologies which children could access:

[action research] 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. (2004:49)

By the end of 2005, there was still an emphasis on the IWB as the means to deliver information, with access to dynamic materials:

The IWBs were appreciated for providing the teacher with a greater range of presentation styles and resources – access to internet resources, dedicated software programs, video, and CD-ROMs... Teachers appreciate the facility to design their own resources and to access, modify and save own and other people's resources... The IWBs can be used to introduce, develop and consolidate a range of learning activities at different stages of the lesson, and when well integrated, can support large or small groups or individuals. (Second Annual Evaluation Report 2005)

A new teacher's first encounters with the interactive whiteboard

"I started searching the internet for resources that would support all areas of the curriculum. I spent time searching the internet for activities and information to support my whole class teaching which were more interactive for the children. At present I have a challenging class and sometimes their listening skills are underdeveloped. But I soon found that by using ICT they were more attentive. I began to use more visual aids using ICT in all subjects.

A good example of this recently was during a lesson about mummification in my history topic on Egypt. I found an interactive game on the BBC website which went through the process of mummification. It involved the children making decisions to ensure the mummification was performed correctly. For example, the first step of mummification is to remove the brain. The children were asked to choose the correct tool needed to perform this. They were then asked to select the correct order or tools to perform each step of mummification. They loved the activity and as a result the work they produced in their books was of a much better quality than if I had simply explained the process to them myself using books and pictures. It enabled me to involve all the children and deliver the lesson in a more visual manner, which is exactly what these children need." Emma Prior, Year 3 teacher, Willington School (2005)

However we also noted a pedagogical development:

Although many teachers identify the visual impact of the screen as effecting engagement and motivation, analysis of studies indicates that it was the management of the group that made the lessons engaging (rather than simply the impact of the large images on the IWB) through frequent invitations to learners to participate in incremental knowledge-building. Thus it appears to be the teacher's management of interaction between learners, and between teacher and learners, that promotes sustained engagement and participation in lessons, rather than just the dynamics of the computerised screen. (2005)

We could conclude that:

In comparison to last year's studies, there is much greater attention drawn to the importance of primary pupils interacting (or even leading) in the IWB environment. (2005)

In the final year's analysis, we have found that the IWB featured less, and was not the main focus. In these final studies, the approach to the IWB was also different, with it being used directly as an activity/display board by the children, rather than as a presentation opportunity for teacher input. One teacher describes how Year 2 children used it via the active slate to share formative assessment opportunities with others; another encouraged two reception children with communication difficulties and inhibitions to use the IWB directly as a large touch screen in musical activities; and one reception class chose the IWB as their favourite piece of ICT equipment because they liked drawing, moving things around, and writing their names.

This incorporation of typical transmission technology into a more child-centred, active environment is interesting, not least as it confirms the suggestion that ICT will usually be integrated (or 'domesticated') into teachers' established pedagogical approach. This offers hope that more liberating uses of transmission technologies will be evolved by those teachers in institutions which actively encouraged the search for more active learning strategies.

In further education IWBs were used for social development from the inception:

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

- Two studies focus on using Classroom Voting System to improve the confidence of low-achieving 16–19-year-olds.
- They suggest that participation with the group through classroom voting system increases students' self-confidence. (2004 Annual Report)

And this was consolidated the following year:

In FE, four of the five IWB studies indicated how smaller groups of learners are assisted in contributing to IWB activities and productions. In these settings the importance of social interaction is often considered as important as knowledge transfer. (2005 Annual Report)

Again, the institutional culture of restoring 'fragile' learners and creating a supportive environment for those with poor academic records and low expectations was fundamental to teachers needing to explore how to deploy the technology to meet learners' needs.

Designing an interactive whiteboard game to encourage childcare students to participate and contribute in the FE classroom

Sandra Hall's research on interactive whiteboard use in the college setting reported on her attempts to improve student participation from students who had been low achievers at school. Her study had the following social and cognitive aims:

- To help students to build the confidence to contribute in the classroom
- To offer students personal satisfaction from their learning
- To enable tutors to obtain evidence of subject knowledge gained by students
- To build confidence with using ICT in sessions
- To encourage students to research subject knowledge.

She concluded that using the board as a focus for subject-centred quizzes, researched and presented by groups of students had improved classroom confidence:

“The more limited students who feared speaking up during previous plenary sessions appeared to have found their voices. They found out they were working amongst friends who shared their subject knowledge and experience and they gained confidence in themselves to offer feedback during plenary sessions.”

She reflected that:

“Although the students themselves reported being nervous of answering due to negative experiences from secondary school, this did not mean that they did not know the answers. It was just a case of them gaining the confidence to speak up in public settings.”

Developing learner autonomy through a range of digital tools

After initial reports in the project focused on how teachers could actually deploy new technology, a significant number of reports looked at how technology could empower learners. Over the project, teachers became more experimental in supporting learners to use the technology as a tool to scaffold learning and build creative confidence.

Using ICT to build confidence in art

At Hartside School, Tootill experimented with an art software package that allowed children to familiarise themselves with the manipulation of colour, tools and effects. This enabled the less able children to spend more time attempting to improve their work than they did on paper. Prior to undertaking their work all of these children hesitated when starting, appearing to be afraid of 'spoiling' their blank paper, but were less concerned with doing so following their work with the software package. All children sustained concentration for longer periods; this was not a replacement for 'practical art', but was a tool to subsequently fully access and enhance the art curriculum. Tootill suggests that both ICT skills and art skills, such as blending and colour mixing, can be developed. There is strong evidence to suggest that this program does in fact contribute to the improvement of practical art skills and understanding of concepts. Tootill noted both subject and personal benefit; increased confidence and raised self-esteem was evident, as children enjoyed using the whiteboard as a canvas whilst an audience observed.

One teacher targeted children who did not enjoy composition work with traditional musical instruments, encouraging them to experiment composing with music software. They did enjoy this, and the music software restored both ICT and musical confidence.

Another teacher changed his Year 3-4 video project focus as a result of hearing learners' independent vocabulary in describing their projects. The above examples illustrate how practice has been developed, rather than transformed by ICT, as the classroom culture begins to incrementally incorporate new expectations of pupil responsibility for their learning.

Beyond the written word – developing critical skills

Mangle's first study of using digital video to make TV adverts illustrated how responsive Yr 4/5 pupils became in evaluating, and then improving upon, their productions. They developed the capacity to critique TV genres and consider detailed characterisations, thus showing independence in analysing film. Mangle noted how their capacity to evaluate differed when freed from the written text: children seemed more willing and able to discuss the changes they needed to make with their work. The power of the visual image and the spoken word appeared very useful for some children who found it difficult to judge their own written work. Some children could not appreciate when a paragraph didn't make sense, or if a poem didn't rhyme, or if a more powerful adjective was needed to persuade an audience; however, they felt confident to evaluate their digital productions. Mangle subsequently discovered that follow-up written work which was the result of video stimulus was attempted with greater confidence.

What is crucial to the above illustrative examples – and a central message from the action research studies – is that the ease of independently and collaboratively manipulating and negotiating a high quality digital product has enabled unusually rich opportunities for children to evaluate and improve their work, even within typical curriculum and classroom constraints.

Associated themes arising from the studies, and endorsed by a range of practitioners include the following:

- Digital imagery activities often stimulate rich language work
- Complex editing and production equipment is counter-productive in achieving learning goals – the simplest imagery equipment is often very effective.

Laptop and PC use

Technical issues impacted heavily on the deployment of laptops. Low battery life and wireless connectivity problems frustrated teachers and learners. However, flexibility was appreciated for deploying limited resources around a school, and mains connected improvisations were often developed. Older pupils and students appreciated personal use for homework.

Some teachers made good use of laptops to help both individual and collaborative working. At times, this led to valuable reflection and self-evaluation of their work, as a complete process in itself (eg animation and story-writing). Laptops were also used to present stimulus information in more directed programmes – eg using software and associated imagery to

stimulate the development of vocabulary. As mentioned earlier, a range of software programmes enabled learners to build knowledge and understanding of practical subjects (art, music, science) eventually leading to more confident encounters with the activities.

In a consultation exercise following the studies, a group of teachers were asked to comment on our findings. They described how laptops were also used for students to work on individual for focused and differentiated work; teachers commenting upon our analysis of their use indicated that well-chosen and individually targeted programmes can allow focussed activities for learners not receiving teachers' attention, rather than "holding" tasks. However, besides technical problems with laptops, some users pointed out that lower-achievers tended to be less adept at laptop use and were thus still disadvantaged.

A number of teachers reported that as the laptop/PC offers a structured and focused experience, it helped them become more confident to allow a range of learners to work more independently on laptop/PC activities (even in nursery and reception). They appreciated being able to discretely differentiate laptop/PC activities for individuals, and reported that learners' working with less supervision on laptop/PC programs eased classroom management concerns and may enhance teachers' opportunities for more focused teacher work with individual pupils.

Whereas some teachers reported favourably on self-instruction programmes that allow students to work independently (thus helping general classroom management), others were more negative, suffering frustrations at server problems (which inevitably resulted in more aggravation for the teacher) and they often rationalised the inappropriate nature of these supposedly personalised programmes – eg major conceptual jumps between stages.

Other teachers commented that whilst well-chosen self-assessment programs can help consolidate and practice skills, a continual degree of teacher intervention and feedback is necessary to supplement and mediate the feedback to ensure that it's personalised. At worst, it can degenerate into a situation where "electronic feedback which gives a whizzy response to relatively meaningless drill questions leads children to click random buttons to get the whiz!"

Teachers also criticised the technology-led nature of pc-based assessment – "PC-based assessment tests have to be administered one-to-one, take a disproportionate amount of adult and pupil time to produce dubious results which are then over-analysed because that's easy to do with ICT-based data."

4 ICT and Assessment Issues

Key findings

- When used sensitively, visualisers and interactive whiteboards can provide a whole-class focus that facilitates formative assessment through sharing learners' work as a basis for whole-class discussion.
- With appropriate support, programmed instruction on a VLE can enable FE learners to assess their progress and take greater responsibility in a structured learning experience.
- Teachers and learners generally feel that classroom voting systems improve whole-class participation and questioning in sessions, both as a teaching and assessment activity.
- Teachers can schedule classroom voting systems activities to operate as a stimulus, review or consolidation strategies.
- With classroom voting systems feedback, some more able primary learners can become more involved in their assessment and appreciate that they have a degree of personal responsibility for improving their assessment scores.
- SEN self-consciousness can be worsened in classroom voting systems activities where learners with SEN can become uncomfortable and embarrassed.
- In FE studies, classroom voting systems continue to be used with teams of learners rather than individuals, encouraging supportive learner involvement.
- From the action research studies, there is no evidence of classroom voting systems providing crucial assessment for learning information that has altered either teachers' subsequent teaching plans or learners' responsive strategies.
- Learners who become aware of their learning shortfalls through classroom voting systems may not necessarily be capable of addressing the situation (is it just a question of "trying harder", or do they need access to a range of different learning strategies?)
- The social dynamics of classroom voting systems (needing to compete to win, or to copy a partner's button-pressing) may hamper its effectiveness.

Assessment is a topic that pervades the project, with many of the very best technology-enhanced learning experiences emanating from learners' self-assessment and consequent reflections. However, at the other extreme, learners could be condemned to a mechanistic closed world of programmed instruction. Classroom voting systems provide a useful focus for reflection upon the dynamics of integrating technology into learning.

Classroom voting systems and assessment

Findings from seven action research studies indicated that class voting systems are appreciated by teachers as improving whole-class participation and questioning in sessions, both as a teaching and assessment activity. Both teachers and learners express enjoyment at participating in this focused activity. Some teachers noted that learners could be involved in the assessment and in some circumstances it improved their sense of responsibility for their levels of attainment.

Classroom voting systems – differentiation difficulties

Tootill surveyed her learners after a test using classroom voting systems. She discovered that many children asked what they needed to do to improve, and so felt that classroom voting systems acted as a stimulus to encourage children to raise questions and become more actively involved in the assessment process. Most children enjoyed the activity, with higher achievers enjoying the competition, and they appeared to want to take responsibility for their future progress. However, for seven SEN children in the class, the classroom voting system was a negative experience. Pleasure at being part of a whole-class activity was replaced by reinforcement of their relative failure. So instead of enjoying competing, some SEN children were embarrassed; "it makes me panic and I need to press one. I just guess. I got two right though before."

Generally, learners expressed relative enjoyment of the assessment activities. Even low-achievers, who in individual interviews admit discomfort at the public display of their relative ignorance, express enjoyment of the focused whole-group climate that voting systems create. They also like the fact that writing is not involved. The teacher appears to be seen as a creator of a more social experience rather than as an assessor or interrogator.

However, six of the seven classroom voting system studies included concerns from SEN individuals about negative whole group experiences which they see as publicly endorsing their relatively poor performance and low status. One teacher noted a culture of learners clandestinely looking to see which buttons the brighter students were pressing, and also felt there could be a tension with the "zappers" encouraging a fast (rather than a considered) response.

It was also discovered that it was the activity rather than the technology which was enjoyable; learners don't need to have the voting handsets, as one IWB multi-choice system with a very large group held up cards (A,B,C and D) to express preference, and this also evaluated very well. In the evaluation, learners did express a preference for the handsets as a possible improvement, but this was considered less important than varying the questions to make the tests more challenging "*The questions could get harder as you go along to make our brains work more*"

Classroom voting systems – evolving valuable strategies

Bailey noted that children were well-motivated and enthusiastic when using the voting "zappers". However, Bailey's research concluded that using classroom voting systems technology to carry out spelling tests did not provide her with a true reflection of her children's ability to spell (though it did indicate their proof-reading ability). She decided to continue to use classroom voting systems to test the children's knowledge and understanding in other subjects where it had proven beneficial, particularly as a starter or plenary activity in maths lessons where the children have to identify the correct answer to a small number of questions related to their work.

From our studies we note that classroom voting systems offer a range of possibilities. They appeal to both teachers and learners, who appreciate them as an engaging focus to gain whole-class ownership in addressing a topic. Teachers also enjoy the whole class refocus and reinforcement of subject matter (which Smith has described as "concert review"). The software allows teachers to prepare and present a topic and offer multiple responses to features of the subject being studied that permit exploration of alternative responses and viewpoints.

However there are a range of issues to be considered in planning their use in sessions. One teacher found that for assessment purposes, while it is easy to construct multi-choice questions, it may be that the intended learning is not really being tested.

In three studies, FE teachers used the classroom voting systems opportunity to develop whole group focus on a topic when working with low-achieving learners. They created carefully designed activities based around team rather than individual responses, in order to create positive classroom learning environments. These FE teachers also encouraged the learners to produce the questions around a topic to ask other teams. This appears to maximise challenge and the learning process and minimise individual risk.

Issues arising from classroom voting systems studies

There are significant issues for each teacher to consider when using classroom voting systems; its adoption is not unproblematic. One major area that needs to be explored is the relationship between voting systems and assessment. Intuitively, voting systems offer teachers immediate whole class data regarding levels of knowledge. However, this assumes that teachers will have the flexibility to respond to fragmented groups of learners who offer a variety of responses (eg if two out of a class of 25 are “failing”, do teachers ignore them or repeat the session?).

If used for whole-class assessment, there is a tension between having a collaborative whole class climate, and a differentiated assessment that encourages deliberative thinking and welcomes exploration of a range of responses. For example, some learners in the studies wanted more challenging questions, whilst others did not want their lack of knowledge exposed.

One must also consider whether enabling the learner to identify their problem areas is any more than a very first step in helping them overcome them. There is a question about whether learners who become aware of their learning shortfalls are actually capable of addressing the situation. Is it just a question of ‘trying harder’, or do learners need access to a range of different learning strategies? Do learners and teachers know what these alternative strategies are?

The action research studies invite caution about accepting the intuitively attractive claim that voting systems necessarily contribute to a formal “assessment for learning” process. Public assessment can isolate and alienate lower-achievers (in one study, mid-range achievers), and there is no evidence that the relatively successful pupils can usefully engage with those areas where they have been identified as unsuccessful. There is also the concern with multiple-choice type answers, that correct answers have been returned for the wrong reasons.

Further research is needed to ascertain:

- how different levels of learners can be accommodated within the voting experience
- how well teachers can actually use classroom voting system information in a planned way to remedy difficulties that become apparent in certain sections of the class
- whether voting systems offer teachers a superficial level of control over the learning – the tight structure and limited options offer a narrow range of learning responses
- how far the social dynamics of the classroom voting system process (the emphasis on speed of replies, of needing to compete to win, or to copy a partner’s button-pressing) confuses its effectiveness as an aid to more deliberate and considered reflection.

Finally, whilst there may be something confusing about “voting” on a right/wrong answer, it may be that this very provision is the key to using classroom voting systems successfully in fundamental educational ways in classes exploring the construction of knowledge.

Encouraging self-assessment

Two studies illustrate contrasting ways in which ICT can help teachers use assessment to guide learning. In the first example, Ellis describes how assessment driven programme can present a disciplined structure for students:

Using assessment to encourage older learners’ self-discipline

Ellis’ FE study was driven by the difficulties of biology attracting large group of students, including both poorly-motivated, low-achieving school leavers and mature students who find it difficult to attend. Ellis believed that many school leavers have little experience of self-disciplined independent learning, which is crucial for A-level. In the past, many learners had passively attended teacher-led sessions before eventually falling behind and/or dropping out of the course.

To counter this, Ellis adopted the role of “learning director” rather than teacher, and designed a course based upon a series of tests that learners were required to pass before moving on to take an exam. Rather than the teacher delivering all in the materials in sessions, multi-media learning materials created using presentation software were placed on the VLE. Learners could access them during the lesson and at home after having a 30 minute introduction to the topic. Following this input, learners could study on their own or with colleagues for the rest of the lesson, and raise any problems arising with the teacher.

Ellis reports on the relative success of this approach during the first seven weeks, with most learners achieving success on the course and appreciating the interactive ICT based learning materials. Three students who failed successive tests in the early weeks were given support to find alternative, more suitable programmes. Most of the learners felt that weekly assessments motivated them and appreciated the interactive materials used, but some also wanted more detailed printed information to supplement the onscreen displays.

In a very different study, a Year 2 teacher explains how whole group formative assessment can be enhanced with a visualiser and slate:

Using the visualiser for formative peer-assessment in Year 2

“Traditionally, the children would write the learning objective at the top of their writing work and I would highlight two things in their work. I used a yellow highlighter to highlight what they had done well and a blue highlighter to highlight what they could improve. This highlighting was always linked to the learning intention. Initially I would also write a comment in red to explain my choices. The children were then given time at the beginning on the next lesson to look at the marking and see what they had done well and what they could improve. They would also use this time to ask any questions they had about the marking. As the children became more used to the system, they tended not to need so much written explanation in their work...

....Using this new marking scheme, I decided to use the active studio package with the active slate at the end of English writing lessons to mark a child’s work as a whole class. An active slate is an electronic board which the teacher uses as a portable mouse in conjunction with the active studio package, which allows you to move away from your desk and around the classroom. The active studio package features include coloured highlighting and writing features. We use this package with the visualiser to capture images of the children’s work and then to annotate it. The active slate can be used by the children and passed around the classroom easily.

I would choose a piece of work from a child and capture it on the visualiser. Then, using the active slate the children would discuss which parts of the writing had met the learning objective particularly well and highlight this in yellow and where an improvement could be made and highlight this in blue. I would then make a brief note on the children’s highlighting and save the work in the child’s e-folder.

As my class became more experienced at this form of marking I began to notice conversations in my classroom which centred around how children could improve their work. These usually involved adjectives, capital letters and full stops. I overheard one conversation where Billy said to Lucy, “I think that would be even more interesting if you put another adjective in just there.” Lucy agreed with this comment and adjusted her work. This conversation pleased me because Billy was a lower attainer and Lucy a very confident higher attainer. It seemed to me that the children were developing their writing critically and more independently...” (Sawyer 2006)

5 ICT and teachers' continuing professional development (CPD)

Key findings

- Over the life of the project, teachers have become more experimental in supporting learners to use the technology as a tool to scaffold learning and build creative confidence.
- Teachers' capacity to encourage learner autonomy has been encouraged by their experience of observing learners' abilities (and their learners' sense of responsibility) with new technology.
- The studies suggest that ICT endorses and improves current practice rather than changing pedagogy.
- Support staff are keen to become upskilled to extend their support role in the classroom, often developing additional ICT skills to the teacher, thus ensuring high quality learner support.
- The studies reflect teachers' motivation to use ICT and their sense of improved professional status when they are successful.
- 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.
- Many teachers are now relaxed managers and organisers of learning situations where ICT is used by teacher and learners.

Our first report in 2004 indicated how,

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.

After receiving the first studies, we arrived at the following interim conclusions:

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. (Evaluation Team First Annual Report, December 2004)

CPD: skills development and professional updating

Two years later, subsequent studies both endorsed and developed the above findings, and it is also interesting to revisit the potential which the studies then promised. The initial professional satisfactions at incorporating new technology into practitioners' professional skill base continue to be widely felt.

Many teachers' studies and responses both to the staff survey and to our consultation meetings to check our interim action research conclusions

indicate that the teachers appreciate laptops and memory sticks for the design and planning of “personalised teaching” resources which give them ownership of a dynamic and appealing classroom experience. Teachers’ growing confidence is mirrored in reports and responses which mention substituting “increased thinking time” for the traditional physical preparation time which is now enabled through access to a wide selection of electronic materials. It is apparent that many teachers benefit from being able to draw upon well-designed explanatory resources to support their teaching in compulsory topic areas with which they may not feel fully comfortable, such as science, history, art and music, and to this extent the materials may offer not just subject content, but also pedagogical development opportunities as teachers observe how learners encounter information presented in a variety of ways.

Throughout the action research studies, there is frequent reference to teacher adaptation, modification and development of ICT materials, but although there is implicit and explicit reference to teacher innovation in designing or applying materials, there seems no explicit evidence in these studies or survey of content sharing of other teachers’ resources from a shared school or cluster bank. The lack of collaborative endeavour apparent in the studies may result from the individualistic nature of research writing, and it may also reflect Gudmundsdottir’s (1990) explanation of how teachers integrate resources to create their own “personal curriculum”, as teachers domesticate ICT into their established pedagogical approach. Miller and Glover (2002) mention teachers’ willingness to contribute their own resources, but not necessarily to use materials which other teachers have created.

CPD and pedagogical development

In 2004 we noted that,

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.

Since then reports have frequently mentioned pupils exceeding teacher expectations for their independence with ICT, and a range of examples where pupils – including some with significant special needs or disadvantage – are given ownership of technology and even responsibility for leading others with the equipment. In some cases this has led to pupils leading lessons (under teacher supervision) or to conducting class project work with video and cameras. To some extent we have seen a development of the learner experience from 2004 when we wrote,

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.

Since then, although opportunities have still usually been time and outcome-constrained, pupils have been given greater opportunities to use the digital video, camera, art or music technology for exploratory and reflective activities within such constraints. From a small number of enthusiastic studies, it appears that confident teachers allow greater degrees of pupil self-management, (for example, pupils with behavioural problems are allowed to use ICT equipment “on trust”) within acknowledged teacher-directed environments.

Pupils’ increased control of ICT has been most noticeable in infant children taking digital cameras and voice recorders home. Unlike with laptops, there are a number of studies which mention children’s exploration of these simple and manageable technologies. In addition, a much greater degree of parental home involvement has been remarked upon when using this equipment, in contrast to parents’ more reserved attitude to laptops, which are apparently perceived as more complex.

Developing pedagogical practice through new technology experiences

Wearmouth began a digital video project with four Year 3 and 4 pupils as an artistic project; this was quickly adapted to include literacy and poetry as soon as the first pupil looked at the camera preview. The pupil camera operator realised he was the only one who could see the detail as he controlled the zoom facility and he could not resist describing what he saw to the others in the group. The language used was unusually descriptive and poetic. Each pupil, taking their turn to film, gave a poetic running commentary.

Building on this, Wearmouth continued small groupwork, with children inducting others into digital video use. He notes that paired work, using an experienced user to aid a novice, seems to work best when the ‘teacher’ is not from the highest ability group. He suggests that pupils who have struggled to gain proficiency have a better understanding of the learning process and seem to show more patience, offering encouragement and a willingness to adopt different approaches when teaching others. Although video-filming cannot be supervised as often as he would like, he suggests that whereas there is a balance between increased supervision and the quality of the final films, pupils learn quickly from their mistakes and from others’ problems. He suggests that standing back from interfering in the decision-making processes and allowing editing errors (such as bad choices for text colour) can nurture excellent evaluation skills and lead to learners progressing to improve the films further.

In terms of pedagogical development, teachers continue to use ICT to support, rather than to change, their established teaching approaches. However, there is some evidence of teachers experimenting with their approaches, to allow children more independence to take greater responsibility for their activities as they demonstrate competence with technology. Some teachers are using ICT to build subject confidence in eg literacy, art, music and science.

However, teachers' 'pedagogical development' is a subjective and relative concept. At the end of the project, most teachers and leaders attending a consultation meeting to help interpret the studies agreed with our tentative proposition that, *"The studies suggest that ICT endorses and improves current practice rather than changing pedagogy."*

We now appreciate that implicit in such a proposition was our belief that many teachers' practice was generally overly didactic rather than learner-centred. In the event, for many of those at our meetings, their current learner-centred approaches had been further endorsed and improved by use of technology. From the studies and responses we have interesting data indicating how aspiring student-centred teachers encountering technology may develop and create further student-centred approaches through the use of technology.

Several teachers talk of breaking through the "wow" barrier, and transcending the novelty and excitement (and pressures) of the new technology to take control of the technology and put it to good service. Thus, teachers talk of discovering the possibilities to use the transmission affordances of the visualiser to transmit learners' work for discussion, *"a visualiser being used to great effect to share work and during show and tell sessions in Yr 3 (the children loved it and were very able users of the technology)"*.

Several teachers talk of the stages in embracing technology as moving beyond novelty and tentative experimentation into domestication of the technology – it can now serve their ends. There are numerous examples of how many very young and low-achieving learners have adopted the technology and can be entrusted to work independently, with varying degrees of direction, and many respondents provide anecdotal evidence of learners working on IWBs, laptops, cameras, microscopes etc, displaying unusual levels of engagement, creativity or responsiveness in sessions. Practitioners describe how materials are customised to meet the needs of specific learners in their familiar contexts, and integrated into established and proven ways of working with the classes. Teachers describe the satisfactions of working at home, customising and creating materials that meet the needs of their learners in their classrooms.

However, it is worth reflecting upon teachers' informal development of resources, when they modify and adapt a range of materials to fit with the curriculum and their teaching style. For example, a number of studies appear to have incorporated the affordances of new technology such as whiteboards,

to develop materials they believe are closer to their learners' needs. These materials are often devised to cope with perceived weaknesses in commercial software – for example, a lack of cultural congruity in the language and content – and teachers provide evidence that students benefit from this redesigned approach. Teachers will then use their personalised materials with minor adaptations in teaching successive groups, but we have no evidence from the (mainly primary) reports that they make much use of other colleagues' adapted materials.

It thus seems safe to conclude that in creating resources, teachers are planning the integration of the technology closely into their personal teaching style. For the teacher, resources are not the lesson, any more than scenery and props communicate the experience of the play. Thus, some important factors appear to be evident when teachers plan and design technological resources, including:

- satisfying the teacher's creative and intellectual needs in planning learning
- satisfying the teacher's need to feel secure that they can manage the controlled event
- satisfying the teacher that they are meeting the established and agreed needs they have identified in their learners.

So whilst technological content and resources are selected as supportive of the teacher's individual approach, they do not (except perhaps with relatively inexperienced teachers) become central determinants of the session. This may explain why (as Miller & Glover (2001:271) discovered) teachers can reject external resources, yet be very willing to share their own innovations.

If the above list of reasons is correct, then it is likely that the resources produced would be teacher-specific, and unlikely to be transferable to other teaching contexts without very detailed supporting information. Several teachers interviewed have explained that they don't use resources from other teachers as their resources are not appropriate for their particular year group of learners; however, the same teachers also say that they use their own resources in subsequent years with different groups with a little adjustment. Seen in the light of the suggested list of reasons above, their explanation for rejecting externally-produced, non-learner specific resources is easier to understand.

However, although such resources are personal and intuitively designed, and unlikely to have been evaluated, there is evidence that they are much appreciated by learners and still valuable in helping the learners to learn. Teachers agreed with our conclusions that:

- 1 where teachers and support staff design targeted learning materials, there appears to be an extremely productive relationship with learners when they are used

- 2 developing content for individuals or a group enhances the teacher's involvement in the taught sessions and learners enjoy such sessions.

Several teachers at the end of the project also stressed that non-ICT resources were equally valuable, depending upon teachers' aims.

Leading teachers' pedagogical development¹

One study on the mentoring of new staff offers some interesting reflections on in-house teacher development. The mentor noted that she was most encouraging about those who could emulate her competence with the new technology, and her efforts were directed into refining their technology confidence, rather than into reflecting on how far such technologies would be appropriate in different contexts. Seen in this light, it is all-important that leaders encourage both the in-house development of skills and also the responsibility to monitor whether learners' needs are being met by the application of the technology. In-house development without supportive pedagogical leadership may well lead to rapid and secure acquisition of technological skills, but there is also the danger that this could be seen as an end in itself. Pedagogical development requires continuing support for reflective review, to ensure that new forms of technological craft cultures don't become embedded in or added onto traditional "coping strategies", which often fail to support active learning

There is also some evidence of teachers reconceptualising learners' needs in the new distant teaching/learning relationship, and introducing resources and approaches (such as web-quests), which invited learners to take a more independent, exploratory approach to the subject being taught. For example, the emailed element of distant learning stimulated greater learner autonomy, moving the emphasis on knowledge acquisition from teacher transmission to learners requesting help with areas of subject weakness.

¹ Several leaders' reports emphasise that the in-school (often informal) development of staff ICT skills was more effective than external training in ensuring technology was used in the classroom. Two leaders' reports emphasised the importance of incremental developments; one encouraged the staff to explore a "one a month" approach to technological changes to their practice, such initiatives then being shared in the staff meetings where established colleagues could evaluate such changes with a secure appreciation of the surrounding context (and credibility) of the change. Another leader spoke of trying to create expanding "islands of change", to which individual teachers who had pioneered new practices would gradually attract others. The 'saturation' of the project was heavily criticised, as the ensuing implementation difficulties and widespread feelings of overload provided a solid platform for those staff groupings resistant to the introduction of new technology. This criticism of "saturation" does not necessarily conflict with the benefits to be gained by the whole-school simultaneous adoption of new technologies, providing such adoption is of single technologies at any one time. Institutional change strategies and structures can then be developed to manage and optimise the benefits arising from the next wave of technological installation.

Rethinking pedagogy in new technological environments

At Sandwell College, the biology tutor (Skilbeck) emigrated at the beginning of the project, but agreed to continue tuition by video-conferencing. Test Bed funding provided intensive support for an innovative programme which would be financially prohibitive in normal situations. It also allowed for an exploration and appreciation of the pedagogic demands in a realistic video-conferencing situation, even if the learners' experiences could not be reasonably replicated in other situations (two attendant staff for five students, supplemented by lengthy individual email/ messenger room tutorials).

Skilbeck's studies are reflections on having to rethink what teachers do in promoting learning. His teaching methods were influenced by the consideration that distant communication might be subject to breakdown, and consequently was inventive in designing a range of student and group-centred independent activities. He felt that he needed to move beyond mere presentation of information, into finding ways of getting better feedback, and of re-presenting information to maximise learners' opportunities to access ideas. He did by, for example, rewriting handouts as interactive worksheets requiring student processing of the information as individuals or as groups; by getting learners to support each other without the teacher being present; and by giving greater consideration to what the learners would do in their own time – thereby reconceptualising homework.

Much of what Skilbeck designed could have also been delivered directly with the teacher present, but his new video-conferencing situation focused attention on how teachers could operate to increase learner independence and interdependence. He designed a range of group activities, interactive handouts, individual and group quizzes, pictorial and labelling activities, and web quests. As in other ICT contexts, the teacher became more confident in ceding control of the learning situation as he began to gain new insights into the learners' potential for independence.

Conclusions

Our initial (2004) report on CPD came to the following conclusion:

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.

However, it appears that whilst teachers' are using the Test Bed experience to enjoy continuing independent creativity in their teaching approaches, and many learners are operating technologies more independently (without supervision), because of teaching constraints, we only have a small number of examples of activities in which learners are involved which could claim to represent "a transformed experience".

6 ICT and special needs provision

Key findings

- Early intervention with ICT in foundation stage – before writing becomes an indicator of SEN – may prevent some learners being designated with SEN status.
- ICT activity often provides a refreshing and positive communication opportunity for the academically marginalised. Such events enable disadvantaged learners to perform above (even their own) expectations, and allows teachers new insights.
- SEN pupils became more confident in the classroom, much more willing to participate and take responsibility for making choices and questioning. This was especially noticeable where children had been encouraged to take control of technology in the classroom and to take it home.
- Children with learning difficulties – often from disadvantaged backgrounds – were more likely to be supported by parents at home in the use of simple technologies (eg cameras rather than laptops), although initiating parental involvement often required teachers to work hard at first to encourage parent participation.
- SEN learners benefit from supported small-group use of ICT; learner-centred activities that can subsequently be shared with the whole class improve the social integration of SEN pupils.
- SEN disadvantage can be worsened in whole-group activities (such as using classroom voting systems and video conferencing), where learners with SEN can become uncomfortable and embarrassed.
- There is a need for sustained follow-up to examine the extent to which the initial valuable interventions documented in action research studies have been (or can be) sustained. Investigation into whether former low achievers improved esteem actually leads to improved academic progress in ICT and non-ICT environments, is also needed.
- Too much ICT work with learners with SEN still seems to be focused on using ICT to better include these learners in specific mainstream activities (thus helping classroom management), rather than using ICT to maximise their potential across all school activities. Too many children with SEN finish a successful ICT-oriented session and then return to their relative disadvantaged status within the class.
- Many of the children with SEN who benefited from ICT use were not allowed access to equipment beyond the designated sessions.

It is particularly interesting to note how a number of studies and responses from surveys have indicated how ICT – especially whole-class technologies – have led to a more inclusive classroom, with all students paying attention, even those who usually become easily distracted and disengaged. However, there is often a lack of explicit detail to indicate the extent to which the low achievers are influenced by this experience, or whether their relative disadvantaged status is simply accommodated and maintained in a more manageable whole-class environment.

In a number of studies, teachers have targeted lower achievers with active strategies to address their marginalised status, directing tools and activities to improve participation in, and expect greater responsibility for, their learning. Many cases have indicated relative success, and there is now scope for significant research and development in this area. There is a need for sustained follow-up to examine the extent to which these initial valuable interventions have been (or can be) sustained, so that the former low achievers then become more successful in mainstream activities.

We noted in 2004 that

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 [combining with] teachers' renewed enthusiasm for preparing resources and using them in their teaching. (First Annual Evaluation Report 2004)

Over the project there have been 16 studies from 14 teachers and assistants focusing upon children with unspecified special educational needs and five studies focusing upon clinically disadvantaged learners, four of whom were on the autistic spectrum. Five of the general SEN studies looked at ways that teachers and assistants could support special needs through the production and/or use of learning programmes – the experience was usually highly-rated by participating pupils. Eight of the studies explored how SEN pupils used a variety of imaging or sound recording technology in class and to take home. This was highly appreciated by children and parents with SEN children displaying unusual levels of response and enthusiasm for communicating their experiences. In these studies, children exhibited an enthusiasm to be active, included, and almost always – within the scope of these limited studies – successful. Such creative and learner-directed experiences were usually noted by reporters as raising the learners' self-esteem and confidence in the classroom, and celebrated as extremely worthwhile experiences.

From the action research studies there has been less attention to whole-class relationships, but more focus on relationships with SEN pupils. Often, the SEN success with ICT has led to better communication between teacher and learner, as both have revised their perception of the learner's potential.

Building SEN confidence through ICT achievements

In a first study, Price noted how using digital microscopes both enhanced the understanding of more able children by giving them (literally) a “bigger picture”, and also supported children with SEN in giving them the opportunity to ‘see things differently’. It provided a different way for them to learn these concepts rather than the traditional teacher-led or paper-based approach. She acknowledged that microscopes, with the large shared images, could enable children to explore through discovery learning and learn concepts more independently. A problem would be posed and the children took an active role in investigating that problem through the use of the microscope. She found that child-led investigations with these easily manageable tools helped children explain (and retain) their findings in greater detail. They had a greater ownership of these learning experiences and were able to apply the concepts which they had developed.

Price noted that learners had developed their language skills in the first study in two ways. Firstly, she found that the discussions about the images were usually more technical, with the children wanting to use the correct scientific vocabulary to really explain their findings. The other children listened carefully and the search for ‘powerful words’ was adopted by a wide range of children – including those with SEN, who would normally struggle with language and word-finding skills.

Building on the earlier study, Price then arranged for SEN children who were enthusiastic about the microscopes to train other children in the class to use the microscope, and through the use of the microscopes the language skills of the children also improved. Price built upon children’s confidence to “find out more” and communicate more effectively by using the microscopes for creative writing, magnifying a piece of rock as a stimulus to descriptive writing about ‘alien planets’.

She found that the boys were particularly engaged with this piece of writing and produced work of an improved quality to that which they may have produced without the support of the microscopes. Children spent time exploring the rock samples in detail and discussing them with their group, giving them the opportunity to share ideas and language. This language was stimulated by the clear images of the magnified rock samples. Price described how some became unusually passionate about their descriptions – continually improving their ideas, adding or improving the vocabulary which they used and building a better picture. She argued that the use of the microscopes clearly acted as a stimulus and scaffold to the learning and the renewed confidence in language which took place.

However, there is still insufficient evidence that ICT is a reliable means to an academic end – from the studies, there is a lack of sustained testing to show whether (and how) the learners' improved esteem leads to improved academic progress in ICT and non-ICT environments. Rather, much ICT work with children with SEN still seems to involve *single* sessions that they enjoy, achieve and be better accommodated in whole-class activities. However, after these sessions, children with SEN return to text-based sessions in which they retain their relatively disadvantaged status.

It is difficult to judge whether the improved general ambiance has been maintained; some of the novelty factor – described as the “wow” factor in the 2004 report – will have subsided, and with it the excited yet unfocused visions that accompanied the technology. In practice, a limited number of reports show some teachers are developing strategies which explore how learners' products can be the subject of “public display” to the class as a whole, through use of the IWB, visualiser and/or slate. It is difficult to gauge whether this remains a development of practice with a limited number of individuals, or whether practice in general has been transformed through immersion in ICT.

We consulted participating action researchers regarding our interpretation of the overall long-term benefits of technology for SEN pupils. This elicited a variety of responses, the most common being an emphasis that generally SEN pupils became more confident in the classroom, very much more willing to participate, and taking responsibility to make choices and to question. Such improvement was especially noticeable where children had been encouraged to take control of technology in the classroom and to take it home. These teachers' perceptions were also confirmed by teachers' reports.

However, there was a resignation from teachers that ultimately, children will be assessed in text and therefore, no matter how much support was given to reduce disadvantage (eg using imagery to stimulate writing and literacy), the text-dominated assessment system would eventually take its toll on these disadvantaged learners. Several opined that at least the learners enjoyed periods of success whilst using the technology. It seemed that only in the early years that ICT was noted as liberating pupils from the SEN status – three nursery/reception teachers remarked how technology had improved learner communicative confidence (and competence) to the point where they were no longer at risk of being labelled SEN. A nursery teacher gave a practitioner's working understanding of the benefits which ICT interventions might have for foundation children who might be at risk of being labelled 'SEN':

“Because SEN is largely recognised by a child's inability to write, it is less of an issue in foundation stage, where everyone is learning to write. However, using ICT for making frameworks for writing – eg text to copy over, or models for news or stories, makes it easier to get less able writers started, possibly preventing some from achieving SEN status.” (Nursery Teacher's comment)

Unfortunately, because of resource limitations, many SEN children who benefited from using ICT were not allowed access to equipment beyond the designated sessions. In addition, as in some schools access to technology was sometimes a reward for good behaviour, to have given learners with SEN behavioural problems greater access to technology could have been seen to be undermining the schools' discipline code.

Five studies focused upon children with clinical difficulties. In these, teachers worked creatively and conscientiously to find new ways of addressing communication needs, often through imagery stimulus. These were reported as successful engagements (although one early study that captured widespread interest reported two years later that ICT didn't sustain the interest of the autistic child in the long-term). Other reports noted that the activity required the sustained investment of responsive teachers' time, and thus children moving upwards through the system still needed this close attention, which was not always apparent from subsequent teachers.

Considering the ICT experience of two children with specific learning difficulties

Hayton's study compared how a nursery teacher tried to integrate two children into school – one had severe learning difficulties, while the other had some language development problems. She reported how the more able child enjoyed using the interactive whiteboard in nursery to support gross motor function. He then also took the digital camera home to stimulate speech development. His subsequent improvement in language use, combined with increased parental contact with the teacher through the home/school ICT activities, led to him eventually integrating confidently with a full range of nursery activities.

However, Hayton concluded that the nursery staff could only use ICT to accommodate the more disadvantaged child – ie as a means to manage his disruptive effect. The teacher found they were using ICT to focus him on PC activities that engaged his attention and prevented him disrupting other social activities, but he was not developing appropriately as he was spending too long on the computers to the exclusion of all other nursery activities. Eventually this child was referred to a special school.

This single study indicates that ICT may be usefully deployed to help certain learners overcome specific difficulties at appropriate times in their development.

SEN, ICT and communication

It is interesting that most of the SEN studies used ICT as a vehicle (or tool, or opportunity) for improving teacher and child communication and relationships. One teacher evaluated formative assessment activities through a classroom voting system response, which then served as a stimulus for individual interviews with a group of SEN children. Others were able to use the technology activities as a focus for discussions with colleagues, the children and their parents. The children's special needs – and ways of addressing, rather than accommodating them – appeared to become central in these studies. In an associated whole-class study, a teacher's use of an electronic discussion board appeared to change the nature of classroom discussion. As a newly qualified teacher, he began to gain rapid insights into the thinking of the children in the class and he was especially grateful that he began to understand the emotions of one particularly angry child, through monitoring the exchanges between pupils. The electronic capacity to address the teacher directly was also commended by another teacher – “the anonymity that they offered the children allowed them to be honest without feeling that they would be reprimanded as well as giving a voice to children who had a very limited one”. However, the electronic discussion board required a certain level of literacy.

Over the course of the project, more studies focused upon SEN pupils. To some extent this contrasts with a significant number of earlier studies, where learners with SEN were often noted as being accommodated unproblematically within the whole-class adoption of technologies – for example, via animated presentations of teacher input. However, there is some evidence from later studies, that where SEN cohorts are examined within studies of whole class activities, while their external behaviour is compliant, they feel significant silent discomfort with the experience. Children with learning difficulties showed signs of embarrassment at whole-class attention to their failings; for example, after a classroom voting system experience, Tootill noted “Comments collected from five of the children on the SEN register reflected disappointment and negativity”.

On the theme of communication, one study of video-conferencing records that mixed ability and more able learners benefited from the input from collaborating teachers, whereas the special needs learners were less receptive and lost focus. This may highlight a limitation with whole class approaches to technology (such as IWB, classroom voting system and video conferencing). From a teacher management perspective, they can accommodate children with lower abilities in whole class activities, but any such whole class sessions may only increase their consciousness of their relative disadvantage.

However, where the SEN learners were active and central in using the IWB, their centrality in the physical classroom space reflected their new status and self-esteem. Where special needs were given special treatment through the accessibility of the available technologies, their performance impressed both themselves and audiences.

7 Leadership

After collecting a first tranche of studies in the First Annual Report 2004, we noted that:

leadership and management 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 [...]

Since then, three headteachers have reflected upon their actions in leading changes across Test Bed. We identified consistent themes across their reports, which matched with the environments described by a range of studies conducted by teachers and support staff:

Key findings

- Leadership of ICT implementation requires confident distributive leadership, to encourage gradual change being led by key individuals (“saturation” could prove counter-productive).
- Effective leaders involve staff at all levels, giving support to and beyond ICT co-ordinators.
- Effective leaders used all LA and external sources of support.
- Pedagogical development in teachers’ use of ICT (for example, a movement towards increased child-centred use by teachers) was evident in schools with supportive leadership.
- From these studies, it appears that schools with leadership teams that encouraged staff to conduct research and take risks demonstrated more productive learning and teaching approaches.

The above conclusions were also endorsed by the consultation group of 21 action researchers. This consultation group comprised of teachers, support staff and leaders who had each contributed between one and five studies to the evaluation. Over a twenty four hour period they provided both challenge and confirmation for our emergent conclusions from the initial cross-case analysis of the collected studies.

For any developments with the technology to be sustained in and across schools (rather than to surface then fade as temporary individual developments within a school), it was necessary that the school leadership endorsed and supported an exploratory, risk-taking approach to ICT use. In this situation, highly directive leaders, perhaps celebrated in other forums for their whole-school presence, could stifle teacher development.²

Thus there are a range of models of leadership evident in the experiences of the leaders and the led. The most productive, developmental schools (as evidenced in the nature of the studies) enjoyed a supportive, encouraging approach from the leaders, with both teachers and support staff researching their ICT practice. In such situations, leaders had used teachers' capacity to do action research to transcend the perceived pressures and constraints of the project, both in "*preventing the project becoming too top-down*" and seen as "*a great opportunity to move the school forward; raising professional standing of teachers; teachers reflecting on practice and changing practice as a result – [professional development] opportunities never before possible*"

² Not all teachers engaged upon research believed they were supported. In a consultation session, several primary teachers expressed criticisms of their schools' defensiveness:

"My head was very protective of his staff and his school and was wary of giving parents access to us. There most certainly was not an open door policy, rather a feeling of suspicion and fear of accusation."

The pressures from Test Bed inevitably impacted upon headteachers, keen to preserve the best they had established before the project began:

While my head was willing for me to be involved, he was protective of his staff and didn't want us to be involved in 'more work'. It was only my own interest that made me push myself into the position of research leader. In fact our large school was very insular and the experience of Test Bed did not lead to greater collaboration between schools [...]. It may be that there was collaboration/ team work between senior managers from the different schools but at a teacher level, Test Bed made no changes to how we worked.

In such schools, teachers wanting to research were tolerated and accommodated, but the research rarely developed beyond interested individuals. In one school, whose Test Bed management and administration is highly rated in inspection reports, an individual teacher researcher noted "not really!" in response to the statement, "effective leaders encouraged a climate of research, a culture of professionalism and were willing to encourage debate".

How did encouraging action research help lead ICT change?

Smith, a primary headteacher, noted how supporting teacher and support staff to do research had benefits for implementing Test Bed at all levels:

a For the school

- The huge investment created a responsibility to share what has been learnt – research was an effective way of sharing news (both positive and negative).
- Can result in changing practices and policy, eg a classroom assistant's research resulted in a change in marking policy.
- It creates staffroom discussions about the possibility of classroom culture change – one teacher's research helped SEN children develop as leaders and problem-solvers.

b For teachers

- Makes teachers consider the impact of introducing new software and hardware and question effectiveness.
- Gives teachers the opportunities for professional dialogue with other clusters and learn from each other; researchers and teachers.
- Teachers presenting their findings at conferences raises self-esteem and gives them a sense of achievement and being value, and produces creative commitment.

c For children

- Children can become the leaders of learning/thinkers, asking questions and reflecting on their own learning.
- Gives children a reason for discussion with teacher on their own learning: how does ICT help?

A classroom assistant from the above school illustrates how her study contributed to personal and school development:

Extending a classroom assistant's role

Oliver, a higher-level teaching assistant, evaluated her role in supporting learners with literacy and numeracy software packages. 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 research subsequently influenced the degree of responsibility that she could exercise. It also had 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 improved her self-perception

Leadership and workforce development

Workforce issues

Twenty one studies were received from support, technical and administration staff. Many of these bear testimony to supportive whole school leadership in developing the opportunity and confidence to explore the potential of ICT. The reports indicate a small number of support staff embracing a range of new technological challenges and of demonstrating skills and responsibility for learning well beyond their role expectations.

Support assistants supporting learning

A number of support assistants used ICT to directly assist with classroom activities including: piloting the use of a 'talking photograph album' to build confidence in a child who was uncommunicative; taking responsibility for helping groups of Year 1 children to make simple videos of stories, and supporting learners with digital video use. Support assistants and content developers worked closely together and were able to produce dedicated resources for specific groups that were evaluated very positively. In three atypical primary schools, where the support staff were given significant autonomy and responsibility to improve learning, they deployed – and researched – ICT creatively and effectively.

Two assistants researching nursery/reception use of ICT demonstrated advanced research skills in identifying significant differentiation in children's approach to, and confidence with, ICT. In the staff survey, an assistant identified how supporting video activities had enabled her to build more sustained relationships with the children through supporting production of a video.

8 Home-school and community links

Key findings

Involving parents

- With sensitive teacher organisation of the simplest technology (such as cameras), the parents of the more disadvantaged children were helped to become more involved in their children's education.
- Disadvantaged parents can be encouraged to learn about ICT if it involves supporting their children (rather than directed as remedial for selves).
- To encourage parental participation in ICT, it was very important to enable face-to-face communication with individual teachers that the participants liked and respected.

Placing computers in home environments

- There are questionable assumptions about the parents' capacity to provide appropriate support and interaction to their children, when they are provided with ICT at home.

School and community links

- Successful outreach into the community using ICT meant marrying ICT with established links and recognised community needs rather than offering discrete ICT provision.
- The quality of employer liaison regarding work placements was improved when a college instigated email links.

Improving educational provision beyond the institution

- In FE, a number of studies intuitively explored ways of improving learning beyond the classroom, using the affordances of email and the VLE. Other than making resources more accessible, these had limited success in enabling higher levels of learner activity.

One of the themes that Test Bed sought to explore was the degree to which ICT could improve links between school and home. In the 12 action research studies, this theme was evident in a number of strands: improving adult involvement in FE; improving parental involvement in children's initial education; and improving administrative contact with external users. Teachers of the youngest children led several successful initiatives.

Several Key Stage 1 teachers allowed children to take home simple technology – voice recorders and digital cameras – in an attempt to try to improve children's communication skills and involve parents in their children's

learning. The following study illustrates the complex nature of reaching and supporting parents who are traditionally “hard-to-reach”:

Reaching non-traditional learners through a sensitive ICT initiative

Mattinson, an FE childcare teacher collaborated with Scott, a primary teacher to manage a small-scale “making a Storysack through ICT” project, which targeted “hard to reach” parents to encourage them to participate in their own, and their children’s education. This had a low-key ICT aspect, which was intended to both extend parents’ ICT knowledge and skill and to enable them to support their children effectively.

Five participants joined the course and each used elements of ICT (basic word processing and presentation software for example) to enhance the creation of the Storysack. For example, one member of the group made a game on the principle of snakes and ladders, which consisted of a numbered table. Contents cards were made using word processing software and three CD-ROMs were burnt with the stories read by two participants and placed in the Storysacks as a resource to support children within the classroom setting and for parents reading to children at home.

In this ICT related home-school link, the skills of knitting, crocheting, woodwork, sewing and drawing were celebrated as having equal value to ICT skills. Through the activity, individual parenting skills were discussed and enhanced through discussion with participants, the host primary teacher and the organising FE teacher. For example, discussion with parents focused upon encouraging children’s recognition of numbers through the “snakes and ladders” game, and literacy skills and visual discrimination through the “snap” game.

Both teachers were delighted that participating parents and grandparents – often with negative personal educational experiences – had the opportunity to experiment with, and extend their knowledge, skills and understanding of the use of ICT through a non-traditional method of delivering ICT training.

Three other studies involved inviting parents and/or relatives to participate in some element of education. These parents were often hard-to-reach learners who may well have been reluctant school pupils themselves.

In an individual study, one classroom assistant established, maintained and evaluated a website. She discovered a keen core of parents (about 10 per cent responded to the evaluation) who used and appreciated the site; there

was a concern that parental interest could become competitive in supporting their children. Similarly, another nursery assistant studied ICT use in nursery children's homes and commented that the digital divide was becoming established at an early stage:

The effects of home use of ICT on nursery performance

Rudd, a nursery assistant, investigated nursery use of computers and how this related to home use. The study involved visits to children's homes. She noted that in the nursery, without teacher intervention, the computers were already being dominated by the children who were more familiar with computers and had good mouse control. She wondered whether ICT-rich homes could advantage some children and acknowledged how important the role of the nursery practitioner was in ensuring equal access for the economically disadvantaged. The assistant makes the point that her school is trying to bridge the digital divide by loaning equipment such as laptops to those who need it, but with limited equipment these are targeted at the older children in the school.

Three studies looked at the use of computers in primary children's homes. One in-depth study of home use by a parent of a child on the autistic spectrum did record some minor improvements (and these were reinforced by his experience over the subsequent summer holiday). However, an anxiety arose from this very committed parent that there was a lack of communication with the school over how he should use the equipment – he noted that a child with his son's condition required specialist help, and at times he was quite concerned that his well-intentioned help might not actually be giving his child what he needed. He had also been worried that he could even be undoing good work that has been done in school, and this could make his child even more frustrated. This would be true for any learner, but for his child it was especially important, as his autism renders consistency highly important. However, this parent was enthusiastic about the development of his own skills, which had been supported by his local college, which had also helped him to install the equipment.

Initial responses to computer roll-out

In Sandwell, the home roll-out of computers was not initially successful: The conclusion from Pinner's early study was that although parents had been given PCs and software and some training, they were not using the parents' portal on the learning gateway as intended, that is, to help support their children. Pinner suggested that where parental direction was not evident, the children tended to resort to non-educational tasks such as gaming or e-mailing friends. Test Bed had sought to address the digital divide by supplying children's homes with computers and connectivity, but the parents do not have the ability to use the facilities given to them. She concluded that there had not been enough initial support or training to enable families to help their children using the home-school computers and so the school must resolve that issue if they were to utilise and get good value out of the expenditure on home-school computers.

A third study of laptops sent home with children indicated that the children had gained confidence in keyboard and software use, but there was not evidence to vindicate the assumption that sending laptops home would realise the exploratory and creative intentions espoused by the teacher.

The limited data available from action research reports in relation to home-use of ICT indicates that

- technical installation of home loan equipment has been effective.
- technical difficulties (such as server problems and low battery-life) can limit laptop use across school/home
- well-targeted supportive ICT activities for parents receiving technology can be of significant benefit
- there are inaccurate assumptions about the capacity of parents receiving technology to provide appropriate support and interaction for their children
- the educational purpose of the home use of the computer must be clarified and suitable guidance provided to learners and parents.

Reaching learners outside of the institution

Several FE teachers looked at ways of using technology to give adult learners additional assistance. For example, mature students missing chemistry practicals could not experience the practical through notes, so the teacher made video clips, which students claimed were the next best thing to a personal demonstration. The clips helped the students to see the techniques that they had previously only heard or read about. They were grateful for any additions to the traditional handouts used to cover the work they had missed.

To some extent, the affordances of the technology invited teachers to explore the potential, but with limited results. One such example is the attempt to establish “e-mentoring” for at-risk learners.

E-mentoring – a step too far?

Mattinson’s evaluation of her e-mentoring project explored the extent to which ‘at-risk’ FE students could support each other through email contact. The project had gone through a number of stages of evolution, at the end of which she concluded that peer-mentoring through email using college loaned laptops was inappropriate, as none of the mentors had a landline within their home environment. A related issue – which may offer an alternative solution to the emailing dilemma – was that mentees often required a quick response to a simple question, which may have been more effectively asked and answered through the use of a mobile phone and texting.

Mattinson realized that establishing a ‘buddy scheme’ through the use of text would have been sufficient in answering many of the questions students wanted to ask their peers, as the mentee would have also been given a quick response as students tend to check text messages regularly. Linked to this was student discomfort with email as a means of conducting a relationship where confidence-building support was often important: “You just reply don’t you. You don’t continue talking if you have got the answer you want, it’s sometimes a bit of a barrier to talking.”

Nonetheless, the students’ educational well-being had been supported through the provision of college laptop for the email mentors. Several students identified how they believed the use of a laptop within the home setting had improved their ICT skills, presentation of written work and their time management in meeting assignment submission dates.

Skilbeck’s study (see chapter five) indicated how video-conferencing and emailed tutorials could support learners, but required considerable resources, human as well as technological. One in-depth study of the VLE indicated the aspirations of the designers, but reflected that the VLE was used too often as solely a content repository.

In another study, ESOL teachers at Barking College explored how learners with a wide variety of needs can be supported by offering self-study programmes on the VLE to enable students to work at home. Students accessed these at college and a range of complex factors affecting the project’s success were identified by the researching ESOL team. These

reveal that extending access to learning through ICT is by no means straightforward or intuitive:

ESOL use of supplementary ICT at Barking College

- Studies of multiple teachers and learners in ESOL programmes indicate that different programs appeal to learners in different ways, in regard to choice and use with and without tutor support, in or outside of lessons.
- Some ESOL learners find it difficult to judge the value of ICT-based activities as a contribution to their learning.
- Managing associated ICT activities can both help and hinder teacher response to other learners in the class. Different learners require differing degrees of ICT familiarisation, which can impinge on teachers' time.
- Although development of materials is costly on one-offs, evolving approaches from the dedicated providers focus on re-usability and teacher control of the materials.
- A classroom assistant would help to support learners as they worked on the programs.
- Some learners could transfer use of the VLE exercises in lessons to their independent study sessions.
- Tracking systems are needed to monitor whether time on computers is being invested productively (and meeting individual needs).

Reaching out to the community

Using ICT to reach the local community more effectively requires sensitivity to the contextual cultural factors which will facilitate or obstruct any progress. Smith reflected upon the range of strategies she had adopted as headteacher to involve the local community over the Test Bed period. She arrived at a number of conclusions:

- Offering technology provision (updating ICT skills) as a focus for community involvement, although popular, had a relatively short shelf-life unless it could be associated with other interests such as photography or local history.
- Offering the school's technology and environment to established interest groups ensured that a critical mass of people who share existing common interest is reached. This may lead to both enhancing the established interest (for example, a local history group) and ensuring a greater chance of sustainability.

- The school was (understandably) most successful in reaching the community (ie the parents and relatives of children) through the pupils.
- Accessing funding and expertise from other sectors, such as adult and community learning and further and higher education, improved provision whilst also addressing the new partners' missions. Meeting the needs that triggered partners' funding (such as providing community education classes) also creates a dynamic towards longer-term viability.

9 Inter-institutional links

One of the research themes of Test Bed was exploring how ICT promoted and facilitated links between institutions. There were few action research studies on this topic, possibly because ICT tended to be integrated into existing practice. We noted in the 2004 report that action research which refers to cluster links tend to be initiated by FE teachers with a tradition of reaching out to (and operating within) the wider community. This has continued, with a small number of collaborative ventures between institutions and largely initiated by FE. Consequently, it would be misleading to attempt to offer key findings emanating from such limited data, and therefore it may be better to consider summaries of the reports that were submitted.

Learning from collaborative experience

Morgan reflected on three studies, involving varying degrees of collaborative success, and derived principles for collaboration between college and schools. He suggested that the developer:

- needs to deal directly with the teacher(s) rather than liaising through a third party such as a nominated ILT Champion
- visits the schools, as this is the testing ground and environment where the resources will be used
- aims to involve between two and five people. With larger groups projects can get bogged down and lose momentum.
- appreciate that resources created for one of primary school might not be relevant to other primary schools. For example, different schools use different letterform systems for teaching joined-up writing.

Teachers

- must be committed to (rather than conscripted to) creating e-learning materials
- must be allocated time to the teacher by their school to work with the content development workshop to create materials and provide feedback
- should visit the content development workshop and talk to the content development team. It is an excellent resource and to get the best out of the partnership the teacher needs to understand what the developer can offer, not simply pass on a pile of papers for him or her to 'get on with'.

The above study reflects upon a major collaborative opportunity created by the establishment of the content development workshop in Barking College. The content development workshop was developed so that Barking and Dagenham Test Bed teachers and Barking College tutors could collaborate

directly with e-learning developers, as the developers understood the technology and the teachers the pedagogy. Early reports illustrated how there were barriers inhibiting communication between teachers and content developers: for example, teachers were reluctant to discuss their ideas as they lacked technological confidence, and developers did not understand the teachers' classroom requirements. Some successful attempts were made by developers to observe the teachers in situ, to help both teachers and developers bridge the divide between pedagogical and technological understanding.

A college's administrative study illustrated how links with educational and childcare providers were greatly facilitated through the use of email. The intention was to improve operational communications about student placements with employers and partners (local schools, nurseries, elderly care homes, SureStart programs, social services) via effective use of email. On the evidence of the first two terms with an e-mail focused employer communication system, there had been a significant reduction in the administrative burden on the work placement officer and the reduction in phone and mail use represents a significant cost saving both in terms of unit costs and employee time. Significantly, employers are now becoming more proactive and using the email contacts to inform the college of changes and suggest improvements. In one instance, a whole year of training was agreed ahead of time.

Two primary studies explored the potential of video-conferencing in Test Bed. From the limited studies, certain principles emerge. Both note that the very carefully synchronised activities require extensive planning and preparation for teachers, and management of the viewing environment. A number of positives could be identified from the experience; teachers felt it had given pupils access to specialist knowledge and created a special sense of audience for the learners in their follow-on work. One teacher reflected on the professional development opportunity it created; sharing different approaches to teaching and learning about everyday topics. However, there are limited reports indicating how video-conferencing is being sustained or developed. The pedagogical implications of video-conferencing – for example, distant teacher/pupil relationships; organising supplementary local materials, and teachers' changed ability to acknowledge learners' non-verbal communication – need to be further researched.

10 Action research methodology

These reports are grounded in practitioners' understanding of carrying out innovatory work with ICT as part of their day-to-day practice. They have provided 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 evaluation. Reading the reports in the light of one another, including systematic mapping of contents, crosschecking 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. The full action research reports can be found on the ICT Test Bed evaluation website and readers are recommended to read them in full on www.evaluation.icctestbed.org.uk/research.

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 led their authors into follow-up action research.

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 a 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, at the beginning of the project, 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 the project – 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, 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.

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).

We have tried to realise this vision by organising a series of consultation events in which participants have been encouraged to critique and contribute to our evolving understandings of their accumulated experiences. 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 would have to master this material and scrutinize it for general trends. It would be out of this synthetic task that general propositional theory could be developed. (Stenhouse, 1975, p. 157) The evaluators’ aim over the life of the ICT Test Bed evaluation was to follow Stenhouse’s advice and use the action research studies as a core element in developing theories. We hope that our preceding analysis, and the resultant theorising, is a just if imperfect attempt to represent the knowledge implicit across these studies.

Reflections on action research in practice: some methodological considerations

In order to encourage teachers to produce action research reports, we provided a range of supportive interventions, though these were necessarily at a low level. Each cluster was supported by a link researcher, and participants were given an introduction to action research methods, a support pack of resources, opportunities to claim supply cover for a day spent planning, conducting and writing up each short report, additional resources as required, and occasional visits from the link researcher. In addition, teachers were offered fees support towards studying for graduate and postgraduate level awards adopting action research approaches. We asked teachers to write short, 500 word accounts of their research, in order to reduce both expectations and workload on very busy practitioners. In the event, writers were over-constrained by this limit and most wrote between one and two thousand words.

Teachers’ studies and ‘action research’

Action research is a broad church, and teachers’ approaches to it varied. Although a small proportion (usually those with some associated experience in teacher research) adopted a conventional action research approach in prospectively adopting a cycle of issue identification – taking action to explore and address the issue, and modifying future actions as a result of reflection upon the emerging evidence – the majority of participants tended to adopt a case study approach to reflecting upon change that had been stimulated by the introduction of ICT and then identify further opportunities for subsequent change. These studies tended towards a “research into previous action” stance, rather than continuing to address the initial findings by sustained practical investigation. However, such studies continued to provide invaluable insights into practitioners’ approaches and attitudes towards the adoption and integration of ICT in schools and colleges, thus providing privileged understandings of the writers’ views of ICT, which may have been impossible to fully comprehend from external perspectives.

A frequently cited criticism of teachers’ action research is reflected in Bartlett and Burton’s (2006) acknowledgement that many teachers use the research opportunity to search for evidence that will support previously held beliefs.

Although at one level, this in itself would provide valuable information, revealing teachers' concerns when addressing ICT in the classroom, we found that most of the action research was not of this nature. Whereas occasional reports from teachers wishing to justify their practices may be apparent amongst those who retrospectively reported upon discrete aspects of practice, the innovatory nature of the ICT experience had often also stimulated a personal improvement within their established practices that teachers then wished to evidence. Such discoveries often represented progress towards greater pupil independence and autonomy – indeed, a frequent discovery from action research (and experienced more widely across Test Bed) was teachers learning that they could allow pupils freedom to explore technology and work with greater self-direction (albeit often within traditional cultural and curriculum constraints). Although, very occasionally writers exploited the opportunity to publish a local study to endorse personal (and micro-political) manifestos, the studies overwhelmingly demonstrate an integrity and commitment to fundamental research ethics, with care and attention being given to the accuracy and authenticity of data collected and presented. In addition to the reporting of ICT related progress in the classroom, in a pleasing number of studies – 25 of the 69 schools' and 14 of the 47 FE reports, one can identify that the research process itself stimulated unexpected outcomes producing “the surprise that is the hallmark of real discovery” that Gorard argues is indicative of original research, and too often missing from some earlier practitioner studies (Gorard, 2002:382).

One intended benefit we had planned in designing this strand of the evaluation (and one which became realised on many occasions) was the effect that action research had upon the teachers' professional appreciation of teaching and learning and the development of professional dialogues beyond the classroom and within and between schools. In some cases, the action research meetings themselves developed intra- and inter-cluster links beyond the more formalised interventions.

Constraints upon practitioner researchers

There were inevitably pressures upon the practitioners in schools to produce action research reports that reflected favourably upon the integration of ICT in the learning environment. The “need to succeed” – or at least, not to be seen as failing in adopting ICT can be appreciated at many different levels. Woolgar (2002) has noted how contemporary society enjoys anticipating a technologically transformed future, and how these confident predictions of success emanate from powerful interrelated constituencies of social, political and media interest groups. Within such an ethos, teachers whose use of technology does not produce improvements could be seen to be a failure (possibly not only as a pedagogue, but also as a fully paid-up member of the 21st century). This imperative to produce evidence of success was evident. The participants in this Test Bed laboured at times under significant expectations of success. As Hennessey et al note, “since digital technology has rendered the production and organisation of information more provisional

and fluid, the belief that ICT-based activity lends itself to open-ended, exploratory learning with opportunities for pupil reflection, experimentation and interpretation is plausible. However, effective pedagogy for supporting these kinds of learning with ICT is currently underdeveloped in typical classroom settings (eg Ofsted, 2001) and is a priority for policy makers and educators (eg DfES, 2003)." (p268)

In this light, many teachers felt as if their failure to use the huge resource to turn 'plausible' expectation into evidenced reality would be noted as inadequacy, and teachers comment how this mission to succeed – or not to admit failure – was transmitted through LAs and schools onto teachers. Teachers did not want to be seen as letting the school down in front of the LA. Bearing this in mind, the most honest of teachers would be impolitic at least, to focus on aspects of ICT use that were not likely to generate success indicators. We must also acknowledge that teachers and researchers not only have different agendas, but different imperatives. Thus, one teacher had initially described a successful initiative that withered quite rapidly, and other colleagues confirmed this situation. However she was keen to research another ICT initiative she was introducing, and could not be persuaded to follow up the reasons for the demise of the original initiative. In this situation we had to appreciate that whereas we in the evaluation team are both interested in identifying why certain interventions have been successful and in understanding why a promising initiative might have failed, the teachers' primary concern – and professional responsibility – is to deploy an ICT strategy that is going to succeed. We should therefore be careful about our expectations of teachers who volunteer to enter the research arena. With limited time to meet competing demands, teachers will not feel attracted to revisit failing initiatives.

As Somekh (2006) has noted, the contemporary inspectorial climate of schooling, which can create a culture of blame, may have limited the degree to which teachers feel that they can write about problematic issues raised by action research, as there can be significant pressures to present the school in a good light. Several contributing teachers openly acknowledged this both in group discussion and text. In contrast, some school leaders actually used the action research to break free from perceived constraints of the project, fully supporting teachers' professional emancipation through exploring the technology and encouraging teachers to adopt and develop a research identity and ethos which could challenge prevailing expectations.

An additional constraint may have arisen from the additional emphasis on the unusual breadth of the wide-ranging Test Bed themes; for many schools the focuses on communication with other schools and the community may have challenged inherited traditions of relative self-sufficiency and self-reliance. In such circumstances, the need to develop ICT whilst demonstrating community links may have seemed a double imposition, which could overstretch their resources and norms and create a sense of vulnerability.

Several participants perceived a material threat to role. A number of posts had been sustained and created by Test Bed, and there is obviously a desire to have such employment maintained; redundancy situations faced a number of practitioner researchers. Consequently, if some reports could be read as publicly emphasising the role and commitment of individuals in managing ICT, this may be understandable. Thus, we acknowledge that teachers are not passive participants: indeed, teachers have their own very different agendas, and the evaluation team has tried to acknowledge this and create a “win-win” situation, whereby there is mutual development.

Finally, there may be problems with individuals’ action research. Might the event-focused aspect of our studies have invited attention to single very visible changes – and other more subtle good work has gone unnoticed? Alternatively, might single isolated incidents have been reported in ways that implied they were everyday practice? Part of the rationale for adopting an action research element in the evaluation was that emerging findings from the four year study could be fed back into participants’ practice. This assumed the adoption of a conventional “best practice” approach, which offered the attractive possibility that such practice would have credibility with the teachers’ peers from the project. In the event, there seems to have been limited discovery of (or sharing of) “recipe knowledge”. Simplistic assumptions underpinning “best practice” have been frequently critiqued. Prestage et al (2003), together with Bartlett and Burton (2003) and Hennessey et al (2005:268) argue that “research shows that teachers who are successfully integrating ICT into their subject teaching tend to be teachers who already have an innovative pedagogic outlook ... so that these findings are not necessarily generalisable to the typical classroom”.

This has both positive and negative implications for our research. In gathering examples of excellent practice, we must be wary of suggesting that examples of exemplary activity can be easily replicated in some (or even most) other educational contexts. However, from these individual studies, we may provide an insider’s understanding of the particular conditions that are necessary in the culture of the institution for such exceptional learning events to occur.

Bearing the above considerations in mind, it is important for readers to remember that the individual studies are considered as professional insights and it is important that reflections by teacher researchers are not generalised beyond the singular contextual case. As Yin and Stenhouse emphasise, single studies cannot and should not be generalised.

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