ICT Research Bursaries

A Compendium of Research Reports

A report on the ICT Research Bursaries 2002–03

ICT Research Bursaries

About the ICT in Schools Programme

The ICT in Schools Programme is the Government's key initiative to stimulate and support the use of information and communications technology (ICT) to improve standards and encourage new ways of teaching and learning. The enormous potential of ICT means that for the first time it is becoming possible for each child to be educated in a way and at a pace which suits them, recognising that each is different, with different abilities, interests and needs. The challenge over the next four years will be to successfully embed ICT in every facet of teaching and learning where it can have a direct impact on raising standards of attainment.

A vision for the future of ICT in schools can be found in the paper, *Fulfilling the Potential: transforming teaching and learning through ICT in schools*. The paper is available online from the Department for Education and Skills (DfES) [http://www.dfes.gov.uk/ictinschools/publications].

About Becta

The British Educational Communications and Technology Agency (Becta), is the Government's lead agency for ICT in education. It supports the UK Government, national organisations, schools and colleges in the use and development of ICT in education to raise standards, widen access, improve skills and encourage effective management.

Findings from Becta's research activities and reports published on behalf of the DfES are targeted at all those interested in educational research. The section of Becta's website that deals with research activities [http://www.becta.org.uk/research/] also provides a gateway to organisations, publications, websites and databases in the field of ICT in education.

Those interested in research on the use of ICT in education can join Becta's ICT Research Network. The ICT Research Network seeks to encourage the exchange of information in order to inform the national agenda. More information can be found on the ICT Research Network website [http://www.becta.org.uk/research/ictrn]. Alternatively, email ictrn@becta.org.uk or write to:

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Millburn Hill Road, Science Park, Coventry CV4 7JJ

Contents

Introduction

The ICT Research Bursaries were funded by the DfES and managed by Becta. They highlight the importance that the Government places on the role of independent research in informing policy and practice relating to the use of ICT in education.

This summary report outlines the findings from twelve diverse studies undertaken as a result of the awarding of bursaries for 2002-03. These findings make a further contribution to the development of a sound and robust evidential base surrounding the use and impact of ICT. The bursary scheme not only supported new projects but also extended the scope of existing studies that were already being undertaken. The scheme is currently running for a second year, illustrating a continued commitment to stimulate research and collaborate with the research and practitioner communities.

The twelve studies summarised here have thrown up a range of diverse and interesting findings that will go some way toward filling knowledge gaps and informing future research and practice relating to ICT use in schools.

Because of the diverse nature of the bursary projects, the focus, sample and technologies studied, it is not easy to read across them in order to draw out consistent key findings. However, it is worth considering just a few of the emergent themes and interesting findings that have been uncovered.

Across the studies ICT was generally found to have either an actual or a potential positive effect on teaching and learning. For example, positive outcomes for learners identified in the evidence include: improved pupil motivation, self-esteem, engagement, confidence, enhanced social and presentational skills, better understanding of concepts and the potential for individualised, specialised and independent learning. Furthermore, there is also evidence that ICT can be used as a diagnostic or evaluative tool. It can be employed to: structure pupils learning, foster reflection, support higher-order thinking skills, encourage creativity and innovation, and act as a medium for facilitating collaborative work. For teachers, evidence suggests that, used well, ICT can support and enhance professional development, facilitate the extension of traditional teaching methods and act as a catalyst for cultural and pedagogical changes that can improve the effectiveness of teaching and learning.

However, while the evidence suggests that these are all possible, it would be inadvisable to overlook the potential barriers to successful use, and the wider contextual and environmental issues that could have an effect on successful utilisation. The bursary studies identify a number of such issues and in doing so, place the Government, practitioners and researchers in a better position to develop solutions that can overcome the related barriers.

There is evidence in the reports that identifies the added value that ICT offers in terms of teaching and learning. Examples include the delivery of materials to support learning, teacher training and the ability of parents to engage with the education of their children. A number of the studies identify the collaborative potential of ICT, with some recommending that ICT should be used more widely to support the development of online communities, which can support the transmission of good educational practice, thereby offering an insight into future possibilities.

Acknowledgements

An assessment of the ways in which teachers evaluate software

Pauline Moss

Introduction

The key responsibilities of ICT co-ordinators are to give advice, purchase software and suggest appropriate use of the latter. However, co-ordinators of curricular areas, and more specifically core subjects, now find themselves in the same position – being expected to provide advice and options as to what software could be used in their area. Furthermore, the non-specialist class teacher also has to make choices as to the selection and use of software in their teaching and learning. Although three different categories, all should use evaluation criteria which, as well as being common to all, are equally based on sound theoretical and pedagogical foundations. The aim of this research was to establish what criteria, if any, were used to make such choices, and to determine a framework for evaluation that would be relevant to all users as well as being based on current theory and best practice.

Research context

The profile of ICT as a tool for teaching and learning has been greatly raised in recent years and, advocated by the Government, ICT is no longer an acronym of which few people know the meaning.

The commercial software producers in the UK were initially quite slow to identify the possibilities of the educational sector as a profitable market place as a result of the higher profile given to ICT. However the development of the National Curriculum dictated a set body of knowledge which all schools had to deliver, and manufacturers could therefore guarantee buyers for packages that incorporated this knowledge. For example, it meant that the market for such software would not be just one or two schools that decided to 'do' the Romans (in the case of primary schools) but that every primary school would be a potential purchaser. In addition, the development of interactive multimedia opened up new possibilities – the introduction of simulations being especially attractive to educators. Because of these developments, schools now find themselves inundated with catalogues promoting diverse software and direct approaches from software representatives are not uncommon.

Research into this area is important. Schools have to implement the ICT curriculum and have to use ICT in a cross-curricular context. Therefore teachers have to know the value of the available materials and resources to the learning and teaching they wish to accomplish. Software must be evaluated and such evaluations need to be based on sound theoretical and pedagogical foundations in order that their use can be justified. The findings of this research suggest that within their ICT policy, schools should acknowledge the need to evaluate software and include a framework for conducting such evaluations. All teachers should be made aware of the obligation to evaluate the software resources they intend to use. Moreover, software manufacturers could then use such a framework to describe their products in a manner that makes sense to teachers and with reference to the context in which the teacher could use the specific package.

Findings from this study are supported by other published research that also indicates that teachers' concentration on content rather than pedagogy is limiting their use of ICT (Osborne and Hennessey 2003). The pressure on teachers to fulfil the requirements of the National Curriculum is a possible reason for this focus on content. However, it is also possible that teachers do not fully understand the opportunities available for independent learning, catering for multiple intelligences, and the desirability of off-computer tasks. This could indicate that post-New Opportunities Fund (NOF) training might include development of teachers' awareness of how ICT can be used to teach children how to learn in various ways, in addition to their need to learn particular content.

This research sought to investigate the means by which teachers carry out evaluation in order to select software for use in computer-based learning and teaching (CBLT), and to identify an evaluation process based on sound theory and pedagogy that could be used to promote such evaluation, thus enhancing CBLT.

Key literature in the field

The study was supported by a review of the literature to identify previous research in three key areas:

- Definition of the term 'evaluation'.

- Learning theories and their relevance to software evaluation.

- Relevance of published evaluation approaches.

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For the purposes of this research, the author uses the term 'evaluation' to include the observations of the selection of software by teachers and the subsequent assessment of such software for its use with students.

Constructivist[1] and objectivist[2] learning theories (Jonnassen 1991) and their relevance to software evaluation were also considered. Independent learning, problem solving and children's autonomy in the learning and teaching process is much valued by many researchers, with ICT thought to be a means of achieving these in a desirable fashion.

Research methodology and focus

Key research questions were:

- What does evaluation mean generally in the context of software? Should it take place before use with students?

- What software features do teachers look for?

- What type of information about software do teachers find useful?

- Where do they find such information?

- What software has the teacher used in the last six months? In which curricular area and why?

- What determined the choice?

- Did the teacher refer to an evaluation carried out by a third party?

- What criteria were used to select software?

- Are teaching styles relevant?

The investigation took the form of action research. The research is based upon the responses to two initial questionnaires that were sent out to a sample of schools, including infant, primary, secondary and sixth form colleges. The project sent out 225 questionnaires to 39 schools, and 67 teachers responded from 26 of the schools.

By analysing the data relating to the selection of software by teachers, it was possible to determine a means of evaluation that would fulfil teachers' requirements as well as ensuring such evaluations have appropriate foundations in acceptable practice when using ICT. In addition, software manufacturers might gain a better understanding of what teachers are looking for in a product. This could then lead to more appropriate and useful information accompanying software.

An unexpected result of the research was a possible focus for future training of teachers. The limited debate surrounding what are desirable or appropriate uses of ICT would indicate that teachers need further training in this area. This could take the form of developing a greater understanding of the capabilities of ICT. Among other strategies, training in delivering the required curriculum while using independent learning and problem solving would also have the desired effect.

Summary of main findings

When evaluating software, the teachers in the sample focused principally on the outcome of the teaching and learning and the content which they hoped to deliver. The means by which these tasks were to be achieved played little or no part in the selection process. This therefore raises questions regarding decisions to use ICT to accomplish their learning outcomes. If teachers are not valuing those aspects of computer-based learning and teaching which make the use of the computer uniquely suitable for a particular learning style or task, why use the computer?

Appropriately selected software can cater for those with different learning preferences and provide independent learning opportunities; thinking skills can be developed and children can be given 'drill and practice' experiences to consolidate learning. Off-computer tasks can provide extension or consolidation of skills initiated on the computer (Moore 1992; Underwood 2000). Such tasks can give the opportunity for reflection to assess the success of the learning achieved through the computer activity and, at the very least, can give teachers with limited numbers of computers a means by which they can organise and manage the learning environment. However, none of these factors were greatly valued by the teachers in the sample. On the other hand, the

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[1] Constructivist: the principal tenet of this theory is that the learner acquires knowledge by actively participating in the learning process and builds on existing knowledge often in a collaborative environment.

[2] Objectivist theory suggests that knowledge exists outside the mind of the individual and therefore, learners need to internalise and replicate this knowledge in order to structure their thinking.

respondents perceived themselves as being advocates of those very qualities.

The majority of the teachers in the sample believed in those teaching and learning styles and philosophies that are advocated by constructivists. However, when selecting software for use, none of these constructivist characteristics were rated highly, if at all. Other researchers (Cox *et al*. 1999) support the overall findings from both questionnaires. Teachers' perceptions of their preferred learning and teaching styles do not seem to be matched by the reality of their selection criteria for software.

The data analyses therefore point to an evaluation framework which would emphasise those aspects of computer learning and teaching which favour the preferred styles as advocated by respondents and are desirable both theoretically and pedagogically. The evaluation would need to ask questions about how the learning and teaching was to be achieved, as well as the content and the intended outcome of the process. The technical aspects of the software were of little importance to the majority of the respondents; therefore, the need for technical questions in the evaluation framework was not thought to be significant.

Conclusions

In the case of most schools, the notion of there being a range of similar software available for a given learning and teaching activity is perhaps misguided; often the choice is limited, with there being only one option for use in many cases.

Matters are further complicated by the requirements of the ICT curriculum. The teacher, while being exhorted to use ICT in cross-curricular activities, is also being asked to ensure that certain ICT capabilities are experienced at certain stages in the school year and life of the student. While it may be more appropriate to use a multimedia approach, for example for particular cross-curricular tasks, multimedia skills may not be developed until Year 6. The teacher would find it difficult to plan such cross-curricular activities until becoming more proficient in identifying opportunities in the learning taking place. Thus, they may be more likely to be restricted by the curricular framework and the use of 'accepted' associated software. The fact that certain software has to be used, rather than the learning being the focus, may govern learning in these instances, which may not be appropriate for delivering teaching and learning supported by effective pedagogy.

The extra time that software evaluation may take, could also limit the extent to which adequate and specific pedagogical consideration of software is undertaken. In practice, teachers gave priority in the selection of software on the basis of:

- learning intention
- content
- recommendation by a colleague.

The use of a review carried out by a third party was not highly rated by respondents. Neither were those characteristics which manufacturers often describe their software as exhibiting. The impact of these findings for teachers, schools and future policy is great.

Teachers should consider the way in which the learning is to take place as well as the knowledge and facts of the learning activities. Schools should include a form of evaluation within their ICT policy, which is suitable for both ICT specialists and non-ICT specialists. The focus (in accordance with Squires and McDougall 1994) should be on the learning preferences and knowledge-base of the pupils, as well as the strategies for accomplishing the learning. The focus should be on how the software can be used to develop broader skills for learning, not merely on transferring the content of the software to the learner.

Both schools and government need to take account of the indication for more teacher training in using computer-based learning and teaching. The awareness of the respondents of the possible learning and teaching available through use of computers seemed to be limited. They recognised the value of independent learning, problem solving and so on, but did not seem to use these as criteria when selecting software for use. It was almost as though the software was being viewed in a similar fashion to a textbook. This could be illustrated by referring to the teachers' view of the software as being in a linear direction rather than in three dimensions.

Software manufacturers similarly need to focus on the learning process in addition to the content. It would also be advisable for all manufacturers to identify the broader value of the accompanying worksheets and materials (where applicable) and say how these could be used as well as their content and focus.

Where possible, an independent evaluator should be used to assess a manufacturer's software from a practitioner's viewpoint, such as the service provided by

TEEM[3]. Such services should be promoted more widely to schools and teachers, with an emphasis on the independence of these evaluations so that teachers can have confidence in their validity and relevance. Purchase of software that proves to be of little use is not only a waste of money but also restricts the learning and teaching process.

Finally, because ICT is a relatively new subject, teachers are being asked to examine their teaching and learning practices, whereas in other subject areas they do not carry out such exercises. For example, teachers are not asked to formally evaluate a textbook before use, neither are they asked to justify its use by referring to current learning theories. The justification is in the outcome – learning has taken place, therefore its use was relevant (and vice versa). This would appear to be supporting the professional artistry as described by Schön (1987) and be an acceptance of a teacher's professional ability to make judgements in teaching generally. However, this ability to 'instinctively know how to do something' and be able to make judgements (knowing-in-action) is not so readily extended to the use of ICT, hence the need for justifications and evaluation.

Future research should include a more in-depth analysis of where responsibility for the purchase of software for the whole school use lies. In addition, it is particularly important to know the status and expertise of the 'colleague' who is used by the majority of the respondents when selecting software. (Many of the respondents were ICT co-ordinators, therefore it may be wrong to assume the ICT co-ordinator is the 'colleague' who makes recommendations.)

However, the principal focus of research in this area should be the cross-curricular use of ICT. Firstly, it would be essential to carry out research in other curricular areas to establish if content rather than the learning process is generally of paramount importance. Once established, it would then be possible to see if there is a correlation between this focus and the degree to which ICT is used in those subjects, thereby displaying the degree of emphasis on content. It may then be possible to determine why teachers use ICT in some curricular areas and not others and encourage a more general use by identifying these influences. As teachers focus mainly on the content of a piece of software, those subject areas

that have a similar focus may be assumed to be more attractive to ICT users for effectively implementing ICT.

References

Cox, M., Preston, C. and Cox, K. (1999), 'What factors support or prevent teachers from using ICT in their classrooms?', paper presented to the annual conference of the British Education and Research Association (BERA), Brighton, 2-5 September.

Jonnassen, D. (1991), 'Objectivist vs. Constructivist: do we need a new philosophical paradigm?', *Educational Technology: Research and Development*, vol. 39, no. 3, pp. 5-14.

Moore, A. (1992), 'Siuli's maths lesson: autonomy or control?', in J. Beyon and H. Mackay (eds.), *Computers Into Classrooms: More Questions Than Answers*, Falmer Press, London.

Osborne, J. and Hennessy, S. (2003), *Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions*, NESTA Futurelab, Bristol, viewed November 2003, [http://www.nestafuturelab.org/research/reviews/se01.htm].

Schön, D. (1987), *Educating the Reflective Practitioner*, Jossey-Bass, San Francisco.

Squires, D. and McDougall, A. (1994), *Choosing and Using Educational Software: A Teachers' Guide*, Falmer Press, London.

Underwood, J. (2000), 'A comparison of two types of computer support for reading development', *Journal of Research in Reading*, vol. 23, no. 2, pp. 136-148.

[3] TEEM (Teachers Evaluating Educational Multimedia) [http://www.teem.org.uk].

Bridging the gap: ICT in the transition year

Andrew Madden, Lynda Bates, Carol Apthorpe and David White

Introduction

The purpose of this research was to investigate the problem of teaching ICT to pupils in transition. Specifically, to look at the range of ICT skills of incoming Year 7 pupils and to discuss strategies for dealing with pupils with widely varying experiences and aptitudes.

Research context

Owing to the rise in expenditure on ICT in education, the age at which pupils have routinely come into contact with ICT has dropped rapidly over the last 10 years. Ten years ago, pupils were unlikely to make regular use of ICT until they went to work or college.

One of the much publicised aims of the new Labour Government in 1997 was the promotion of ICT in schools, and while primary schools also benefited, it tended to be secondary schools who saw the first significant positive effects of this initiative. Where ICT was used in primary schools, it often served the function of a 'pacifier' – used to provide an activity for pupils who finished a task before their peers (Selwyn and Bullon 2000). Pupils often arrived from primary school to find substantially better ICT resources than they had previously encountered and, in most cases, teachers could confidently treat them as ICT beginners. Now, with ICT expenditure per primary student approaching parity with expenditure per secondary student, transition has begun to be a problem, particularly as many children now use ICT at home for a wide range of purposes, including those linked to their formal education (Somekh *et al*. 2001). This research, therefore, investigated the problem of teaching ICT to pupils in transition.

Key literature in the field

The literature reviewed in the full research report considered the speed at which computers have changed society over the last 30 years. It was noted that even as little as 10 years ago, while personal computers (PCs) were familiar sights in universities and offices around the country, they were only just beginning to become commonplace in schools, and access tended to be restricted. In 1993-94 the average secondary school in England had one microcomputer per 10 pupils and only 30% of these microcomputers were capable of supporting a graphical user interface (GUI) (DfE 1995). At this time, the youngest of today's teachers might well have been contemplating their Key Stage 4 options and any computer experience they had at school was likely to have been on a BBC or an Archimedes. Limitations in ICT usability and availability severely restricted the use to which computers could be put across the curriculum (Opie and Katsu 2000). In the intervening 10 years, the learning landscape has changed markedly with increased expenditure on ICT resulting in a proliferation of PCs within classrooms, while the rise in processing power has played a large part in making the PC a practical tool in the classroom.

Secondary school teachers have had a little longer than primary school teachers to become accustomed to the incursion of computers into the classroom. More recently, however, ICT spending in primary schools has risen faster than in secondary schools (DfES 2002a). As a result of additional funding, the average number of computers used mainly for teaching and learning in English primary schools increased from 13.3 in 1998 to 20.7 in 2001, and 31.0 in 2002 (DfES 2002b). Consequently, the age at which pupils have routinely come into contact with ICT has dropped rapidly, meaning that there are now problems associated with transition.

Research methodology and focus

The City School in Sheffield is the focus of this study. It is a mixed community school of 1,500 pupils in an economically deprived area of the city. It is, however, exceptionally well provided with ICT resources, having five computer rooms, a cybercafé, and a City Learning Centre, giving staff and pupils access to over 400 online PCs. School staff have therefore been able to accrue an unusual breadth of experience in using ICT and implementing it in their teaching.

The study took the form of both qualitative and quantitative research. Qualitative research consisted of telephone interviews with representatives of twelve feeder schools; one representative was a headteacher and eleven were learning mentors. Interviews were also undertaken with eight Year 7 pupils of varying abilities from three feeder schools. The ICT teachers rated these pupils according to ICT ability; two were rated as

'excellent', four as 'capable', and two as 'struggling'. Parents of these pupils were also interviewed by telephone. Furthermore, two ICT lessons were observed to supplement the findings. The observations recorded the extent to which the pupils engaged with tasks using publishing software and digital cameras, and identified the range of ICT experience apparent among the pupils.

Quantitative research consisted of three questionnaires and a workshop exercise. The first questionnaire was distributed at an evening for parents/carers of new Year 7 pupils. It was designed to gauge perceptions of ICT among the parents/carers and, in turn, their perceptions of their children's abilities and experience. In total, 100 responses were returned, reporting on 83 pupils.

A second questionnaire was designed to explore what type of information resources pupils used in order to complete homework assignments. This was completed at least once a week during morning registration by students in two Year 7 classes. This report includes a summary of data collected over a five month period. When completing the questionnaire, students were instructed to think about the homework they had most recently completed. They then filled out the questionnaire, giving details of where they had obtained the information for that homework, and how useful the different sources had been.

A third questionnaire was circulated among Year 6 and Year 7 pupils to learn more about their attitudes and access to ICT. In all, data was collected from 245 pupils, consisiting of 161 pupils from four primary schools (80 girls, 81 boys), and 84 from four different classes in one secondary school.

The workshop exercise took place in a class of twenty Year 7 pupils. They were divided into groups of four, provided with a list of information resources, and asked to rank them according to perceived usefulness and give reasons for their selection.

Summary of main findings

The survey of parents

One hundred responses were returned in the survey designed to gauge parent perceptions of ICT and of their children's abilities and experience. The responses covered eighty-three pupils.

ICT skills

Parents' perceptions that a child's ICT skills were above average were associated with the following (according to Spearman Correlations):

- The child's gender (boys were more likely to be considered to have above average ICT skills).

- The parents' estimation of their own ICT skills as above average.

- The parents' belief that the ICT resources at the student's primary school had been above average.

- The parents' belief that the ICT teaching at the student's primary school had been above average.

Interestingly, the presence of a home PC and the availability of help at home were not correlated to perceptions of a child's skill – but they were correlated to a parent/carer's perception of his or her own skills. The correlations also suggested that male parents/carers were more likely to consider their own skills above average than were female parents/carers.

Internet concerns

Parents who perceived primary school ICT teaching and resources to be above average appeared less likely to be concerned by what their children might look at on the internet.

Not surprisingly, in view of media coverage, the most widely held concerns were that pupils could gain access to pornography, and that they might come into contact with undesirable people. From an educational perspective, however, it is interesting to note that fewer than 25% of parents were concerned by the quality of information on the internet.

Evaluating ICT resources and teaching

When asked for their opinion of the ICT resources and teaching of the primary schools, a high proportion of parents/carers ticked the 'Not sure' box (17% 'resources', and 21% 'teaching'). Of the remainder, however, it is far from clear what assessment criteria were used.

For the last two years, The City School has been asking new Year 7 pupils to sit an online multiple-choice test in order to assess their ICT knowledge. A Spearman Correlation analysis was performed to see if parental evaluations of primary school ICT teaching and resources were related to the results of The City School's

ICT test, and to standard assessment test (SAT) scores. Becta's report on ICT and standards in primary schools (2002) suggests a clear link between the quality of ICT training and provision in primary schools and student performance. This research supports this finding, with highly significant correlations between the results of the SATs and the ICT score. Parent/carer assessments of ICT teaching and resources are not correlated to any of these performance indicators; however, this finding may reflect a lack of awareness about ICT teaching resources among some parents.

Interviews

ICT resources

According to the school representatives interviewed, all the feeder schools had suites of online PCs. None had sufficient to allow every student in a class to work alone, but there were enough for pupils to work in pairs. Not all the interviewees knew whether or not there were PCs in every class, but half were certain that this was the case. It was reported that all the schools either had, or were expecting to get, interactive whiteboards to support teaching and learning.

Most of the eight parents interviewed were non-committal on the subject of school resources; none were critical, although it is probable that few of them felt qualified to comment. None of them claimed to know much about computers; they were either self-taught, learned from relatives (usually their children), or learned 'a little bit' at work.

ICT teaching

ICT lessons were held weekly. Most of the interviewees from feeder schools reported lessons of around an hour, but some offered weekly lessons of only 30 minutes; at the other extreme, one school provided double lessons of 100 minutes each. In addition to dedicated ICT lessons, suites could be booked for curricular activity, with the result that pupils often used the computer suite twice a week. All teachers had received (or were undergoing) NOF training.

Opportunities for learning ICT in school were supplemented by a range of after-school homework and computer clubs, and related community schemes.

ICT was popular with all the pupils interviewed, and nearly all praised their primary teachers. The value of ICT lessons at primary school was recognised by all of the pupils. All of the pupils felt their ICT skills had developed

since moving to The City School. It is of course possible that they were merely saying what they thought the interviewer wished to hear, but in most cases their parents also commented on the improvement.

The internet

Invariably, pupils specified that what they had learned since their arrival at The City School were internet-related skills. Despite this, at the time of the interviews (halfway through Year 7), there was still evidence of widely varying perceptions of the internet. Some pupils talked with confidence of searching, while others were less confident in their skills and abilities.

Libraries

Feeder schools varied widely in the range of library resources they provided. At one extreme, the school representative acknowledged that there was no 'proper library', though some books were available. Another school had 'a small room' to which pupils could be taken, a few at a time. At the other end of the scale was a school with a permanently staffed library in which the Librarian works closely with the ICT Co-ordinator. Most of the schools had libraries that were either un-staffed, or run part-time by volunteers or teachers.

All of the pupils were members of a local public library, and most of them used it. Many of them had not been allowed to borrow books at their primary school libraries, but most made regular use of The City School library.

Other information resources

Almost all of the parents and pupils interviewed mentioned computers, or the internet, when asked to state where they might look for information. It is likely that they were prompted to do so because the interviewer mentioned these things when describing the project. However, one parent took the view that the internet had 'taken over' from reference books and encyclopaedias, and many other parents and pupils seemed to share her view.

Lesson observations

The lessons took place in a small room in which a bench, supporting ten PCs, ran along three walls. At the centre of the room was an island of tables surrounded by chairs. The lessons were notable for two things:

- the extent to which the pupils engaged with their assignments
- the range of ICT experience apparent among the pupils.

Engagement with the tasks

Both classes dealt with desktop publishing. However, in each case, only about a quarter of the 60-minute lesson was spent in demonstrating the software. The focus in both lessons was on the task for which the software could be used, rather than the software itself. Pupils demonstrated a high level of engagement in both lessons.

Range of experience

Several incidents provided evidence of the range of knowledge and experience within the class and of the teachers' strategies for coping. Knowledgeable pupils were quick to call out, while less confident pupils either let their partners take control of the PC (a fact noted by the teachers), or sought advice from friends. The teachers coped with the range of experience by overtly acknowledging it, and by encouraging pupils to use knowledge which the teacher was certain was common to most of the class.

One teacher commented that, at primary school, pupils often learned programs that were unavailable at The City School and failed to transfer the skills they had learned. He noted that transition would be easier if The City School was told what software had been used at primary school.

Year 6 and Year 7 ICT use and access

This element of the research considered findings from a questionnaire completed by Year 6 and Year 7 pupils to identify their attitudes, aptitudes and access to ICT. Two interesting points were raised:

- The number of pupils who enjoy using a PC increases considerably in Year 7.

- Year 7 pupils (particularly boys) appear to be far less confident of their keyboard skills than Year 6 pupils.

Information resource usage

Class workshop

Five groups of four Year 7 pupils were given a list of information resources. The pupils were then asked to rank the resources according to how useful they were in supporting learning. The resources were ranked as follows:

- internet
- books
- newspapers and magazines
- relatives
- teachers

- schoolmates
- television and radio
- librarian
- friends outside school
- compact discs (CDs) and digital versatile discs (DVDs).

With the exception of one group, which ranked the internet in eighth place, all other groups ranked it most useful or second most useful. Although the internet received the same mean rating as books, most pupils ranked it higher. Conversations with the pupils revealed that the low position given to CDs and DVDs arose from the fact that these were regarded solely as entertainment media, and not as software storage media.

Information resources used to complete homework assignments

Data from over 240 questionnaires were analysed and produced findings that contrasted markedly with those from the workshops. Resources that pupils report as being used to complete homework assignments are clearly different from those that they perceive as being useful.

These rankings generated by this exercise are as follows:

- parents
- teachers
- books
- schoolmates
- friends outside school
- other relatives
- information from computer
- newspapers and magazines
- librarian
- television and radio
- internet (World Wide Web).

The internet is the least used of the resources listed. However, this does not necessarily represent the pupils' willingness to use such a resource. This research did not explore the degree of any potential restrictions to ICT access they may have encountered in the home. Nonetheless, parents and teachers were the most frequently reported sources of information, and were consulted around five times as frequently as the internet, and approximately twice as often as computers in general. Pupils were also more satisfied with the information received from parents and teachers than they were from any other source. However, the relatively few pupils who did use the internet also found much that was helpful or extremely helpful.

Conclusions and recommendations

Conclusions and recommendations from this research are presented under several key headings:

ICT in primary schools

Galton (2000) states that:

> *"The main function of the first school stage (known as primary or elementary) is to impart basic skills of literacy and numeracy."*

The skills needed to use ICT are the means to various ends. It is easy to forget that the same can be said of reading, writing and arithmetic. With computers now becoming common in primary schools, Galton's assessment of the school's function should perhaps be amended. Arguably today, it should be revised to:

> *The main function of the first school stage is to impart basic skills to help with the acquisition, processing and exchange of information.*

It is for this reason that this study considered a range of information resources, instead of focusing solely on ICT.

ICT as an information resource

If primary schools successfully perform the function described above, pupils can enter their secondary schools and begin to engage with the range of subjects they encounter there. To do so successfully, however, they need to be able to select and use appropriate information resources. It is interesting therefore that from the findings presented above, the perceived value of the internet was high, yet the reported use of the internet at home was low. This suggests there may still be issues relating to the 'digital divide' that mediate use in the home and that schools might further consider how more effectively to link home and school using ICT.

It is clear from the interviews that both pupils and their parents have faith in the internet as an information resource. The survey of parents suggests that few have concerns about its reliability as an information source. The picture among teachers is more varied however.

Although The City School pupils express confidence in the internet, they do not seem to use the internet very much for their homework. There are many possible reasons for this, but one in particular is relevant to the issue of transition. It is noticeable that, of the resources listed in the homework survey, five of the top six used are people, with books being the exception.

People are, of course, the most versatile of information resources, so this is not surprising. Books are probably there because they are familiar, easy to use, and most pupils have ready access to them. Many will be specifically written to tie in to the National Curriculum and therefore are likely to be profitable. The internet may have a more limited or less obvious range of resources dedicated to the National Curriculum. While there is undoubtedly a great deal of valuable material available, users of the internet need the skills and time to find appropriate materials.

Teaching ICT to Year 7 pupils

Teachers encountering Year 7 pupils for the first time can easily gain an indication of their skills in literacy and numeracy from their SAT scores. Pupils with low SAT scores can be identified prior to transition and appropriate help can be provided. As yet, little guidance is available to teachers needing to know a student's ICT abilities. Moreover, as the findings from parental interviews in this study suggest, parents may not be knowledgeable and therefore particularly well placed to help teachers in this assessment of children's ICT skills. This lack of a baseline standard for ICT is a source of frustration to teachers.

Internet perception

Interviews with the pupils revealed some interesting misconceptions about the internet. Some of the pupils had clearly learned appropriate terminology, and talked with confidence about search engines, and accessing information. This demonstrates an ability to use phrases in the right context; it does not necessarily say much about the pupils' concept of the internet. One student of average ability, for example, felt she might 'confuse her computer', suggesting that she held a weak conception about what ICT really is. Perhaps teachers in the primary phase should place more emphasis on ensuring that pupils understand what ICT really is?

A rudimentary understanding of the internet should form part of the basic ICT education provided by primary schools. Teachers are often frustrated by pupils' inability to search the internet critically (Madden forthcoming). One possible reason for this inability is

that pupils have an inaccurate conceptual model of the internet. A common perception of the internet, for example, is that it is a form of electronic library. A student regarding it in this way will tend to treat all documents retrieved as authoritative.

Ratzan (2000) in studying perceptions of the internet, noticed:

> "the frequency of this description decreasing consistently with higher skill levels."

The observations described in this report are limited, so care should be taken when interpreting them in case they prove misleading. At the very least, however, further research is warranted into the answers to the following questions:

- What images do pupils have of the internet?

- What effect (if any) does a student's mental model of the internet have on that student's ability to search for materials on the internet, and to evaluate the materials they retrieve?

A portfolio of information resources

To be an effective educational tool, ICT needs to be used in the context of other available information sources. Having acquired the skills needed to access a range of information resources in primary schools, pupils will need to apply those skills in secondary schools. The current emphasis on ICT may lead to the neglect of other information resources. The perception by Year 7 pupils of the internet's importance as an information source suggests that this may be common. While it is important that ICT is promoted, care should be taken to ensure that this is not at the expense of other information resources, such as libraries. Unless pupils have experience of a variety of resources, they cannot acquire the skills needed to decide which are most appropriate for a given task.

Keyboard skills

The question of why Year 7 pupils should feel less confident in their keyboard skills than Year 6 pupils cannot be answered here. However, it may simply be that they are required to do more writing with the computer in secondary than in primary school.

In summary, it is clear that ICT is an enabling technology. Like numeracy and literacy skills, it enables pupils to locate, evaluate, use and exchange information. Used in conjunction with more established resources such as libraries, it offers pupils a powerful suite of information tools. Care should be taken however, to ensure that it is taught as a complement to existing information resources, rather than a replacement. Teachers of Year 7 pupils can now reasonably expect new pupils to arrive with some ICT experience (even if there is no indication of how much). However, pupils also need to be adequately informed about the various information sources that are available to them and also how to discern the quality and robustness of digital content.

References

Becta (British Educational Communications and Technology Agency) (2002), *Primary Schools ICT and Standards: A Report to the DfES on Becta's Analysis of National Data from Ofsted and QCA*, Becta, Coventry.

DfE (Department for Education) (1995), 'Survey of information technology in schools', *Statistical Bulletin*, issue no. 3/95, HMSO, Norwich.

DfES (Department for Education and Skills) (2002a), *Schools in England*, 2002 edn, Statistics of Education series, HMSO, Norwich; also online: viewed March 2003, [http://www.dfes.gov.uk/rsgateway/DB/VOL/v000359/dfes schools_final.pdf].

DfES (Department for Education and Skills) (2002b), 'Information and communications technology in maintained schools in England: 2002 (provisional)', *Statistical First Releases*, issue no. SFR 19/2002, HMSO, viewed March 2003, [http://www.dfes.gov.uk/rsgateway/ DB/SFR/s000347/contents.shtml].

Galton, M. (2000), 'School transfer and transition', *International Journal of Educational Research*, vol. 33, pp. 321-323.

Madden, A., Ford, N., Levy, P. and Miller, D. (2002), 'How do school children search the Internet? Teachers' perceptions', paper presented to the first international conference on IT and Information Literacy (IT & ILit 2002), Glasgow, 20-22 March.

Opie, C. and Katsu, F. (2000), 'A tale of two national curriculums: issues in implementing the National Curriculum for information and communications technology in initial teacher training', *Journal of Information Technology for Teacher Education*, vol. 9, no. 1, pp. 79-94.

Ratzan, L. (2000), 'Making sense of the web: a metaphorical approach', *Information Research*, vol. 6, no. 1, viewed March 2003, [http://InformationR.net/ir/6-1/paper85.html].

Selwyn, N. and Bullon, K. (2000), 'Primary school children's use of ICT', *British Journal of Educational Technology*, vol. 33, no. 4, pp. 321-332.

Somekh, B., Mavers, D. and Lewin, C. (2001), *Using ICT to Enhance Home-School Links*, ICT in Schools Research and Evaluation Series No. 4, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/research.cfm?id=2607].

Colouring outside the lines: research into the potential of using new digital technologies to increase home-school interactivity in a conductive education environment

Allan Johns

Introduction

Parents of children with disabilities, especially those with children with complex support needs, occupy a central unifying role in the children's lives, often well into adulthood. They play a key role in managing the statutory agencies of education, health and social services (and for some, legal advisers, too) and the links between them. There is little or no formal research into the pressures that this imposes on families – on the longevity of relationships, on the long-term health of parents, or the effects on other family members such as siblings. There is, however, a wealth of anecdotal evidence that the impact is a severe one.

The very recent and increasing momentum for inclusion of children with more complex and profound special educational needs in mainstream schools presents an unfamiliar challenge to all staff in such schools, not just in relation to the children but also in dealings with their parents and the wider family.

New digital technologies have the exciting potential for innovative strategies to ensure that parents of children with disabilities have equal opportunities for more effective participation in the formal educational lives of their children. The South Yorkshire eLearning Project (SYeLP), for example, aims to create a virtual learning environment (VLE) for all secondary schools in South Yorkshire. The VLE will provide an area for parents. However, to ensure this does not remain a largely 'technical' exercise, it is instructive to listen to the voices of disabled people, putting the person before the disability and the disability before the technology.

This research investigates the potential of using new digital technologies to increase home-school interactivity in a conductive education environment.

Research context

Paces Campus in Sheffield is a wholly 'grassroots' families and community-led enterprise. The campus is centred on a DfES registered Conductive Education School, which provides education and transition services for children with physical disabilities. It opened in 1997 in a former comprehensive school in High Green, a semi-urban village on the rural northern boundary of Sheffield.

At Paces, the model operating places people with disabilities and their families, their needs and aspirations, at the heart of the inclusive suite of community facilities. The Paces Project Group is wholly committed as a matter of principle to the 'social model' of disability.

Over 1,000 people per week access the inclusive services provided by the variety of campus-resident groups. In addition to the Conductive Education School and Parent-and-Child group, the campus houses a thriving community nursery, sports facilities, out-of-school club, computer recycling and sales, and a comprehensive learndirect and UK online ICT suite.

The Paces Project aims to help families support children with disabilities into independent adulthood as active citizens. The project is creating an integrated set of education, training and job creation solutions. It is innovative, it is regional in scope and, in several key respects, it is a unique national initiative.

Paces works closely with another parent-founded and parent-led organisation, the Disability Information Service for Children and Young People (DISC). DISC provides a one-on-one information service to parents and other carers. In addition to the DfES-registered school, three of Paces' current projects with which this research project interconnects are:

• Family Support Programme: the provision of structured support, mentoring and training, aimed at parents and intended to provide advice, information and collective solutions; a two-and-a-half-year project funded by the Home Office.

• Phoenix Venture Project: a three-year project funded by the DTI Phoenix Development fund to create entrepreneurial career options for young adults with severe disabilities.

• South Yorkshire eLearning Project (SYeLP): the campus has been proposed (as part of Objective One, a major European Union funding project) as the ICT resource-base and training centre for teachers of children with special needs in secondary schools in South Yorkshire.

Key literature in the field

General literature on inclusion, disability and home-school links and ICT is extensive[1], however, literature relating to the use of digital technologies to enhance home-school interaction among parents of children with disabilities is very limited.

Research methodology and focus

The main aim of the project was to assess the take-up and experience of ICT by parents of children with disabilities, in support of their child and their child's schooling, with a view to influencing new models of practice – both regionally and nationally.

Objectives:

• To investigate how to increase home-school interactivity by utilising new and cost-effective digital technologies for communication, creativity and learning experiences.

• To assess the most effective platforms upon which a broader spectrum of innovative communication, creative and learning opportunities and experiences can enhance home-school interactivity, personal expression, and the integration of formal and informal learning to evaluate the most efficient processes for effecting change.

The participants were a small group of parents and other family members of children and young people with disabilities who are associated with Paces Campus.

[1] See, for example:
HumanITy website [http://www.humanity.org.uk/research/].
ICT Advice site [http://www.ictadvice.org.uk/index.php?section=tl&cat=002].
ICTeachers website [http://www.icteachers.co.uk/teachers/links/tsen.htm].
Specialschool.org website [http://www.specialschool.org/weblinks.htm].

Several were families of pupils at Paces School for Conductive Education. The children and young people had mainly (but the group was not restricted to) physical and learning disabilities with complex support needs.

Three stages of research were conducted:

Stage one

A baseline assessment of ICT knowledge was gathered. This was done through a formal survey, in which questions about ICT were included among other questions relating to the information needs for families with children with disabilities. Copies of the survey were widely distributed across South Yorkshire through DISC and sent to families on the database held by Paces. More than 2,000 surveys were distributed and 81 surveys were returned. It was recognised from the outset that only a few families would have the time and energy to invest in the later stages of the research.

The survey included a question asking respondents to score their confidence in relation to their use of the internet for research and communication with others (discussion forums and email). Analysis of the responses identified this as the most widely reported critical issue, with 49% of respondents confirming that they lacked confidence in using ICT in this manner.

Stage two

Twelve families attended two structured workshops at Paces Campus. The participants worked in small groups with specialised workshop leaders to examine issues in terms of ICT, conductive education, and statementing. Further detailed information was gathered in relation to families' existing ICT skills and access to equipment, via both structured interviews and a further ICT-focused questionnaire.

The focus for the first workshop was on using the internet, email, search engines, weblogs, creating an internet community and taking part in existing community forums. The second workshop concentrated on using 'LifeMaps Online'[2] as a tool to explore parents'

own experiences in their interaction with statutory agencies. All participants were assisted to begin and/or complete their own family's life map using the link on the DISC website.

Stage three

Parallel work in relation to using ICT for personal expression and home-school interactivity was also conducted. The aim of this part of the project was to develop the reading appetite and skills of young people with disabilities and their families by using laptop computers. Some of the strategies used included photo diaries and using the internet to tell family stories. The 12 families taking part were loaned laptops, and skills and knowledge were shared via a series of Family Days at Paces during which the ICT needs of families or carers were addressed.

Summary of main findings

Stage one of the research sought to provide a baseline assessment of ICT knowledge. Key findings were:

- of the 30% who did not have access to a computer, all were interested in further support from Paces to acquire computer-based skills

- 70% already had an internet connection

- 50% were interested in some help in using the internet

- 50% were users of email to some degree

- 80% of email users expressed some lack of confidence in using email tools

- 30% belonged to web-based discussion groups or mailing lists.

These findings suggest that while a significant number of respondents had ICT access and skills, there are still significant skills and confidence gaps. To some degree, this could limit the potential of ICT and initiatives such as The Paces Project to help families support children with disabilities into independent adulthood as active citizens.

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[2] LifeMaps Online is available via the Disability Information Service for Children and Young People website [http://www.disconlineuk.info/lifemap-app/index.php].

[3] These further activities were not developed as part of the bursary research but are part of the ongoing programme for development and improvement at the school.

The second stage of research consisted of two workshops. The LifeMaps Online website, in particular, met with some very favourable reactions from participants. (As it is still in its early stages there is room for a lot of improvement, and work is continuing on upgrading and improving the website and LifeMaps Online.) In using LifeMaps Online as a training or research tool with families, the workshop identified the need for:

- basic instructions for first time users

- extra navigational aids

- preparing users for a linear scrolling experience as opposed to the traditional vertical approach, and background and text colour formatting

- enhanced graphics to express the overall warmth of the original idea.

Other challenges identified by participants were:

- how to encourage potential users to take part and use the site on a regular basis

- how to stimulate awareness in users that, through either the online forum or email, they have control over the content and how the site looks and works.

As a result of the feedback from families, a series of further drop-in ICT workshops have been organised (in the UK online centre at Paces) to enhance the skills-base of the families and build upon the enthusiasm and interest generated during the original workshops. Information and invitations to join the workshops have also been distributed to a wider group of families living in north Sheffield. The project team is also investigating how events can be organised as part of the Family Learning Week campaign[3].

Several case studies were created as a third stage of research.

Overall findings from the research can be summarised as follows:

- ICT has tremendous potential to provide families with children with disabilities opportunities to overcome isolation and engage proactively in home-school interactivity.

- Specific support is needed for parents/carers of a child with disability.

- Most families (parents/carers and siblings) need 'substantial' training and technical knowledge to build

upon the enthusiasm shown in face-to-face personal contact, whether provided via one-to-one sessions, family workshops or by home-based support.

- Supportive input is essential to raise awareness of the potential of ICT to promote home-school interactivity among this group of parents/carers who have very heavy demands on their time.

- Training for parents/carers is essential in the special communications technologies, both hardware and software, which individual children will be using.

- Specific resource commitment will be necessary to enable such parents/carers to engage with even 'ordinary' ICT facilities and for these to be made available to all parents.

- Access to continuing technical support and back-up in the home is vital.

Conclusions

The following recommendations are made as a result of this study:

- To provide adequate assistance to families supporting children with disabilities into independent adulthood requires significant investments of time and resources, particularly given the multi-faceted and specific needs of individuals. Funding is not always widely available and is often fragmented, in that resources need to be drawn from a range of agencies. Consideration needs to be given to raising awareness of the resources required, as well as to the possibilities of streamlining and increasing the efficiency of the funding process.

- Further research with this or similar groups of pupils and their families would offer a valuable opportunity to capture in a systematic way:

  - the impact of having a child with a disability on parents' capacity to engage fully with home-school interactions, whether digitally based or not

  - whether there is any relationship between the increased parental use of ICT for home-school interaction and the capacity of their severely disabled children to acquire ICT skills and experience, and vice-versa.

- Schools and other agencies should look beyond the application of increasingly sophisticated technology to the unmet needs of parents. Four specific measures, as tools to this end, are recommended:

- assembling an online resource-base of materials relating to disability history and awareness – which might be used offline by schools and parent-groups in training workshops or by individuals

- writing an online empowerment training course, which uses online tutors

- within the models of virtual learning environments and other such emerging technologies, to create cross-institutional discussion forums specifically for parents of children with special educational needs in mainstream schools and other educational settings

- to consider resourcing the further development of prototype training tools, such as the 'LifeMaps Online' project, for parents to record and share experiences with professionals, individuals and groups.

The development and use of a computer-based model for assessing thinking skills

Tim Denning, Tony Fisher, Chris Higgins, Mike Johnson, Avril Loveless and Rob Tweats

Introduction

As use of ICT in education has matured, the focus of interest has now started to shift from an overriding concern with the skills and competencies associated with the technology itself, towards an engagement with the potential for ICT to act as a catalyst for the development of new styles of teaching and learning. The scale of this emerging debate is evidenced not only by the attention given to thinking skills in recent policy documents, but also by the large and growing community of researchers and educators active on the internet. A simple document search using the Educational Resources Information Center (ERIC)[1] to identify material associated with 'thinking skills' produced some 5,500 hits and suggested a further 36 related topics. This resurgence of interest has provided an opportunity to explore new possibilities for developing higher-order thinking skills, metacognitive capacity and positive attitudes towards continued learning and, perhaps just as importantly, the place of these capabilities as desirable qualities in the future workforce.

This research and development activity sought to provide the initial framework for an assessment process that, subject to further development, would allow teachers to integrate the monitoring of higher order and metacognitive skills into their regular classroom teaching and assessment. The outcomes could then be used formatively to guide the planning of future tasks and provide a mechanism for tracking and exploiting the positive shifts that might result from the wider use of ICT to support teaching and learning.

Research context

The continuing and growing investment in the use of new technologies in our schools is based on the expectation that 'standards' of achievement will rise as a result of

[1] Educational Resources Information Center (ERIC) [http://www.eric.ed.gov/].

increasingly effective teaching and learning. There remains, however, a gap between that which is most often measured as a contribution to 'standards' and the acquisition and use of higher order and metacognitive skills that may also go hand in hand with the use of ICT in the classroom. It is this gap that the current research is designed to begin to explore.

In this context there is a welcome broadening of interest in the wider aspects of 'thinking skills', illustrated by the recent work of McGuinness (1999). McGuinness provides an informed and concise account of the present state of our engagement with, and understanding of, 'thinking skills' but emphasises the further work that is needed if educators are to fully understand the impact that ICT can have on learning and thinking.

While there has been some attempt to identify classroom activities that involve higher-order thinking skills, the challenge of tracking the development of these capabilities at an individual level remains. The issue then is to identify, if possible, assessment processes that are reliable and valid yet which are sensitive to the need to reflect and support effective approaches to teaching and learning, and which are accessible to classroom teachers.

This research seeks to investigate the implications of introducing an element of automation to an established paper-based instrument. It is hoped that this developmental research will establish a bridge between the more elaborate open response approach often found in research instruments and the practical constraints of the classroom.

Key literature in the field

The study was supported by a preliminary review of literature to identify key areas of work, research and the issues raised in a consideration of the potential impact of ICT on thinking skills in the classroom. Three areas were considered:

• higher-order thinking skills
• metacognition
• learning styles.

The literature review indicated that both learning styles and metacognition could be fruitful areas to pursue, and that metacognition could, to some extent, stand proxy for other forms of 'higher-order thinking' in this initial research. It should be stressed, however, that the choice of metacognition as a focus for this 'proof of concept'

work was one of convenience and should not be taken as an indication that the researchers believe this to be the only available or the most significant proxy for wider cognitive faculties.

Research methodology and focus

Broad aims and objectives:

• To identify existing approaches to assessing and monitoring thinking skills in the broadest sense, which might form the basis for a computer-based instrument.

• To explore the issues involved in the development of such a computer-based instrument.

• To establish whether the results obtained from a computer-based instrument are comparable to those obtained from an equivalent normalised paper-based instrument.

• To investigate whether the information about cognitive processes could be useful in informing classroom practices.

The study encompassed a literature review, the identification and administration of a paper questionnaire, the design and administration of a computer-based activity and the presentation of data for discussion. A seminar group also considered issues associated with the possibilities for using such an activity to track and promote higher-order thinking in teaching and learning activities.

The Metacognitive Self-Knowledge (MSK) Questionnaire (Goos 1999) marketed by NFER/Nelson was selected as the starting point for developing the computer-based assessment. While this instrument was set firmly in a mathematics context it matched the other research criteria – it had strong face validity, was already established as a measure and was available as a paper-based questionnaire that could be used with school students of a range of ages. It could also form the basis for computer-based assessment.

The Goos MSK Questionnaire was originally designed for use with mathematics students between the ages of 15 and 17. For the purposes of the research, it was important not to introduce variations into the original design for the questions and coding framework. This would enable use of the paper-based questionnaire as a reference point, against which to assess the effectiveness of the computer-based version. As a

consequence, the subject context remained that of mathematics. However, the use of the questionnaire was not restricted to Goos' original target age group but was used with a Year 6 group, two Year 9 groups and two Year 10 groups.

Five teachers with an established interest in reflective practice and classroom research each administered the paper-based questionnaire to a group of pupils and, some days later, repeated the process using the prototype computer activity. This would enable consideration of the performance of the computer-based test against the validated and normalised paper-based questionnaire. Following the completion of the school-based trials, the teaching staff involved were invited to join a one-day seminar convened at Keele University in order to discuss the use of both the questionnaire and computer-based instrument and to explore possible applications and further developments.

Summary of main findings

Findings from this study are presented in three key areas:

- The use of such computer-based activities to track cognitive developments.

- Teachers' practice in schools.

- Areas for further research.

Computer-based activities to track cognitive developments

- Computer-based activities of this kind can be a tool which, while it may not be sufficiently fine-grained for testing individuals' scores, could give indications of shifts in selected aspects of cognition in small populations, such as class groups.

- The activity offers teachers two types of information: the responses themselves, which can both inform pupil profiles and make explicit the implications for pedagogy; and the scoring which can provide information regarding broad group shifts in cognitive processes. The presence of this type of activity as a resource in the classroom could have an impact on the teachers' awareness of the role of differing teaching strategies in promoting and supporting cognitive development.

- The level of 'scaffolding' provided by the computer-based instrument raised issues about the advantages and disadvantages of providing prompts for responses

rather than allowing respondents to generate free text responses, as in Goos' original instrument. These issues are echoed in discussions of possible formats for questionnaires, which might include multiple choice or free text options. It is possible to design formats for the computer-based activity which would incorporate a number of features to allow further investigation of these issues. In particular, a development of the original computer-based instrument, deployed at the time of writing, asks for free text responses to each question which the pupil is then asked to characterise with a best-fit against responses chosen from a response pool.

Teachers' practice in schools

Teachers reported on the potential contribution of such tools to their practice in three areas:

- The use of the instrument to provide information which is different from current standardised tests in scope and purpose.

- The use of the information provided to promote higher-order thinking skills with their pupils.

- The use of the information provided to support reflection on teaching strategies, curriculum and assessment frameworks.

The teachers reported that the activity was easy and quick to use and motivating and engaging for pupils, thus offering opportunities to teachers to have a tool which can be used easily at the beginning and end of courses of study or for specific interventions. Activities of this kind can provide information about individual pupils' responses concerning their higher-order thinking (in this case, metacognition). It can also provide information concerning broad patterns in shifts in metacognition in groups of pupils. The nature and focus of this information is different from that provided by current standardised tests and assessment frameworks.

The diagnostic data provided by a more fully developed instrument would provide a starting point for discussions with pupils about their higher-order thinking skills and strategies, and offer opportunities to track developments. This approach would enable pupils and teachers to be explicit about the demands of the tasks undertaken and the strategies used, as discussed by McGuinness (in DfEE 1999) and Collins *et al*. (1989). The teachers reported that pupils were highly motivated in completing

the computer-based instruments and worked with more independence than with the paper questionnaires. The pupils' experiences of working with the instruments might also serve as a starting point for self-review of the approaches to higher-order thinking.

The presence of this instrument as a resource in the classroom could have impact on the teacher's awareness of the role of differing teaching strategies in promoting and supporting cognitive development. Reflection upon pupil responses and discussions of approaches to higher-order thinking would also raise questions about curriculum development and assessment strategies. Responses in the free-text questionnaire identified specific curriculum areas and topics of confidence or concern for pupils. Likewise, the scoring of types of metacognitive strategies adopted provided information about the scope of strategies that might be encouraged or modelled.

Areas for further research

This small-scale study has raised a number of questions about:

• the design of the computer-based instruments
• the experiences of pupils and teachers
• the contexts in which the instruments can be used.

The computer-based instrument could be further developed to explore the nature and range of prompted responses available to users and the opportunity for free text responses. The design can also be adapted for web-based access. Mechanisms for scoring and providing an overview of the tasks and the feedback profiles might also be developed. The questions underlying these elaborations will relate to the validity and reliability of the additional features, and the issues raised in the implementation of the activities.

The pupils' experiences of engaging with these activities can be investigated in more depth and over a longer period. Questions will relate to their experience of using the instruments and any influence the activity may have on self-review and awareness of higher-order thinking strategies.

The teachers' experiences of using these activities can also be investigated by further enquiry about the implementation of the instruments, what was learnt about their pupils and their teaching strategies for higher-order thinking by participating in the activity, and suggestions for developments in pedagogy, curriculum and assessment.

Conclusions

The starting point for this study lay in questions about the role of ICT in higher-order thinking and the issues raised in the development of a computer-based instrument for tracking metacognitive development and informing classroom practices.

The development of computer-based activities to provide insight into aspects of higher-order thinking could play an important role in the evaluation of pupil experience and achievement when working in ICT-rich environments. Such a range of instruments could offer a broader view of the 'added value' of ICT.

Further consideration needs to be given to creating effective guidance for teachers seeking to extend their pedagogy, curriculum and assessment in order to support higher-order thinking in ICT-rich classrooms.

Further research would also enable the development of 'soft measures' to provide insight into pupils' higher-order thinking and metacognitive processes.

References

Collins, A., Brown, J. and Newman, S. (1989), 'Cognitive apprenticeship: teaching the craft of reading, writing and mathematics', in L. Resnick (ed.), *Knowing, Learning and Instruction: Essays in Honor of Robert Glaser*, Lawrence Erlbaum Associates, Hillsdale, NJ.

DfEE (Department for Education and Employment) (1999), *From Thinking Skills to Thinking Classrooms: a review and evaluation of approaches for developing pupils' thinking*, a report prepared for the DfEE by C. McGuinness of Queen's University Belfast, Research Brief series RB115, DfEE, London; also online: viewed March 2003, [http://www.dfes.gov.uk/research/data/uploadfiles/RB115.doc].

Goos, M. (1999), Development and use of the metacognitive self-knowledge questionnaire, unpub, [http://www.uq.edu.au/].

The Hedley Walter High School: cultural change in learning through the use of new technologies

Ian Terrell and Stephen Capper

Introduction

The Hedley Walter High School is an 11 to 19 co-educational Comprehensive Foundation School situated in Brentwood, Essex. The school opened in 1936 and has expanded over the years to its current roll of 1,450 students, with a strong sixth form of approximately 200. Attainment on entry is broadly in line with the national average with a rising trend in Years 7 and 8. The school has improved year-on-year over the last five years in terms of Key Stage 3, GCSE and AS/A2 results. Similar rising trends apply to attendance, number on roll and increased expenditure on buildings and accommodation.

As part of the Specialist Schools Initiative (SSI), Technology College status was designated in January 2003. This was a major achievement for the school at its first attempt and is a clear marker of the school's intent to become a leading-edge Centre of Excellence for the 21st century.

A priority for the school is to become an ICT-rich centre of learning for its students and the wider community. At the core of this vision is the transformation of the whole school through the appropriate use of ICT. To be effective the school has developed an action and enquiry research-based approach, which engages and involves participants initially from the school and later from other schools and the wider community. Group members participate in action research and communicate through reports, meetings and a dedicated online learning platform.

Research context

In the spring of 2002, the new Principal initiated a complete review of the school's approaches to, and uses of, ICT. Working closely with the school's ICT consultant, a staff and student audit was conducted and a series of meetings were held. What has emerged is a surprising and exciting series of plans. These plans will reshape the future of the school and create an ICT-rich learning environment that will change the way that we think about teaching and learning, supported by budgets made available through the school's successful SSI bid.

One of the most important proposals is to change pedagogy: embracing new approaches to teaching and learning in order to ensure that students can gain maximum benefit from all that the ICT-rich environment can afford. The intention is to do this across the whole breadth of teaching and learning. Where appropriate and effective, teachers and learners will adopt new strategies that make learning more successful and rewarding, and which help to maximise potential.

That single task of defining new school-wide pedagogies is a daunting one. The outcomes will have great significance for the school; they will also offer great potential for teachers and learners well beyond the boundaries of the school and Brentwood.

The proposition is simple: how does ICT affect classrooms in a profound and beneficial way and how can teachers be supported to change their classroom practice in order to deliver those benefits? What makes this proposition different is that it is to be a school-wide programme, which looks at the issues of institutional as well as individual change.

Clusters of teachers will be supported as they collaborate in trying new classroom pedagogies. These small steps will be carefully managed and evaluated so that the improvements that they bring can be demonstrated. Where such changes are successful, teachers will commit to adopting them permanently before moving on to explore other areas.

This incremental approach is based around case studies of classroom practice. These case studies will provide the evidence to support the new strategies for learning and changed pedagogy that will support the continuing development of the school. They will also provide a rich vein of resources that all of the teachers can tap into as they tread this path of change. The project website will provide access to these resources while allowing for input from a wider community.

An online action research learning platform is being developed, in which all teachers, learners, and others supporting this project, will become effective members of a research community. The school wishes to develop research capability that will enable the lessons that it

learns from these changes and the change-process to be an evidential base for others. The Hedley Walter High School is not the first school to undertake change of this sort. However, it does seek to create a new model: developing a research community that evaluates and validates its changing day-to-day practice and produces evidence of the impact of this change.

Key literature in the field

The broader school project at Hedley Walter is based upon the notion (outlined by Hopkins *et al*. 1994) of school improvement as a continuous process, building the internal conditions and capacity of the school to take on external pressure for change to raise the achievements of all pupils. The building of the 'continuous process' itself is planned to take at least five years. The pressure for change is the pressure for developing the use of ICT in schools encouraged by the Government and other external demands.

The project offers the opportunity for the school to discuss and debate the meaning of 'achievement of all pupils' and what effective learning looks like. It is felt that while the National Curriculum and Key Stage 4 assessment are important, other measures and qualities such as self-direction, creativity and independence are also very important.

School effectiveness and improvement literature has emphasised the school leading development. Fullan (1991), Hopkins *et al*. (1994) and others, emphasise the school being the centre of improvement. Hopkins *et al*. emphasise the conditions that maximise school improvement as being a combination of factors including distributed leadership, involvement and ownership of the change process, co-ordination, planning, and staff development. In addition, teacher enquiry and reflection, and focusing on the learning process and outcomes, are central. The Hedley Walter project is based upon the notion of building these capacities in the school through the project. A core of staff is leading ICT development in their subject areas, producing examples and evaluations of their activities. These products will be used as resources for staff development with other members of staff.

Practitioner enquiry and reflection is at the heart of the process of curriculum and cultural change. This notion was first discussed by Stenhouse (1975), and followed up in the work of Elliott (1997), Joyce *et al*. (1999) and

Frost *et al*. (2000). Moreover, building a 'community of practice' has been outlined as a powerful model for professional learning (Wenger 1998). The characteristics of such a community include engagement in dialogue with others about practice, the negotiation of meaning and engaging in mutual support. This project hopes to build these characteristics through workshop discussions and the designated online community.

Research methodology and focus

The research overall will be a full four-year project and is planned to have two phases. The ICT Research Bursary helped support the development of the first stage.

Phase one: September 2002 to July 2003 - 'Creating the template for change'

The aims of this phase were to:

- create a school enquiry and development group

- undertake a programme of supported enquiry and development tasks

- engage in regular online and face-to-face discussion about ICT and learning development

- undertake collaborative review of the project.

Specifically, each participant was required to investigate a use of new technology in the learning process. A teaching programme using the technology in a learning context was planned and developed as a case study of practice. The examples were then collated in a school portfolio of exemplar materials and used for dissemination purposes.

In addition, each investigation was required to evaluate the quality of learning using six questions for curriculum evaluation, namely:

- What did the pupils do?
- What did the pupils learn?
- Is it worthwhile?
- What did the teacher do?
- What did the teacher learn?
- What happens next?

The questions focus initially upon collecting data about learning activity and the outcomes of the learning process. Participants were encouraged to undertake classroom observation, discussions with pupils and assessment of students' work to gather this data.

The key issue of why the use of new technology in these activities is worthwhile was discussed through the collaborative discussions of the group and the online community. Identifying what the teacher does to make the lesson using ICT effective is a central part, and yet the questions may also be regarded as part of the 'continuous process' of reflection and review required by the wider project. Hence this process is central to building the capacity of continuous improvement (Hopkins *et al*. 1994).

Phase two: September 2003 to July 2006 – 'Applying the template for change'

Phase two will be conducted independently of the ICT Research Bursary. However, it is worth outlining this phase to put the broader school project in context. The focus of this phase will be on dissemination and development of the use of new technologies in learning across the school. The phase will include staff development activities in departments and across the whole school. The portfolio of exemplar materials and evaluations will be a key resource. In this phase the core of participants will investigate more fully the process of leadership, change, and improvement in the learning process using ICT. It is envisaged that the participant group will increase to include partner and other schools as well as the wider community.

Summary of main findings

The school has been successful in establishing 20 individual projects at the core of the cultural change project. Each individual project has a planned timeline to deliver exemplar materials and an evaluation of a use of new technology in learning. These will be stored in both a virtual and a physical portfolio of materials.

The topics under research are:

- an analysis of the process of cultural change in ICT in a secondary school
- the role of the teaching assistant in ICT lessons
- ICT in a Year 9 cross-curricular assignment during activities week
- using ICT to develop independent learning in geography
- institutional change in the art faculty
- a critical evaluation of self-directed learning and the use of ICT

- doing a first degree in ICT
- use of video in physical education (PE) lessons
- effective learning using free websites
- English: newspaper articles
- digital photos in the ICT department
- storyboards
- explaining mathematical concepts using spreadsheets and presentation software
- encouraging independent learning using writing frames
- development of online learning modules for catering
- evaluating search engines on the web in English A-level.

Preliminary findings from the individual projects indicate positive benefits in several key areas:

- higher levels of performance
- valuable feedback to students
- extension of traditional teaching methods through access to a variety of software packages
- improved understanding of difficult concepts
- improved confidence, self-motivation and esteem
- increased opportunities for independent learning.

The issue of what makes effective learning using new technology has begun to be explored in workshops and online communities. Although it is too early to draw any firm conclusions, a number of key issues are emerging which will help to inform the continuing project work:

Time: prioritisation and time lags

Time was a key factor in the process of cultural change. Change that involves planning, development of teaching materials, evaluation and engaging in dialogue requires that time be allocated to these tasks. However, planning time is a major difficulty in co-ordinating the change activities. There are also major difficulties where staff are already fully committed to a timetable and other duties. Staff shortages exacerbate the situation. The leadership team, therefore, needs to discuss how to prioritise and allocate time for project participants, and to maximise the use of allocated time such as Inset days and department meeting time focused on cultural change in the use of ICT in learning.

Co-ordination

Co-ordination of initiatives across the school is also a major issue arising from the project. The current fragmentation of the various projects, and funding regimes, does not help co-ordination. The school is also engaged in developments associated with Key Stage 3 numeracy and literacy, changes in Key Stage 4, specialist school status, and changes in learning. Co-ordinating these projects so they contribute to each other and do not compete for time, energy and resources is a major problem, particularly for co-ordinating development with the acquisition and delivery of hardware and software. The leadership team needs to co-ordinate the various development projects focused on cultural change in learning and the use of ICT. Attention also needs to be paid to exchanging information across different projects within the school – possibly through the use of materials and conversations in the online community.

Where people are

Planning for change and thinking about the use of new technologies in learning is constrained by where people are in terms of how they think about learning and the use of technology. The school therefore needs to consider where people are in terms of their notion of learning in their subject and in terms of their access to ICT resources. However, projects such as this one also need to continue to emphasise the issues surrounding effective and worthwhile learning and to continue to look at different models and possibilities.

Embedding models of learning

Some of the 20 individual projects raised issues concerned more with the model of learning rather than simply the use of new technology. For example, the project in PE, which is investigating the use of video in analysing and giving feedback on performance, is dependent upon first establishing good processes of observation and analysis of performance. The video enhances the possibilities of this happening rather than being central to the model. Several of the individual projects are based upon a notion of self-directed and independent learning. Developing a culture and the processes that enable this to happen is central to the overall school-based project. Using the new technology is an important additional characteristic and that may support and even enhance this movement. The overall project therefore needs to continue to develop links between the staff involved in each of the individual projects in the school, as well as wider, non-ICT initiatives.

Building a community of practice

Participants have identified the power of, and the need for, professional conversations, facilitated through the workshops and online community. These occasions are marked by dialogue about effective learning and are seen to be essential and rewarding. It is significant that participants felt that not enough occasions existed for such exchange of views before the project was established. Participants also perceived that co-ordination with other school developments and initiatives was also valuable. There is a need to continue to prioritise the online asynchronous discussion as a forum for the wider project, and for cross-fertilisation among the different individual projects in the school.

Creating prioritisation through external support

Participants felt that the involvement of an outside agency was valuable in creating the focus and pressure for change. In a sense, the expectations of the outside agency has helped the prioritisation of the development activity in an environment where participants had many demands on their time.

Fear: a barrier to developing learning and the use of ICT

Participants, particularly at the start of the project, felt that they might be going in the wrong direction. They worried about how they would establish what made using new technology more effective, and what sort of data would be good enough for research. However, teachers have the skills to observe and assess learning, and the professional knowledge to debate, discuss and draw conclusions about why activities are worthwhile based upon their knowledge and experience. The project has helped to build confidence in these areas.

The online community

The online community has helped staff to engage in conversations – even within the school. Staff were able to overcome the isolation and fragmentation felt because they and others were busy working in their own school areas. The online community has also been exploited to connect staff within the school with staff in other schools undertaking similar projects. This has enabled exchange of resources and ideas drawn from different working contexts.

Hardware and software

The project has immediately led to demands for expenditure on new technology. Clearly, staff who do not have access to equipment or software cannot use the technology. However, processing and prioritising purchases takes some time and creates a time lag in the movement towards cultural change, before staff can even begin to evaluate the full potential of ICT. The leadership team should therefore explore ways of prioritising and mapping resource acquisition timelines and integrating them into curriculum developments. Development of a planning and bidding framework for resource acquisition should be considered.

Using internal expertise

The project has already begun to raise issues concerned with the best use of expertise found within the school. In particular the project has found that members of the ICT department could support the use of ICT in subject areas. In return, the department will benefit from contact with curriculum activities.

Conclusions

In conclusion, initial findings from the study indicate that teacher engagement is critical to pedagogical and cultural change. The pace of change is supported by infrastructure and availability of new technologies and resources. The use of new technologies to facilitate communication and exchange of ideas is much more immediate, widespread and permanent than traditional approaches to educational development.

References

Elliot, J. (1997), 'Quality assurance, the educational standards debate and the commodification of educational research', *The Curriculum Journal*, vol. 8, no. 1.

Frost, D., Durrant, J., Head, M. and Holden, G. (2000), *Teacher-Led School Improvement*, Routledge-Falmer, London.

Fullan, M. (1991), *The New Meaning of Educational Change*, Cassell, London.

Hopkins, D., Ainscow, M. and West, M. (1994), *School Improvement in an Era of Change*, Cassell, London.

Joyce. B., Calhoun, E. and Hopkins, D. (1999), *The New Structure of School Improvement*, Open University Press, Buckinghamshire.

Stenhouse, L. (1975), *An Introduction to Curriculum Research and Development*, Heinemann, London.

Wenger, E. (1998), *Communities of Practice: Learning, Meaning, and Identity*, Cambridge University Press, Cambridge.

ICT and subject literacies: a study of the relationship between ICT and subject literacies in the secondary school

Andrew Goodwyn and Kate Findlay

Government initiatives are promoting the use of ICT in all secondary school subjects, and with the Key Stage strategies being implemented across the secondary curriculum, it is important to develop a better understanding of the effect ICT can have on subject literacies. This research was devised to help gain a greater insight into the interface between ICT, literacy, and subject teaching and learning in the secondary school.

Research context

At the time of data collection, schools were implementing a number of government policies and initiatives relating to ICT and to raising the standards of literacy. The notion that literacy is a concern of all subject teachers in the secondary school is a key objective of the National Literacy Strategy (NLS). The Key Stage 3 National Strategy is centred on a 'framework' for teaching English (DfEE 2001), but with recognition of the centrality of language in all subjects (QCA 2001). A parallel drive to promote the use of ICT in subject teaching and learning is evident in the revised National Curriculum for 2000–05, with ICT being established as a core subject. The need for teachers to be trained in the integration of ICT in subject learning is reflected and embedded in the National Curriculum for initial teacher training (DfEE 1998). Nonetheless, policies focusing on literacy and ICT are not always linked and there is little evidence to suggest that there is any clear understanding of the ways in which ICT may be affecting subject literacies.

The authors' previous research in this field investigated literacy and ICT in a number of subjects in the secondary school, and provided evidence of teachers integrating ICT into their practice, but this was not conceptualised as connected to literacy teaching and learning. The lessons nominated by teachers as representative of how literacy 'fits' their subjects did not include the use of ICT.

Teachers were often seen to be 'adding on' ICT and literacy as separate objectives in lesson plans and schemes of work, suggesting they regard the two as distinct requirements.

This research investigated three curriculum areas: English, history and science. The selection was based on the hypothesis that each of these subjects would provide evidence of ICT use and associated literacy practices, which could be usefully compared. Teacher participants were chosen because they were experienced and reflective subject specialists, competent in using ICT and committed to integrating it into their practice.

The value of this research lies in providing examples of what is possible and feasible, and in providing models of practice that might inform the work of other teachers.

Key literature in the field

The original conception of the study was informed by the following three basic understandings emerging from literature and research in the area of literacy, ICT, and subject teaching and learning:

- Teachers' beliefs about teaching and pedagogical orientations are shaped to a significant extent by the subject cultures they inhabit.

- Literacy in the secondary school operates within these subject domains, and it is appropriate to refer to school literacies, since pupils are required to gain competency in, and manage the transition between, a number of subject-specific literacies which are both the means and content of learning in the secondary school.

- ICT is having an impact on subject teaching and learning in the secondary school, and may be changing what it means to be literate within each subject.

This research brings these ideas together to develop an empirical base for understanding the ways in which ICT may be affecting teaching and learning in a selected range of subjects.

Further literature and research informed the theoretical framework for empirical research and analysis.

Research methodology and focus

The research was conducted as a series of case studies in a number of local schools. The decision was made to focus on one school for science and one school for English, with three teachers in each being studied. As

good practice had already been identified, it was felt that the teachers within these departments would provide good examples of successful practice in relation to ICT and subject teaching. In the case of history, three teachers from different schools known to engage in effective teaching were chosen in order to capture a range of good practice data.

Ethnographic data collection techniques, such as observation and interview, were adopted and utilised within the schools as appropriate to the exploratory nature of the study. The design of each stage of the research process was informed by findings from the literature review and was intended as a means of gaining evidence of teachers' perspectives and beliefs about practice, and also their actual practice in the classroom. Methods employed included teacher interviews, teacher and pupil focus groups, and lesson observations.

The case studies developed provided descriptive snapshots of teachers and classrooms where ICT is being integrated into subject teaching. They are not necessarily representative or even typical, and the findings emerging from the study must be regarded as case specific. However, a number of insights were gained into what pedagogy looks like and the new literacies which are being developed around ICT, which may be relevant to other teachers and policy makers concerned with promoting ICT in schools and raising the literacy attainment of pupils.

Summary of main findings

The research findings are reported in line with four key questions addressed in the study.

ICT and subject cultures

What is the role of ICT in the teaching and learning of history, science and English in the secondary school?

Findings suggest that:

- Subject cultures have a significant influence on teachers' reasons for adopting ICT and the ways in which they incorporate it into their practice. For example, while science and history teachers related the value of ICT to learning subject-related skills and content knowledge, English teachers were unique in making specific reference to the relationship between school learning and pupils' experiences outside school, and saw English as preparing pupils for participation in society.

- Teachers believe that ICT must serve the subject and that the subject must not be allowed to become a vehicle for teaching discrete ICT skills.

- Diversity exists both across and within subjects in teachers' reasons for engaging with ICT and the ways in which they do so.

ICT and pedagogy

What is the impact of ICT on the roles available to teachers and pupils in lessons, and what interaction patterns emerge between teacher, pupils and the technology?

Findings suggest that:

- ICT use is affected by subject cultures, but within these domains of practice a number of pedagogical orientations are evident. For example, while history teachers in the study did not perceive any changes in their practice as a result of ICT use, science teachers experienced changes in their methods of teaching, and English lessons involved a higher percentage of time using computers and working collaboratively.

- Teachers are increasing their pedagogic repertoires as a result of ICT, and integrate ICT in ways that are congruous with their teaching objectives.

- Access to ICT is only part of the issue, and teachers' beliefs and pedagogical orientations are important factors in determining the impact of ICT on teacher/pupil roles and ways of working in lessons.

ICT and literacy

How does ICT influence the literacy practices which characterise teaching and learning in these subjects?

Findings suggest that:

- Subject teachers are engaging in the literacy practices associated with new technologies but teachers often engage with them more than the pupils.

- These practices of reading, writing, researching and communicating using ICT exist alongside conventional oral-and print-based literacies, which teachers continue to value in subject teaching and learning.

- Teachers and pupils are generally competent in the operational dimension of technological literacy. Most literacy activity exists in the cultural domain and is strongly related to subject learning. There is little evidence of teachers developing the critical dimension of literacy.

- Teachers are conscious that assessment procedures are largely based on print literacy and that there is a need to develop traditional skills of oral discussion, researching books, taking notes, drawing graphs and diagrams, and writing essays.

ICT in context

How are lessons that involve the use of ICT organised, and how does ICT relate to other supporting work, learning aims and tasks and classroom management and organisation?

Findings suggest that:

- ICT use in subject lessons is intermittent and most lessons do not use ICT.

- ICT is often one resource that accounts for a small percentage of the activities in a lesson.

- ICT leads to changes in classroom organisation, which place new demands on teachers, and successful integration of ICT depends on teachers managing these demands.

Conclusions

The findings raise a number of issues, which might be considered by those responsible for literacy and ICT in the secondary school:

- Teachers in secondary schools see the benefits of ICT in making the teaching and learning of their subjects more effective. However, there is little evidence that their practice is being transformed as a result of ICT. There is a need for more subject specific examples of innovative practice to be made available to teachers who are receptive to new ideas but are not always afforded the professional development opportunities to meet their needs.

- Formal training was often criticised by the participants for taking a 'blanket approach' that ignores their subject-specific needs. Training in ICT should recognise teachers' pedagogical orientations and beliefs about their subjects and be aware that this influences the ways in which they integrate ICT into their practice.

- The assessment system was felt to influence and limit the opportunities to use ICT. Delivering a curriculum that is content and assessment led frequently dissuaded teachers from engaging in ICT activities,

which can be time consuming and sometimes perceived as high risk, particularly where technical support was felt to be inadequate.

- Curriculum structures militate against the use of ICT to develop critical literacy. Most literacy activity is subject related and the potential of ICT to break out of the confines of content are often regarded as a problem by teachers. English teachers seemed more alert to the possibilities of ICT to open up the curriculum and engage in social practices with relevance beyond the school.

- Use of the internet is valued by subject teachers as a research tool, but they are conscious of a need to direct pupils to specific websites to avoid wasting time and the problem of pupils encountering unsuitable material. Pupils express frustration at the limited access to the internet in school, and much of the profitable work takes place at home. However, as some pupils do not have access at home, teachers are dissuaded from formalising such work, but the effect is to leave some pupils at a disadvantage. Schools therefore need to focus on both these issues simultaneously in order to maximise the potential of ICT yet avoid disadvantaging pupils.

References

DfEE (Department for Education and Employment) (1998), 'Annex B: initial teacher training curriculum for the use of information and communications technology in subject teaching', *Requirements for Courses of Initial Teacher Training*, Guidance on the Law 4/98, DfEE, London; also online: viewed March 2003, [http://www.dfes.gov.uk/publications/guidanceonthelaw/4_98/annexb.htm].

DfEE (Department for Education and Employment) (2001), *Key Stage 3 National Strategy: Framework for Teaching English Years 7, 8 and 9*, DfEE, London; also online: viewed March 2003, [http://www.standards.dfes.gov.uk/keystage3/strands/?strand=english].

QCA (Qualifications and Curriculum Authority) (2001), *Language at Work in Lessons: Literacy Across the Curriculum at Key Stage 3*, QCA, London; also on online: viewed March 2003, [http://www.qca.org.uk/ages3-14/subjects/2932_2071.html].

An investigation into the visual and kinaesthetic affordances of interactive whiteboards

Ian Davison and Dave Pratt

Introduction

It is clear that interactive whiteboards are very popular with teachers and pupils; however, many people are questioning whether they represent good value for money, or whether alternative projection technologies are more useful (Moore 2001).

Previous research into teachers' perceptions indicates that they were generally very positive regarding interactive whiteboards. However, there were a few negative views expressed regarding fear of the technology, frustration at network crashes and views that interactive whiteboards have little to offer their subject.

The teachers believed that the pupils were very keen on the interactive whiteboards: they enjoyed the size of the boards, and the involvement generated by being able to touch the board (primary) or giving presentations (secondary). These views are very much in line with other research (Glover and Miller 2001a and 2001b; Smith 2001; Levy 2002).

Overall, previous research suggested that teachers see interactive whiteboards as hugely motivational, but that they are generally less clear about direct improvements in learning. Therefore, this project analyses the ways in which interactive whiteboards are currently employed to find situations that are most likely to facilitate conceptual change. From this analysis, a single suitable curriculum area was selected for which there was an initial case that change might be promoted, enabling investigation into the relationship between the affordances of the interactive whiteboards and that conceptual change.

Research context

In recent years, government policy has seen an emphasis on whole-class teaching. For example, in the National Numeracy Strategy (NNS)[1]:

> "It is particularly important for the whole class to be together at the beginning and end of the lesson, so that the objectives for the lesson can be made clear, and, at the end, the teacher and pupils can sum up together what has been learnt, and correct any errors or misconceptions."

ICT has often been seen to be in conflict with whole-class teaching, because pupils interact individually or in pairs with a computer. However, key technical developments have enabled the use of ICT with whole classes. Projection technologies such as interactive whiteboards appear to have helped solve this dilemma.

It is interesting to note that Charles Clarke[2], Secretary of State for Education and Skills, stated that he believes it important to look at how technologies help teaching across the curriculum:

> "I want …to shift the emphasis away from the hardware, important though it is, to really working on the pedagogy of how ICT can be used as a device in every part of the curriculum to increase the excitement and capacity that we are involved in."

Mr Clarke goes on to single out interactive whiteboards as having remarkable potential to transform teaching and learning:

> "To give an example of the whiteboard... The power of the imagination unleashed by the technology in this area is remarkable and takes you to a different league of what can be achieved."

This investigation into how interactive whiteboards can facilitate learning therefore fits well with the national drives to promote whole-class teaching and to integrate technologies into this style of teaching.

Key literature in the field

At this stage in the development of interactive whiteboards, relatively little academic work has been published on their use that could inform the first iteration of this project. However, there are ongoing projects at Keele, Birmingham, Wolverhampton, and Hull. At Hull

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[1] National Numeracy Strategy [http://www.dfes.gov.uk/numeracy/chapter3.shtml].

[2] Statement by the Rt. Hon. Charles Clarke, MP, Secretary of State for Education and Skills at the BETT Exhibition, Olympia, 9 January 2003 available on the TeacherNet website [http://www.teachernet.gov.uk/educationoverview/briefing/strategyarchive/charlesclarkeict/].

University[3] materials are being collected to encourage interactive whiteboard research and usage.

In contrast, there is a sizeable literature, which concerns the teaching of mathematics using dynamic geometry software (DGS), and this was used to inform the second iteration of the project.

Research methodology and focus

This project investigated ways in which interactive whiteboards have the potential to shape pupils' learning. It consisted of three stages, or iterations.

For this study, the key question is: How do the visual and kinaesthetic affordances[4] of interactive whiteboards support the cognitive aspects of learning? In order to research this question, smaller aims were employed for each iteration as follows:

Aim for the first iteration:	To clarify and categorise the affordances of interactive whiteboards as perceived by teachers.
Aim for the second iteration:	To investigate the impact of the visual and kinaesthetic affordances of an interactive whiteboard upon the learning of geometry in Year 7.
Aim for the third iteration: *(The third iteration continued beyond the ICT Research Bursary)*	To design a scheme to investigate how the properties of interactive whiteboards and tablet PCs may shape pupils' learning of the inclusive nature of quadrilateral definitions in Years 5 and 7.

The first iteration analysed previous interview data from thirteen teachers: this resulted in categorisation of visual and kinaesthetic affordances. In addition, the ways (or 'scenarios') in which teachers employ interactive whiteboards were classified; and these scenarios were categorised in terms of teacher or pupil use, and the predominant affordances that were utilised. This analysis guided the design of the second iteration.

The second iteration investigated the use of an interactive whiteboard to aid Year 7 pupils' learning of geometry. To do this, a dynamic geometry scheme of work was created. These children were provided with learning experiences that seemed to make good use of the visual and kinaesthetic affordances of the technologies employed. However, at the end of the lessons, they only had partial understanding of the inclusive nature of quadrilateral definitions.

Therefore, the ongoing third iteration, which continues beyond the ICT Research Bursary, looked to improve the use of the technologies to help pupils learn this very demanding idea. The scheme of work was modified to focus upon inclusive quadrilateral definitions. In addition, a few tablet PCs were employed alongside the interactive whiteboards and conventional PCs. The findings from these lessons with pupils in Years 5 and 7 are being analysed and will be reported in the near future.

Summary of main findings

Findings from the first iteration

The aim of the first iteration was to clarify and categorise the affordances of interactive whiteboards as perceived by teachers.

Comments by the teachers regarding affordances of the interactive whiteboard divided into two main themes: 'visual' and 'kinaesthetic'. The visual comments relate to size, projection and so on, and kinaesthetic comments are related to physical movements.

The visual or display affordances would be identical if a digital projector was used without the interactive whiteboard element. Many teachers were not clear about the difference between a digital projector and an interactive whiteboard. However, some ICT co-ordinators believed that most teachers would do just as well with a digital projector.

Reference to kinaesthetic or action affordances included non-specific comments about kinaesthetics, such as "…a child getting up, walking to the front, is an important part of the learning process, particularly for kinaesthetic learners". In addition, there were several examples where text is annotated on the screen.

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[3] Interactive whiteboard research forum [http://www.ros.org.uk/iwb/].

[4] Kinaesthetic affordances refer to the design aspects of a 'tool' or object that suggests active 'learning by doing', touching and practicing things.

Dragging items across the screen was only described in mathematics and ICT.

The researchers generated the following possible meanings of the affordances described by the teachers:

Visual affordances (as applied to interactive whiteboards, digital projectors and link pads[5], compared with normal whiteboards, over-head projectors (OHPs) and videos):

- Size: everyone can see.

- The movement and colour of the image attracts and sustains attention.

- More pictures and diagrams are used, which are easier to understand for many pupils (related to learning types, so graphical as opposed to linguistic).

- Superior quality of presentation: text and diagrams are better perhaps by being neater and clearer; but also because they are more complete and precise as they have been prepared earlier.

- Computational graphics: the software allows connections to be made for example using hyperlinks, spreadsheet macros, or dynamic geometry software dependencies; this does not refer simply to 'turning the page' which would apply to all software packages.

Kinaesthetic affordances (as applied to an interactive whiteboard compared with a digital projector being controlled by the teacher) are properties of the interactive whiteboard system that facilitate learning because of the possibilities for the teacher or pupil to move. The categories below describe some ways in which movement may help learning.

Pupil's own movement:
- Movement makes the learning situation more vivid: just as acting out a play is more vivid, real and memorable than reading it, so working at the active board is more vivid, real and memorable than simply watching[6]. It is assumed that this physical movement enables the pupil to understand the learning situation by being immersed in it, and so it promotes learning. For this meaning, it is irrelevant that there is an audience.

- Being on stage: as a pupil, if you take part (at the front), the added excitement helps you learn. So, for this meaning, the audience (teacher and other pupils) is the crucial factor.

- Movement helps prevent boredom as pupils don't like sitting down, and hence movement aids concentration and thus learning. Also, moving is fun for pupils, partly due to the relative novelty in class.

Observing movement:
- Teacher movement: seeing movement by the teacher is more dramatic and memorable than simply seeing a screen presentation.

- 'Theatrical tension': a pupil 'up at the front' produces tension and theatre, so it is more memorable than a teacher presentation. This theatrical tension is there because there is more likelihood of the unexpected happening.

Computational control:
- This links with computational graphics: software that has computational graphics usually will have the capability to be kinaesthetically controlled (for example, dragging a shape in a dynamic geometry package). Pupils gain conceptual understanding as their movements are computed by the software and give immediate feedback.

Scenarios
Teacher interviews were searched for examples of activities involving the interactive whiteboard. Sixteen examples, or scenarios, were selected that appeared to encapsulate the range of activities. When the scenarios were categorised, the different definitions of visual affordance were not useful. Indeed these visual affordance categories overlap, so it is perhaps not surprising that no pattern emerged. In contrast, the kinaesthetic categories did seem to create different groups of scenarios. In addition, the scenarios were divided into whether the teacher or a pupil was using the interactive whiteboard. On this basis, these scenarios were placed into the following groups:

- Teacher led visual only.
- Teacher led with use of kinaesthetic affordances.

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[5] ILink pads are touch-sensitive portable screens that can control the projected image; they are like miniature interactive whiteboards.

[6] The learning of sports, for example, is different: obviously you need to practise kicking a ball rather than simply watching or talking about it; but we are concerned here with learning maths, history and so on, not about learning motor skills.

- Pupil use with mainly visual affordances.

- Pupil participation that makes use of the kinaesthetic affordances:

  - being immersed in the activity
  - theatrical tension
  - theatrical tension and causal linking.

These scenarios indicate a wide range of use of interactive whiteboards in schools. However, the data also indicate that individual teachers used only a narrow range of scenarios and usually were unaware of alternatives. This may have been due to limited experience of the technology and lack of training.

There was, however, little reference to genuine kinaesthetic learning whereby the pupils learn via bodily movements. This was disappointing as it is one of the powerful attributes of interactive whiteboards, and so it was the focus of the second iteration. Geometry was chosen as the subject area because it is simultaneously visual and conceptually demanding. Therefore, it was felt that the computational control element may be able to facilitate the required conceptual learning, and theatrical tension could be employed to improve motivation.

Findings from the second iteration

The aim here was to investigate the impact of the visual and kinaesthetic affordances of an interactive whiteboard upon the learning of geometry in Year 7. This was done through observation of one class of pupils, although specifically focusing upon three pairs of pupils through a series of seven lessons agreed between the researcher and the teacher. The lessons were designed to give the pupils some familiarity with the dynamic geometry package, and to teach or reinforce properties of triangles and quadrilaterals, and there was a lesson exploring the angles in regular polygons. In addition, there was a lesson looking at reflections and translations, and a final 'fun' lesson using the animation command to explore loci.

One pair of pupils were clearly constrained by referring rather infrequently to the properties of the figure. This tendency to refer to prototypes was evident despite attention on the interactive whiteboard in the teaching programme to the way in which quadrilaterals can be manipulated in a dynamic geometry package. Pupil prototypes are useful resources for

simple manipulations of orientation but do not support hierarchical inclusive definitions. In the teaching programme, squares were seen quite explicitly as special types of rhombi; and the pupils themselves had dragged a kite into a rhombus. Unfortunately, these experiences, it seems, were insufficient to encourage the pupils to refer consistently to conceptual criteria.

Fischbein (1993) has described understanding of geometrical shapes in terms of a 'figural concept'. The figural aspect relates to what is seen, and the conceptual element refers to logical properties. It seems that children using prototypical thinking are using the figural rather than the conceptual aspects of the figural concept. It is reasonable to suppose that the figural component might have been reinforced by the visual affordance of the interactive whiteboard. However, it is clear that task design and teacher-focus are crucial if the kinaesthetic affordances (of both the DGS and the interactive whiteboard) are to be harnessed in support of the conceptual aspect of the figural concept. The researchers do not believe that the kinaesthetic affordances were properly exploited in this iteration[7].

On the basis of the evidence from three pairs of pupils and the lessons generally, the researchers decided that the next iteration should focus upon the inclusive nature of quadrilateral (and triangle) definitions. To do this, several tasks needed to be incorporated in which the kinaesthetic affordances of the dynamic geometry software and the interactive whiteboard were required. In addition, the researchers considered whether it was reasonable to expect such children to understand the definition of a kite when they do not appreciate the utility (Ainley and Pratt 2002) of a definition. An additional task was therefore designed which used the approach advocated by Gardiner and Hudson (1998) in which children are put in the position of being definers themselves.

Conclusions

This project investigated ways in which interactive whiteboards have the potential to shape pupils' learning. It consisted of three stages, or iterations.

- Analysis of previous interview data leading to categorisation of visual and kinaesthetic affordances and the ways teachers employ interactive whiteboards.

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[7] For a more detailed discussion of this second iteration, see Pratt, D. and Davison, I. (forthcoming), 'Interactive Whiteboards and the construction of definitions for the kite', Proceedings of the Twenty Seventh Annual Conference of the International Group for the Psychology of Mathematics.

- Primary investigation of the use of interactive whiteboards to aid Year 7 pupils' learning of geometry through learning experiences making good use of the visual and kinaesthetic affordances of the technologies employed. However, this resulted only in partial understanding of the inclusive nature of quadrilateral definitions.

- Improved use of technologies to help pupils learn, modified and focused upon inclusive quadrilateral definitions.

In line with government objectives, this research highlights the need to focus careful attention upon the pedagogy required to use interactive whiteboards successfully. The researchers believe that the categorisation of scenarios in which the interactive whiteboard is employed provides a framework for discussing the pedagogy associated with interactive whiteboards.

From this framework, subsequent research was focused upon the kinaesthetic affordances of the interactive whiteboards. Clearly, research needs to be highly focused and detailed to find instances of exemplar use. As an on-going area of study, the researchers hope to further add to the body of knowledge in this area.

The research base shows that with sufficient training and resources, most teachers welcome the introduction of interactive whiteboards. These boards appear to have immense potential to enhance both motivation and conceptual learning. However, it is likely that a combination of all of the following ingredients is needed to realise this potential for facilitating conceptual learning:

- tasks that make use of the kinaesthetic affordances of the interactive whiteboards, particularly those which utilise computational control

- skilful teaching, especially employing theatrical tension

- utilisation of the interactive whiteboard as a forum for discussion.

References

Ainley, J. and Pratt, D. (forthcoming), 'Purpose and utility in the design of pedagogic tasks', *Proceedings of the Twenty Seventh Annual Conference of the International Group for the Psychology of Mathematics Education*, IGPME. [http://igpme.org/].

Hudson, B. and Gardiner, J. (1998), 'The evolution of pupils' ideas of construction and proof using hand-held geometry technology', in A. Olivier and K. Newstead (eds.), *Proceedings of the Twenty Second Conference of the International Group for the Psychology of Mathematics Education*, vol. 2, pp. 337-344, IGPME [http://igpme.org/].

Fischbein, E. (1993), 'The theory of figural concepts', *Educational Studies in Mathematics*, vol. 4, pp. 139-162.

Glover, D. and Miller, D. (2001a), *A Report to Blackburn and Colne EAZ on New Technologies*, Department of Education, Keele University, Staffordshire.

Glover, D. and Miller, D. (2001b), 'Running with technology: the pedagogic impact of the large-scale introduction of interactive whiteboards in one secondary school', *Journal of Information Technology for Teacher Education*, vol. 10, pp. 257-276.

Levy, P. (2002), *Interactive Whiteboards in Teaching and Learning*, Sheffield Excellence in Cities Partnership, Sheffield; also on online: viewed March 2003, [http://www2.sheffield.gov.uk/services/education/eic/clc/iw/default.htm].

Moore, A. (2001), 'Interactive whiteboards – a luxury too far?', *Teaching ICT*, vol. 1, no. 2, pp. 52-57.

Smith, H. (2001), *SmartBoard Evaluation: final report*, Kent National Grid for Learning, viewed March 2003, [http://www.kented.org.uk/ngfl/whiteboards/report.html].

Making IT happen: patterns of ICT use among a group of UK school staff

Christopher O'Mahony

Introduction

A number of commentators have highlighted concerns regarding the implementation of ICT policies in schools. These concerns revolve around issues relating to access to ICT resources, access to ICT training, and the encouragement of ICT confidence and competence. Conventional wisdom suggests that high access to ICT and high ability with ICT must lead to high use of ICT. It is unclear in the literature, however, how these issues may be linked, if at all (Mumtaz 2000).

This research considers patterns of ICT use among a group of UK school staff in terms of access to, and use of, ICT both in and outside of school. It also considers the perceived and desired ICT ability of staff, and examines issues that inhibit increased use of ICT in teaching, learning and administration.

Research context

As secondary schools across Britain devote more time and money to ICT strategic planning, it is important to build in regular evaluation to assess the efficacy of their ICT investments and management structures (Baker 1995; O'Mahony et al. 1996). In addition to providing a basic level of ICT hardware and software, most schools recognise the importance of ICT training for staff. Ability must go hand in hand with access, so that it leads to confident use of resources for teaching, learning and administration. At the same time, schools are continually challenged to respond to technological change and realise the potential of electronic-learning innovations (Jamison 2001).

The researcher completed a pilot study in late 2001 (O'Mahony 2002) that investigated the use of ICT by teaching and non-teaching staff at one English secondary school. Three key areas were investigated:

- Access to ICT both in and outside the school.

- The perceived and the desired ICT ability of staff.

- The issues preventing increased use of ICT in teaching, learning and administration.

Results showed that a major challenge facing the school was not access to ICT resources, but the provision of relevant and supportive training for staff.

Using the pilot study as a basis, this research extends the scope to a wider selection of independent girls' schools (25) across the UK with a target population of some 2,800 staff. These schools are drawn from the Girls' Day School Trust (GDST), which has a total staffing of 3,500. This is the largest group of independent schools in the UK, currently educating around 9% of all girls in the fee-paying sector. The same research design and methodology were used, with slight variation to the instrument. In this way, it was anticipated that results from the pilot study would either be corroborated across a wider population, or alternative trends elucidated.

Key literature in the field

The literature was reviewed in terms of the four key research themes: ICT access; ICT ability, ICT use, and inhibitors to greater use of ICT.

ICT access

One dimension of debate concerning ICT in schools is recognition that high levels of access are required to achieve a 'critical mass' of user confidence and ability. Over recent years schools have experienced large-scale funding of infrastructure and equipment, especially in connection with the NGfL (DfEE 2001). Case studies reflecting successful computer integration have shown many schools to be provided with excellent facilities, technical back-up and financial resources (Mumtaz 2000).

ICT ability

Much research exists concerning ICT professional development for teachers (Mumtaz 2000), and many exemplary initiatives have been attempted around the world (see Selwood et al. 2000; Watson 2001). Broad brush government initiatives have provided a sound starting point, but it has also been noted that the ICT training of staff needs to be customised to the circumstances of individual schools and individual staff (McDougall and Squires 1997). However, it is generally acknowledged in the literature that getting ICT professional development 'right' is very difficult to achieve. At the same time, despite the difficulties, there is also recognition that there are critical links between staff ICT ability and staff ICT use, and staff ICT ability and student ICT ability (Kennewell et al. 2000).

ICT use

A number of factors influence staff ICT use. This project looks closely at relationships between ICT access, ICT ability, ICT use, and inhibitors to its use. Mumtaz (2000), reviewed work in this area, highlighting both positive and negative factors affecting ICT use. Positive factors identified included: collegiality among computer-using teachers in schools, resources for school development, school support for consequential computer activities, smaller class sizes and more formal computer training. Technical support and senior management commitment were other recurring themes.

Another theme apparent in the literature is the attitudes of staff. National Statistics[1] notes that, based on survey data, 76% of teachers feel confident using ICT in the curriculum. However, whether this relates to confidence in practice is debatable, and as Mumtaz (2000) points out, 'schools can only go so far to encourage ICT use - actual take-up depends largely on teachers' personal feelings, skills and attitudes to IT in general'. (See also: Hruskocy et al. 2000; Kirkman 2000; Yee 2000.)

Inhibitors to using ICT

Although reports concerning improvements in ICT access and ICT confidence are encouraging, such improvements appear to be patchy across phases, subject areas and geographical location. A number of inhibitors to ICT use are evident in the literature, which are cross-phase, cross-department and geographically independent. Foremost among these inhibitors are the following:

- Lack of time (Harrison et al. 2002; Comber et al. 2002; Mumtaz 2000; Kirkman 2000).

- Lack of training (Kirkman 2000; Mumtaz 2000).

- Lack of senior management support (Kennewell et al. 2000; Harrison et al. 2002; Passey 2002).

- Lack of technical support (Sheingold and Hadley 1990; Somekh et al. 2002a and 2002b; Yee, 2000).

- Lack of a genuinely supportive culture (Sheingold and Hadley 1990; Hadley and Sheingold 1993; Fullan 1992; Kennewell et al. 2000; Mumtaz 2000).

- Lack of teacher confidence and motivation (Kirkman, 2000; Harrison et al. 2001, 2002; Comber et al. 2002).

- Lack of ICT resources (Sheingold and Hadley 1990; Mumtaz 2000).

In summary, the literature is rich in both qualitative and quantitative studies concerning the four dimensions under investigation in this research project. Although these four dimensions frequently appear, there are few studies that attempt to quantify the relationships between them.

Research methodology and focus

This research aimed to explore the relationships between:

- staff access to computers both at school and at home

- staff perceived ability with computers

- staff desired ability with computers

- staff use of computers both at school and at home

- issues preventing increased use of ICT in teaching, learning and administration.

The research hypothesis can therefore be summarised as *access + ability = confident use*.

The main research questions, then, were as follows:

- What are the current levels of access to ICT resources among school staff in the study?

- What are their current levels of ability with ICT?

- What are the current levels of use of ICT resources?

- What are the main barriers to increasing the use of ICT in teaching, learning and administration?

- What links can be perceived between ICT access, ability and use?

This project relied on two specific methodologies - scholarship and survey. These two methods can be seen to be complementary, and highly appropriate to this research domain. The scholarship phase involved a close review of relevant literature, theoretical analysis and model development, being an example of constructive research (Cornford and Smithson 1996). The survey phase provides quantitative empirical data with which to test hypotheses generated from the scholarship phase. Together these methods present a convergence of theory and practice, which provided robustness and validity to the conclusions drawn from the study (Leedy 1993).

The target population for the survey phase were the staff of 25 schools owned and operated by the GDST. These

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[1] DfES National Statistics 2002 [http://www.dfes.gov.uk/rsgateway/].

schools are located throughout England and Wales, and generally take students between ages 3 and 18. The Trust indicated its interest in the study and any results, and its willingness to support the researcher in gaining access to staff. The potential sample size was 2,800 teachers and teaching support staff. A response rate of almost 50% (1,366 responses) was achieved, with 377 staff from the primary sector and 989 from secondary. Results were analysed according to strata such as school, region, age, phase (primary, secondary) and department.

Summary of main findings

The main findings are presented under each of the research questions. Although the study makes use of a large population, this population is drawn from a specific educational sector. It must therefore be pointed out that this sample is not representative of primary and secondary education sector as a whole. Nonetheless, suggestions are made that may have relevance to the wider schools sector.

What are the current levels of access to ICT resources among school staff?

Findings:
• Home access to ICT (PC or Mac) was high (95%).

• Business/Economics (10 respondents), careers (2), medical (4), psychology (4), special educational needs (SEN) (4) were all departments reporting 100% home access to ICT. Participants from ICT departments (37) reported 97.3% and headteachers (22) reported 90.1%. Catering (6) and administration (109) departments reported lowest home computer access with 50% and 86% respectively.

• A high proportion of respondents have home access to the internet (84%).

• Access to ICT resources at work was reported as generally good, across all strata. Some variation was evident between departments, although dissatisfaction was noted among respondents in departments such as catering, English, music, PE, psychology, and SEN.

• Results suggest that home ownership of ICT equipment among GDST staff is higher than the national average – with every expectation that it will continue to rise over the next few years. The Trust operates a policy of encouraging staff to buy their own ICT equipment, and offers financial assistance to make this possible. It would appear that this policy is justified

in helping to improve home access to ICT among the Trust's staff.

Suggestions:
• Computer loan schemes could be promoted and extended, encouraging staff to purchase ICT equipment. It is further suggested that such schemes could target those staff who still do not have home access to ICT.

• Where high levels of home access are reported, it is suggested that schools should capitalise on the development and deployment of 'extranets', virtual learning environments (VLEs) and so forth.

• Local Education Authorities (LEAs) should continue to target variations through individual school ICT Action Plans, clearly linked to whole-school strategic development plans and LEA policies.

What are the current levels of ability with ICT among school staff?

Findings:
• Most staff perceived that they had a core competence in ICT applications, and were seeking to extend their abilities to a higher level. While confidence was generally expressed with core applications such as word processing, email and internet searching, the main priorities perceived by GDST staff are for training in presentation-based applications (hardware and software), with the clear implication being that they recognise genuine benefit for teaching and learning from these skills.

Suggestions:
• Schools and headteachers could give further consideration to the provision of targeted ICT training, giving due regard to variations between phases, age groups and departmental areas.

• Schools might further explore the development of a central ICT staff training function in collaboration with other schools and institutions in the immediate geographical area. Any developments would be additional to the existing ICT support and assessment functions, and could assist in the co-ordination of staff training as well as being a mechanism for sharing exemplary practice for teaching and learning.

• Schools could further explore specific mechanisms for celebrating exemplary ICT practice. In this way, they would send clear signals to staff regarding a commitment to adding value through ICT.

What are the current levels of use of ICT resources among school staff?

Findings:
- There was high use of ICT in the home (5 hours per week on average), with staff reporting high use of home ICT resources for school purposes.

- School use of ICT outside classes was also high, but with great variation depending on departmental area.

- Use of ICT in classes showed great variation, from very low to very high (between 0 and 11 hours per week), depending on departmental area.

- The 35 to 44 age group reported the highest class use of ICT. One possible interpretation of this result is that these are more experienced teachers, who have had greater exposure to ICT and have succeeded in embedding its use into their subjects.

- There was a weak positive correlation between ICT access, ICT ability and ICT use.

Suggestions:
- Establishing remote access between home and school will enable staff to be more effective, and will enable the exploration of innovative work/life practices.

- Variations in departmental use of ICT outside of classes should be explored more closely at school and departmental level, with a view to rectifying any inequities through school ICT Action Plans.

- Variations in departmental use of ICT within the classroom should be subjected to further analysis to identify areas for development.

What are the main barriers to increasing the use of ICT in teaching, learning and administration

Findings:
- Lack of time was the most frequently reported inhibitor to staff progress with ICT.

- Satisfaction with the quantity of ICT support was variable across the GDST. By contrast, staff generally expressed their satisfaction with the quality of ICT support.

- Despite a significant number of initiatives, the quality and quantity of staff training continues to inhibit staff confidence with ICT.

- The quantity and quality of staff ICT resources was a significant issue for many staff.

Suggestion:
- School authorities could work with schools to highlight current and future innovative models for enabling staff to have sufficient time to assimilate new learning technologies into their teaching.

What links can be perceived between ICT access, ability and use?

- There is a weak positive correlation between ICT access, ability and use.

- This correlation is most pronounced among staff under 35 years old.

- Work access is seen as a stronger predictor of ICT use than home access.

Suggestion:
- Schools should be aware that access to ICT alone does not automatically equate with use among staff. Auditing processes could be put in place to ascertain whether ICT is being used or not, and if it is not, why it is not when access is possible. The findings could provide a more informed basis on which to develop strategic ICT policies and tailored ICT training and support. The auditing process may also identify individuals and groups who may require specific support in relation to access, ability and use.

Conclusions

This research sought to answer questions regarding ICT access, ICT ability and ICT use among a large sample of UK school staff.

On the one hand, there are some encouraging results, suggesting that core issues regarding access to ICT resources and core competence with ICT are being addressed. This is the result both of interventionist policies by the GDST, as well as the influence of external factors outside the control of the Trust. Similar findings are no doubt likely in relation to the wider national picture.

On the other hand, challenges exist. Despite an underlying willingness to move forward with ICT ability and ICT use, staff feel constrained by issues such as lack of available time, and a lack of relevant training. Like other schools and school authorities, the Trust is also constantly faced with other challenges, such as

sustainability, security, cost management, technical support management, and change management. Again, these issues may reflect the concerns of schools nationally. Further work needs to be undertaken in this field, particularly the dissemination of materials generated by schools themselves that identify a range of effective and practical solutions to these problems.

The future for ICT in schools looks exciting, as they consider the way forward with evolving technologies such as VLEs and managed learning environments (MLEs), integrated management systems, video conferencing and the like. By maintaining their agility in an ever changing ICT landscape, staff are well-placed to respond positively to these evolving technologies, and truly 'make IT happen'.

References

Baker, B. (1995), 'The role of feedback in assessing information systems planning effectiveness', *Journal of Strategic Information Systems*, vol. 4, no. 1.

Comber, C., Watling, R., Lawson, T., Cavendish, S., McEune, R. and Paterson, F. (2002), *Impact2: Learning at Home and School: Case Studies*, ICT in Schools Research and Evaluation Series No. 8, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/impact2].

Cornford, T. and Smithson, S. (1996), *Project Research in Information Systems: A Student's Guide*, Macmillan, Basingstoke.

DfEE (Department for Education and Employment) (2001), *ICT Access and Use: Report on the Benchmark Survey*, report prepared for the DfEE by Neil Russell and Nick Drew of Research Surveys of Great Britain, Research Brief 252, DfEE, London; also online: viewed March 2003, [http://www.dfes.gov.uk/research/data/uploadfiles/RB252.doc].

Fullan, M. (1992), *Successful School Improvement: The Implementation Perspective and Beyond*, Open University Press, Buckinghamshire.

Hadley, M. and Sheingold, K. (1993), 'Commonalities and distinctive patterns in teachers' integration of computers', *American Journal of Education*, vol. 101, pp. 261-315.

Harrison, C., Cavendish, S., Comber, C., Fisher, T., Harrison, A., Haw, K., Lewin, C., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B. and Watling, R. (2001), *Impact2: Emerging Findings from the Evaluation of the Impact of Information and Communications Technologies on Pupil Attainment*, ICT in School Research and Evaluation Series No. 1, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/impact2].

Harrison, C., Comber, C., Fisher, T., Haw, K., Lewin, C., Lunzer, E., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B. and Watling, R. (2002), *Impact2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*, ICT in School Research and Evaluation Series No. 7, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/impact2].

Hruskocy, C., Cennamo, K., Ertmer, P. and Johnson, T. (2000), 'Creating a community of technology users: students become technology experts for teachers and peers', *Journal of Technology and Teacher Education*, vol. 8, pp. 69-84.

Jamison, C. (2001), 'Choosing the right school for your child', *Foreword to the 2001 Independent Schools Guide*. Kogan Page, London.

Kirkman, C. (2000), 'A model for the effective management of information and communications technology development in schools derived from six contrasting case studies', *Journal of Information Technology for Teacher Education*, vol. 9, no. 1, pp. 37-52.

Kennewell, S., Parkinson, J. and Tanner, H. (2000), *Developing the ICT Capable School*, Routledge Falmer, London.

Leedy, P. (1993), *Practical Research: Planning and Design*, 5th edn, Macmillan, New York.

McDougall, A. and Squires, D. (1997), 'A framework for reviewing teacher professional development programmes in information technology', *Journal of Information Technology for Teacher Education*, vol. 6, no. 2, pp. 115-126.

Mumtaz, S. (2000), 'Factors affecting teachers use of information and communications technology: a review of the literature', *Journal of Information Technology for Teacher Education*, vol. 9, no. 3, pp. 319-341.

O'Mahony, C., Wild, P., Selwood, I., Reyes, M. and Kraidej, L. (1996), 'Evaluation strategy for ITEM quality, in A. Fung, A. Visscher, B. Barta, and D. Teather (eds.), *Information Technology in Educational Management for the Schools of the Future*, Chapman & Hall, London.

O'Mahony, C. (2002), Managing ICT access and training for educators: a case study, in I. Selwood, A. Fung, and C. O'Mahoney (eds.), *Management of Education in the Information Age: The Role of ICT*, IFIP (International Federation for Information Processing) vol. 248, Kluwer, Dordrecht.

Becta (British Educational Communications and Technology Agency) (2002), *ICT and School Management: A Review of Selected Literature*, report prepared by D. Passey, Department of Educational Research, Lancaster University, viewed March 2003, [http://www.becta.org.uk/research]

Selwood, I., Smith, D. and Wisehart, J. (2000), Supporting UK teachers through the National Grid for Learning, in C.Nolan, A. Fung, and M. Brown (eds.), *Pathways to Institutional Improvement with Information Technology in Educational Management*, IFIP (International Federation for Information Processing) vol. 199, Kluwer, Dordrecht.

Sheingold, K. and Hadley, M. (1990), *Accomplished Teachers: Integrating Computers into Classroom Practice*, Centre for Technology in Education, New York.

Somekh, B., Woodrow, D., Barnes, S., Triggs, P., Sutherland, R., Passey, D., Holt, H., Harrison, C., Fisher, T., Flett, A. and Joyes, G. (2002a), *NGfL Pathfinders: Second Report on the Roll-out of the NGfL Programme in Ten Pathfinder LEAs*, ICT in Schools Research and Evaluation Series No. 10, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/reports/pathfinders].

Somekh, B., Woodrow, D., Barnes, S., Triggs, P., Sutherland, R., Passey, D., Holt, H., Harrison, C., Fisher, T., Flett, A., and Joyes, G. (2002b), *NGfL Pathfinders: Final Report on the Roll-out of the NGfL Programme in Ten Pathfinder LEAs*, ICT in School Research and Evaluation Series No. 11, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/reports/pathfinders].

Watson, G. (2001), 'Models of information technology teacher professional development that engage with teachers' hearts and minds', *Journal of Information Technology for Teacher Education*, vol. 10, nos. 1 & 2, pp.179-190.

Yee, D. (2000), 'Images of school principals' information and communications technology leadership', *Journal of Information Technology for Teacher Education*, vol. 9, no. 3, pp. 287-302.

Networking success: an investigation of the effectiveness of the Birmingham Grid for Learning's ICT Research Network

Rachel Pilkington

Introduction

In response to the need to support teachers in their professional development and enable them to research new and innovative ways of working with ICT, Birmingham established its ICT Research Network in 1999. The aim was to provide a framework within which to support teachers in evaluating their own practice through a year-long programme of action research. This research investigates the effectiveness of the network.

Research context

Recent government initiatives have called for all schools to become equipped with modern ICT facilities and for teaching staff in schools to become confident and competent in using ICT within the curriculum (Ofsted 2002; Becta 2001). However, Dawes (1999) suggests good teaching with ICT requires considerable adaptation on the part of the teacher and argues that the success of initiatives, in generating effective use of ICT, ultimately depends on teachers' professional development. Kennewell (2001), in commenting on NOF training, found that teachers do not just need ICT training – a considerable change in pedagogy is also required for many to incorporate ICT effectively in their teaching. A major barrier is the isolation of teachers from those with the necessary ICT and subject knowledge to act as role models in the classroom.

In response to this need to support teachers in their professional development and enable them to research new and innovative ways of working with ICT, Birmingham established, in 1999, an ICT Research Steering Group. The aim of the group was to provide a framework within which to support teachers in developing and evaluating their own practice with ICT and in sharing examples of good practice with each other. It was initially decided to support 15 teachers in ICT-linked action research projects by providing them with 15 half days of cover and accreditation linked to a 30 credit MA module offered by a local university.

The year-long programme for action research involved four half days at the university examining research methodology and five half-hour tutorial support sessions in the researcher's school. Key research project outcomes were to be linked to the Birmingham Grid for Learning (BGfL). Now in its third year, the project has 28 teacher-researchers, some supported by Best Practice Research Scholarship (BPRS) funding while others are supported by the Birmingham LEA support package. This year (2003) an online learning environment is providing additional types of support.

This research examines one community of teacher-researchers who are engaged in trying to marry the aims of research and teaching in ways that enable them to be more reflective in their practice. In examining this community the aim is to shed light on the ways in which the network is currently meeting the needs of its members and the goals of the community as a whole, and the impact of the network on teacher-researchers' professional development and the boundary communities in which they work. A model of the network emerges from the reflections of its participants. Based on the findings, some recommendations for the future are made.

Key literature in the field

This research is based on an activity theory framework (see, for example, Engeström 1987; Ekeblad 1998; Virkkunen and Kuutti 2000) and the work of Benzie (2000), in turn underpinned by Lave and Wenger (1991), and Wenger (1998). The project investigates teacher-researchers' perceptions of the network as a space within which to share knowledge and the degree to which they feel central or peripheral to its goals and activities. It also investigates the ways in which members interact, both within and between the network and related communities of practice.

Lave and Wenger's concept of a community of practice (1991) describes how we learn from 'doing with others' – participating in shared enterprises. These activities typically produce new objects (artefacts) which become 'things' in themselves from which others can learn. The kinds of object or artefact differ according to the nature of the community but they might include reports, presentations and resources, discussions and web pages. These artefacts can be boundary objects – that is, they can be used to bring meanings first created within the community to a wider audience or to other overlapping communities which share some common objectives.

A community of practice involves such joint enterprise in which participants mutually engage according to an overlapping set of goals, tools/resources and methods of working. Individuals within the community may have different levels of engagement with the activities of the group and may have a trajectory in their participation, from relatively peripheral participation as a newcomer toward fuller participation over time. Particular roles and activities may also shift over time and some individuals may have specialised responsibilities or roles. For example, individuals may have or develop 'boundary trajectories' which provide a link between different communities.

In the teacher-research community, tutors may have a primary role as a researcher or academic in a university while teacher-researchers themselves have a primary role of teaching within a school. The ways in which the objectives of an individual interconnect with the aims of the community as a whole, and the extent to which the tools and shared repertoire of the group support them, will ultimately determine how much individuals within the community learn from each other and what they are able to take outside the boundary of the community to share with other communities (such as the LEA, university and schools).

Thus, as Edwards (1999) and Cole (1996) suggest, the attempt to link research and practice to encourage reflective practice among teachers using ICT is not just about learning more about teachers' knowledge of ICT in preparation for helping them to learn how to make better use of ICT. Participants within the communities of research and the communities of teaching need to find ways of weaving together their experiences, objectives, tools and roles in ways that enable good practice and the dissemination of it to emerge as a shared joint outcome.

Research methodology and focus

Schools with members of the network were targeted and sent copies of a questionnaire by email and by post; the questionnaire was also made available online on the group's website. The questionnaire gathered information from respondents about:

- how they came to join the network

- their understanding of the aims of the network

- their attitudes toward it

- the ways in which they are currently using and benefiting from the network (including communicating with others within the network)

- the provision of guidance

- access to resources (directly or indirectly) through the network.

A number of open questions asked for comments on the ways in which membership of the network had affected their professional development and any suggestions or recommendations for improving the network. In all, 28 questionnaires were sent to network members and the findings presented relate to data provided by 14 returned questionnaires.

Since such questionnaires give limited opportunity for respondents to express additional issues that matter to them, or for the researcher to follow up or clarify emerging issues (Aldridge and Levine 2001), the questionnaire also asked for volunteers to take part in semi-structured interviews and two focus groups. In all, five follow-up interviews and two focus groups sessions, in which seven teacher-researchers took part, were also conducted.

The interviews, in addition to allowing greater scope to comment on their role as a teacher-researcher and their access to resources through the network, enabled interviewees to place their research in context, explore any external or personal constraints and benefits in their involvement in the network, and suggest ways in which the network had affected their professional development and the school.

The main aim of the focus groups was to provide a forum in which members could work constructively together to brainstorm areas for development, improvement or change that they felt would further the aims of the network in the future. Data from the focus groups directly informed the recommendations in this report.

Summary of main findings

Based on the results of the participants' own reflections on the extent to which the community was meeting the aims and objectives of its members, a number of recommendations were made.

In response to the questionnaire it was noted that respondents commented on how it was difficult to think of ways to improve the network and many left this section blank. It was also noted that any improvements to the network were constrained by teachers' existing workload and that an input of time and resource would be needed to make such improvements – teacher-researchers and tutors didn't necessarily have this time or resource.

Notwithstanding this, the following identifies overall impressions (based on questionnaire responses, follow-up interviews and focus groups) of those things which participants felt the network helped them with and should continue to do, those things which participants wished for more of, and those things which they suggested as potential developments or foci for change.

Benefits in teaching and learning and professional development

- Findings reveal participants felt the most positive effects of the network were in enabling them to gain insight into contemporary issues surrounding use of ICT in the classroom; enabling a better understanding of the positive impact ICT could have on their own practice and the learning of their students; improving their research and ICT skills through the opportunity to exchange ideas and information with tutors and other teacher-researchers.

- In terms of the impact of the network on the teacher-researchers' own schools, the feeling was generally positive, with most reporting that as a result of their project the profile of ICT had been raised, students had benefited and other staff had been encouraged to adopt similar techniques.

- Some mentioned how membership of the network had improved their own teaching and the learning of their students, encouraging them to integrate ICT more effectively into classroom activities and leading to improved ICT skills, to the extent that some were subsequently called upon by colleagues for help and information.

- Professional development was felt to have increased and a common theme related to the ways in which conducting a research project had made them focus upon key contemporary issues in the effective implementation and pedagogic use of ICT in the classroom.

- Additional reported benefits were the provision of a forum where they could discuss ideas and projects with other teachers, tutors and ICT professionals, and the access to resources it gave them.

Features that should continue

- As a main aim, the network should continue to maintain a close link between teaching and research, enabling the teacher to research that which they are directly seeking to achieve in their schools in order that the work continues to benefit their own professional development and the effective use of ICT in the school.

- The network must continue to seek resources to help teacher-researchers fund their work. Most participants agreed that without some funding (such as support to pay the fees of the modular enrolment at the university or to provide teaching cover) they would not have undertaken their projects.

- Participants commented that the supervisory support from the tutors on the university modules, which enrolment entitled them to, was excellent and hard to fault. Moreover, most agreed that the university library facilities they had access to as a result were essential to their study. The regular face-to-face meetings were also seen as an essential part of this support.

- The website was valued as a place where resources and information such as research papers could be found and downloaded. The articles posted on the website were the main incentive to log on to the learning environment. The 'useful links', research questions (FAQs) and calendar pages on the website were all valuable.

- Current one-to-one support between tutor and student was felt to be generally excellent and there was concern that future website development shouldn't be at the expense of individual support where tutor time was limited.

- The annual showcase event was seen as the main vehicle for publicising the results of the research and sharing best practice. There was support for its continuation. Participation in these events was itself felt to be an aspect of teacher-researcher professional development.

Features to be increased

- As a main aim, the network should have the goal of minimising the burden of research on teachers' workload through the provision (and, where possible, enhancement) of support and guidance.

- An extension of opportunities for discussion between members – through some additional meetings and more time on discussion activities – would be welcomed. In particular, there was a request that the supervisor initiate more regular and smaller group meetings where teacher-researchers could get together among themselves to study and talk through issues.

- Members in schools clustered within a particular area of Birmingham could perhaps meet together more regularly to share experiences and the website might help them in identifying each other, making contact and organising/scheduling and publicising these meetings.

- Articles posted by the tutor, particularly research papers that could be downloaded, were the biggest incentive to log on to the website and teacher-researchers would appreciate more of such material. They could also make more use of the website to share articles they had found. The website should increase the links to useful sites for research and this should be dynamic to the areas of study within the group.

- Members should make more active use of the research questions (FAQs) facility on the website.

- Details of the members' work should continue to be added to the website and also to the open access area of the BGfL's website, where a wider audience of teachers and others interested in the use of ICT could gain access to reports of the group's work. It was felt that these links needed to be more prominent.

- There was felt to be a role for tutors and the steering group in selecting and encouraging the promotion and publication of suitable work both on the BGfL and in academic and professional journals.

Areas for innovation or change

- To improve the focus of supervision and guidance there was felt to be a need to improve teacher-researcher input into the agenda setting prior to meetings. Some additional tutor online support within the learning environment – perhaps through synchronised chatroom style meetings for discussion - would be welcomed if this did not detract from other one-to-one provision.

- To improve sharing of best practice, there was scope for additional mechanisms for putting members with shared interests in touch with each other (for example, those with a common interest in particular subjects or technologies).

- There was scope to improve the library provision through improved access to hard-copy or electronic journals that were more relevant and up to date with respect to specialist aspects of ICT. There was also scope to improve the library support in obtaining accounts for accessing e-journals.

- The idea of a bank of loan equipment (laptops and tablet computers) was suggested. Some other dedicated research equipment (video or digital cameras and headphones, for example) might be purchased for individual use or to share by the group through a loan system. Other suggestions included meeting part of the costs of online connection for communicating with the network from home.

- It was suggested that the website have an up-to-date abstract of each researcher's project together with a photo, contact/email link and a link to any reports. It was noted that this had already begun but that further development was still required to enable participants to contact people with similar interests and expertise.

- It was noted that for the website to reach its potential, members' readiness to use learning environments needed to be improved. It was felt that a workshop on using the learning environment, including strategies for getting the most from it, would be beneficial.

- It was felt there was a need to develop mechanisms for auto-alerting members to new items or items of personal interest on the website. This could be done by forwarding 'alert messages' to members' email accounts. A list of active tutors and surgery dates was also requested.

- To boost teacher-researcher postings, points could be awarded to those who answered other teacher-researchers' questions or posted useful links, papers or discussion items.

- Suggestions to increase the impact of the group's work included presentation at other conferences and workshops including headteachers' conferences, and ITT- and Inset-related events.

- Particular case studies should be publicised at curriculum subject events other than IT events – geography IT case studies could be made available at geography co-ordinators' events, for example. A display or notice board, including abstracts of completed projects, should be prepared for use at such events.

Conclusions

The aim of this research was to examine a community of teacher-researchers engaged in trying to marry the aims of research and teaching in ways that helped them to be more innovative and reflective in their use of ICT in the classroom and, as a community, to produce case studies of good practice to disseminate. Through a process of triangulating a variety of different data collected from

teacher-researchers and tutors, it was possible to gain insights into the ways in which the network is currently meeting the needs of its members and the goals of the community as a whole, the impact of the network on teacher-researchers' professional development and the boundary communities of school, university and LEA.

The model of the network which emerges is one in which tensions between the different repertoires (methods) of teachers and researchers must be minimised through the sharing of closely linked goals and where the methods of research are used to serve the goals of teachers, enabling them to learn to reflect upon and improve their teaching practice. Without a commitment to such close linking, workload pressures on teachers' time and resources would prohibit research activity. Throughout the questionnaires, interviews and focus groups, this tension was highlighted and the imperative reiterated to keep research and teaching goals closely linked. The guidance and support of the tutor-researchers was felt to be a crucial component in helping teacher-researchers to maintain this close link, learn to use the tools of research to these ends and in helping them to present the results to other boundary communities.

In many ways, while the teachers provided the boundary link to schools, access to the contexts of the research and the raison d'être for the research, the tutor-researchers provided the boundary links with the wider audience for the dissemination of findings in ways that could potentially influence policy makers. Tutor-researchers also provided a link to the repertoire of skills and methods which would both assist teachers in reflecting usefully on their practice and produce artefacts (reports, papers, web pages and displays) that would be judged credible in the boundary communities of academics and policy makers. The network appeared successful and sustainable as a community genuinely sharing common objectives and depending upon each other's support. However, the tutors had a highly specific role in maintaining and co-ordinating the network activities and supporting teacher-researchers in securing resources without which it is hard to see how the network would continue. There was clearly scope for teacher-researchers to engage with each other more independently (as well as through their tutor) for their mutual support, and the website was seen as one potential and important tool in helping them to achieve this.

References

Aldridge, A. and Levine, K. (2001), *Surveying the Social World: Principles and Practice in Survey Research*, Open University Press, Buckinghamshire.

Becta (British Educational Communications and Technology Agency) (2001), *The Secondary School of the Future: A Preliminary Report to the DfES*, Becta, Coventry.

Benzie, D. (2000), 'A longitudinal study of the development of information technology capability by students in an institute of higher education', PhD thesis, University of Exeter, Exeter.

Cole, M. (1996), *Cultural Psychology: A Once and Future Discipline*, Harvard University Press, Cambridge, Massachusetts.

Dawes, L. (1999), 'First connections: teachers and the National Grid for Learning', *Computers and Education*, vol. 33, no. 4, pp. 235-252.

Edwards, A. (1999), 'Research and practice, is there a dialogue?', in H. Penn (ed.), *Theory, Policy and Practice in Early Childhood Services*, Open University Press, Buckinghamshire.

Ekeblad, E. (1998), 'Contact, community and multilogue – electronic communication in the practice of scholarship', paper presented to the Fourth Congress of the International Society for Cultural Research and Activity Theory, ISCRAT 1998, Aarhus University, Denmark, 7-11 June.

Engeström, Y. (1987), *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research*, Orienta-Konsultit Oy, Helsinki.

Kennewell, S. (2001), 'Is there really a lack of pedagogy for ICT?', *The ITTE Newsletter*, Spring 2001, p.6.

Lave, J. and Wenger, E. (1991), *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, Cambridge.

Ofsted (Office for Standards in Education) (2002), *ICT in Schools: Progress Report April 2002*, HMI 423, Ofsted, London; also online: viewed November 2003, [http://www.ofsted.gov.uk/publications/docs/19.pdf].

Virkkunen, J. and Kuutti, K. (2000), 'Understanding organizational learning by focusing on activity systems', *Accounting, Management and Information Technologies*, vol. 10, no. 4, pp. 291-319.

Wenger, E. (1998), Communities of Practice: Learning, Meaning, and Identity, Cambridge University Press, Cambridge.

The Ripple Project: the whole school impact of conducting learner-centred ICT projects in infant classrooms

Dr Bridget Cooper

Introduction

Schools in the UK are increasingly being filled with ICT equipment, yet headteachers and staff struggle with how to best deploy the equipment, both strategically and operationally, and how best to support staff in its most appropriate use. The immediate purpose of this research was to discover to what extent and in what ways the installation of two 'futuristic high tech classrooms' in a primary school near Leeds has had a wider impact on the perceptions and use of ICT throughout the school and on staff, co-ordinators and managers not based in the 'high tech' project classrooms. Through a detailed case study, the research sought to understand more profoundly the supporting and constraining factors on the nature and spread of good ICT practice in schools.

Research context

The Ripple Project builds on the work of two innovative projects conducted at Glusburn County Primary school: the *NIMIS* project[1] (Networked Interactive Media in Schools) and the *ICT and the Whole Child project*.

The *NIMIS* project was a successful international project funded by the European Union and designed by the Experimental School Environments Group. It designed, installed and evaluated computer-integrated 'classrooms of the future' in three European schools, as well as developing three software applications to support literacy and narrative skills in 5 to 8 year-olds. The classrooms and software were created using 'participant design' – with the involvement of teachers and children from the outset – and used the latest child-friendly technology to meet the needs of learning in the classroom most appropriately. To enhance literacy and personal and social skills, the project aimed to enhance classrooms by

maximising interaction and supporting existing human relationships. The *NIMIS* project was the only one of the three projects funded by the EU that really considered the whole classroom environment in its evaluation. The context in which ICT is used is central to its evaluation, and is becoming increasingly recognised as a key factor in the design of successful technological learning environments.

The success of the *NIMIS* project led to a follow-on project, called *ICT and the Whole Child*[2]. The project sought to provide evidence of the effects of such classrooms over a longer time-scale and the possible learning benefits of such a system. The project therefore installed a second set of equipment, similar to the first, but updated with more wireless technology, in a Year 2 classroom. The evaluation followed infants over Years 1 and 2 to assess the impact of two consecutive years of the use of such child-centred classrooms, and compared these children with a parallel class using more conventional computing facilities.

Both child-centred classrooms have a small network of computers clustered around a table to encourage collaborative work and cognitive and emotional support. Instead of the traditional large monitors, the design incorporates high-quality tablet PCs, which children can write on and manipulate with a pen that acts as a mouse. These lower-level screens encourage normal human communication around the table as well as encouraging sharing and discussion activities. Each classroom also has a large touch-screen which is used daily by the teachers and the children, encouraging sharing and discussion of work and allowing children to take a more interactive role in lessons. All of the PCs are networked together for ease of communication and the sharing of data and ideas. A range of age-appropriate software is installed on each system covering key subject areas for daily use by the class. Both classrooms have a digital camera and a scanner as well as printers for daily use.

The *NIMIS* and *ICT and the Whole Child* projects demonstrate the highly attractive and flexible nature of the two classrooms installed in the school, and how easily project staff have come to use the equipment for

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[1] NIMIS project [http://www.cbl.leeds.ac.uk/~paul/projects/cblnimis/].

[2] ICT and the whole child project [http://computing.unn.ac.uk/staff/cgpb4/projects/ict-wholechild/].

many hours per day and across the curriculum. This research sought to investigate what impact this had had on other non project staff in school and whether there was a perceivable ripple effect of attitudes to, and understanding of, ICT throughout the school.

Key literature in the field

The theoretical understanding behind the learning in the *ICT and the Whole Child* project is extended for this research. The researcher believes that the same concept of learning, through intense interaction, supported by the natural affective and cognitive interchange in human relationships, applies to staff within schools as well as to children within classrooms. This is reinforced by recent literature on teacher learning (Hoban 2002). Staff working closely together in positive relationships, caring for and supporting each other on a daily basis, are more likely to support each other's learning. If the learning can be highly interactive and frequent and can be seen to be immediately and practically useful, they are likely to adopt and internalise it more rapidly.

Necessary to the development of learning is a trusting and empathic relationship between teacher and learner (Cooper 2000), and a low child-to-teacher ratio to provide adequate one-to-one discourse (Cooper 2002; Beard 1999). Owing to large class sizes, this task is very difficult for teachers, suggesting that newer, perhaps more technologically advanced methods, might be useful in providing additional support for young learners (Wray 1994; Sharples 1985). Technology can offer the opportunity for young learners to work in groups supporting one another (Wray 1994), and to experience one-to-one support offered by the computer itself (Elsom-Cook 1988).

Pupils motivated by the use of technology (Thompson 1994; Sharples 1985), by its practical, flexible, and often, exciting potential, can take greater control of their learning. Teachers can be released from more traditional classroom management issues and are able to take a more facilitative role, devolving responsibility for learning to pupils. This places them in a more empathic position with pupils, with less need for traditional teacher domination and in a better position to work with and understand individuals, thereby modelling an empathic approach which pupils are likely to imitate.

The *NIMIS* project findings showed the success of the classroom and the high levels of engagement around both the large and small screens as well as the helping behaviours of children working in groups together despite their young age (Cooper and Brna 2002a). In the *ICT and Whole Child project*, teachers and children rapidly learnt to use the software and the system and both their ICT skills and literacy skills showed improvement over the other class without the facilities. Children's ICT skills and literacy skills improved more rapidly in the project classrooms, as measured by reading and skills tests. Teachers were observed using ICT with greater confidence across the curriculum and after two years, children in the project class had used five times as many programs as a comparable class and had developed sophisticated and transferable ICT skills, which were notably lacking in the other class. Teachers frightened of ICT in both previous projects rapidly gained confidence and competence and saw at close hand the benefits of ICT for children (Cooper and Brna 2002b).

The findings of the recent ImpaCT2[3] research study are also relevant to this project. It shows problems associated with the digital divide have to be addressed in schools, as does the need for more technical support in schools, more teacher training and a need to shift from skills-based to topic-centred, even child-centred, teaching. Research into affective issues in ICT learning suggest that emotional factors need closer consideration in children's learning, while leading educational researchers have also called for further research into affective and moral issues in education (Broadfoot 2000; Hargreaves 2001). The Ripple Project begins to address these issues for teachers' learning with ICT.

Research methodology and focus

The research was designed to capture the understanding and attitudes of all staff in the school (beyond those directly working in the project classrooms) towards ICT through a series of semi-structured interviews. Classroom observations and sample video recordings confirmed the findings.

The grounded theory methodology used in the Ripple Project is appropriate for evaluating teachers' perceptions (Strauss and Corbin 1997). It elicited findings directly from the data, analysing and illuminating both the

[3] ImpaCT2 [http://www.becta.org.uk/research/impact2/].

teachers' perceptions and the observations in classrooms, creating a rich database and subsequent understanding about the effects of the previous projects.

From late-November 2002 to mid-February 2003, semi-structured interviews were conducted with all the staff in the school (13) who did not teach (except on rare occasions) in the project classrooms, including the headteacher and deputy. Three student teachers on final teaching practice were also interviewed to gain their perspectives. In addition to the original proposal, two teaching assistants, who work quite closely with the children in small groups on the computers, were also interviewed. Thus, there were 18 interviews in all. Teachers were released and supply cover brought in to allow them to fully participate in the project to ensure full commitment and involvement without additional burdens to their workloads. After Christmas, observations and video recordings in classrooms were made to gain an additional sense of how teachers perceive and use ICT. Transcribed interviews were given back to teachers for further reflection and verification before analysis to strengthen the validity of the data (Robson 1993). The data was then analysed using software designed to support qualitative research generally and grounded theory methodology in particular. Videotapes were analysed with the help of the video-analysis scheme developed in the NIMIS project, which produced interesting data on the quality of interactions and engagement in the classroom.

Summary of main findings

The research findings can be categorised into a number of key topic areas:

The feelings of staff about themselves in relation to ICT

Teachers in the research study demonstrated a wide range of emotions in relation to their own use of ICT. Many teachers had negative emotions about ICT, feeling anxious and pressured about using it both in the home and in the classroom, and frustrated by their lack of skill or inability to solve technical problems. Consequently they had low self-esteem, and as a result avoided using ICT. Conversely, most staff felt great surges of positive emotion when they achieved new skills in ICT.

Most (but not all) staff felt reasonably or very confident with the software and machines in their own classrooms, and were eager for training to enhance their skills, and

enthusiastic about the opportunities offered by ICT. Some older staff were less convinced of benefits, and historically, had bad experiences with ICT through insufficient or older equipment.

Some staff, although confident in their own ICT skills, were relatively uninspired by how they had to teach ICT. They were frustrated by trying to use it to teach skills across the curriculum with mobile equipment, large classes and limited machines which were away from their immediate supervision. They had little 'mental space' for imagination and creativity and felt they largely kept to narrow objectives.

Perceptions relating to the positive effects of ICT to pupils' learning

Most teachers believed there was a range of benefits of ICT for pupils, especially in terms of motivation. Many teachers associated ICT with strong positive emotions: raised self-esteem, greater success and progress, better social and helping skills, an autonomous approach to work, and improved presentation and writing skills. They felt that multimedia helped learning and that ICT generally increased engagement.

The effects on teacher-pupil relationships were also recognised. Many staff felt that the relationships around computers were positive, closer and friendlier.

Negative perceptions relating to ICT in schools

Teachers' beliefs about the positive effects of ICT for children's learning contrasted sharply with their many negative feelings about the ways in which they had to work with ICT in schools. Their largest problem was inadequate or failing equipment, which resulted in anger and frustration and infrequent access. This was followed closely by lack of time and the strong belief that ICT simply had to be easy to use for teachers to manage it along with classes of children.

The logistics of doing ICT were often impossible given the numbers, lack of time and equipment, with space also being a problem both in infant and junior classrooms. Problems with inadequate software were another key issue, as was the slowness of work with children who struggle with keyboard skills or other aspects of the software. Other problems were lack of adult support on computers, children missing other lessons to do ICT work, and the sheer range of ICT attainment in class.

Factors which facilitate ICT use and learning in schools

Teachers had many ideas about how to improve the use of ICT in schools; the most common being to increase access and frequency of use, which would require more and better machines with a greater range and better quality of software.

Perceptions relating specifically to training and support

Training was a very emotive issue. Formal training by external providers held mainly, but not entirely, negative responses and for what appeared to be valid reasons. There was sometimes little hands-on experience on courses and when teachers returned to school they had neither the software they had practised on, nor the money to buy it.

In addition, the sheer amount of software teachers were meant to master means they often use some software as little as once a year, and the following year they have forgotten what to do. Equally, changing year groups presented similar problems of re-learning. Teachers did not have time to practise in school and they didn't have the school software at home to prepare lessons. Many teachers spent a lot of time and effort learning ICT skills on their own, and they placed great value on informal support networks.

Perceptions of the project classrooms

Whether they had tried them out or not, teachers generally had a very positive attitude towards the project classrooms. The classrooms looked and felt good even if the respondents were not exactly sure how they, or other teachers, might use them on a day-to-day basis.

When probed about the different aspects of the classroom, most were very positive about the benefits to learning of the large interactive screen even if they were too frightened to use it currently. They felt the big screen was very interactive and engaging. They could see how teachers could model the use of ICT frequently and then have enough machines to let children try software within a short space of time and get rapidly confident. They were also very positive about the small cluster of machines around a table to facilitate interaction and to give greater access.

Most teachers, when asked if they would like this equipment or use it if it was in their classroom, said they would. Most felt the staff with experience in those rooms would have career benefits. Most felt parents and student teachers in school would be pleased and impressed by the equipment. Managers felt the projects had been motivating and had helped the school to move forward in its ICT use and that it had become a 'leading school' for ICT.

The ripple effect

The attitudes of staff towards the policy and practice of ICT were synthesised into diagrammatic form illustrating a ripple effect.

The attitudes of highly enthusiastic staff from the 'high-tech' classrooms (equipped by the previous projects) are at the centre, where positive emotional feelings about ICT are greatest. These emotions cool down towards the outer edges, where teachers are typically more distant from the previous projects emotionally, physically, experientially and educationally.

The five layers might be described as follows, from core to periphery:

- **Converts and converters** (ICT passionate teachers and core project staff) with very positive experiences of ICT at close hand in their classrooms with very positive pupil/computer ratios and top quality equipment and a range of software. These teachers were learning rapidly from first hand experience using the big screens and from the children, and their enthusiasm was infectious.

- **Outer core-converting** – managers who were clearly converted to the use of ICT in classrooms. They were able to observe classrooms, and teaching and learning, and work in different classrooms to compare them. They also enjoyed the scaffolding and different perspectives provided by their link with the research team. The ICT Co-ordinator was using both large screen and small screens in a more cross-curricular way and is tremendously enthusiastic and competent when using ICT.

- **Converts with caveats** (keen people) with very considerable teaching experience or close interaction between pupils and ICT but who had not worked in the project classrooms. Although they knew the benefits they were fairly happy with two or three machines at their disposal. Teaching assistants had gained numerous opportunities to work with children at close hand and realised the benefits of ICT.
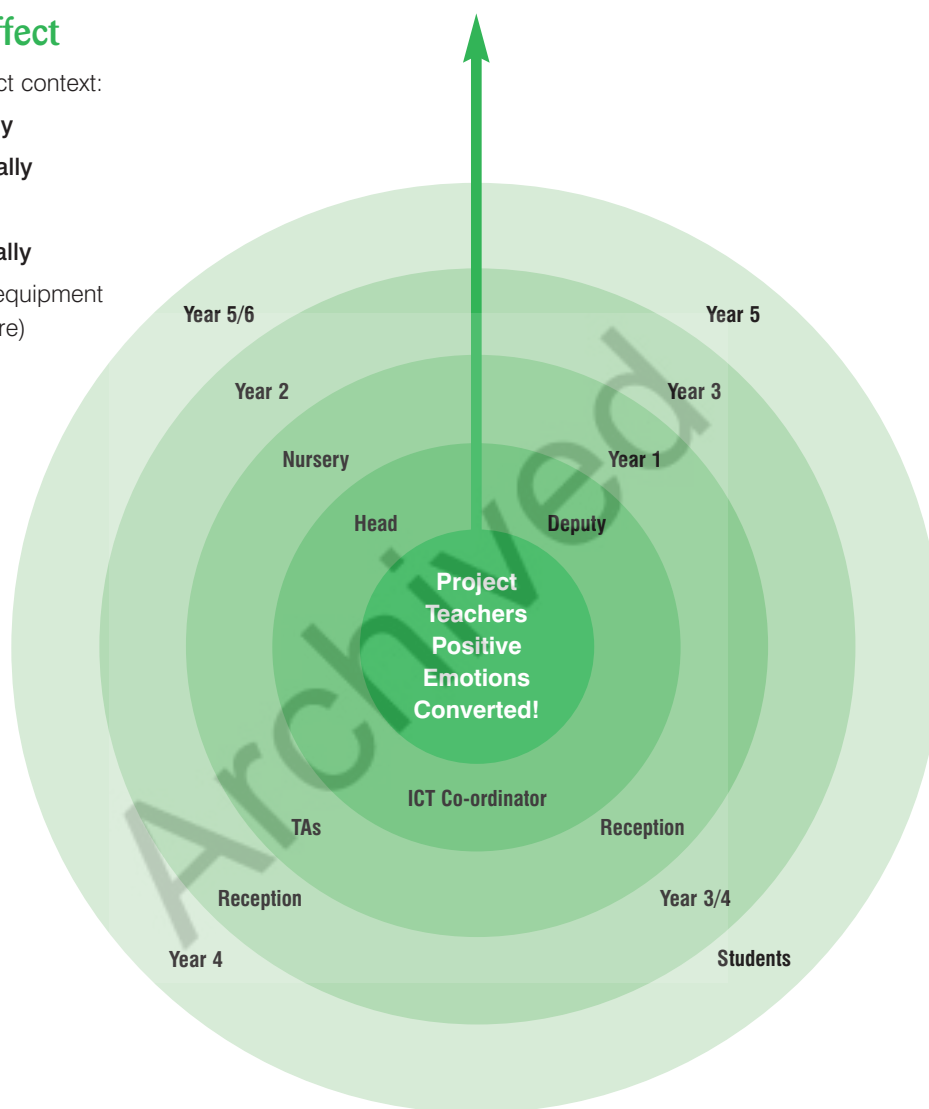
The ripple effect

Further from project context:

Emotionally

Educationally

Physically

Experientially

(including equipment and software)

Year 5/6 · Year 5 · Year 2 · Year 3 · Nursery · Year 1 · Head · Deputy · **Project Teachers Positive Emotions Converted!** · ICT Co-ordinator · TAs · Reception · Reception · Year 3/4 · Year 4 · Students

- **The jealous resistors** were much more reserved about the value of ICT but also more frightened, with lower esteem and having had bad historical experiences in terms of computer/pupil ratio, quality of machines and software. However they were immensely positive about the way their own self-esteem was lifted by their achievements with ICT.

- **Teacher, mechanics and skills dominant** seemed more detached altogether. These were mainly junior teachers. Although they could envisage some of the benefits, they were struggling with large classes, historically unfavourable pupil/computer ratios (though better very recently) and focusing on skills more than meaningful activities. In the classroom the teacher was more dominant and the atmosphere less interactive. The computers were outside the classroom and teachers seemed less aware of what children enjoyed or learned during computer use. The student teachers were similar in outlook, mainly due to lack of teaching experience. Interestingly, this group was more ICT literate but mostly less experienced teachers.

Conclusions

Like children, teachers need positive experiences of ICT. Crucially they require frequency and appropriateness of support in their learning in a safe and secure atmosphere

where they will not feel inadequate or anxious but understood, enthused and supported. Negative experiences of ICT may make teachers poorer learners, and might impair their ability to teach effectively with ICT. Current levels of equipment and training may be insufficient to adequately address the digital divide (Somekh *et al*. 2001) or give all teachers positive experiences of ICT. Having established again the significance of positive emotion to learning and self-esteem, smaller classes and more computers would seem to support an improved emotional atmosphere in classrooms.

The findings from this study, although not generalisable, would seem to suggest that where possible and where space permits, classrooms should be equipped with an interactive whiteboard with wireless keyboard and a small cluster of high-quality computers with appropriate access to a wide range of shared software and initial and ongoing training for the teacher. This would immediately enhance frequency of teacher learning in classroom time (solving practice problems) and also continually model ICT and allow children appropriate access across the curriculum.

Interactive whiteboards enhance the engagement and interaction of staff and pupils, and small clusters allow supported and appropriate work in class at the right moment. The research found that the time pupils spent working with computers (within a cluster) in project classrooms is approximately four times the amount spent in other classrooms – they also got support from other children, the teacher, and any additional adult support. Frequency of use and emotional scaffolding allows rapid learning and much greater impact and is beneficial to pupils' motivation. Teachers also need to be able to take home one of the computers with all the classroom software on it for exploration of software and preparation of lessons.

Problems of space for computers in small rooms could be solved by pack-away laptop computers and wireless networks – or even better, by reducing the numbers of children in classrooms. In order to provide adequate adult support and achieve high-quality learning, schools probably need to increase the number of computers and decrease the number of children in classrooms.

The research suggests that primary schools require quality technical and curricular support to maintain and develop the use of ICT across the curriculum. This means having a technician on site for at least part of the week and giving the ICT Co-ordinator much more non-contact time in which to support individual staff development and to understand the needs of different age groups through detailed consultation with staff inside and outside school. Without such support, staff development and competence competence in using ICT is likely to progress slowly.

The findings from this research also suggest that teachers need to be given opportunities to work one-to-one with children on computers to see the benefits and problems and/or to see videos of children using ICT in relevant settings to reflect upon and discuss the issues.

It might also be inferred that ICT training should be mainly in school and person specific as far as possible, rather than blanket or externally provided by trainers who do not know the people or their needs. Staff felt less anxious and more supported by in school and person specific provision and would have benefited from more support by the ICT Co-ordinator, whose time was limited due to balancing staff needs with her role as a full-time Year 6 teacher.

It might also be argued that learning with ICT should be focused on topics and goals that enthuse and interest children rather than on the learning of skills that fail to interest teachers or children. Frequency of use in interactive classrooms will allow skills to develop more rapidly and naturally.

Schools might also benefit if they work with universities and other bodies to further improve their understanding through joint research projects which support staff learning and development so they progress further and adapt creatively to rapidly changing technology.

Student teachers in training need to be given opportunities to use interactive whiteboards and have hands-on experience with a range of age-appropriate software on their courses. Student teachers in this study found training on basic software like word processors, spreadsheets and databases inappropriate and boring. It might be geared towards the standards required of them but they had used these significantly prior to the training.

Many of the above recommendations may have profound implications for secondary as well as primary schools.

In conclusion, the project has reiterated the understanding about the significance of affective issues in learning for children and teachers discussed in both the literature and shown in the results to date from the

other two projects Brna 2002a and 2002b). The interviews have revealed complex understanding about the causes of staff motivation, interest and learning in ICT. Having projects in school and seeing novice or phobic staff succeed has persuaded, even inspired, some of these teachers that more machines and interactive boards would be an asset. However, a number of staff are currently influenced strongly in their attitudes by their existing limited provision and its inappropriateness, either through insufficient equipment or software or time for teacher learning to enable them to integrate ICT effectively into the curriculum. Teachers are essentially pragmatic people with a large and difficult task to fulfil. If their resources are adequate and seen as helpful to their task, they will make the effort; if not, they see their effort quite rightly as wasted. Their attitudes are rightly time-precious.

References

DfEE (Department for Education and Employment) (1999), *National Literacy Strategy: Review of Research and other Related Evidence*, report prepared for the DfEE by R. Beard, DfEE,London;also online: viewed December 2003, [http://www.standards.dfes.gov.uk/literacy/publications/research/63541/?leaf=0]

Broadfoot, P. (2000), *Culture, Learning and Comparison: Lawrence Stenhouse's Vision of Education for Empowerment*, Stenhouse Memorial Lecture 1999, British Educational Research Association (BERA), Nottinghamshire.

Cooper, B. (2000), 'Exploring moral values – knowing me knowing you – aha! – rediscovering the personal in education', in R. Best (ed.), *Education for Personal, Social, Moral and Spiritual Development*, Cassell, London.

Cooper, B. (2002), 'Teachers as moral models? The role of empathy in teacher pupil relationships', PhD thesis, Leeds Metropolitan University, Leeds.

Cooper, B. and Brna, P. (2002a), 'Supporting high quality interaction and motivation in the classroom using ICT: the social and emotional learning and engagement in the NIMIS project', *Education, Communication and Information*, vol. 2, nos. 2 & 3, pp. 113-138.

Cooper, B. and Brna, P. (2002b), 'Hidden curriculum, hidden feelings; emotions, relationships and learning with ICT and the whole child', paper presented to the British *Educational Research Association Annual Conference*, University of Exeter, 12-14 September.

Elsom-Cook, M. (1988), 'Guided discovery tutoring and bounded user modelling', in J. Self (ed.), *Artificial Intelligence and Human Learning*, Chapman & Hall, London.

Hargreaves, D. (2001), 'A capital theory of school effectiveness and improvement', *British Educational Research Journal*, vol. 27, no. 4, pp. 487-503.

Hoban, G. (2002), *Teacher Learning for Educational Change*, Open University Press, Buckinghamshire.

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

Sharples, M. (1985), *Cognition, Computers and Creative Writing*, Ellis Horwood, Chichester.

Somekh, B., Mavers, D. and Lewin, C. (2001), *Using ICT to Enhance Home-School Links*, ICT in Schools Research and Evaluation Series No. 4, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/research.cfm?id=2607].

Strauss, A. and Corbin, J. (eds.) (1997), *Grounded Theory in Practice*, Sage Publications, London.

Thompson, N. (1994), 'Computers, curriculum and the learning environment', in B. Moon, and A. Shelton Mayes (eds.), *Teaching and Learning in the Secondary School*, Routledge, London.

Wray, D. (ed.) (1994), *Literacy and Computers: Insights from Research*, United Kingdom Reading Association (UKRA), Cheshire.

The use of interactive whiteboards in the primary school: effects on pedagogy

Julie Cogill

Introduction

The interactive whiteboard differs from other ICT devices in so far as it is a tool directly relating to teachers and teaching. Unlike other technologies, it is not intended for individual learning but for whole-class use. Thus it is particularly interesting in relation to the effects it will have on whole-class teaching, whole-class interactivity and on the lives and pedagogical outlook of teachers themselves.

This study investigates the use of interactive whiteboards in the primary classroom across the curriculum, rather than their use in ICT lessons. The focus of the research is on teaching and teachers and some of the wider questions raised include:

• Is whiteboard use changing whole-class teaching and the integration of ICT with classroom practice?

• Does use of this new technology change or just reflect teachers' existing beliefs and practices both in teaching and in attitudes towards ICT?

• What are the issues that teachers encounter as they engage with this new technology?

Research context

For the past 20 years, computers have been used increasingly for teaching and learning in schools. During this period, the sophistication of the technologies available has developed, together with increased access. Increased funding through the Government's National Grid for Learning initiative (Ofsted 2002; DfES 2001) has accelerated change in recent years.

The interactive whiteboard is just one of many technological and software developments which have recently become available: networks and the use of computer suites in primary schools, the use of laptops, wireless technology, more sophisticated and less expensive software and potentially faster, easier internet access through broadband. Though few of these new technologies are yet widely used in the majority of schools (DfES 2001), each raises practical and technological issues for educational use, so making them the current focus of much research and debate (Harrison *et al*. 2001; Somekh *et al*. 2001; Ofsted 2002)[1].

The importance of this research lies in the need to address issues concerning the use of the interactive whiteboard while it is still in the early stages of adoption. It has several purposes:

• To assess the benefits of the whiteboard for teaching and learning. If more classrooms are to be equipped, there is a need to investigate the conditions under which implementation may be successful.

• To consider any changes in attitude towards ICT by teachers who have whiteboard access. Will its use 'unlock the door' for teachers who are resistant to adopting ICT into their teaching repertoire?

• To investigate how, and for what purposes, a whiteboard is used and what is effective pedagogy when employing this new technology.

Key literature in the field

As yet there is little published research literature on the use of this new technology in primary schools[2]. The use of the interactive whiteboard is intrinsically linked to the use of ICT. In order to use a whiteboard, teachers require some computer skills, and many resources for the whiteboard require the skills to manipulate software applications. Consequently, relevant issues on teachers' use of and attitudes towards ICT and the pedagogical skills associated with using ICT in the classroom are briefly reviewed to provide a literature base for the study.

Evidence from prior research was used to form the basis of the interview questions for teachers and to provide pointers to the analysis of classroom observations.

Research methodology and focus

The research aims were to investigate what is happening in the 'whiteboard classroom' and the pedagogical approach of teachers using an interactive whiteboard. This report is the result of three distinct research projects: an initial pilot study involving two schools, two teachers and one

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[1] See also the research section of Becta's website [http://www.becta.org.uk/research/].

[2] For further references to research on interactive whiteboards, see the Becta website [http://www.becta.org.uk/page_documents/research/wtrs_whiteboards.pdf].

headteacher; a deeper study involving two further schools and five teachers; and an ongoing study which is designed to track the use (across one year) of the interactive whiteboard in two schools by twelve teachers, including one headteacher new to its use. Data was gathered from four schools in the South East: two inner-city, one suburban and one rural school, and results draw on findings from 26 lesson observations (three at Key Stage 1 and 23 at Key Stage 2) and 32 interviews. Of the 18 teacher participants in the four schools, 15 have full-time access to the whiteboard in their classroom. A predominance of lessons observed featured literacy and numeracy, although other observations included history, geography, ICT, religious education (RE), personal, social and health education (PSHE), and music.

Summary of main findings

The study found many examples of the interactive whiteboard being used in interesting and creative ways.

Teachers' use of the board and associated pedagogy

Teachers were enthusiastic about the interactive whiteboard as a new tool for teaching. Their statements suggested that it is being used (by those who have daily access) across most areas of the curriculum and with many software applications, including the internet and CD-ROMs. When used with a whole class, several common factors within teaching practices were observed, with participants using the board effectively to:

- provide an initial structure for their teaching
- save time scribing
- provide a large display that children could see and read easily
- demonstrate skills for children
- attract and retain children's attention
- provide images or text that children could not easily have had access to in other ways
- engage in quizzes or tests within the whole-class environment
- increase class participation by children writing their solutions on the board.

A few teachers were adopting the board for what may be considered higher-order pedagogical whiteboard skills to:

- save work so that the teacher and class could access their joint contributions at a later stage

- provide a tool for children to create their own multimedia screens for class presentations
- enable collaborative work between the teacher and the class
- use ICT or a traditional resource after having adapted it to suit particular needs
- provide images that could later be adjusted by children to display their own work
- foster independent thinking skills in children and improve their cognitive skills.

Teachers were using the interactive whiteboard in different ways and had different views and interests in its potential and this largely reflected each teacher's pedagogical stance, especially in their need to direct classroom events versus handing part of this responsibility over to children themselves. Although data of this nature can never be exhaustive, it presents a range of activities to describe, 'What is happening in the whiteboard classroom?'.

The board was particularly valued by all respondents because it helped to hold children's attention and saved time scribing in class or handing out pieces of paper. As one teacher commented, she now has more time to teach.

The relationship between good use of ICT and whiteboard use

As the study progressed, the research focussed on the relationship between what is considered good use of ICT from established research and what was emerging from the researcher's own perceptions of whiteboard use. The research findings suggest that a whiteboard may obviate some of the demands and difficulties that teachers find in integrating ICT into classroom practice:

- The fact that teachers are able to adopt the interactive whiteboard largely in accordance with their existing practice appears to ease the process of change for teachers as this new technology is introduced.
- Teachers are more in control of the learning in the whole-class situation. They are using the whiteboard and any software according to their own needs, rather than implementing others' ideas, as might be the case when children are learning individually at a computer.

None of the participants who had sufficient access noted a loss of control of the learning process when using the

whiteboard. Even though some reported their very first use as intimidating, they also reported that they could initially use the whiteboard in a way that did not change their classroom organisation and that gradually allowed them to build up confidence. A few participants were able to hand more control of the learning over to the children while using the board.

The whiteboard may enable some teachers, but not all, to integrate ICT more easily into the curriculum. It is possible that the underlying difference in integrating ICT lies within teachers' existing ICT skills and their pedagogical skills and constructs. For example, those teachers with fewer ICT skills and confidence with ICT were less well placed to integrate whiteboards into teaching and learning confidently and effectively. Moreover, it might be argued that those who still resist the use of technology because they are not convinced it will add significantly to the quality of their teaching may not change their mind until they see practical and stimulating examples of effective whiteboard use in their subject areas. In the later stage of this research (which is yet to be completed), the researcher hopes to understand more fully what these constructs may be through working with teachers as they start to use the whiteboard.

The main findings from this phase of the research can therefore be summarised as follows:

- The facility to use the interactive whiteboard as a whole-class resource appears to alleviate some of the issues (established from prior research) that teachers have in using ICT with individual learners: the whiteboard enables teachers to use the technology in accordance with their existing practice and to gradually build up their confidence and competence.

- Many teachers noted that the time 'to play' was almost as important as training during early use of the board so that they could find their way round, discover its potential and reflect on how to integrate it with their teaching.

- Those teachers who have only occasional access find it difficult to gain the experience required to feel confident in using the board. In particular they lacked 'playtime' access. This is exacerbated if the board and projector need setting up each time the technology is used.

- All teachers were enthusiastic about the tools the whiteboard offers: to help structure their lessons; to save time scribing, which creates more time for teaching; to attract and retain children's attention; and to provide large attractive text and images.

- At least three of the participants were making more extensive use of the resource to enable collaborative work with the whole class and foster children's cognitive skills.

- Those teachers with full-time access who had used the board for a year or more reported that they used the board every lesson across almost the full range of subjects and software applications. They felt that they could 'make do' if they no longer had access but would undoubtedly miss the facilities that it offers.

- Participants were each using this new technology in different ways, which partly reflected ICT experience, but more particularly their pedagogical approach to teaching in general. Teachers used the interactive whiteboard in different ways and had different views and interests in its potential. Although supporting data is limited, the extent to which they utilised the whiteboard appeared to be mediated by their overall teaching style, and whether they perceived the need to direct or control classroom events or were more comfortable handing part of this responsibility over to children themselves.

- As a result of the use of interactive whiteboards, some of the teachers were undertaking more collaborative work with the whole class to foster children's cognitive skills and were involved in greater sharing of resources, especially within year groups.

- Observations identified teachers blending resources and approaches when using the whiteboard, with some using almost the full range of subjects and software applications. Some participants were making more extensive use of the resource to enable collaborative work and engaged pupils by actively involving them in manipulating the screen.

- Some expressed a view that use may be overdone in two ways: use of the board may sometimes be over-long and a lesson become too didactic; and complex graphics may distract from the learning if children become over-interested in presentation rather than the content.

- School leadership and support appear to be important aspects of ensuring that this technology is used in ways that enhance learning.

- The boards appear to create a greater sharing of resources, especially within year groups, sometimes through an electronic filing system of resources.

- Time for lesson planning was not necessarily a problem. Several teachers noted that to make the most of the board, time was needed to find interactive resources and there is need for very thorough and precise search mechanisms.

Conclusions

In conclusion, current research on the use of interactive whiteboards is still at the 'early adopters' stage. It is important that research continues, especially in the area of training new users who may be less than enthusiastic to adopt a new technology. It would be a missed opportunity if the whiteboard, were it to be universally adopted in the future, were used largely as a traditional chalkboard. Several suggestions can, however, be drawn from the research to date:

- If schools are purchasing one or two interactive whiteboards, which may frequently happen owing to the cost of the technology, they should consider carefully why a whiteboard is needed, how it will be used, where it should be placed and who is going to use it.

- A single system may get better use if it is fixed in the classroom of one capable teacher rather than either being moved around (which may mean setting up the projector and calibrating it each time) or 'dedicating' a room to the whiteboard.

- Teachers need to have reasonable ICT competence to make best use of the resource. This may not mean huge expertise but they need to feel comfortable in moving between windows, at ease with filing systems and comfortable in using the internet and searching for resources. Last, but not least, they need to be interested in using still and dynamic images and interactive resources for teaching and learning.

- Interactive whiteboard training for new users may be best when it takes place in quite small steps every couple of months. The important thing is that teachers have sufficient time to 'play' with the board between sessions. Those teachers who are very ICT confident and competent will forge ahead under their own steam regardless.

- The sharing of whiteboard resources and maintenance of year group files of lesson resources is potentially a hugely time-saving task for teachers which could be adopted as a strategy if schools decide to put whiteboards in every classroom. This requires not just a management system but a culture of sharing resources in a school.

- School leadership and support are important aspects in ensuring that this technology is used in ways that will really enhance learning.

- There is a need for excellent search mechanisms for software resources appropriate to whiteboard use so that teachers can integrate interactive resources into their teaching without spending too long either searching or re-inventing the wheel.

References

DfES (Department for Education and Skills) (2001), 'Survey of information and communications technology in schools, England 2001', *Statistical Bulletin*, issue no. 09/01, HMSO, Norwich.

Harrison, C., Cavendish, S., Comber, C., Fisher, T., Harrison, A., Haw, K., Lewin, C., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B. and Watling, R. (2001), *Impact2: Emerging Findings from the Evaluation of the Impact of Information and Communications Technologies on Pupil Attainment*, ICT in School Research and Evaluation Series No. 1, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/impact2].

Ofsted (Office for Standards in Education) (2002), *ICT in Schools: Effect of Government Initiatives*, HMI 712, viewed March 2003, [http://www.ofsted.gov.uk/ publications/docs/2615.pdf].

Somekh, B., Barnes, S., Triggs, P, Sutherland, R., Passey, D., Holt, H., Harrison, C., Fisher, T., Joyes, G. and Scott, R. (2001), *Pathfinders: Preliminary Report on the Roll-out of the NGfL Programme in Ten Pathfinder LEAs*, ICT in Schools Research and Evaluation Series No. 2, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/reports/pathfinders].

Video conferencing in the mathematics lesson

Jenny Gage

Introduction

A number of schools already have the facility to use video conferencing, and as the technology develops, this use is increasing. Schools are now taking part in projects of various types in which video conferencing is used as an educational medium. However, there is little research into the effectiveness of video conferencing as a medium for teaching and learning at school level in the normal classroom setting, and into what good practice is in this field.

This research project was designed to explore the feasibility of video conferencing as part of a normal lesson, and to examine its specific contribution to mathematical communication. Schools need to know if video conferencing is suitable only for special events, or if and how it can be used as a part of the normal range of ICT media used for delivering the curriculum. The research also considered whether use of video conferencing might specifically aid pupils' mathematical communication skills by giving them an opportunity to discuss mathematics with another class from another school.

Research context

The published findings from the ImpaCT2[1] project, concerning the use of ICT in schools, have established a link between attainment and the use of ICT in a number of subject areas (Harrison *et al*. 2002), including mathematics. This project has also documented broader benefits for both teachers and pupils (Comber *et al*. 2002), which includes growth in confidence generally and confidence in the use of ICT.

Case studies have also been published, describing schools' use of video conferencing. In particular, use of video conferencing as a tool for teaching and learning was the subject of some of the EDSI projects (Education Departments' Superhighways Initiative, summarised in Scrimshaw 1997). These studies looked at the use of

video conferencing for remote tutoring of pupils in remote areas (Hall *et al*. 1997); provision of professional development for teachers (McFarlane *et al*. 1997); contacts between pupils at different schools around the UK (Passey *et al*. 1997); contacts between Year 6 and Year 7 pupils at the primary/secondary transition (Galton *et al*. 1997; Comber and Hargreaves 1997); and individual tuition for pupils with special needs (Thorpe 1998). A wide range of social and educational benefits was found to derive from the use of video conferencing.

However, as yet only a minority of schools have taken part in any form of video conferencing. According to ImpaCT2, only 1% of pupils had used it in English, mathematics or science (Harrison *et al*. 2002). In the case studies of ImpaCT2, Comber *et al*. (2002) were not able to report any video conferencing activity occurring in the schools they observed, despite information and advice on using video conferencing having been made available to schools from the Becta ICT Advice site[2] for some time. Nevertheless, there are schools finding ways of using it effectively, and more schools are keen to get involved once financial and practical difficulties have been resolved.

At present, there is little guidance to inform schools considering investing in video-conferencing equipment. Much of the literature is not very accessible to teachers, and information on the internet consists mainly of descriptive case studies with little evaluative content. While this research takes the form of a case study, it also contains a qualitative evaluation of attitudes of both teachers and pupils to video conferencing, and a semi-quantitative analysis of the effect of video conferencing on pupils' mathematical communication skills. The findings overall are sufficiently strong to indicate that this is an area which would benefit from a much larger-scale study of schools' practice in video conferencing, which is in fact ongoing during 2003 (by a team from the Universities of Leicester and Cambridge). This larger study will look at existing practice, evaluating what teachers feel is good practice in video conferencing. It will not look at the issue of communication skills, or other specific potential benefits to pupils, and this would be a suitable area for further work.

The indications of this small-scale study are that video conferencing has the potential to contribute significantly

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[1] ImpaCT2 [http://www.becta.org.uk/research/impact2/].

[2] ICT Advice site [http://www.ictadvice.org.uk/index.php?section=te&rid=188].

to pupils' communication skills and to their self-confidence. Furthermore, it increases their motivation, and gives them opportunities for genuinely collaborative work.

Key literature in the field

Literature on video conferencing tends to be focused on higher education, distance learning and case studies. Much of what is written concerns the USA, Australia and the Far East.

In their review of the literature, Heath and Holznagel (2002) found only a limited number of studies aimed at school pupils. What they found mainly concerned the use of video conferencing to support distance learning, rather than as an additional tool for children undergoing a more traditional type of education. They were sceptical about findings from older pupils and adults being transferred without further consideration to younger pupils, whose learning styles are often different, and where course style is often different also.

In the UK, much of the literature on video conferencing use in schools is in the form of suppliers' 'case studies' on the web, yet there is relatively little in terms of research evidence[3].

Research methodology and focus

The purpose of this small-scale case study was to see if video conferencing could be used as a regular method of classroom teaching for normal curriculum work in mathematics, and to see if it could enhance pupils' mathematical communication skills. Two secondary, comprehensive schools, which had already taken part in Motivate[4] special events via video conference, worked together during the autumn term of 2002. Various types of data were collected to assess the feasibility of the video-conferencing medium for normal classroom work and to evaluate whether mathematical communication was enhanced.

Four Year 8 classes of comparable ability were chosen to take part in this study. One at each school was an experimental group, which took part in the video conferences; the other at each school was a control group and did not take part in the video conferences.

Year 8 seemed to be the only possible choice of year group, as all other year groups either have public exams at the end of the year, or are just beginning a new key stage, and would be likely to be in new groupings with new teachers. Unfortunately, since one of the schools is a 12 to16 school, the pupils here were, in fact, new to the school. However, comparisons were not directly made between achievements of the pupils at the two schools, but just between the experimental and control groups at each school. One teacher at each school and one additional support teacher also participated.

As this was a small-scale case study, it was felt that a qualitative methodology would be most appropriate (Mills 2000). All data collected was of a qualitative nature, consisting of semi-structured interviews, questionnaires containing open-ended questions, videotapes of classroom discussion and accompanying written work. The interviews and questionnaires were analysed to find out about the teachers' and pupils' views on video conferencing, including any problems encountered, and their views for its potential. This was done by coding individual clauses, phrases and statements, and using the categories that emerged. The data was also compared with the categories which Ruthven and Hennessy (2002) found to be significant when they analysed teachers' views on what makes for good practice in ICT in mathematics.

The transcripts of the classroom discussions and the pupils' written work were similarly analysed by clause, phrase and statement to see if there were any changes in the pupils' mathematical communication skills after the video conferences. Similar data was collected from the control groups for a comparison. It cannot be claimed that the video conferences are the sole possible cause of any change, of course, as there are many other variables which could not be controlled. Nevertheless, it may serve to give an indication as to whether research in this area is worthwhile.

The two schools agreed to hold five, 30-minute video conferences at fortnightly intervals. Topics for the video conferences were agreed by the teachers during a planning meeting at the beginning of the project, but

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[3]   Research findings are outlined in Becta's 'What the Research Says': Video Conferencing in Teaching and Learning
      [http://www.becta.org.uk/research/research.cfm?section=1&id=546].

[4]   Motivate is part of the Millennium Mathematics Project, University of Cambridge, and runs mathematical video conferences, connecting school pupils with
      mathematicians, and giving them the opportunity to create their own mathematics and to report on it via video conference [http://www.motivate.maths.org].

were changed as necessary to coincide with the schemes of work followed and pupils' progress. The first conference was mainly 'social', and then each class set the other a short problem to be worked on for the next video conference. Teachers felt that the open-ended tasks they chose were appropriate tasks for the video conferences, giving students of different abilities and backgrounds a chance to access the work. At one of the conferences, pupils also tried to teach one another for a short while.

Summary of main findings

The main findings from the study are categorised under several key topic areas:

Attitudes to video conferencing

Attitudes to video conferencing were very positive overall. However, confidence, or lack of it, was commented on especially by and about the pupils. Some of the pupils found it embarrassing, although most felt that they could cope with this, or that as they got used to it this ceased to be such an issue. The teachers felt that they could have got through the same amount of work more quickly in a normal lesson. Both pupils and teachers felt that social issues were more important than during a normal lesson, and they also made comments about the sound and picture quality, and that it would be better if these could be improved. Nevertheless, both pupils and teachers also made frequent comments about gains that would not have been present in a normal lesson such as a change in lesson focus, broadening of horizons, and enhanced communication and collaboration skills.

Problems experienced

For teachers, involvement in the project raised many management and pedagogical issues that were quite different from the normal classroom situation. A key issue was general management. Matching timetables at two different schools was a problem, meaning that one participant school had to prolong a double lesson into the lunch hour. Many pupils resented this, despite being willing participants at the outset of the project.

Class size was also an issue – one teacher felt that the size of her class made it difficult to involve all pupils in preparation and contribution to the video conference. The timing of the video conferences also meant that there was not sufficient time for both groups to contribute fully, particularly for necessary social interaction, and

teachers felt that they were unable to finish off topics as they would normally have done.

Technical issues, particularly the sound and picture quality, also had management and pedagogical consequences, illustrating that careful consideration must be given to purchase of equipment to suit local needs. Pupils also commented on the technical difficulties, feeling that this at times had consequences for the learning experience. On a positive side, poor sound quality did in fact place greater demands on communication skills, as pupils had to learn quickly how to make themselves heard.

It is clear that if video conferencing is to be used on a regular basis, sound and picture quality need to be considered, and participants need to be trained to make the most of the available technology. One participant teacher commented several times that if he were to do something like this again, he would spend much more time training the pupils in advance.

Interaction and communication

Pupils commented more, proportionately, on issues to do with interaction and communication than teachers did in the interviews and questionnaires. Positive responses included views on collaboration, meeting new people, and gaining a different perspective on mathematical problems. Technical difficulties and embarrassment at communicating in such a way however, were cited as problems.

Comparison with other forms of ICT

Based on a study by Ruthven and Hennessy (2002) which investigated teachers' views on good practice in the use of various forms of ICT to support teaching and learning, the research considered the use of video conferencing under a number of 'success themes' concerned with 'securing and enhancing the participation of pupils in classroom work, the pace and productivity of such work, and the progression in learning arising from it'. From within ten operational themes developed by Ruthven and Hennessy, six were found to be prominent in this study:

- **Ambience enhanced** – ICT use associated 'with change, difference or variety in working ambience'.

  Comments from teachers and pupils alike recounted increased motivation through a different approach to a mathematics lesson.

- **Motivation improved** – ICT use associated 'with the motivation of student towards classroom work'.

  Teachers' comments alluded to increased motivation, enthusiasm and a positive attitude towards the subject, while pupils found the video conference to be a fun way to learn more.

- **Engagement intensified** – ICT use associated 'with deeper and stronger student engagement in classroom work'.

  Teachers recounted a greater engagement by pupils who would be more reticent to respond in a typical classroom situation, while pupils felt that they had a greater say in what they learnt through this method of teaching.

- **Routine facilitated** – ICT associated 'with facilitation of relatively routine components of classroom activity'.

  Ruthven's and Hennessy's 'routine facilitated' category concerned ICT speeding up routine work, focusing on speed and ease as prominent factors. While this can not be strictly applied to this study, pupils did however make statements about the video conferences helping them with their work.

- **Ideas established** – ICT associated 'with the formation and consolidation of ideas'.

  This category was used only by pupils and included comments on greater understanding of topics.

- **Activity effected** – ICT use associated 'with securing and enhancing the pace and productivity of classroom activity as a whole'.

  Unlike other categories, remarks about activity effected were negative and exclusively made by teachers. Comments mainly related to the lack of preparation time available, and the limitation of learning benefits that could be gained in half an hour of video conferencing.

Two further categories emerged from the interview and questionnaire data in addition to those of Ruthven and Hennessy:

- **Confidence increased**
  This concerns how use of ICT can help to build up pupils' confidence, enabling them to take part in situations or tackle problems they would have avoided previously. Many pupils commented on how the experience had increased their confidence, or that they thought it would, should they have another opportunity to take part in a video conference.

- **Collaboration enhanced**
  Collaboration is enhanced as a result of working with ICT, compared to a lesson without ICT use. Teacher A felt that she was team teaching with Teacher B, which she found a useful experience. Teacher B in particular commented on the increase in collaborative working among his pupils, as did several pupils from both schools.

The future

The majority of the pupils (approximately 80%), and all the teachers felt that they would like to be involved again. Both participant teachers suggested some changes to the organisation of such a project:

- pupils to play a greater part in the planning and execution of the video conference

- smaller group sizes (maximum of 12 pupils)

- extended video conference sessions (half an hour was not felt sufficient to gain true learning benefits)

- time outside of the video conference to produce tangible results (for example, display materials) for which the video conference would be the catalyst or stimulus

- use of a radio microphone to enhance sound quality and give a clearer indication of who is speaking

- opportunities for more social interaction between participant groups of pupils, possibly meeting physically at some point.

Conclusions

Attitudes of both teachers and pupils to the video conferences were on the whole good: video conferencing added to the pupils' motivation and provided a sense of excitement which is not normally a feature of mathematics lessons. The level of confidence of the pupils increased, although some expressed feelings of considerable embarrassment. The video conferences contributed to opportunities for genuine collaboration, and increased the mathematical communication skills of the pupils. Against this, there were a number of management and pedagogical issues, which the teachers had not anticipated and which were different from those of a normal lesson. In particular, social time needed to be incorporated, while picture and sound quality were found significant in affecting pedagogical issues also.

If schools are to use video conferencing as an addition to a normal lesson, there are issues that need to be thought

out in advance, including the provision of equipment of adequate quality, and some training for both teachers and pupils. The benefits to the confidence and communication skills of the pupils (and teachers) are worth considering, however, as are the opportunities for increased collaboration both within schools and between schools.

As the technology improves, and costs decrease, video conferencing will become increasingly available and is well worth considering as another tool to help equip pupils with the skills necessary for modern life. It can also be used to facilitate observation of good practice, and to bring good teachers to a wider range of pupils.

References

Comber, C. and Hargreaves, L. (1997), 'The impact of information and communications technology (ICT) on transfer between primary and secondary schools in the UK', paper presented to the Annual Conference of the European Conference on Educational Research (ECER), Frankfurt, Sept. 24.-27., 1997

Comber, C., Watling, R., Lawson, T., Cavendish, S., McEune, R. and Paterson, F. (2002), *ImpaCT2: Learning at Home and School: Case Studies*, ICT in Schools Research and Evaluation Series No. 8, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/impact2/].

Galton, M., Comber, C., Hargreaves, L., Lawson, T., Fogelman, K., Thorpe, R. and Roberts-Young, D. (1997), *Education Departments' Superhighways Initiative (EDSI): Group A: Curriculum Projects in England and Wales Final Report*, HMSO, Norwich, and the UK Education Departments, in association with the National Council for Educational Technology (NCET), Coventry; also online: viewed November 2003, [http://edsi.ngfl.gov.uk/help/navigate.html].

Hall, J., McPake, J. and Somekh, B. (1997), *Education Departments' Superhighways Initiative (EDSI): Group S: Curriculum Projects in Scotland Final Report*, HMSO, Norwich, and the UK Education Departments, in association with the National Council for Educational Technology (NCET), Coventry; also online: viewed November 2003, [http://edsi.ngfl.gov.uk/help/navigate.html].

Harrison, C., Comber, C., Fisher, T., Haw, K., Lewin, C., Lunzer, E., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B. and Watling, R. (2002), *Impact2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*, ICT in School Research and Evaluation Series No. 7, HMSO, Norwich, and DfES, London, in association with Becta, Coventry; also online: viewed November 2003, [http://www.becta.org.uk/research/impact2].

Heath, M. and Holznagel, D. (2002), '*Interactive videoconferencing: a literature review*', Paper prepared for the K-12 Interactive National Symposium for Interactive Videoconferencing, Dallas, Texas, October; also online: viewed December 2003 [http://neirtec.terc.edu/k12vc/resources/litpolicy.pdf].

McFarlane, A., North, R. and Stain, M. (1997), *Education Departments' Superhighways Initiative (EDSI): Group C: Teachers' Professional Development Final Report*, HMSO, Norwich, and the UK Education Departments, in association with the National Council for Educational Technology (NCET), Coventry; also online: viewed November 2003, [http://edsi.ngfl.gov.uk/help/navigate.html].

Mills, G. (2000), *Action Research: A Guide for the Teacher Researcher*, Merrill, New Jersey.

Passey, D., Forsyth, K., Hutchinson, D., Scott, A. and Williams, D. (1997), *Education Departments' Superhighways Initiative (EDSI): Group D: Home-School Links Final Report*, HMSO, Norwich, and the UK Education Departments, in association with the National Council for Educational Technology (NCET), Coventry; also online: viewed November 2003, [http://edsi.ngfl.gov.uk/help/navigate.html].

Ruthven, K. and Hennessy, S. (2002), 'A practitioner model of the use of computer-based tools and resources to support mathematics teaching and learning', *Educational Studies in Mathematics*, vol. 49, no. 1, pp. 47-88.

Scrimshaw, P. (1997), *Preparing for the Information Age: Synoptic Report of the Education Departments' Superhighways Initiative (EDSI)*, HMSO, Norwich, and the UK Education Departments, in association with the National Council for Educational Technology (NCET), Coventry; also online: viewed November 2003, [http://edsi.ngfl.gov.uk/help/navigate.html].

Thorpe, R. (1998), 'The use of personal video conferencing with special needs pupils from three schools serving rural areas: a case of successful adoption of new technology', *Journal of Information Technology for Teacher Education*, vol. 7, no. 3, pp. 395-412.

Author biographies

An assessment of the ways in which teachers evaluate software

Pauline Moss is currently a serving teacher in a junior school in the South East of England and is Deputy Headteacher, ICT Co-ordinator and Literacy Co-ordinator. Before this she was part of the team that delivered NOF training and determined policy within the Highlands. The issue of software evaluation has been a recurrent theme of research for Pauline and formed part of her research for a MEd. in ICT and Learning with the University of Aberdeen. In addition, while carrying out her role in the Highlands, many colleagues requested help with the selection and implementation of software. In her current role, frequent choices have to be made as well as recommendations to colleagues with respect to the implementation of the ICT curriculum as well as cross-curricular use in other subjects.

Bridging the gap: ICT in the transition year

Andrew Madden has been working with ICT in education since 1995. His involvement began when he joined a project team developing Computer Assisted Learning (CAL) materials at Aberdeen University. He left to research the impact of CAL at Sheffield Hallam University, after which he spent time at Barnsley CFE supporting and training lecturers. After two years establishing and running a Learning Resources Centre at a comprehensive school in North London, he returned to Sheffield, where he is now employed as a Research Fellow investigating ways to improve the information seeking skills of school students.

Lynda Bates began her career as a Nursery Officer for Social Services. She then worked on local childcare projects in a voluntary capacity, and gained an Advanced Diploma in Childcare and Education. She has worked at The City School in Sheffield since 1995 where she currently holds the post of Senior Learning Mentor. She has a particular interest in Key Stage 2/3 transition and is part of the team responsible for this.

David White is Assistant Headteacher at The City School, Sheffield with responsibilities for managing the DfES *Excellence in Cities* initiative and the EU Objective 1 programme, *South Yorkshire e-Learning Project* both of which have been used to promote a number of research activities. He has been a consultant for Becta for a number of years particularly in respect of the use of ICT in careers education and guidance. He is currently on secondment to Ofsted.

Colouring outside the lines: research into the potential of using new digital technologies to increase home-school interactivity in a conductive education environment

Allan Johns is a teacher, trainer and ICT specialist with over 30 years professional experience. He has latterly been developing inclusive ICT resources and facilities at Paces Campus, High Green, Sheffield.

The development and use of a computer based model for assessing thinking skills

Tim Denning is the ICT and Computer Studies subject tutor for the PGCE Initial Teacher Training course at Keele University, where he is also responsible for taught modules and ICT support at both undergraduate and postgraduate level. He is currently leading a major national evaluation project for Becta and the DfES concerned with online professional development materials for Key Stage 3 subject teaching. Until recently he was the leader of an international research group exploring the development of ICT pedagogy during pre-service and in-service teacher training as part of the European MM1010 project, funded by the European Commission.

Tony Fisher is a lecturer and researcher at the University of Nottingham School of Education, where he is also the ICT Co-ordinator. He teaches on a range of courses at undergraduate and postgraduate level, including an online taught doctorate in teacher education. He previously taught geography and humanities in a comprehensive school. He has been an evaluator of a number of national ICT initiatives, and is currently a member of the team conducting the evaluation of the development and use of online professional development materials to support the use of ICT in Key Stage 3 subject teaching. He is currently Chair of the Association for Information Technology in Teacher Education.

Chris Higgins is Principal Lecturer at Westminster Institute of Education, Oxford Brookes University and is a member of the Westminster Institute Research Centre for Able Pupils. His research interests include evaluating the use that children can make of ICT as a cognitive tool, and investigating the diverse ways in which children work in ICT-rich environments.

Avril Loveless is a Reader in the School of Education at the University of Brighton, where she is responsible for teaching at undergraduate and postgraduate level, and research and evaluation in the Educational Research Centre. She is a member of the major national evaluation project for Becta and the DfES concerned with online professional development materials for Key Stage 3 subject teaching. She has worked with teachers and artists in a number of projects investigating the creative use of digital technologies in schools, and is a member of the Creating Spaces Network.

Rob Tweats taught biology at secondary high schools for 18 years before moving to his current post as PGCE curriculum tutor at Keele University, lecturing in biology and broad balanced science. He is a science consultant for NQTs, an external examiner for all science related degrees and PGCE science at Liverpool John Moores University, an A level examiner for Edexcel, and is a member of SITE (Society for Information Technology and Teacher Education) science international group. His research interests include evaluation of a DfES commissioned/Becta managed continuing professional development (CPD) online pilot in Key Stage 3 science, and group research into CPD of associate science teachers.

The Hedley Walter High School: cultural change in learning through the use of new technologies

Ian Terrell is Director of Research and Studies at Ultralab and has been focusing on a number of projects including a new online degree; Talking Heads, an online community of headteachers; and Ultralab Learning: an online community of enquiry. He taught in schools for a number of years before going on to work for an LEA advisory team, and as an educational consultant. He joined Anglia Polytechnic University as Head of Continuing Professional Development before moving to Ultralab in 2001.

Stephen Capper read English and Philosophy at St Martin's College, Lancaster before training as a teacher of English and Drama at Hilde Bede College, Durham. He began teaching in an 11 to 19 Community College in Leicester in 1986 and went on to work in urban and rural Essex. He became a Head of English in East London in 1996 and through that role became heavily involved in piloting National Literacy and ICT as well as a range of other school improvement, research and development

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ICT and subject literacies: a study of the relationship between ICT and subject literacies in the secondary school

Andrew Goodwyn taught English in secondary high schools for 12 years before moving to a teacher education post at The University of Reading. He is currently Course Leader for all secondary English student teachers and for the Masters in English and Language in Education, as well as being Director of Teaching and Learning. He has written a number of books and articles and has a specific interest in the ways information and communication technologies are changing the subject and affecting the nature of expertise that English teachers develop.

Kate Findlay is a secondary school teacher and Research Associate at The Centre for Language, English and Media Education (CLEME) at the University of Reading. She has worked on several research projects investigating the emergent relationship between ICT and literacy and has had work published relating to improving literacy at Key Stages 2 and 3.

An investigation into the visual and kinaesthetic affordances of interactive whiteboards

Ian Davison completed a PhD in Experimental Psychology, before training as a teacher. He worked as a secondary school teacher for 14 years, with various roles such as ICT Co-ordinator, Head of Science, and Senior Teacher. More recently, Ian has worked as a Research Officer at Warwick University to investigate the use of interactive whiteboards in schools. His current research is concerned with tangible user interfaces, and he is also an Associate Lecturer for the Open University.

Dave Pratt is Director of the Centre for New Technologies Research in Education (CeNTRE), University of Warwick. The CeNTRE is involved in a range of research projects aimed at understanding the relationship between digital technology and learning. As a secondary school teacher for 15 years, he became involved in curriculum development projects mostly concerned with developing computer-based microworlds. His research over the last 13 years has focussed on how software tools shape children's mathematical thinking. His work on children's

probabilistic thinking and on graphing is internationally recognised, and his work in this field has led him to the elaboration of theory on situated learning.

Making IT happen: patterns of ICT use among a group of UK school staff

Christopher O'Mahony is the Manager of Information Systems at the Royal High School Bath, an independent girls' day and boarding school, which is part of the Girls' Day School Trust (GDST). He holds a PhD in Information Systems from Macquarie University, Sydney, Australia. He has been a practitioner in the field of IT for Educational Management for the past six years, and has conducted research in this area since 1994. Results of his previous research have been presented at the 1996, 1998 and 2002 ITEM (Information Technology in Educational Management) conferences, the Fourth and Fifth Australasian Conferences on Information Systems, the 2001 UKAIS (UK Academy for Information Systems) conference, and the Second European Conference on IT Evaluation.

Networking success: an investigation of the effectiveness of the Birmingham Grid for Learning's ICT Research Network

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The Ripple Project: the whole school impact of conducting learner-centred ICT projects in infant classrooms

Bridget Cooper is a Research Fellow in both the School of Education at the University of Leeds and in the School of Informatics at the University of Northumbria. She obtained a BA in History at Hull University in 1978, followed by a PGCE in 1979, an MSc in Computing at De Montfort University in 1993 and obtained her PhD in 2002 with a thesis entitled, 'Teachers as moral models? - the role of empathy in the relationships between pupils and

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The use of interactive whiteboards in the primary school: effects on pedagogy

Julie Cogill was Head of Mathematics and a senior teacher in a secondary school before joining the BBC in 1987. She was Chief Education Officer at the BBC until 2001 and is now working as an educational media adviser, and undertaking a research degree at King's College London.

Video conferencing in the mathematics lesson

Jenny Gage has been working in the video conferencing field for over two years, as academic co-ordinator of the *Motivate Project*, part of the *Millennium Mathematics Project* of the University of Cambridge. The Motivate Project organises mathematically based video conferences and projects for school students aged 5 to 18, together with courses introducing video conferencing to teachers and students. Since the beginning of 2003, the Motivate Project has also been involved with a group from Leicester University in a Becta/DfES research study of video conferencing in schools throughout the UK. Before this, Jenny was a secondary mathematics teacher for 15 years.

ICT in Schools Research and Evaluation Series

The ICT in Schools programme is central to the Government's ongoing programme of school reforms. Fulfilling the Potential, launched by the Secretary of State for Education and Skills in May 2003, outlines future directions for ICT as an enabler in whole school development and teaching and learning. Copies of *Fulfilling the Potential* are available on www.dfes.gov.uk/ictinschools. Research and evaluation is being undertaken using a variety of techniques, both qualitative and quantitative, and at both national and local level.

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