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Using ICT in the Primary Classroom

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This Spotlight explores some of the issues arising from an evaluation of two experimental projects concerned with the use of information and communications technology (ICT) in the primary classroom. Both of these projects showed that ICT has the potential to be an effective teaching and learning tool even where there is not access to the full range of top-level high-speed equipment. The focus here is on ways in which ICT can be used to enhance the learning process in the classroom and, in particular, on interactive teaching and learning in which pupils collaborate with other schools, and teachers also teach across schools.

The research on which this account is based was part of the Education Departments' Superhighways Initiative (EDSI), set up by the four education departments in the UK. For evaluation they selected 25 information and communications technology (ICT) projects from across the UK and from all sectors of education. Eleven teams undertook the evaluations. There were two Scottish projects, both evaluated by a team from the Scottish Council for Research in Education. The aim of the initiative was to explore the potential of emerging 'information superhighways' for education.

INFORMATION SUPERHIGHWAYS IN SCOTLAND

What is a 'superhighway'? It refers to a 'broad band' electronic communications network – that is, one which is capable of very high speed transmission of data, probably over fibre optic cable. In contrast, 'narrow band' technology is the more familiar connection of computers via modems over conventional telephone lines to a network. In between there is a range of 'intermediate band' technology based on high speed telephone (ISDN) lines. At the time the evaluation was commissioned broad band had become relatively widely available in the UK as a whole, which meant that using the Internet for information gathering and research, for example, became a practical proposition for many schools. Similarly, the quality of video communications is significantly enhanced by broad band technology, making it a more attractive proposition for distance teaching and learning.

However, much of Scotland is outwith the current fibre optic cable network and the schools involved in the two Scottish projects had access only to narrow and intermediate band technology. The two Scottish projects selected for evaluation were *Superhighways Teams Across Rural Scotland* (STARS) and *Modern Communications For Teaching And Learning in Argyll and Bute*. Both involved primary and secondary schools but the focus of the evaluation was on primary schools, most of which were small (four teachers or fewer), and in remote, rural locations. In terms of focus and scope, however, the two projects were very different.

SUPERHIGHWAYS TEAMS ACROSS RURAL SCOTLAND (STARS)

STARS was set up and coordinated by staff at Northern College, and ran for one year (January to December 1996). In all, 18 small primary schools and two secondary schools, serving rural areas in the north of Scotland (including Orkney, Shetland and some of the Western Isles) participated in the project. These schools had not been in contact with each other before. This was intentional as one of the aims of the project was to create a *new* network based on existing electronic communications equipment. In contrast to other EDSI projects which had started by installing new equipment in schools and were therefore very expensive, the idea behind this project was to see what schools could do without extensive resources. The entire project ran on a budget of £1000, and operated on a 'lowest common denominator' principle: to participate, schools had already to have either an Apple 475 or an IBM 486 computer (or better) and a 14.4 Kbs modem (or better). None of the core activities required any more equipment than this (although some of the schools had considerably more advanced equipment) – but some optional elements did allow schools with better equipment to try out activities which the others – with the minimum level – could not attempt.

A second aim was to enhance provision for 'able' pupils. A particular concern for this group of lecturers was that able pupils in small primaries can be particularly isolated: they aimed both to put able pupils in different schools in touch with each other, and to provide challenging activities for them to work on. In practice, the definition of

able was fairly elastic, and it was up to class teachers to decide who would be involved in the project. In some cases, the work was restricted to two or three upper primary pupils; in others the whole school (from P1 to P7) became involved.

Thirdly, the project was intended to encourage pupils to develop problem-solving and critical and creative thinking skills. The coordinators devised a set of materials, some stand-alone and some linked by the theme of a journey through space, which were then sent to all the schools involved via computer. Schools in the network could download the materials as they appeared, work on the activities, and then, in turn, post their responses on the site.

At first, pupils involved were asked to work on discrete lateral-thinking tasks in their own schools and to send their solutions to the coordinators by computer when ready. The coordinators sent comments and additional ideas to the schools individually. Subsequently, the tasks linked to the voyage through space required pupils from different schools to collaborate with each other electronically on a series of maths, science and language tasks, using e-mail and attachments, before posting their results on the STARS site. Some tasks made use of the Internet in an experimental way, though for technical reasons these activities were restricted to a small number of schools. Plans to include video-conferencing in the course of the project using software available via the Internet had to be abandoned for similar reasons.

The final aim of the project was to develop teachers' awareness of the potential educational benefits of ICT. The coordinators wanted to give teachers some idea of the range of activities which ICT can offer schools, so that they could acquire the skills they needed, become familiar with the ways in which their own equipment could operate, and might begin to devise their own projects with others with whom they had come into contact as a result of STARS.

MODERN COMMUNICATIONS FOR TEACHING AND LEARNING IN ARGYLL AND BUTE

This project was coordinated by the educational development and support unit of the education authority. It was set up in 1993 and is still running. It involves all 22 school clusters – or cooperatives as they are known in Argyll and Bute – in the authority, comprising (at the time of the evaluation) 88 primary schools and ten secondaries. Over three quarters of the primary schools in this area are small (ie fewer than 120 pupils) and a substantial number are in remote rural areas, on the mainland or on islands. Because of the size of the initiative, the evaluation was based on two cooperatives, one island and one mainland.

The project aimed, firstly, to develop a communications strategy for schools serving a scattered population in remote rural and island locations. The authority set up an electronic communications network, using telephones, fax machines, its own authority-wide computer network, *Argyll Online*, and, in areas where ISDN lines could be installed, video-conferencing units. The aim was both to make for speedier communication between schools and the authority, and to enable schools to have greater contact with each other than had previously been possible.

The principal purpose of developing such a strategy was to enhance the curriculum. The curriculum in isolated schools can be more limited than in others for a number of reasons. Teachers have fewer opportunities to confer with colleagues, and the sharing of ideas, teaching approaches, or materials, which is taken for granted in larger schools, is therefore less common. Similarly, pupils in a small, remote school may have few peers – sometimes none – and thus have little opportunity to work with others, talk things through, make comparisons. Furthermore, resources tend to be more limited, because small schools usually have small budgets, have fewer opportunities to share resources with other schools or make use of a resource centre, and tend to be far from municipal facilities such as libraries or museums. A major aim was therefore to enable teachers and pupils to have greater contact with, and thus to benefit more from, each others' ideas and resources. In particular, the project was intended to promote interactive teaching and learning. This meant encouraging teachers to develop educational activities which would involve pupils and teachers from different schools in working collaboratively. It was also intended to develop ways of increasing access to specialist teaching for schools in remote areas outwith the range of peripatetic specialists.

The authority also hoped to enhance personal and social development (for pupils and teachers). Isolation limits pupils' and teachers' opportunities for social contact. The intention was to increase contact and thus enhance personal and social development.

Finally, the project aimed to support staff development in the use of technology. It was recognised that teachers would need considerable support both in learning to use the technology and in thinking through how to integrate its use into the day-to-day work of the class. The aim was to ensure that all teachers had adequate training in the use of the technology and opportunities for development in ways which they themselves felt appropriate. A centralised rolling programme of training and development was set up. A key feature of this was to avoid creating 'experts' and 'technophobes' (ie a situation in which some teachers became heavily involved – and consequently highly experienced – in ICT initiatives, while others played no part). Communications across the authority depended upon everyone having the confidence to use the network and exploiting it as fully as possible.

THE FINDINGS

Interactive teaching and learning

Before looking at how successful the two projects were in promoting interactive teaching and learning, we need to consider why this is important. This seems a particularly significant question at a time when some educationalists

have been advocating a return to 'traditional' teaching styles which focus on the individual rather than on collaborative learning. ICT is about communicating with others. If teachers are unconvinced of the value of collaborative work and rarely attempt this within their own classrooms, it is unlikely that their pupils will have the skills to collaborate with children in other schools, and their experience of ICT initiatives may turn out to be negative. In order to make use of ICT effectively, teachers must see collaborative learning as a valuable approach to learning, enabling pupils to pool knowledge, ideas and skills and to produce a higher quality of work together than they would have been unable to produce individually.

Making and sustaining contact with other schools

Interactive learning is not necessarily easy even when the benefits of collaborating electronically are clear. It is hard to work with those you have never met before, particularly when communication is primarily through writing. Both projects developed ways of breaking down barriers.

In the STARS project, before embarking on interactive work, pupils were invited to write descriptions of their schools and themselves and share these with the others. They were also able to make social contact with the other pupils with whom they were working via an electronic feature called 'on-line chat' which enables users to 'converse' in writing. At the outset of the project this feature had considerable novelty value. Later, it became less popular for a variety of reasons: pupils' typing speeds were not very fast, and responding to messages was time-consuming (and therefore costly). In addition, teachers were somewhat wary about the content of these messages and their educational value. It was also difficult to arrange times at which pupils in several schools could be on line at the same time. The use of on-line chat thus declined markedly over the life of the project but by the time this happened its function as an ice-breaker had been fulfilled.

In Argyll and Bute, where teachers were able to take a longer-term view, teachers developed a variety of strategies. One example of these was a buddy system. At an early stage in developing ICT skills, pupils are allocated one or more buddies in other schools (usually within the cluster). They first 'meet' at the point at which pupils are being introduced to video-conferencing, and therefore see each other on screen, and work through a series of exercises designed to help them get to know each other, as well as to develop video-conferencing skills. Later they can work together on a range of activities, using e-mail and fax as well as video-conferencing to communicate with each other. The Argyll and Bute teachers emphasised the importance of meeting in person from time to time, as well, however, and arranged inter-school activities where buddies could meet each other. They felt that electronic communication does not do away with the need to get to know face-to-face, the person you are working with.

Supporting interactive learning: appropriate materials

Pupils and teachers in both projects stressed the importance of stimulating materials. In both, developing appropriate materials was extremely time-consuming. As ICT becomes more widespread the need for good materials linked to the goals of *5–14* and which exploit the potential of electronic media, will increase.

In the STARS project materials were developed by the college staff, in consultation with teachers in the schools. One example, part of the 'voyage through space' theme, had pupils exploring the physics of bouncing. Pupils were asked to investigate what determines whether balls bounce high or low and the number of bounces per drop. They were also asked to consider the factors which would enable them to develop a fair test. By this stage pupils had been divided into cross-school groups, each of which fulfilled a different function on the voyage. The investigation task was given to two groups – scientists and communicators. (Other jobs included navigators, engineers and space anthropologists.) There was extensive correspondence among scientists and communicators in five of the schools, as well as comments from the coordinators ('Mission Control') during the course of the work. A total of 47 messages were posted by the pupils over four weeks. For example:

16 May 1996: G School

We fetched the balls from the gym. We agreed we would have to bounce each ball from the same height – 1 metre using a metre stick. We did not bounce the balls we let them fall out of our hands and used tally marks to count the bounces. We all worked on the same floor. Our bounce count was practically the same for each of the three groups.

We agreed some materials are better bouncers, some materials are heavier. The height, weight, material and landing surface all affect the number of bounces.

22 May 1996: Sk School

We have experimented with the ball we got like everyone else's, these are our results.
On the cushioned lino the ball bounced up to 70 cm.
On the thick lino the ball bounced up to 75 cm.
On the carpet the ball bounced up to 60 cm.
On the wooden floor the ball bounced up to 70 cm but the floor is uneven so it varied.

To make sure we measured the same height we drew a line on the ball and put the purple side facing upwards. We held the middle of the ball at the top of the metre stick. The conclusion is the harder the surface, the higher it bounces.

We are hoping to borrow a video camera to put on slow motion with the ball bouncing off the floor and up the metre stick to measure it more accurately. Our next test will be how well a football bounces with different amounts of air in it.

The messages show how pupils were able to take up ideas initiated by pupils in one school, and how, over time, they all came to realise that the key factors were the ball itself, the height from which it was dropped and the surface on which it fell. It is likely that they would have come up with these features working within their own school (particularly if they had others to work with) but the effect of the repeated experiments in different locations increases their experience and the conviction with which they can ultimately make the case.

Skills for distance communication

What is also significant about these messages is that the pupils have to formalise the sharing of information – they make arrangements to communicate and they apologise for failures – in a way which would not be necessary in the classroom, and which is likely to develop their understanding of how to collaborate with others, as the following example shows:

> ***4 June 1996: H School***
> *We think we should do it again so our schools are using the same kinds of balls. The balls should be the same weight, measured from the same height and the floor surface should be much the same. We will be on line at 2.15 pm on Tuesday afternoon and the same time on Wednesday if you want to talk about it.*

> ***11 June 1996: St School***
> *We are very sorry, we were supposed to write you a letter about what we decided on our chat yesterday, here's what we decided.*
>
> *We decided to use the same tennis ball and power ball, and we decided to use the same heights (1m and 50cm) and count how high the first bounce went up to. We decided to use the surfaces of wood, tarmac, grass and carpet. We were supposed to have the results in by 11.00 today but some schools haven't got their answers in yet. Please could you have your answers in as soon as possible. We also decided that we (St School) would do the single report and we said that we would have it in by this afternoon. We hope you can get your answers in quickly and we are very sorry that we didn't put this letter in yesterday.*

The importance of feedback

The role of Mission Control was also important in providing feedback to the pupils as they worked and in validating the results of their experiments. In the following message, Mission Control praises the children's achievement and provides detailed feedback on the work the they have done. Both pupils and teachers agreed that the interest and commitment which the co-ordinators gave to the project was crucial to the success of a complex and sometimes frustrating way of working.

> ***12 June 1996: Mission Control***
> *Important message from mission control.*
>
> *We acknowledge the receipt of your final message on bouncing.*
>
> *Well done all the Communicators and Scientists (H, G, Sk, Hy and St Schools).*
>
> *Your efforts at communicating have been excellent!*
>
> *The production of a single report has been completed despite some communication difficulties and the occasional breakdown.*
>
> *You HAVE –*
> - *focused, as instructed, on ACCURACY*
> - *made considerable progress in TAKING ACCOUNT OF ALL THE FACTORS which might influence your study of the phenomenon of bouncing*
> - *shared your knowledge*
> - *developed and demonstrated your skills in testing a theory, in observation and in recording your findings*
> - *shown considerable expertise in communicating and sharing ideas, findings, and differences*
> - *achieved the goal of preparing a single report on your work which will now be the basis of any future work on bouncing in the STARS Trek programme*
>
> *You should feel justifiably PROUD of your ACHIEVEMENTS*
>
> *Your success has been noted and recorded in the STARS Trek records at Mission control.*

Teaching at a distance

The two projects offer different models of the teacher operating at a distance. In the STARS project, lecturers at the college were able to interact with pupils in many different schools across the north of Scotland and to coordinate work on a common project. This happened in Argyll and Bute too, usually within clusters however. Argyll and Bute also developed a particular approach for use by specialist teachers whose access to the more remote primaries was very limited. At the time of the evaluation, for example, an art specialist was piloting an approach based on a combination of video communication and electronic networking to work with pupils in schools many miles away.

In both projects, the success of teaching and learning at a distance was closely linked to the extent to which the distant teacher was able to consult the class teacher and plan activities in advance. As with pupils, it was easier to develop a working relationship if the teachers had some opportunities for face-to-face contact. In Argyll and Bute, the art specialist developed a series of procedures to be used by himself and other teachers working at a distance, to ensure that his work was integrated into the work of the class and was compatible with the way in which the class teacher wanted to approach the activity. The procedures committed the specialist and the class teacher to a significant amount of planning time before the pupils came into

contact with the specialist. (They were able to make use of the electronic network to support their planning too.) The specialist's contact with the school via the video-conferencing unit could be used in various ways, but these also needed to be thought through in advance. One advantage of this approach is that when the specialist demonstrates particular techniques, the demonstration can be recorded for repeated viewing. The procedures also established methods of feedback (using the network) and ways of ensuring continuity.

Developing pupils' ICT skills

Although the primary learning goals of both projects were in other areas of the curriculum, both acknowledged that pupils would also need to develop specific ICT skills in order to benefit.

Particularly in the STARS context, part of the aim was to help pupils and teachers to explore the potential of ICT for future work, and by the end of the project all pupils involved were confident about using e-mail and about sending attachments.

In Argyll and Bute, where teachers could take a longer term view of the development of pupils' ICT skills, work had been done to link ICT skills with the *5–14* IT curriculum, establishing a hierarchy of skills and ensuring that these were acquired methodically by all pupils. For example, pupils training in the use of the video-conferencing unit started with the basics in primary four (when pupils were already familiar with basic IT skills such as creating and saving documents on disk) and continued to primary seven, by which time pupils were able to use the technology to work collaboratively on a shared document, discussing the work and making changes or additions as they did so. As with teachers, a key principle was that the presence of technology should not encourage divisions into 'experts' and 'technophobes'. Use was monitored by teachers to ensure that all pupils completed basic training and that they subsequently built the use of the equipment into their day-to-day work.

Despite this detailed emphasis on the development of ICT skills, the goal of the project was not the acquisition of the skills but to enable pupils to make use of ICT in their daily work. Pupils were encouraged to consider the appropriateness of different types of equipment for making contact with others outside the school, gathering information, and working collaboratively. For example, in one cooperative pupils were expected to set their own learning targets for all aspects of the curriculum, and integration of the use of ICT was a feature of the target-setting process.

BENEFITS

In both projects teachers were convinced that collaboration with pupils from other schools had brought a number of benefits for their pupils. They had increased their range of contacts and made new friends. Academically, one of the major benefits lay in improvements to pupils' communication skills. Communicating in writing required pupils to state issues clearly, ask relevant questions and present their work in ways which others could easily understand. Because they were *really* communicating, and not simply producing written work as a classroom requirement, the reasons for particular written conventions became much clearer. If pupils who received their messages could not understand, they had no hesitation about saying so and requiring the writer to redraft the message.

Pupils became more aware of the potential of the media they were using, and began using them for other purposes. For example, a pupil engaged on a project about fish-farming faxed a questionnaire to several businesses in the area and received a number of responses, culminating in an invitation to visit a farm. Thus pupils' potential collaborators can extend from pupils in other schools to anyone with a fax or an e-mail address who is prepared to become involved. (Of course, teachers need to monitor such communication to ensure responsible use: some have expressed unease about such activities. But pupils' opportunities for external contact will increase as ICT becomes more widespread, and it will be important at some stage to consider the education implications of wider contact.)

In Argyll and Bute, where pupils also collaborated orally via the video-conferencing unit, teachers noticed developments in pupils' oral skills too. In part this was a result of a deliberate strategy to develop appropriate 'good manners' for communicating in this way. For example, pupils were taught expressly to greet each other politely and to thank each other for calling at the end of a call. They were also encouraged to think about the image they were projecting and how to show work or demonstrate procedures to others on screen. However, teachers noticed other, unexpected benefits. In two different schools, pupils with social difficulties found it easier to communicate with others electronically than face-to-face. One teacher noticed that a child who normally had difficulty making eye contact was unaffected by this when communicating by video, and was thus able to develop more positive relationships with pupils in other schools.

CONCLUSIONS

What can other schools learn from the experiences of those involved in projects? Firstly, developing ICT in the classroom is hard work. For this reason, if no other, teachers need to be committed to the principle of collaboration, valuing what collaborative learning can achieve for their pupils, and recognising what they themselves can gain from collaborating with other teachers, at a distance. Secondly, what emerges from both projects is the importance of developing relationships among those in contact with each other electronically. It is difficult to work effectively and meaningfully with someone you have never met and with whom you have had no contact before the moment of an electronic 'event'. Thought needs to be given to the

development of longer-term relationships, which ideally involve face-to-face contact as well as electronic communication.

A significant finding from the Scottish evaluation is that even 'outdated' technology has a substantial amount to offer schools, and teachers should not be daunted by thinking that they cannot always keep up with the latest developments. It may be more valuable – from an educational perspective – to explore the potential of a few technological innovations very thoroughly and use them well, than constantly to seek new tools and develop only a superficial competence. This is not to say, of course, that Scottish schools in rural areas – and others in similar settings – will not be at a disadvantage in the long run, if they do not, for example, have reasonably speedy access to the Internet.

In the view of the SCRE evaluation team, the gains to be made from the use of ICT in the classroom are substantial, when the collaborative nature of the endeavour is recognised and supported. Children's desire to communicate is stimulated and, as a result their ability to do so, orally and in writing, is enhanced. When this feature is combined with challenging educational materials there is the potential for children to produce work of a very high quality. Like most educational innovations, the input and the support provided for children by their teachers – their own class teacher or a teacher working at a distance – are crucial to success. Approaches which recognise the key role of the teacher and the importance of integrating work using ICT with other classroom activities are likely to yield the greatest benefits.

End notes

1. The authors would like to record their thanks to teachers and pupils in schools in the two projects who took part in the research, as well as to education advisers from Argyll and Bute Council and lecturers from Northern College who co-ordinated the two projects.
2. The four UK education authorities have published a synoptic report, summarising the findings from the 25 projects selected for evaluation: *Preparing for the Information Age: Synoptic Report of the Education Departments' Superhighways Initiative.* London. DfEE. 1997. The full reports, on each of the 25 projects, can be found on the Internet, at http://vtc.ngfl.gov.uk/reference/edsi/
3. Further information about the STARS project can be found in Ewing, J., Dowling, J. and Coutts, N. (1997) *STARS Report.* Dundee: Northern College.

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