The development of the professional values and practice standard in the secondary graduate initial teacher training route in England

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Implementation of a major E learning Strategy in Secondary Schools in South Yorkshire

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Abstract:

The paper reports on the implementation phase of a major E learning project in South Yorkshire, England. A longitudinal case study approach is being used to monitor how secondary schools are using the additional resources that come into schools, which started at different stages in maturity in the use of ICT. These have been mapped against recently established UK maturity models. The main findings are that effective school leadership, understanding of the change management process, and engagement of staff are all very important for success. The project has been very successful in meeting targets for numbers of pupils gaining ICT qualifications – which will impact on their future employment and contribute to the economic regeneration of the region.

Introduction

E-learning has now been in use in English secondary schools for several years and is beginning to transform the educational experience. Many different initiatives have attempted to harness the potential it offers, but there still remains little evidence of what works and how it can be most effective. While there is no shortage of evaluative reports on the impact of initiatives they quickly become dated, due to the rapid pace of technological change, and investment decisions regarding hardware, infrastructure etc. are having to be made without a real understanding of their longer term impact. The e-SY.info project is injecting new capital for technology and training into South Yorkshire secondary schools and a team from SHU is studying the responses and effects at the level of school management, teachers and pupils over a three year period. This paper reports on our findings mid way through the implementation phase in the context of related research in the UK and internationally

The e-SY.info project

The e-SY.info project www.e-sy.info/SYELP/Portal/Welcome.aspx is a regional project funded by Objective 1 European funding, to develop the educational and career opportunities of young people in an economically disadvantaged area, through the injection of region wide ICT equipment and training. It is being implemented by Research Machines plc and partners. The whole project includes community wide intervention in post-compulsory education and in small and medium sized enterprises, as well as within secondary schools, but this paper is reporting only on the intervention in schools. This project was set up to be a technological approach to the economic development of a disadvantaged area, with the idea that pupils at school and adults in the community could be given opportunities for gaining additional technological skills and qualifications - to create an e-literate society of entrepreneurial young people with advanced ICT skills for developing new industry in the area. At the same time the computer equipment provided to schools could impact on teaching in other subject areas. Each school was given a budget to spend

on additional ICT equipment – including cabling, wireless connections, desktop and laptop computers, printers, digital cameras and camcorders and other specialist ICT equipment. A particularly important aspect of the project was the establishment of a new regional Virtual Learning Environment (VLE). This promised to provide genuine opportunities for pupils and parents to access materials from home, and for schools to share their expertise and teaching ideas, as well as to access for their own teaching a vast range of resources from the internet.

These changes and opportunities were also facilitated by a programme of training made available to the teaching staff of the schools. The schools were required to negotiate a number of outputs which they would achieve, in terms of new ICT qualifications for pupils and teachers. Within the schools the provision of additional ICT equipment and the VLE was also expected to enable much of the teaching and learning in other curriculum areas to be conducted with and through ICT, and result in an increase in student achievement, motivation and engagement with learning.

Context of the teaching of ICT within schools in England

The government has centrally funded, in part, the development of ICT in education since 1980, when it set up the Microelectronics Programme to encourage the development of the use of computers in schools (and even earlier in the university sector). Despite its successes, funding was withdrawn in 1986 and it was replaced by the National Council for Educational Technology (NCET) and later BECTa and during this time funding was available for a number of ICT projects. However the developments were seen, by many in the field, as short term and patchy. As early as 1992 Davis described this, saying

> *"Other schemes followed, approximately annually, often at short notice with little time for planning and most required part funding from other sources. Teacher education institutions were rarely included. Training for practising teachers was recognised as important from the start, but was mainly in the form of inadequate short courses. Advisory teachers and regional support centres have received national funding as well (for more detail see POST, 1991). These developments have resulted in an uneven distribution of equipment and a lack of trained teachers."*
> *(Davis, N. 1992)*

In the latter part of the 1990s, the government began a major, ongoing, programme of investment in the IT infrastructure in schools and closely coupled this to a variety of ways of subsidising the purchase of workstations for pupils, administration and teachers. Major changes were introduced into the ICT curriculum and in the ways in which schools were expected to deliver the necessary skills and capabilities. A number of studies have been funded on the effectiveness of various parts of the programme and into its impact on teaching and learning.

The need to train serving teachers in the use of the new technologies was recognised and the New Opportunities Fund (NOF) ICT Training Initiative provided £230 million for this over a three year period from April 1999. The internet was seen to be a significant resource for this training, much of which relied upon networked materials and support. The initiative focussed on the use of ICT as a tool for teaching and learning and did not set out to train teachers in basic ICT skills: they were expected to have mastered these before starting the NOF training. Combined with changes in the requirements for initial teacher training, this should mean that all serving teachers in the UK have been trained in the use of ICT to support their teaching and the pupils' learning.

As the number of computers in schools has risen, so has the number of pupils wanting to take ICT qualifications – and, indeed, the number of qualifications available. This has 'soaked up' most of the increase in computer numbers and only recently has sufficient

capacity been developing for other subject areas to have significant access to ICT facilities for teaching and learning.

In recent years, schools in England have been progressively separated from the local government control (under which they were previously funded) and more funding has been given directly to schools. They have also been encouraged to apply for Specialist School status in particular curriculum areas, both with the intention of driving up standards and of offering parents and pupils more choice of types of schools. ICT has played a part in this, being seen as an essential requirement to support the specialist subject area. Many schools have also chosen technology or ICT as the specialist area. Special status does bring with it higher funding allowances for a number of years, so those schools without it are effectively financially penalised.

In 2002 the government introduced the Key Stage 3 National Strategy, (DfES 2002a http://www.standards.dfes.gov.uk/keystage3) and in particular the *Framework for teaching ICT capability: Years 7, 8 and 9 (*DfES, 2002b) sets out the minimum expectations of teaching in ICT which schools must provide. This includes the provision of one hour per week throughout years 7 – 9 in ICT subject teaching. ICT will be regarded as a core subject at KS3 with externally marked (on-line) SATs in Y9: the first trials of this system have already taken place in schools earlier this year.

The current emphasis of the strategy is intended to “increase pupils' rates of progress” (DfES, 2005) and a number of documents, such as “Raising standards and supporting whole school improvement” (DfES 2004) are available to support this.

Pupils at KS4 (Y10 - 11) are also expected to have 1 hour per week and to take one of the many approved qualifications at the end of the keystage. Although the ICT may be incorporated within a vocational subject, such as Business Studies, or Leisure and Tourism, the vast majority of schools offer specific ICT sessions. There is now a dual award ‘vocational’ GCSE available, Applied ICT. In addition, ICT is expected to be used across the curriculum in all subject areas. This use could include information retrieval from the internet, preparation and use of multimedia presentations, and use of particular topic-related software relevant to particular subject areas etc. The development of ICT within schools has thus not been a sudden discrete change in the way schools are run but has, over time, involved continuous adaptation and change, with considerable external pressure on the schools to update themselves and their teaching, but with no guaranteed funding to do this. Inevitably some schools have been proactive in meeting these challenges, whilst others have been following along trying to keep up.

Many of the South Yorkshire schools, before the start of the e-learning project, were not meeting these government expectations for teaching ICT, having too few computer-rooms to meet the requirement. Some were not providing the statutory one hour per week to KS3 pupils but, more commonly, others were not using ICT across the curriculum in all subject areas, for all pupils. Historically the area has been chronically under funded in recent decades and in many schools the buildings were also in a poor state of repair. Funding for new equipment from the project then made a significant different to most of these schools.

Information and communication technology moves on rapidly; what schools can do with the technology necessarily lags behind; and what constitutes effective, worthwhile use of the technology is largely unproven. By following developments in the schools over the life of this project we hope to add to the relatively small, but rapidly growing, knowledge base of how to ensure successful implementation of ICT programmes in schools.

It is not only in the UK that the gap between intent, practice and outcome is apparent. The New Zealand Education Review Office has recently reported that:

> *"Most schools had developed their vision and direction for e-learning … … tangible links between the school vision and teachers' classroom practice were not always evident"*

and

> *"… e-learning generally increased student motivation and enjoyment of learning … the extent to which e-learning was embedded … was limited" (ERO, 2005)*

One of the key conclusions of an EU funded study of ICT innovations in schools was that

> *"The effectiveness of ICT based innovations … relies on [its] successful integration into existing educational activities." (Kikis-Papadakis, 2002)*

These studies and many others clearly show the importance of getting the implementation phase right. What is less clear, however, is what constitutes 'right': can we predict conditions for success across a range of school situations.

SHU role and research questions

Throughout the project the Sheffield Hallam University (SHU) team have been carrying out an evaluation in schools in the region on the way that the project is being delivered and how it is effecting teaching and learning across the schools. We have taken a longitudinal case study approach, working with 12 of the 76 secondary schools in the project. This has provided a unique opportunity to investigate the ways in which the project has fitted into and contributed towards the on-going ICT development within schools over a period of several years, studying:

- the approaches taken by the school leaders in their selection and deployment of equipment, training and personnel;
- the effect of additional equipment and training on the ICT use of the teachers; and
- the resulting outcomes for the pupils in these schools.

In this paper we are focussing on two research questions that are concerned with the implementation of the project in secondary school. They are:

- What models of strategic implementation of ICT best support development of desirable learning outcomes?
- What are the critical factors which enable teachers within a school to develop their teaching and the learning of their pupils through the use of ICT?

We address two areas in which there is already a substantive literature. The first is that of educational change, in particular the *implementation of change*, and the second concerns pedagogic knowledge on how to apply ICT within the curriculum which has for sometime been a widespread concern to teachers, even those in leading schools (Leask and Younie, 2001)

Implementation of change – models of strategic implementation

The models of educational change which apply to the e-SY.info project need to relate more to evolution rather than revolution. Early models of change within institutions, focussing on leadership understanding have highlighted the essential part that leadership does play in developing successful adaptation (Fullan, 2001). In one widely used model of the change process by Huberman and Miles (1984) there are three phases - *initiation, implementation and institutionalization*. In our study the initiation phase was already largely completed as schools had already been introduced to the use of ICT within the curriculum, but needed to be initiated into the purposes of e-SY.info project and the outputs that were expected by the project funders. These outputs were largely related to measurable ones, such as numbers of qualifications achieved. Agreements about outputs were negotiated at the start of the project between representatives of Research Machines plc, LEA project coordinators and school leaders. Most schools had previous experience of the monitoring procedures that are required for European Funded Projects (through participating in a work related learning project *Pathways to Success*). Most of what we are reporting in this paper therefore lies within the *implementation* phase. The extent to which change has become institutionalized will not become apparent for at least another 2 to 5 years. This is because a large number of schools in the South Yorkshire region are being rebuilt or remodelled as part of a national programme and, for many, this will be an opportunity to build in flexible learning and teaching spaces that will facilitate *e-learning.* There is a substantial capital investment in new ICT equipment associated with these rebuilds.

In secondary schools, SMT support and involvement is required initially in making the facilities available for teachers to use, as well as encouraging ICT to be written into the schemes of work of every subject, but leadership at the departmental level is also important. In a study of science departments taking part in the national training in ICT, Finlayson and Rogers (2004) found that the training was most successful and teachers were pleased with the results of teaching sessions in science using ICT, when they were part of a supportive, democratic department. Here ideas on how to use particular software were shared between members, and the more confident ones worked with their colleagues. These departments were also characterised by having at least one member of staff with a good understanding of the pedagogy of teaching with ICT in the subject area.

Pedagogic Knowledge

This need for pedagogic understanding of how ICT can be incorporated into subject teaching has been highlighted in other recent research. For example:

McCormick and Scrimshaw (2001) analysed the way ICT could enhance the teaching of mathematics, particularly through the use of interactive white boards (*i*WB). They concluded that this enhancement could only occur if the teachers understood how to use interactivity, between teacher and pupils, pupil and pupil, and both teacher and pupils making use of the in-built facilities in the *iWB*. This requires a different approach to the use of *i*WB and multimedia from the use as a mere visual support for didactic teaching. The interactivity is seen as the key element to pupils' learning and sustained interest, but teachers need to learn how to teach in this way.

Too often powerful tools are used for trivial exercises, because the teachers have had insufficient training in their use and are unaware of the more profound possibilities. However, the need for staff training in the use of ICT within their subject areas is often overlooked by school's senior management team (SMT), and is one of the factors which makes the simple management of change model less appropriate for the development and embedding of ICT within an educational institution.

Within subject pedagogy

As the Finlayson and Rogers study showed, the presence or absence of individual staff members with particular ICT enthusiasms can make a considerable difference *to workforce maturity.* In the first Impact study Watson (1992) noted that good practice with ICT in a department often depended on a single enthusiastic teacher who developed materials for ICT expertise. Unfortunately such teachers were commonly regarded as mavericks by their colleagues, and when they moved on to other posts, the ICT use moved on with them. There have always been some early adopters of ICT who could provide inspirational teaching and inspire others. But the power structures within schools have often stood in the way of further development of *leadership maturity*

We have moved a considerable way since then in terms of teacher experience of ICT, but this is not to say that all, or even most, teachers are confident in their use of ICT in the classroom. In discussing confidence in using ICT Cox and Webb (2004) noted

> *"Teachers are confident in their uses of ICT so long as they have chosen those uses. Few teachers are confident in using a wide range of ICT resources, and limited confidence affects the way the lesson is conducted. Many teachers still fear the technology, which prevents them making much use of ICT in their teaching. "*
> *Cox, M. & Webb, M. (eds 2004)*

Recent research on the introduction of *i*WB technology divides teachers and leaders in to groups of *missioners*, *tentatives* and *luddites*, (Glover and Miller 2002). Missioners are the enthusiasts who can develop and use the software to good educational effect. The tentatives can be encouraged to use the software with support, but lack the technological confidence to do it on their own, whereas the luddites have no desire to change their current teaching approaches. In Glover and Miller's view senior leadership in the school also have to have this belief in the efficacy of ICT in teaching to provide the support and equipment for their staff. Issues of finance and priorities come in here, as decisions on how to spend limited discretionary budgets can either empower teachers with their own classroom ICT facilities, or frustrate them through additional hurdles of organisation and competition for too few bookable resources.

We therefore feel that the complexity of implementing ICT development is probably best captured by maturity models. For example, BECTa (2004) produced a discussion paper on maturity models in the context of supporting organisational change, looking at how different levels of maturity could apply to educational institutions. Underwood and Dillon (2004) have taken this idea forward in producing a multidimensional maturity model as a predictive tool for educational institutions. The different dimensions in which ICT maturity is considered are: Technological, Curriculum Leadership / Management, Workforce, and Linkage 1&2. Each of these has a set of different aspects on which their maturity can be scored reflecting the current practice in the institution. In our study we are looking at issues of leadership maturity, technological maturity and workforce maturity, all of which contribute to the ability of the school to respond to initiatives, such as the e-SY.info project, and which should also be changed by participation in the project.

In this model (adapted from Underwood and Dillon, 2004) for ICT to be successfully embedded in an institution:

- The leadership team need to be giving it some priority and have in place a policy, development strategy and regular procedures for monitoring and evaluating initiatives as they are introduced.
- There also has to be adequate technical resources and support for teaching and learning with ICT, in which teaching staff are not expected to use unreliable

equipment or trouble shoot minor technical difficulties at the same time as teaching.

- The workforce (teachers + learning support) need to have good access to technical equipment, so that they can plan their use of ICT, with the confidence that it will be available for their teaching. They also need to have a good understanding of how ICT can best be used to enhance the learning experience of their students, and have time to prepare and develop their uses of ICT.

Developments in these three areas tend to progress in stages, with some iteration, and fit well with the idea of maturity, as all need to go through the process of development. There is a complex interplay between the leadership, physical resources, technical support, personnel and teaching issues.

Methods, techniques and modes of enquiry

We are taking an instrumental case study approach to the evaluation (Stake, 1995) collecting data from a number of schools in the project, in order to examine and analyse the underlying issues and relationships; thus going beyond the immediate cases to the possible generalisations beyond them. The comparisons between the cases help to identify the critical factors that facilitate the integration of ICT across the whole school. This type of approach has been taken by Pettigrew and Whipp (1991) in identifying "common and differentiating factors" that lay behind successful management of change in large companies.

The data we are collecting is also longitudinal, gathered in 6 repeated visits to the same schools over the three years of the study, so that a dynamic picture of school development is produced. This allows for the testing of mini-hypothesis from the performance of the more advanced schools, in the development of the others, as they reach the same stage.

Data sources and evidence

Most of the data is qualitative, based on taped interviews, informal discussions, observations and class participation. Interviews and informal discussions have been held with senior leaders with responsibility for ICT, network managers, and teachers and classroom assistants involved in using ICT within their teaching. This has been supplemented by teacher surveys of the use of ICT within subjects and pupil's perceptions of which subjects at their school make most use of ICT within learning.

At this stage, midway through the study, the data is based on 3 repeated visits to each of 12 schools. For each series of visits a set of guidelines were produced based on the developing conceptual framework, to provide the focus of the visit and interviews with different teachers. The reports were then written along these themes and shared in a team analysis. Reflection and rereading of the reports allowed for new aspects to arise, modifying the conceptual framework. These new hypotheses were then used in the preparation for the next round of visits. For instance, information given by senior leaders in the first visit was checked against observations, records and discussion with other teachers in subsequent ones. The repeated visits, several months apart, therefore enabled both triangulation of the data, and a measure of progress in the integration and use of ICT.

Findings

Findings in the context of Leadership maturity

At the start of the project we were introduced to and worked with the e-SY school project co-ordinator. This person was our contact for future visits and we carried out several interviews with him/her.

In several schools, ICT had not been considered a high priority issue before the start of the e-SY.info project, and the school leadership had not chosen to invest their own funds in technological equipment or technical support. Two particular case study schools came into this category. Both had other problems with old buildings and were awaiting agreement for new premises to be built. These schools were the least mature in terms of ICT leadership. The contact person in each one was the ICT co-ordinator, who reported to the SMT, but was not a member of it. They were each in an isolated position within their schools – excluded from the main decision making forum, and unsupported in terms of policy and technical support. They had insufficient computer labs and teaching staff to meet the government's KS3 teaching requirements in ICT, and the cross-curriculum teaching was very patchy so that the experience of different pupils within school was very varied, depending on by whom they were taught. ICT was used across the curriculum only by staff who were particularly keen to use it, and it was not written in to any of the schemes of work. As ICT co-ordinator, the contact was not in a position to be able to suggest to Heads of department that they should incorporate ICT and ensure the equity of delivery to all the pupils. The lessons from the pathfinder studies showing the need for SMT involvement clearly had not been learned in these schools. When discussing why schools were successful in implementing the NGfL changes, they said

> *Some schools are managing the NGfL Programme very effectively. In all cases this is where ICT is seen as a senior management responsibility with devolved responsibility to all staff.*
> *(Somekh, Bridget et al. 2002)*

Some schools, though previously very badly equipped with new technology, had begun to improve the situation by volunteering for any funding which was offered. Two of the case study schools had volunteered to take part in the pilot phase of the e-SY.info project – though at the time they knew nothing of what it involved. They saw it as a way to improve the standard of their ICT equipment, since they received additional equipment as part of the pilot. In these schools the contact person was the ICT co-ordinator, but was working closely with one of the senior management team, usually an assistant or deputy head who took a strategic view of ICT across the school.

Several other schools also had this partnership of a senior manager + an ICT specialist spearheading the drive for technological development. In some cases this working partnership had been operating over a number of years. It proved to be a very successful combination for strategic planning taking into account practical technological considerations. An independent report from one of the LEA managers involved in the project also identified this type of partnership as an important element in the leadership maturity of schools that enabled technological development to take place.

Some leaders expressed concern that their staff would not be able to cope with the demands of the technology – particularly the VLE. They therefore did not expose the staff to it, but focused on other aspects of the project.

Over the course of the project there were some changes of personnel, and in some schools the contact person was promoted to take on a more strategic role.

Findings in the context of technological maturity

1. Only 3 of the case study schools were sufficiently well equipped at the start of the project to be able to meet the government requirements for teaching ICT as a subject in KS3 and KS4. The others required more computer suites to accommodate this teaching. Some also required new servers, cabling and wireless outlets.

2. At the start of the project most of the ICT co-ordinators informally had a trouble shooting role with respect to technical problems. There was usually a network manager in post, but few schools had full time technician support.

3. The advent of new and different equipment increased the technical burden, so in the more mature schools, as the contact person was required to take on a more strategic management role, so new technical staff were appointed to take on the technical duties.

4. Several schools received sets of laptop computers as part of their new equipment, when they had previously only had desk top computer suites. This therefore required a new way of working. In two schools it was decided that the teaching staff should take charge of the laptops, with respect to setting them up for teaching and recharging. But both schools found difficulties with this arrangement; the laptops were not getting used by all the staff to whom they had been allocated, for practical reasons related to their movement and setting up. One school was considering putting in technical support for the laptops to overcome this difficulty. In the more ICT mature schools technical staff were also given additional training

Findings in the context of workforce maturity

1. Training for teachers was available as part of the project, but this was generally technical training on how to teach ICT as a subject, as in MOS and ECDL qualifications which formed most of the outputs for the schools. In some schools the training was taken by a small core of staff, but in others a variety of staff with an interest in ICT were encouraged to attend. Similarly training for the use of the VLE was undertaken by at least one member of staff from each school, often the contact person. In one or two of the more mature schools this training was cascaded to other staff, so that others had the capability to understand the working of the VLE and to prepare and upload materials to it.

2. Staff questionnaires were given out in schools, some staff said that this was the first formal training that they had received. Most staff said that they had not had any training over the past year, including any in teaching ICT in their own subject area.

These questionnaires also asked staff about the use of ICT within their teaching, and their reasons for using it.

Pupils' questionnaires were also obtained from some pupils in KS3 and KS4. These asked only how much teaching with ICT – using computers or *i*WB – the pupils experienced in different curriculum areas. These were used to ascertain the amount of cross curricular ICT teaching that was going on.

Chosen approaches for implementation of e-SY

The choice of equipment and its deployment that each school made depended on the initial situation that they were in - and the demand for KS3 teaching. They also agreed outputs in terms of ICT qualification to be gained by pupils and adults (teachers and teaching assistants) related to the school.

Our data suggests that three most common approaches have been for schools to request:

- more desk tops and wiring (with some projectors & a few *i*WB)
- sets of laptops
- more interactive whiteboards

Those moving towards ICT or technology specialism welcomed the focus on ICT subject as an opportunity to give their pupils a recognised qualification in ICT. Some of these schools have needed to increase the number of desk top machines and establish more computer suites.

Laptops were often chosen for ICT teaching, to use in ICT suites to overcome space limitations within the school. However, they were found to be less suitable when used as regular lab machines, because of their requirement for recharging, and their more limited keyboards. Some laptops were chosen to boost cross curricular teaching with ICT - and sited in particular parts of the school. Here the physical layout and fabric of the school had a more than expected effect on their successful use. Failure of wireless networking, due to the nature of the buildings in some cases severely limited the flexibility of use as did short battery life

Others schools opted for increasing the number *i*WB, though the funding was insufficient to cover all required. Schools often supplemented *i*WB provision with their own funds (some through getting specialist status). . In some schools these were given to areas which already had some laptop computers which may have been getting old. In others it was hoped that the *i*WB availability would help teachers to get into using ICT within their teaching.

Consequences of the project and the strategy adopted

Schools that had invested in suites desk tops were in a strong position to extend courses leading to qualifications and achieved or exceeded their agreed project outputs. Cross curriculum usage of ICT within lessons was variable- but evidence that this was increasing in all schools. However some teachers were seriously frustrated by the lack of progress in being able to teach their subjects with the aid of ICT - particularly where they nominally had facilities in their area, but they were old and unreliable.

One science teacher commented that he had been able to use more ICT in his teaching in the previous year, despite the e-SY project

> *"There is no doubt that ICT is very important and rewarding part of science teaching but, because of the very poor ICT facilities in school, our department is falling short. We have one iWB for 15 science staff and a trolley of laptops to share between the whole department which is unacceptable with 15 staff and 1600 pupils."*

Schools with laptops generally used them as computer laboratories, or placed them into particular areas where they were always used. Typically this was in subject areas such as science, modern languages or geography. One school found that where the laptops were

intended to be shared between four different curriculum areas, in practice they were used only by the area in which they were situated, and particularly the room where they were kept on the trolleys. This came about not through the desire of the room teacher to keep them all to himself, but because moving them down the corridor, setting them up, and making sure that they were all working before the lesson, and packing them away afterwards took an additional 10 to 15 minutes out of the available lesson time.

Those schools that decided to enhance *i*WB provision had a significant increase in teacher use of ICT within subjects. One e-SY.info contact commented:

> *"in 15 years of doing this job, this is the first time an initiative has really made a difference in getting staff to use ICT"*

In this school the contact (with whole school responsibility for ICT) demonstrated ideas for using the *i*WB within his own subject area, and encouraged other staff to share their ideas too. Staff also attended LEA curriculum meetings where different ways of using the *i*WB interactively within the curriculum area were shown and discussed, and brought these ideas back into school.

In another school, a history teacher who had never used ICT in his teaching before was enthused by the possibilities of the *i*WB for his teaching, particularly using facsimiles of original documents and other illustrations from the internet, to engage the students' imagination and interest in historical evidence. English teachers in the same school shared their *i*WB resources, the more technically literate one being happy to let his colleague teach with the same materials.

Table 1 below shows the extent of use of computers in lessons across the curriculum, by students at KS4 in four different schools. The data was obtained from the pupils questionnaires and represents the percentage of lessons in each subject in which computers are used. Instances where computers were used in more than 20% of the lessons have been highlighted in the table

TABLE 1: Percentage of Keystage 4 Lessons Involving Use of Computers

	School			
Subject	**A**	**B**	**C**	**D**
Art & Design	14	6	6	41
Business Studies	11	34	40	22
Citizenship / PSHE	12	0	24	24
Dance	0	0	0	8
Design Technology	54	30	35	47
English	34	17	19	52
MFL	41	20	3	40
Geography	62	0	30	0
History	4	4	10	25
Maths	17	24	31	32
Music	0	0	13	10
PE	18	0	7	11

RE	17	0	20	7
Science	67	87	36	28
Vocational Studies	6	22	4	94
mean	***24***	***16***	***18***	***29***

The schools show varied amounts of penetration of computer use across the curriculum, with schools A, C and D showing use in most subjects, whereas use in school B is more patchy. All have substantial use in science, design technology, mathematics and English.

Table 2 (below) shows the same schools with the estimated use of the iWB within classes, from the pupils' data

TABLE 2: Percentage of Keystage 4 Lessons Using the Interactive Whiteboard

	School			
Subject	**A**	**B**	**C**	**D**
Art & Design	5	0	0	28
Business Studies	6	0	7	36
Citizenship / PSHE	12	0	0	41
Dance	0	0	0	8
Design Technology	20	10	2	54
English	10	0	0	91
MFL	45	4	3	60
Geography	19	6	28	13
History	0	0	0	13
Maths	12	4	2	87
Music	6	0	3	20
PE	15	0	2	4
RE	17	3	0	20
Science	19	24	2	71
Vocational Studies	6	7	0	94
mean	***13***	***4***	***3***	***42***

Here the use of *i*WB across the schools is markedly different. School D chose to go for *i*WBs as its approach to the project, and so has obtained a high level of use in almost every subject. School C, in many ways similar to School D, chose to follow a mixed desk top / laptop approach to the e-SY.info project and installed *i*WBs only in the geography and music departments. School A has a reasonable, but not high coverage of *i*WB use across the curriculum, suggesting that only some classes have the iWB installed.

These findings indicate only **how much** the *i*WB and computers are being used within classes. For an assessment of the quality of the use, we have looked at the data from the staff questionnaires. The staff were asked to say which of a list of reasons for using ICT in

the classroom they thought were important for them. Some of these reasons related to cognition within the subject area, and to learning how to learn. These we are calling Cognitive Reasons.

Using ICT:

- makes subject more accessible to students
- allows students to take charge of their own learning
- provides situations in which they can help each other and both understand more
- enables them to investigate the subject in a way impossible without ICT
- helps them to think about their own learning

Some reasons are not related to the specific subject area, but relate to improving the general learning situation, so the students may be more receptive to learning. These are Focus Reasons

Using ICT

- captures the students' attention when teaching with it
- enables students to concentrate more
- allows learning to be personalised
- makes the students more motivated to learn

Other reasons are essentially for learning other skills, not directly related to the curriculum area. These are Other Skills

Using ICT

- enables students to practice computer skills
- enables students to practice researching information

Table 3 below gives the average scores for all the science teachers in the four schools on these three categories of reasons which they think are very important. These have been calculated so that if all the teachers in that department thought all the cognitive reasons were very important, then the score would be 100. A score of 50 would represent half the teachers thinking all the reasons in that category are very important, or all the teachers thinking half of the reasons very important.

TABLE 3 Average Scores for Science Teachers

School	number of responses	Cognitive reasons	Focus reasons	Other skills
A	8	75	29	81
B	4	62	58	88
C	5	32	25	40
D	2	20	50	100

Caution must be exercised in interpreting this data, in that clearly all the science teachers in each school did not complete the questionnaire, and particularly in school D the results are based on only 2 teachers. However the indication is that although school D makes greater use of iWB science than the other schools, the use is mainly for focus reasons, and for other

skills, such as internet searches. Schools A and B are using computers and some *i*WB more for cognitive reasons. This would suggest that the science teachers in schools A and B have a good understanding of the pedagogy and potential of ICT to support pupils' understanding in science, and represent at more ICT mature workforce in these schools.

Science teachers in School C show a certain lack of enthusiasm for ICT in teaching. In fact the low average scores for cognitive reasons there were based on two more enthusiastic teachers, and 3 who felt they were being 'forced' into it. School C shows quite a wide disparity between different departments. In maths a lot of specific mathematics software is being used, and the teachers are using it for cognitive reasons. In contrast, in English 2 of the 3 staff members are not using any ICT, and none see any cognitive reasons why they should.

TABLE 4 Scores for Three Subjects in School C

Subject	number of responses	cognitive reasons	Focus reasons	Other skills
Maths	n=6	43	29	9
Science	n=5	32	25	40
English	n=3	0	8	50

Returning to the research questions addressed in this paper

- What models of strategic implementation of ICT best support development of desirable learning outcomes?

It became clear to the research team at an early stage that schools were adopting different approaches to the use of the additional resources supplied by the e-SY.info project. The desired learning outcomes, as interpreted by the LEA organisers, were more than meeting simply meeting the outputs required by the project funders. Progress in the school towards the development of greater use of ICT in learning and staff participation were also factors. Those schools that seemed to making the best progress had recognised the strategic importance of developing e learning for the school as a whole and identified this as a priority for school development. This sometimes resulted in the establishment of a new senior role in the school, within the leadership team. While the development of learning with technological aids might be seen as unique in some respects a key feature of success remains that of leaders having a good understanding of the principles of change management. This includes having a leadership team that has the right balance of educational vision, technical competence and people skills. The project has led to the promotion of staff to new leadership roles e.g. Director of E learning.

- What are the critical factors which enable teachers within a school to develop their teaching and the learning of their pupils through the use of ICT?

Embedding of ICT across subjects is taking place more rapidly in the schools promoting the use of *i*WBs. These schools typically:

- were already at the stage of pushing ICT as a way to regeneration, going for any grants which could be useful
- had in place the key ICT leadership partners – Assistant Headteacher (E learning) and ICT coordinator - working together on the strategic development
- had an ICT coordinators with good personal skills who knew all the staff with any interest in ICT across the school, and were open to ideas and suggestions from others
- promoted a collaborative ethos within the school, where teachers were happy to share their practice, and their prepared teaching materials with their less ICT confident colleagues, in the same department, and across them
- had distributed responsibility for ICT in every department - with one member of staff having a time allowance for his ICT link role
- took advantage of training from the project was made available to any who expressed an interest (though generally taken up by those in ICT based subject area)
- had a core of staff who were positive about the use of ICT (though some of them were converts after they started teaching with their own *i*WB

Most of these findings were also found by Tearle, 2003 in her detailed research of one good school integrating ICT in its teaching (before the KS3 requirement to give all pupils 1 hr per week in ICT subject area).

In contrast, in some of the schools taking the ICT laboratory approach many teachers could see little point in using ICT within their subject area, or, if they wanted to use it found it very difficult to put it into practice. Many of these staff did not see ICT as supporting the development of pupils' understanding in their subject area, but focused instead on possible motivational effects from clearer presentations (using projectors, not *i*WB), pupils learning to research information from the internet, and developing better ICT skills. All schools found that apparently small issues in terms of practical teaching arrangements provided considerable barriers to teaching with ICT e.g. timetabling and sharing of resources.

Our findings to date suggest (and are supported by Cox,2004) that teachers are confident in using ICT when they have been involved in the choice of use, but as yet few teachers are confident in using a wide range of ICT resources, which affects the way in which lessons are conducted. Schools involvement with the e-SY.info project is clearly making a positive contribution to their movement towards the development of new ways of learning that will equip school leavers with the skills needed for employment in the new industries that are being attracted into South Yorkshire.

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