


Education Departments' Superhighways Initiative

Group A: Curriculum Projects in England and Wales

Final Report

University of Leicester School of Education

Maurice Galton, Chris Comber, Linda Hargreaves, Tony Lawson, Ken Fogelman

University College of Wales, Aberystwyth - School of Education

Richard Thorpe, Dilwyn Roberts-Young

External Consultants

Tony Eldridge, Mike Rumble

The evaluation

1. This evaluation concerns seven curriculum-focused projects that were based mainly in the primary and secondary sectors in England and Wales. Two further projects in the group were located in Scotland, and were the subject of a separate report produced by the Scottish Council for Research in Education (SCRE). The projects were extremely diverse in scale, ranging from a single infants school with two machines to a group of around 30 secondary schools and sixth-form colleges exploring a range of technology. Projects also varied greatly in their organisational and technological structure, and their aims and objectives. What united the group was a classroom focus, with teachers and pupils exploring the potential of a range of ICT technologies to enhance teaching and learning.

6. THE DYFED SATELLITE PROJECT – OPENING THE DOOR TO SATELLITE REMOTE SENSING

6.1 The evaluation was conducted jointly by staff from the Schools of Education at University College of Wales, Aberystwyth and Leicester University. Meetings of the project director with evaluators from Leicester and Aberystwyth were held at the Satellite Project Centre, Aberarad, in March and December 1996 and Spring 1997. Three rounds of site visits to schools were carried out to six schools in Summer 1996, four schools in late Autumn 1996 and late January 1997, supplemented by visits to two schools and the Centre by the evaluators' technical consultant in March 1997. Additional visits were made throughout the period of the trial to observe training sessions and particular events. Local government reorganisation of the old county of Dyfed into three new authorities, Carmarthenshire, Ceredigion and Pembroke, resulted in the withdrawal of schools in Pembroke from the Project's services. The Pembrokeshire schools could buy in project services, and some opted to do so.

Description of project

6.2 The EDSI project, 'The Superhighway – Opening the Door to Satellite Remote Sensing', was one aspect of the longer-standing Dyfed Satellite Project (DSP) that was based at the Dyfed Satellite Centre (DSC) at Aberarad, Newcastle Emlyn. Its main aim was to provide cost-effective support for geography teachers' usage of remote sensing in geography at Key Stage 3 and above, through remote tutoring and access to an extensive archive of satellite images. This evaluation is restricted to the first and second waves of the initiative, in which eight schools per wave were accepted onto the Project.

6.3 The basic aims of the EDSI Project included the provision of on-line INSET for teachers, remote video-conference tutoring for pupils in the use of satellite images in geography at Key Stage 3 and above, and on-line technical support to schools. The Project also provided Internet access at local call rates. Schools wishing to take part in the Satellite Project were asked to submit proposals on how they would use the new technologies offered, both within the project and in other curriculum areas. A variety of other uses and positive outcomes ensued, such as video conferencing between pupils with special needs, staff networking, on-line distance learning in A-Level social sciences from other centres, and remote tutoring for able primary children.

Sponsors and other parties involved with a level of sponsorship

6.4 Dyfed Satellite Centre was a curriculum unit originally set up with the support of TVEI and the Micro-Electronics Programme with the general remit to support schools in the area of satellite technology and remote sensing. It had no direct local authority funding apart from rent-free accommodation in premises belonging to the local authority. No other sponsors were directly involved, although the equipment for the Satellite Centre, a gift from Intel, and ISDN lines were installed free of charge in the schools by West Wales Training and Enterprise Council (TEC).

6.5 The Satellite Centre offered INSET courses in geography within the Carmarthenshire LEA Service Level Agreement menu. These consisted of a one-day meeting followed by four or five video-conferencing sessions.

6.6 In addition, two teacher centres in the County had facilities to link with the Satellite Centre for INSET, and courses were also provided via video conferencing to four

authorities outside Wales, including Cornwall and West Yorkshire. These were arranged in conjunction with the Education Business Partnership.

The schools

6.7 The participating schools were 11–18 mixed comprehensive schools, including Welsh- and English-speaking schools in the old authority of Dyfed. They ranged in size from 500 to 1400 pupils, although the majority had less than 1000 on roll. Most served small towns with rural catchment areas. Levels of home ownership were typically in the region of 70%, and unemployment was 20%. About 10% of the pupils had free school meals and 12–20% of the pupils were at some point on the SEN register.

Hardware and software used

6.8 The first schools to be equipped were provided with Pentium 75s, enhanced for video conferencing. The second group of schools received Pentium 133s, and the first schools were to be upgraded with Pentium 200MMX chips that quadruple the speed of still-image processing, double the speed of audio performance and improve video performance by 70%. Initially, the video-conferencing service was point-to-point. The upgrade in late 1996 to multi-point conferencing allowed up to five sites, the Centre and four schools, to conference at any one time using 'continuous presence', i.e. all participant groups in view, or up to eight sites using an approach whereby the speaker on screen at any one time controlled the dialogue.

6.9 INTEL Proshare was installed, which allowed simultaneous video conferencing/ data sharing and Internet access. Schools had Gandaff bridges to provide Internet access to a number of machines from a single ISDN line.

6.10 The Satellite Centre, using the same hardware and software as the schools to ensure compatibility, had two personal conferencing access points. The Centre and all schools had broadband satellite reception that used British Aerospace DARTCOM Secondary Data Units (SDUs), with map references and national boundaries added in schools and Primary Data Units/High Resolution Picture Transmission (PDU/HRPT) at the Centre.

External connectivity

6.11 The schools were equipped with ISDN lines in Spring 1995, at no charge, by West Wales TEC, with the second wave of schools connected by September 1995. Connectivity between schools was by ISDN lines. BT provided the ISDN service. The Centre had four ISDN lines initially but pressure of use led to expansion to eight lines.

Project timetable

6.12 The project began in Autumn 1994 when schools were invited to bid to participate. Equipment was installed and connectivity established in the first of the eight schools whose bids were successful, in February 1995. A second group of schools, bringing the total number of schools in the network to 16, bid in Spring 1995 and were connected by September 1995. The DSP was committed to connecting all 16 secondary schools in Carmarthenshire by the end of the 1996/7 academic year. Schools in Ceredigion were to be connected as funds became available.

Aims and objectives

6.13 Whilst the Project had a general set of aims as set out below, each school had its own particular aims and objectives, which, in addition to those related to geography

teaching and the use of remote satellite sensing, included increasing the social interaction of pupils with special educational needs and the development of the IT skills of staff and pupils.

6.14 The original aims of the Project were to:

- further support teachers to introduce remote sensing to enhance the teaching of geography at KS3 and above
- provide remote-sensing INSET on a regular basis and in a cost-effective manner
- provide schools with on-line access to a large archive of remotely sensed images, image processing software and on-line support to use them
- deliver remote sensing enhancement modules to pupils in schools to support their National Curriculum studies
- provide on-line technical support to schools.

Evaluation

Project initiation

6.15 The project was initiated by the Satellite Centre in Autumn 1994. Bids were invited from Dyfed schools to participate on the basis of 50% funding from the school, amounting to £2100 per school for the costs of the hardware. The remainder was met by GEST funding to support specific initiatives for video conferencing, which was ring-fenced by the LEA.

6.16 Successful schools were required to designate responsibility for the project to a senior member of staff who would be available for meetings. In addition, each school was also required to show how and where in the curriculum the technology might be used, and bids were judged on the quality of these proposals. This advance commitment of money and senior staff time would ensure that the project was given time to get started, on the one hand, whilst the proposed curriculum applications would involve staff other than IT experts, on the other.

Initial training

6.17 A round of training on video conferencing was held at the Centre in Spring 1995 for the senior staff designated by schools to be project co-ordinators. It had been agreed with the schools that these would not be IT teachers, to ensure a broader curriculum base. The latter point was subsequently reinforced by each school's establishment of a support group of staff who were next to be trained.

6.18 The project co-ordinators set up this training in their schools. Most of it was done on line through video conferencing with the Centre, usually in small groups. The amount of training varied from school to school but usually consisted of 2–3 hours spread over several weeks. This was supplemented where necessary by school visits from members of the project team. In addition, the equipment was typically introduced to the rest of the staff through an INSET-day programme. All training was included in the LEA Full Service Agreement.

6.19 One school devised a particularly effective example of training, designed by the project co-ordinator, the deputy head, which enabled staff to move quickly beyond the introductory/awareness stage. The programme was structured in three phases beginning in May 1995. These comprised:

- short after-school sessions to introduce the majority of staff to the system
- on-line training with the DSC, singly or in pairs, via the video link
- development of staff proposals for use of the facilities in their curriculum areas.

The programme was followed by two 90-minute slots timetabled in teachers' non-contact time. In addition, three awareness-raising bulletins for staff were produced that reported developments.

6.20 Fifty of the 60 staff in the school participated in the first two training phases and about half came to the third. Of these, 10 submitted proposals. The co-ordinator had identified a colleague who was being encouraged to take over the role of project co-ordination and who would be responsible for running a new round of training.

6.21 This clearly worked and the structured approach to training, which fitted teachers' timetables, was very successful. Encouraging teachers to submit their own ideas ensured that they would embed their use of the technology within their curriculum objectives and gave them ownership of their projects. After a slow start, in which the leaders were teachers of special needs and business studies, teachers from other curriculum areas came forward. The more typical response in other schools visited was that, following the initial school-based INSET, co-ordinators felt that they could not put any pressure on teachers, but instead had to wait for the teachers to ask for support. Permeation beyond the four or five staff in the initial support groups, therefore, appeared to be slow, and might have benefited from opportunities for those using the facilities to share their work with other staff.

6.22 Other school-based training at one school included a specific link-up with the World Computer Conference that involved 16 pupils, three teachers and office and technical staff.

Satellite courses and video-conferencing training

6.23 Seven of these courses, offered as part of the Carmarthenshire service level agreement, included video conferencing in their delivery. The courses contained a mixture of formats: remote training via video-conferencing sessions, full day on-site training with follow-up extra remote tuition, or remote training followed by fieldwork and subsequent class-based work. The focus was either in the use of video conferencing itself or in the use of different satellite images, i.e. Landsat or weather satellite images for classroom use or fieldwork, or the use of weather satellite receiving equipment. Six of the seven courses concerned video conferencing for geography teaching and the remaining one consisted of tailor-made 1-hour on-line packages for teachers.

6.24 Other formal courses had included links to the two teachers' centres. For example, a series of after-school INSET meetings for primary school teachers consisted of alternating remote exchanges with face-to-face contact at a teachers' centre.

Management strategies

External

6.25 There were half-termly, and later termly, meetings of the school project co-ordinators with the project director and an advisor at the Centre, to deal with both pragmatic and curriculum issues. Technical matters were deliberately kept out of these meetings and dealt with separately so as not to dominate business. Whilst the freedom from technological debates was appreciated by teachers, formal

opportunities for the technical support staff to meet to discuss technical problems and solutions could have been beneficial. One useful suggestion was for a bulletin board for technicians and network managers to share information.

Internal

6.26 The internal management varied from school to school, but senior management involvement as a prerequisite seemed to ensure that the project had a high profile and status and time allotted to it, at least initially, within the schools. Other staff most closely involved were usually the IT co-ordinator, the network manager, and key members of curriculum staff, such as geography, special needs and distance learning.

6.27 Video-conferencing slots were timetabled and were under teacher supervision. The degree and type of use of the Internet varied. Younger pupils were monitored and supervised by teachers, with greater freedom being allowed for sixth-form students. Software to exclude undesirable sites, Surfwatch, was in place in some schools and the Satellite Centre screened out certain product groups that might contain undesirable sites, for example newsgroups and Internet Relay Chat (IRC). This issue is discussed further later in the report (see paragraph 6.60)

Implementation at project and institutional levels

Obtaining and installing equipment

6.28 The equipment was obtained and installed via the Satellite Centre. While schools were not obliged to use the system suggested by the Centre, most accepted their advice, which ensured compatibility between schools. One school, however, which had made very fast progress in Information and Communications Technologies (ICT) was, with the benefit of technical knowledge, exploring other makes and suppliers. During the first phase, eight schools had equipment installed, with the first installation taking place in February 1995 and the remainder being installed throughout the Spring and Summer terms. The second phase involved a further eight schools that received their equipment between April and September 1995. Since local government reorganisation (LGR) in Wales in April 1996, the Satellite Centre is situated in, and serves, the new county of Carmarthenshire, and also serves the neighbouring county of Ceredigion through a reciprocal agreement. Carmarthenshire was committed to the installation of the equipment in all secondary schools by the end of the Summer Term 1997, a total of 27 installations. By Spring 1997, a total of 23 schools (16 in Carmarthenshire, 4 in Ceredigion and 3 in Pembrokeshire) were on line.

6.29 In addition, a further seven sites had installed this equipment themselves, giving a broader network of 30 sites. These were four teachers' centres (2 in Carmarthenshire, 1 in Ceredigion and 1 in Pembrokeshire) and three administrative centres (all in Carmarthenshire).

Creating cross-institutional relationships and support

6.30 New cross-institutional, face-to-face relationships were established through the half-termly meetings of senior managers (see paragraph 6.25), and staff subsequently used the communications technology on an *ad-hoc* basis. In a few cases, membership of older TVEI consortia meant that staff knew each other and thus had an initial basis on which to build their communication. One headteacher lamented the fact that the other schools in his TVEI consortium were not yet on this network as the existing close links between these schools would provide a strong basis for inter-school communication. As chair of the area headteachers' group, he had attempted to set up a multi-point conference, which would, in this rural area, save considerable travelling time for those concerned. The links had experienced

technical problems, however, and the idea was shelved. Similarly, video link-ups between teachers of modern languages, geography and science to discuss curriculum matters, which had been enthusiastically envisaged, foundered when the links proved unreliable.

6.31 In other schools, there was some formal and informal contact over the link on an *ad-hoc* basis, for example to arrange sports fixtures, but the most significant new development was the mutually supportive contact between special needs teachers. This was a by-product of the phone calls necessary to set up the links. One teacher, who realised her previous isolation, greatly valued being able to communicate with other special needs teachers since through video conferencing they could observe and discuss the progress of their respective pupils.

6.32 Primary–secondary transfer was another area that schools were keen to develop. One secondary school had 35 small rural feeder primaries, and opportunities to introduce induction activities were limited by costs and by the sheer number of small schools involved, a problem that could be easily overcome with e-mail. At a Welsh medium school, a cross-phase video conference in Welsh was observed, in which an enterprising group of Y7 girls shared a geography session with Y6s from their former primary school who were making use of the nearby Satellite Centre. The two groups of pupils worked jointly on the interpretation of satellite images of the locality. The Y6 pupils, directed by a tutor at the centre, asked questions of and provided information for the Y7 group. Both groups therefore had to engage with the images. This link up illustrated the potential to create genuine cross-phase curriculum continuity on common tasks using video conferencing.

6.33 Some primary schools made use of secondary schools' ICT facilities, particularly for extension activities, through remote tutoring for high achievers. However, such cross-institutional arrangements in rural areas depend on the existence of transport and, in this project, the school capitalised on the transport provided to take children for swimming lessons at the neighbouring pool, by scheduling the secondary school visits to coincide with school swimming times.

6.34 There was a sense, however, that the potential of personal conferencing had not yet been realised. Most of the schools were still in the early stages of adapting to the technology so that new contacts were often set back by technical inexperience. New forms of communication are likely to take off most effectively where there are previously established lines of communication or a strong purpose for communication. Thus, the former TVEI contacts could have been exploited if, for example, several members of the same 'close' consortium had been connected in the first phase. Two co-ordinators remarked that, with this in mind, they had bid with other members of their previous consortia.

6.35 Schools pointed out that, in the absence of a directory, it was difficult to find other schools with video-conferencing facilities. A number of contacts had been made as a result of conferences such as the World Computer Networks exhibition, BETT and the National Eisteddfod. Other institutional links are listed below, under classroom implementation (see paragraphs 6.39–6.60). One co-ordinator reported a 'very very useful' discussion of administration and software with the deputy headteacher of a school in Birmingham, following a contact made as a result of an interview with TES.

Maintaining equipment

6.36 Maintenance and repair was the responsibility of the Satellite Centre. Installation was carried out by the Centre's technician, with further remote support available wherever possible or through site visits as part of the service-level agreement. Technical back-up and further support was extensive, conducted remotely wherever

possible through the diagnosis and remedying of faults on line. For example, in a situation where the school had visual but not audio contact, a series of exchanges using the notepad facility, plus camera views of the screen and various connection points, showed a lead plugged into the wrong ports, and so the fault was soon rectified. In general, early technical difficulties with making connections and problems of echo or retransmission with the sound system had been addressed and the system was now seen as user friendly by staff and pupils.

6.37 On-line technical support, however, depends on the successful achievement of a link in the first place, and, in one isolated case, a school had faced such unreliability in the linkage that the headteacher's opening remark was to the effect that teachers' initial enthusiasm and motivation had been sapped. The Centre had attributed the problems to external interference with the ISDN lines that was beyond their control, but this was not clear to the IT co-ordinator who, having followed a trail of problems around the hardware, software and connective technology over an 18-month period, said, 'Frankly, it didn't work' and felt that the installation had been too rushed. Other schools visited had not experienced such difficulties, however.

6.38 Reliability or rapid repair become a crucial matter for staff and pupils, as they gradually increase their dependence on ICT, particularly as coursework deadlines approach or as pupils prepare for examinations. One school, where use of the video link contributed strongly to pupils' coursework, was able to employ a network manager, who arranged that if parts of the system failed, jeopardising pupils' chances of meeting deadlines, back-up facilities were available.

Implementation at classroom level

6.39 The primary aims of the project were to support teachers further in the introduction of the use of satellite remote sensing to enhance the teaching of geography at KS3 and above, to provide remote-sensing INSET on a regular and cost-effective basis, and to deliver remote sensing enhancement modules to pupils to support their National Curriculum studies. Site visits showed that these aims were either being achieved or that there was clear progress towards them in the second tranche of schools. In the light of their own aims, the schools were beginning to use the system in other curriculum areas, particularly for special needs and modern foreign languages (MFL). For example, as well as the cross-phase geography link-up described above (see paragraph 6.32), the evaluators observed video conferences of Y9 pupils with special educational needs (see paragraphs 6.62–6.72). In terms of permeation across departments within institutions, however, progress after the initial introduction was quite slow. Since the original aims of the Project referred specifically to geography this is not surprising, but more staff were beginning to show curiosity.

6.40 Two factors perhaps militated against faster in-school dissemination. The first was the relative insularity of departments, despite the senior management involvement in the projects. Pupils in one school, and a teacher from another, pointed out that they had been unaware that their school had such equipment, or, in another case, that it was about to be installed. The second factor was a possible mismatch between teachers' favoured means of classroom organisation and the small number, a maximum of five pupils, able to participate comfortably in a remotely tutored session. This limit was the result of the limitations of the field of view of the video camera and access to the keyboard, etc., where shared data was in use (see paragraphs 6.45–6.48).

6.41 Other examples of classroom implementation show how remote tutoring and video conferencing were being used to supplement the curriculum offered in small rural secondary schools. There was, for example:

- remote tutoring of A-Level students in sociology and psychology from centres at Swansea, Llangefni and Preseli
- links with other schools to provide IT experience for GNVQ pupils in Year 10
- exchanges with a technology college in Birmingham
- the use of multi-point video conferencing to enable pupils in other schools to talk with a German assistant in one school
- a school linked into the Jason Project in Florida, which allowed pupils to access an underwater facility called Aquarius, whereby cameras enabled pupils to see what it is like to live and work in a submerged environment
- staff and pupil links between the school and the Intel stand at the World Computing Conference in Birmingham in July 1995
- role play for business studies, in which pupils at different sites took the roles of supplier and dissatisfied client, an activity made more realistic for the pupils involved because they did not know each other.

6.42 Both video conferencing and the Internet were used by pupils in non-timetabled time through lunch-time clubs, sixth-form free periods and other non-contact time, including Saturday clubs and holiday activities. Schools were also involved in other ways, including:

- taking part in specific events such as linking in with exhibitions, including Eisteddfodau (Welsh National cultural events)
- developing curriculum projects
- accessing materials from archives, including archived satellite images.

6.43 For teachers, video conferencing was becoming an established medium for external INSET. In one such example, Y7 girls contributed to INSET for primary headteachers through the video link. In one school, staff appraisal training had been carried out with the help of a remotely based expert witness.

6.44 The video link also provided several opportunities for exchanges in the Welsh language for both native speakers and for the teaching of Welsh as a second language. For example, the remote geography sessions were conducted in Welsh, and children learning the language were able to practise with Welsh speakers from other schools.

Remote teaching of A-Level Geography

6.45 Video conferencing between A-Level Geography groups and an expert tutor based at the Satellite Centre, on a point-to-point basis, was a major usage of the system. Such sessions addressed specific aspects of the WJEC A-Level Geography syllabus relating to Physical Geography, which involved satellite imaging in weather forecasting; rainfall analysis; land use; and the study of rain forests.

6.46 The course offered by the Centre usually involved a series of four 1-hour lessons through the medium of English or Welsh, on an aspect of geography. A typical series included the analysis of land use and consisted of 22 pages of prepared documents, satellite images, including Meteorsat weather images, Landsat high resolution images and Spot very high resolution images, graphs and diagrams, which could be worked on by both tutor and pupils, and saved as meeting files.

6.47 In one observed remote geography tutoring session, five students were seated around the computer, with one person in charge of the mouse and keyboard. The tutor from the centre introduced a physical geography session on air currents and landmasses. As this was the first time these students had used the geography link-up, the tutor guided them and they assimilated rapidly how to move around the screen and switch between images and the notepad. Students shared documents such as satellite images from either their own weather information-receiving equipment or from live or archived satellite images from the centre. The notepad facility was used by the tutor and the students to create shared diagrams. In an observed session, for example, the tutor asked students to indicate on a simple diagram the flow of air currents. The group of students discussed this and then drew the air currents, thus giving the tutor access to their understanding of the processes involved, with the opportunity to point out factors they had not taken into account.

6.48 These students said later that they would not normally work in small groups. In this small school, the geography teacher was not expert in this field of geography, and so remote tutoring was being used to complement the curriculum. The remote sessions, therefore, provided a potential source of INSET in terms of both content and organisation, for example in the use of small groups. After the session, the documents could be saved as a meeting file, printed and/or worked on as a follow up to the video link by students and their teacher in a consolidation lesson.

Raised standards, value-added and improved quality of work

6.49 For pupils, the particular value of remote tutoring was the opportunity to work with an expert and to access and work jointly on satellite images drawn from the archive. They reported that the interaction with this tutor had 'made them think', as the drawings and diagrams they made to modify the satellite images, or the diagrams showing airflow, were effectively expressions of their hypotheses, as the tutor went beyond the work that they had already done. In the session discussed above, the students spontaneously shared the role of keyboard-/mouse-user for drawing and labelling diagrams, although one student in this group of five barely participated in the proceedings. Teachers therefore need to ensure that all students, even in a small group, participate verbally and take the role of operator.

6.50 The contact with the expert would have been more effective if the students had been able to ask more questions, but the students felt that they would do this when more familiar with the tutor. The link therefore ensured their experience of a novel learning arrangement, with implications for the regular classroom organisation. In another school, one student was the only participant in a tutoring session because his peers were sitting an exam. He subsequently peer-tutored the others in his group, using the saved meeting file. Whilst this might be economical in terms of student time, in general the value of the saved session would depend on the quality of interaction sustained by the individual student.

6.51 An example of the remote use of the satellite images archive was one student's coursework project in which he had used a series of images showing the effects of mechanised deforestation and reforestation of tropical rain forest at regular points over several years. Use of the images in this way also served as a valuable form of personal INSET by some teachers.

Fundamental new skills

6.52 Pupils and teachers rapidly learned to use the video-conferencing facility. Pupils quickly became adept at shifting in-set images around the screen in order to work on obscured areas, but needed a little practice at drawing lines on the shared diagrams with the mouse.

6.53 The interpretation of satellite image themselves and the ways in which these could be modified, as for example when pupils had to trace the course of a river and identify the features that distinguished it from a road, were new skills learned. Whilst this example could have been executed on a paper image, the use of increased magnification to help in identifying defining details was not possible without the technology.

6.54 There were challenges to teachers' favoured organisational strategies, for example where there was only one access point to the Internet, or the Satellite Centre, since pupils needed to work individually or in small groups. Whilst this could be accommodated in pupils' 'free' time, some teachers would need to adapt their classroom organisation strategies in order to use the facilities effectively during lesson times. This is a critical issue because free-time access could be biased towards particular groups (see paragraph 6.61).

Development of IT and information-handling skills

6.55 The training needed for staff was minimal and consisted of a short INSET session for the whole staff and a 10-minute individual session followed by help when required over the link from the Centre.

6.56 Some of the pupils did not consider themselves to be particularly confident or competent in the use of IT but nevertheless learned the basics of using the system very quickly, following instructions given by the 'video tutor' during the initial geography session. The pupils' evaluations of the sessions were extremely positive. They enjoyed its novelty, found it user friendly, and considered the interaction with the tutor as being intimate rather than artificial. Pupils were very much in control of the technology in these sessions, with the teacher taking more of a facilitating role.

6.57 Information-handling skills were clearly enhanced as the pupils soon familiarised themselves with the technology and were able to interact with confidence using the link, and load and save meeting files and manipulate data with ease. Those pupils already motivated were further motivated by the technology and were particularly proud of the work produced in this manner.

6.58 Whilst these sessions were clearly helpful and motivating for the pupils, the limiting factor in future would be the availability of the tutor and the difficulty in timetabling sessions once more schools were involved.

6.59 Pupils needed to learn how to dial-up, load and save meeting files, but much of the on-screen work was mastered rapidly as it was similar to Windows-type systems. Pupils' interpersonal skills were being developed incidentally during these sessions as they interacted with the tutor and with each other, particularly in listening to each other and allowing time for individuals to respond to the tutor's questions. There was no need for the teacher to be directly involved, although, in order to obtain the potential INSET value, teachers would need to follow one such session.

The Internet

6.60 The Internet was used more by pupils than video conferencing. Access generally took place in non-timetabled periods and was predominantly by sixth-form students. Younger pupils' usage was lower, and usually under closer supervision during lunch-time or at after-school clubs. Teachers expressed concern about pupils accessing undesirable sites and most, therefore, closely supervised and/or used walled garden or filtering software. Teachers generally reported that such software was effective in controlling inappropriate access. The Satellite Centre itself did not include links to any potentially undesirable sites, and did not carry chatlines. Staff used the Net on an *ad-hoc* basis as a lesson resource, but for the most part did not use it with the pupils as an integral part of the curriculum. One school had

developed its own Web site, and the Satellite Centre was actively encouraging others to follow suit.

Access and equity issues

6.61 Typically Internet access was available to sixth-form and, to a lesser extent younger pupils, as a voluntary activity during lunch hours. It was not as yet embedded in the curriculum. Video conferencing was almost always used during curriculum time and was limited to small numbers of selected pupils determined by the limited range of curriculum activities underway. Whilst access was not restricted formally in terms of pupils' achievement levels, it was either very able pupils or pupils with special needs who appeared to have more access. This meant that the majority of pupils did not as yet have access. One school had as specific objectives in its IT development plan, to increase access to Web sites for curriculum areas on a rolling programme and to increase use of video conferencing. Two voluntary curriculum projects did show strong gender biases, however. In one case, when asked why there were no boys involved in their project, the girls said it was because they had started the project at a Saturday club, and that 'boys play football on Saturdays'.

Learners with special educational needs

6.62 The main inter-school use of the video-conferencing system was for pupils with special educational needs, such as emotional and behavioural difficulties, and hearing and visual impairment. Three schools were involved. The aims were, firstly, to improve the children's social functioning, and communication skills; secondly, to motivate them through use of new technology to improve their IT confidence and competence; and thirdly to exchange curriculum information, for example in local history and geography. The link up was in its second year, and teachers had been able to reflect on and modify the way they used the sessions, as more pupils were involved.

6.63 Groups of up to five Y9 or Y10 pupils per school, withdrawn from other curriculum lessons, conferenced on a weekly or fortnightly basis, although one teacher had found that three pupils was the optimal group size to ensure that all took part. The sessions were usually supervised and supported by a special needs teacher, but as the pupils became more confident, one teacher suggested that a care assistant could take over the sessions. Multi-point conferencing had been tried, but the pupils had found it uncomfortable and reverted to point-to-point, possibly because they were still learning to interact effectively with one other group. The aim for a number of the pupils was to improve their interpersonal skills through video conferencing, because use of this medium made it possible to focus on conversational protocol, such as introductions and endings, turn taking, listening and responding appropriately. Two such point-to-point conferences were observed and are described in more detail below.

6.64 Typically, teachers worked with the pupils beforehand by getting them to prepare questions and to anticipate possible answers, and the conferences were followed up by discussions about the exchange in the individual schools. Topics of conversation included hobbies, work experience, holidays, weekend activities, mutual acquaintances, their activities in the forthcoming Eisteddfod and exchange of other personal information. The medium also enabled first-language Welsh speakers to help others who were Welsh learners. On other occasions, pupils had read poems and sung.

6.65 Observation showed that these interactions were generally carefully structured, and the pupils were well prepared with questions and information. The observed sessions were conducted entirely through speaking and listening, but previous sessions had included document sharing and use of the notepad facility. In some cases, however, pupils' spelling and typing skills were very slow, and as one

teacher pointed out, the particular benefit for these pupils was that the medium did not depend on literacy. She was, therefore, delaying introduction of the notepad. As the project progressed, teachers had moved away from getting pupils to work from prepared lists of questions, because these inhibited the flow of conversation. Instead of listening to their correspondents' replies, the students would focus on reading the next question correctly. The new strategy, therefore, was to discuss possible topics and kinds of questions in advance, and then work without a 'script'. As the conferences drew to a close, the participants would decide what to talk about next time. In this way, they could engage in more general discussion of the topics and also develop their listening skills.

6.66 Teachers reported that this was a very effective way of improving language skills and building confidence in pupils who were often withdrawn and disaffected. Observation and interview evidence confirmed this view. Timid and withdrawn pupils became more forthcoming over the link. One boy, for example, who refused to be in the field of view in the first observed session, and sat at the back of the room, listening but clearly uncomfortable and reluctant to be present, contributed to the follow-up discussion, and then participated in the next conference. Similarly, a girl who said, 'I was very nervous. I wouldn't speak at all' in her first session, was taking a lead in the discussion and helping to draw in others in later sessions.

6.67 The pupils' reported variously that it was exciting, fun, easy to use, and that they felt 'special' because they were allowed to use the system. They understood the aims of the project. Some said that they felt more at ease talking to others than they would face to face. One pupil, asked whether he would prefer a larger screen, said he would feel shy, but that he felt comfortable with the smaller format. Another said that it made him aware of his own personal appearance and that of the other pupils and he had decided to dress differently for future conferences. Pupils reported that they had to think about what they were going to say and to listen carefully in these informal sessions. They also quickly realised they had to speak more clearly if they were to be understood by people from different parts of the county. Others learned that they needed the self-discipline to wait their turn and to allow others to speak.

6.68 The view of all the teachers interviewed was that using the video-link motivated the pupils, making it easier to get them to write and inspiring them to work. Pupils who were normally reluctant to write did so to communicate with people in other schools. The initial motivating value of the conferences, however, was the lack of dependency on literacy skills. Thus it improved pupils' social and communication skills and confidence. It also broke down their isolation by putting them in contact with other pupils with similar difficulties. One learning support teacher felt that it increased her level of IT confidence. She felt that it had a distinct advantage over classroom learning in that the children would attempt things over the link that they would not normally do in class, such as using the shared notepad. Another teacher reported that she had 'become a convert' after considerable initial scepticism of the value of the activity, and was so convinced of its benefits that she had called her colleagues in to watch a session.

6.69 Once communication was well-established on a social basis, the teachers had introduced exchange of curricular information related to local history and geography. In one lesson, for example, pupils exchanged material concerning the involvement of their locality in the Second World War. Another project involved pupils exchanging information about a disused railway line that used to link the two towns, and one boy had made this the topic of his dissertation.

6.70 Video conferencing between hearing-impaired pupils, who could use the notepad facility, was another specific benefit. One special success had been its use with a pupil with impaired hearing who would not speak at all in school, but would do so over the video link to a pupil who was visually impaired. In another case, video

conferencing had been built into a behaviour modification programme for a pupil with behavioural problems.

6.71 The remote tutoring facility was used to support a child gifted in maths, science and technology, whilst he was in Years 5 and 6 of junior school. Arrangements were made for him to use the video-conferencing facilities in the local comprehensive school for weekly remote tutoring from the Satellite Centre, as an alternative to putting him into a higher class away from his peers. The tuition was beyond the content of National Curriculum Key Stage 2 and served to stretch his capabilities and allow him to apply skills and knowledge in the specific field of the weather. Prior to the project getting underway, the tutor met with the headteacher, the parents and the pupil so that everyone would know one another face to face. The pupil has now moved to Year 7 of the local comprehensive and no longer needs this support.

6.72 The sessions, which took one afternoon per week, began in November 1995. The pupil was accompanied to the site by a care assistant and a member of the technical staff was on hand during the session. Each session consisted of a preparation period during which the pupil carried out pre-set tasks, sent via the link, faxed or posted. This was followed by an interactive 1-hour session with the tutor at Aberarad in which they worked together on shared documents and saved these as meeting files, to be printed out in Aberarad and then faxed or posted back to the pupil. The pupil has worked on geostationary satellite images from archives; investigated the accuracy of weather forecasts; used current data and satellite images; built a weather station; analysed visible and infra-red scans for weather and cloud types; and collected and analysed data obtained in school. In addition to sharing Aberarad documents, the boy imported his own files as meeting files and used the video link for discussion of technical detail, for example when building his weather station. Subsequently five more children have been identified in the primary sector with similar needs and arrangements are being made to support these in a similar way.

Productivity gains

6.73 These sessions took place during those times when pupils were normally withdrawn from the mainstream, which allowed a sufficient degree of flexibility. However, timetabling constraints did mean that special arrangements needed to be made on occasions. This is likely be the case in the future as use of the system for special needs use expands.

6.74 The remote geography teaching provided INSET for the teachers while the pupils were also gaining. On the other hand, the method of working with small groups might be seen as a challenge to regular teaching styles.

Changed teaching styles

6.75 The use of the technology affected the teacher's role, moving it away from the more traditional role of the teacher as instructor. Although teachers felt that while their role was somewhat different in these situations, their essential teaching style was not significantly changed. As well as preparing the pupils beforehand and debriefing afterwards, the teacher took a supportive role during the interchange, prompting the pupils and managing the social interaction whilst keeping mainly in the background. This worked well, because the teachers involved knew the capabilities and personalities of the individual pupils. All special needs teachers interviewed were enthusiastic about the project and saw considerable potential in extending its use to other pupils. One recommended that video conferencing should be incorporated into some SEN Individual Education Plans (IEPs). Other special needs teachers were becoming involved and being trained within their departments to use the system.

Meeting the aims

6.76 The Project's original aims focused on enhancing geography teaching and using satellite images. It was generally successful in meeting these aims, in identifying and training senior personnel, providing technical back up, and initiating and supporting curriculum activity, particularly in A-Level Geography. It also succeeded in providing Internet access to the networked schools. In addition, outcomes that were not in the Project's original aims, but were specified by the schools themselves, were being achieved, particularly in special needs education, but also in other curriculum areas such as social sciences, modern languages and business studies. Cross-phase interaction between schools was being explored.

6.77 The Project fulfilled its aim to be cost effective. There was no doubt that the service to schools, and the charges they were paying, were reasonable. The project director estimated that the schools were getting services worth £10k per year at the cost to them of only £2.5k. There is certainly a great deal of potential for the expansion of the use of video conferencing in the schools and the challenge at this stage is in further developing its use.

6.78 The remote teaching of A-Level Geography served two purposes. As well as directly teaching the students, it also raised the awareness of the teachers regarding the use of the technology. It also provided them with a form of INSET for newly introduced curriculum areas. The next step in this process will be for teachers to move from their present, relatively passive role towards a pro-active one, whereby they use the technology to access archives and organise sessions themselves.

6.79 A particular feature of the project was the role of the project director, whose initiation of the project anticipated the need for senior management involvement, curriculum-based objectives and training developed in schools from the outset. There had been consultation with project co-ordinators throughout that kept a sense of 'project'.

6.80 The success in special needs work demonstrated the way in which the technology can be expanded into other areas. The critical factors in one school, where exchanges had been particularly successful, were that:

- teachers were given a free hand to develop ICT themselves in their own way and in their own curriculum area, thereby taking responsibility and developing ownership
- there was no need to radically change their style of teaching to adapt the use of the technology
- the technology was easy to use.

6.81 A number of other initiatives had been planned, but had made little or in some cases no progress during the period of the trial. These include linking up with language assistants, pupil-to-pupil linking for GNVQ IT, exchanging information on local geography and history, linking to more distant schools to compare cultural/religious differences, interviewing an expert witness and distance learning.

6.82 A number of factors contributed to the slow progress on these initiatives:

- Connectivity problems occurred in some instances, and the negative experience of this may have put some staff off the idea of using the system at an early stage. It is perhaps worth waiting until the system is running smoothly before introducing it to other staff.

- Contact between current and potential users in the different schools was limited, and needs to be facilitated so that ideas can be exchanged and further links set up.

- Link ups required planning and booking in advance and entailed more preparation than other curriculum activities. Timetabling needs synchronising for regular contact. Sufficient schools need to be involved to provide enough schools wishing to link up over the same issues.

6.83 In addition to dealing with these issues, a number of initiatives would help to move these projects forward:

- the provision of extra time for staff to develop the curriculum use of the facility

- awareness-raising amongst staff concerning the potential of the system in their curriculum area; in one school this was tackled by forming a user-group to share ideas

- encouraging and supporting those staff already involved to take further ownership, which could be achieved by allowing greater access and introducing more training

- other staff who could take responsibility in the future need to be identified and prepared to take delegated responsibility, which was already happening in one of the schools

- funding for a designated person to take overall responsibility, on a network or county level, for managing and facilitating curriculum innovation using the technology .

Costs and cost effectiveness

6.84 The Dyfed project sought to make available to schools, at a cost-effective rate, a valuable educational resource. The project used specific GEST for technology in Welsh schools to fund 50% of setting up of the ICT facilities. Technical training and INSET in using satellite remote sensing, plus on-line and site-based technical support was part of the LEA service level agreement, while the Satellite Centre offered local-rate access to the Internet, a saving for most schools in terms of line and access charges of the order of £5000 per year.

6.85 In return, schools were required to identify clear educational objectives, to commit to paying for 50% of the hardware, and for all on-line costs, and to identify a senior member of staff with responsibility for managing the project. For these small, rural secondary schools, the opportunities to enhance and broaden the curriculum was a considerable incentive to participate in the scheme. Finally, a stepped approach was taken that involved linking and training one group of schools at a time over 2 years.

6.86 In addition, the Centre devised ingenious ways to make use of existing resources. For example, although not strictly part of the EDSI project, primary schools had access to the Centre's server via conventional telephone lines. The schools bought the modems but software was provided free, and they then paid the on-line charges that were at local rates for all but 12 of the primary schools. Primary schools with only one daytime telephone line available avoided installation costs or sharing the line by using the alarm phone lines, not needed during the day, for Internet access. An additional 35 schools in Carmarthenshire were linked to the Internet via the Centre's server in this way, and a rolling programme of providing access for more schools was underway with approximately 10 new schools per month.

6.87 There was a clear sense that ICT had become embedded in the culture of the most active schools. The network provided a valuable, cost-effective facility and is worthy of continued support. The costs to schools, already relatively low, were offset further by savings of travel costs and supply cover costs. At the same time, there was added value in the close contact with a subject expert in geography for advanced-level students. Teachers' inter-institutional links were gradually increasing and these could help supplement and enhance the curriculum. However, more face-to-face meetings might be needed to establish this. Where a small rural secondary school was limited to a small number of curriculum specialists, remote tutoring was a clear benefit.

Conclusions

6.88 The Project demonstrated the great potential of the use of remote sensing images in secondary geography, for remote INSET, and for the remote teaching of pupils. Moves were being made towards greater inter-school staff conferencing to supplement shortage subjects by sharing expertise between schools, particularly at post-16 level, and distant mentoring/tutoring of student teachers.

6.89 Work with the primary school pupils demonstrated that the Project also had considerable positive applications in this sector. Potential also exists at a school level, for example addressing the problem of rural isolation by clustering arrangements between small rural schools, facilitated by e-mail and video-conferencing exchanges between pupils and teachers. Other possibilities include primary/ secondary links and contacts with more distant schools.

6.90 As the network expands to serve all secondary schools in Carmarthenshire, there will be more scope for contact between schools on common issues, so that curriculum use is likely to expand. Other services were planned using video conferencing, for example to provide access to a careers officer in a given slot each week, and this type of use is likely to grow. The Satellite Centre was also in receipt of a European Regional Development Fund (ERDF) grant, a by-product of which was an expansion of the service, which in turn allowed for greater access for other schools.

6.91 Accessing the Internet is likely to remain a major use of the network, with more secondary schools developing homepages and some development of intranet facilities. The rolling programme of offering Internet access to primary schools is likely to continue, and all in the county have been given the option to join by the end of 1997.