



THE USE OF TELEMATICS IN THE CONTEXT OF TEACHER EDUCATION

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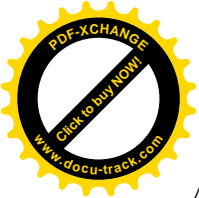
The use of telematics in the context of teacher education and the professional development of teachers was the topic of research that led to the preparation of the following three case studies.

Study 1: The Exeter text telematics case. This study investigated a case of using text based telematics applications such as email and computer conferencing, by PGCE (Postgraduate Certificate in Education) enrolled students at the University of Exeter School of Education (at Exeter in the United Kingdom), during the academic year of 1994/95.

Study 2: The Exeter multimedia telematics case. This study investigated a case of using multimedia telematics applications such as point-to-point desktop conferencing (DTC) and video conferencing (VC), by students and staff at the University of Exeter School of Education, during the academic years of 1994/95 and 1995/96.

Study 3: The Minho telematics case. This study investigated a case of using telematics in a Portuguese teacher education context around the University of Minho. It focused on the academic year of 1994/95, which was the first academic year after the conclusion of the MINERVA project (a national programme, started in 1985/86, for the introduction of IT in Portuguese education). This case involved the use of telematics applications such as email and computer conferencing by:

- a) teachers from small rural Primary Schools in the Peneda-Gerês National Park;
- b) an informal interest group including Minho teachers and teacher educators.



Although from a distance, I tried to play a role described by Robson (1993:197) as participant-as-observer in the Minho case. This role was clear to the other participants from the start and my participation and “expertise” was used either to help in project management, training or to provide general advice.

Table 1 - List of telematics applications expected to be used within the different cases.

Telematics applications	Case 1	Case 2	Case 3
Email	Yes	Yes	Yes
Computer conferencing	Yes		Yes
Databases	Yes		Yes
File-transfer	Yes		
Gopher	Yes		
World Wide Web	Yes		
Desktop conferencing		Yes	
Video conferencing		Yes	

These three cases constituted a multiple case study of a contemporary event in a multiple site location. This allowed the collection of evidence from the use of technology by student-teachers, teachers and teacher educators in various stages of their careers. It also permitted the study of different services and resources provided by telematics, as shown in Table 1. In this way, the different cases ensured a complementary balance in the search for evidence on the topic of research, using several telematics applications.

Bearing in mind that the cases had different and relatively distant geographical locations, this research required methods of collection of data from a distance, which needed planning and continuous attention and reflection both when collecting and also when analysing data. The process of doing case studies provided an in-depth view of the use of telematics during a period of time when this technology was developing very rapidly. The period of time in which I focused my data collection was the academic year 1994/95, although I included examples of previous and subsequent telematics activities. The Internet 'explosion', a period of exponential growth of telematics development and use, occurred during this time. When, in order to achieve a PhD degree, my research started, the word 'Internet' was familiar only within the



academic and research community; at the conclusion of that period of study (1993/97) this phenomenon has become a reality of daily life.

The three case studies also provided a good representation of the use of a range of telematics applications. They provided substantial evidence of the potential of telematics. In addition, after careful analysis of how activities were designed and organised, the studies also provided detailed evidence of the problems that may arise with the implementation of telematics projects in teacher education.

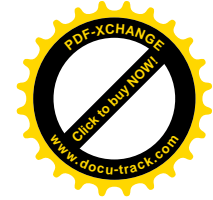
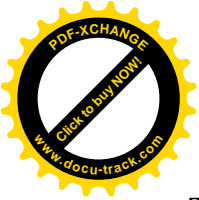
Moreover, the case studies covered a number of perspectives. They provided an overview of the potential and problems of using telematics at various stages of the continuing process of teacher education and professional development. They provided insights into the use of telematics in activities interlinking students, teachers and lecturers of different subjects (e.g. Mathematics, Language, IT, Professional Studies) and in various phases of schooling (primary, secondary, higher education). The case studies also offered an international perspective on the use of telematics by teachers working within the context of the educational systems of two different European countries, England and Portugal.

Although my case studies were instances of the introduction of technological innovations in education, the issues emerging from the analysis of evidence collected with the case study approach provided a useful contribution to the more general field of educational change.

In this paper I present such emerging issues as follows:

1. the potential of telematics in teacher education;
2. problems arising from the implementation of telematics in teacher education;
3. telematics for teacher education, a case of educational innovation.

1 The potential of telematics for teacher education



The case studies provided ample evidence for the potential of telematics in teacher education.

Telematics includes a wide range of telematics applications, most of which were used to support activities organized within each case. The variety of teacher education activities that benefit from telematics is another way of demonstrating the merits of telematics. Moreover, the value of telematics for teacher education is highlighted by its capability of providing flexible and motivating new modes of communication.

I illustrate, in more detail, the potential of telematics for teacher education, as follows:

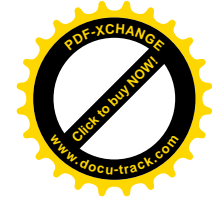
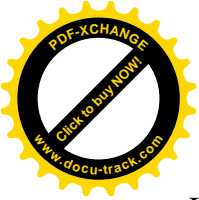
- 1.1 range of telematics applications;
- 1.2 variety of teacher education activities;
- 1.3 new modes of communication and interaction.

1.1 Range of telematics applications

Within telematics technology there is a range of software applications with educational potential. Various examples of these telematics applications were used in the three case studies. They comprised text telematics and multimedia telematics applications as follows:

- email;
- computer conferencing;
- access to on-line information;
- desktop conferencing;
- video conferencing.

This list offers already a considerable number of options, although each of the applications listed itself provides a variety of uses and may cover the features of other applications in the list. I illustrate this with the first and last applications indicated.

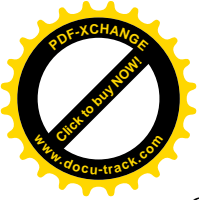


In its basic use, email was used for individual exchange of messages. This was so among Exeter PGCE student-teachers and between them and their tutors. I also relied almost entirely on email to collect information from Minho activities.

Email was also used for group communication through mailing lists, which may comprise a handful or thousands of members. The list 'aventura', which supported a group activity at Minho, was an example of a list restricted to selected users. In contrast, mailing lists may be open to anyone, they may be informal or provide moderated discussions. Mailing lists provided means to collect information and were used as computer conferencing. At Exeter the <uk-schools@mailbase.ac.uk> list was subscribed to by various people and at Minho mailing lists were used by tutors to provide information for their students and also to facilitate discussion among people involved in telematics projects.

Video conferencing, which developed from earlier desktop conferencing applications, was used for audio and video conversations at a distance, such as the supervisory video conferences between Exeter student-teachers and their tutors. The video conferencing software available provided the means for additional modes of interactivity or collaborative work. This included simple data file transfer, shared work on a common task (e.g. reading and editing a text or diagram) or remote access to multimedia information and other software packages.

In most of the activity I was able to follow, these applications were provided by different software packages/programmes. However, there were occasions when a number of applications were included in integrated packages. For example, the UVA (University of Virginia Public Education Network) node at Exeter contained email, computer conferencing and various sources of on-line data including access to library catalogues and databases. UVA and the Minho BBS (Bulletin Board System) were examples of integrated text telematics services.



Currently, these services were replaced by hypertext and hypermedia based services which include multimedia and interactive material (text, sound, image, video). In many institutions and organisations dealing with teacher education the use of e-learning or b-learning approaches is being intended.

The range of telematics applications options available for an educational activity or project is wide and flexible enough to provide innovative and interesting experiences. These enable exposure to state-of-the-art technology. More importantly, these technologies appear to have an effect on the kind of communication that takes place. If email, for example, seems to support an informal type of communication, video conferencing, on the other hand, was described as requiring a much formal and intense mode of communication. In addition, telematics technologies appear to support and facilitate new and challenging modes of teaching and learning for teacher education, as presented below.

1.2 Variety of teacher education activities

The case studies have shown there was a variety of teaching and learning activities supported by telematics applications. The extent to which telematics applications were used also varied. However, there was evidence of benefits resulting from telematics support. I illustrate this with the following teacher education activities:

- use of telematics in teaching activities;
- supervision;
- practice of teaching;
- training;
- administration and management.

Use of telematics in teaching activities. Telematics provides the means to support the 'delivery' of teaching modules, courses, seminars or lectures. In addition, a telematics project

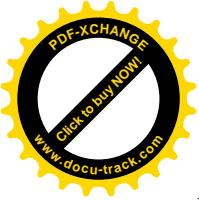


may be designed to include 'traditional' face-to-face activities in combination with on-line components. Examples are the LuxLink conference format which I described and discussed in Osorio (1995) and the use of computer conferencing by Exeter PGCE student-teachers. These are examples of 'traditional' learning activities enhanced through telematics.

Supervision. The use of telematics for supervision of student-teachers was particularly relevant in the Exeter context due to the requirements for increased school-based work, specially in 1994/5 and 1995/96. Through email, DTC or VC, tutors provided various forms of support for their students and developed ways of putting into practice the Exeter model of learning how to teach, which values the use of a criteria for argument to analyse episodes of teaching, during supervisory conferences. Although not formally or explicitly, this approach was also used in the email communication among the members of the two Minho groups: for example, primary teachers in national park schools were supported by members of the project team.

Practice of teaching. At Exeter, one of the initial experiences with DTC consisted of enabling student-teachers to practice small episodes of teaching at a distance. Although this need has probably diminished due to increased school-based activity, such a use of telematics provided evidence of an innovative use of technology to allow student-teachers (or teachers) to develop skills of teaching. This applies not only to the act of teaching 'delivery' but also to the capabilities of planning teaching. This experience had a short duration and suggests the need for further research on how best to assess and apply its value.

Training. Email, DTC and VC were used to support IT training at a distance. There were informal occasions when, via individual email, a technical task was explained. There were occasions when DTC was used to follow a programme of IT training for a teacher. These



demonstrations of IT and telematics training through telematics have shown that similar approaches may be used for training of other topics or disciplines.

Administration and management. The use of telematics was also helpful to support the administration and management of educational activities. There were various examples of the use of email and other applications to support project management and the co-ordination and organisation of activities. There were also occasions when telematics applications were used to sort out practicalities, require and provide information, deal with administrative tasks. This may be seen as a minor use of telematics in the context of education. However, the increased adoption of telematics applications is a demonstration of its own value.

Most of the examples used to illustrate how telematics supports forms of teaching and learning for teacher education were relatively short activities. On occasions, the performance of these activities was obstructed by a number of difficulties. However, my three case studies offered considerable evidence to show how telematics has a beneficial role in the continuing process of teacher education from its initial stages all the way through to career professional development.

Table 2 - Areas of teacher education that may benefit from telematics

	Initial Teacher Education (ITE)	Continuous Professional Development (CPD)
UK	Undergraduate (BEd) and postgraduate (PGCE) courses, both during University based and school-based activity	Support for Mentor training schemes CPD courses both at the University and at a distance. Individual or small groups training or advising
Portugal	Early years and primary teacher education courses; Post-primary teacher education courses	University postgraduate courses (including Masters). Formal CPD courses. Support for formal or informal groups of teachers



This idea is summarised in Table 2 where various areas of teacher education that may benefit from telematics services and its applications are indicated for the English and Portuguese contexts.

1.3 New modes of communication and interaction

In the information age, one of the widely acknowledged characteristics of telematics is the possibility it offers of access to vast sources of information. This was shown by the case studies which provided evidence of searching on-line information, through databases or web sites.

This use of telematics implies an individual, possibly lonely interaction between the user and the telematics service and represents the one-alone paradigm defined by Paulsen (1995). It sometimes provides an excuse for critics pointing out the negative effect of information and communication technologies in the development of social skills and behaviours. This is not completely fair because, at least in education, the collection of on-line information is very often carried out by people organised in small groups.

However, the more important and newer contribution of telematics for education is the provision of new modes of communication and interaction. This is so because telematics provides not only private individual communication but also group communication among small or large groups of people. This was well illustrated by the need felt at Exeter to use telematics to maintain contact between tutors and students in school-based work. This was also the case with the teachers in isolated schools of the national park in Portugal.

Borrowing Paulsen's (1995) terminology for pedagogical CMC techniques, I identify the following modes of communication and interaction, illustrated by examples from the case studies:



- **one-to-one communication** - communication between two individuals - email or video conferencing exchanges between student-teachers and their respective tutors in the Exeter cases; email exchanges between teachers in the national park and members of the project team;
- **one-to-many and many-to-one communication** - communication between one individual and a group - computer conferencing postings by Exeter student-teachers; video conferencing intervention of the Exeter librarian, at Exeter, in a conference held in Minho; Minho lecturer's use of a mailing list to disseminate information for a group of students; email messages from groups of pupils in the national park asking for information and news from me in a foreign country;
- **many-to-many communication** - communication between groups - Exeter email activities in an "Email Day"; group writing of a story in the national park project;

The medium of communication when using text telematics applications was writing and most of the times was asynchronous. However, the use of multimedia telematics such as DTC and VC enabled synchronous audio and video communication. There were also occasions of synchronous communication in some computer conferencing sessions that took place in face-to-face activities.

With such a potential for communication, telematics applications provide the means for the creation of communities regardless of distance and strict timetables. As pointed out in the literature, this feature of telematics allows the development of international and cultural understanding and the involvement of those living in isolated locations. This was also illustrated by short activities within the case studies, including international video conferencing sessions (e.g. between Exeter and Minho) and the email exchanges within the national park schools. In teacher education, this is important not only because the professionals can become



involved in a wider professional community but also because these technology developments introduce new educational dimensions which teachers need to be able to deal with.

The three case studies provided examples of activities offering a useful insight in the use of telematics applications for teacher education and for education generally. The potential of the technology to support and enhance teacher education and professional development was well illustrated through the use of a range of telematics applications, the development of a variety of educational activities and essentially by the demonstration that telematics has great potential to support and promote communication. In contrast, a variety of difficulties and problems were also identified and those are the focus of the following section.

2 Problems arising from the implementation of telematics in teacher education

I have identified two major groups of problems arising from the implementation of telematics in teacher education. From the analysis of the detailed evidence collected, I now discuss the following issues:

- 2.1 issues of access to the use of telematics;
- 2.2 issues of people involvement and project management.

2.1 Issues of access to the use of telematics

The case studies provided illustrations of various occasions where difficulties in access to telematics services caused problems and prevented telematics use. The lack of telephones in Minho primary schools, the lack of access to modem use by Exeter student-teachers, and low network performance on occasions are a few examples. However, the causes of these problems and difficulties were not only technical. A number of issues were involved in the provision of suitable access to telematics and I shall now list the following:

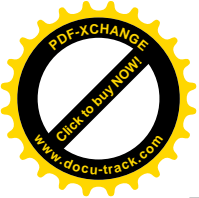


- connection to networks;
- installation and maintenance of a telematics service;
- selection of telematics applications;
- location of equipment;
- user experience and network performance;
- funding.

Connection to networks. The main providers of network access in both the Exeter and the Minho cases were the respective Universities. Teacher educators, teachers and student-teachers and others involved in the telematics activities that took place were given user profiles in the British and Portuguese academic networks which gave them world-wide Internet connection. This solution enabled the development of various forms of telematics activities and guaranteed an essential condition in telematics: connection to a telematics service.

However, both in Exeter and Minho, while the use of the networks by University staff or students was reliable especially when accessed at the University, there were some restrictions for its use by teachers. At Exeter, due to established rules, the use of the network was restricted to University teaching, study or research. At Minho, although there were no such written or advertised rules, the quality of the dial up service available made the use of the network more difficult, especially from locations outside the local public telephone network.

Alternatives to University networks included commercial Internet providers in the Exeter case and the possibility, not fully explored, of using BBS services in Minho. In both locations and elsewhere, the development of the web provided additional access to telematics and to the Internet. The provision of telematics services was completed by the use of point-to-point multimedia communications over integrated digital lines (ISDN) in the Exeter case.



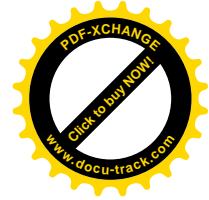
This overview shows there was a variety of networks and telematics services available for educational purposes. This variety of services and applications reflects the wide range of options provided by telematics. It also results from continuous changes in a technology in fast development.

The availability of various networks and services provides the possibility of choice. As a consequence it implies a process of selection which appears to require awareness of the characteristics of the various options available and the definition of a criteria for selection. This appears to be a situation where the strength of telematics is a weakness. The wider the options available the more difficult the choice, especially at early stages of using the technology.

Installation and maintenance of a telematics service. The use of telematics services required decisions in relation to the technical infrastructure to be adopted, installed and maintained. Various activities adopted telematics services available as a domain or service in an existing network (i.e. the use of telematics applications available in the educ.ex.ac.uk domain). Other activities used services set up on purpose (i.e. ISDN point-to-point links at Exeter or the Minho BBS in Portugal).

The adoption of existing services avoided the installation of the core infrastructure but required the installation of support services for users. For the text telematics activities, for example, a dial up service both at Exeter and Minho was used. At Exeter, it was necessary to install additional modems and telephone lines to receive dial up connections from student-teachers in school-based work. Also, at Exeter and Minho, it was necessary to provide schools with modems.

However, this process proved to be difficult due to the different views of different schools in facilitating equipment to install modems or in giving access to telephone lines. Difficulties with telematics services also included the lack of helplines and helpdesk specific to student-teachers



and teachers. Although some support documentation was identified both at Exeter and Minho, there were various suggestions that more was necessary.

Selection of telematics applications. As shown in the previous section, a range of telematics applications were used. Both in Exeter and Minho, most of the text telematics activities were carried out using software running on the Unix operating system. This use of telematics was generally not considered user-friendly and may have been the cause of a refusal to adopt telematics by a number of people who did not feel comfortable with command line instructions. More user-friendly software, such as DTC or VC applications and HTML based materials, became available and provided more attractive multimedia environments, providing users with easier graphical interfaces, specially towards the end of the 1994/95 academic year. However, these options often require equipment up-grading or replacement and this situation caused problems specially in the national park schools, after 1994/95. This appears to be another paradoxical situation in the use of technology in education. The earlier we adopt a technology, the faster we have obsolete equipment. This is a difficult problem, for which creative solutions are required.

Location of equipment. Equipment providing access to networks was available in various locations at the universities and schools involved in the case studies. At universities, especially at Exeter, the availability of computer rooms with networking links provided good conditions of access to telematics services. However, with the increase in telematics use or at certain times (i.e. closer to periods of completing assignments) there were occasions when students would have to wait for their turn.

The problem of access to the place where equipment was located was more difficult in situations when equipment and analogue or digital (ISDN) telephone lines were required.

Schools in partnership with the University of Exeter for school-based work were advised to



place computers linked to lines in areas easy both to supervise and access, such as a library or a resources room. Where these instruction were not followed, equipment was placed in teaching rooms or in locked areas. This resulted in lack of access when classrooms were occupied with classes or when door keys were not available. The exception of placing equipment in a classroom was the situation of small one-room schools of the national park in Portugal, where the computer 'corner' was always available to children and teacher.

User experience and network performance. The case studies highlighted various occasions when low performance of the technology hindered telematics use. Some examples include:

- low speed of network, especially through dial up links, both in Exeter and Minho;
- unreliability (uncertainty) of dial up connection in the Minho case;
- lack of fully compatible software, in particular in the supervisory video conferences of the Exeter multimedia telematics case.

Users' lack of experience also played a role in preventing higher telematics use. Lack of experience was a result of lack of time for example in the case of an Exeter student-teacher or a result of difficulties of access such as those found by teachers in Minho. In contrast, there was also evidence of users exploring the causes of technical difficulties and trying to find ways around. For example, Minho teachers realised they could avoid losing work if they prepared messages off-line. Another example was provided by the collaborative support between student-teacher and tutor in order to develop their skills in operating the video-conferencing system they were using for supervisory sessions.

These examples, however, may not be representative of the average potential user of telematics. Becoming an expert telematics user requires motivation, time and support and all these need to be facilitated for teaching professionals. User-friendly applications which facilitate users' learning of its various functions became increasingly available and are likely to



attract less computer confident people. This will probably increase the number of telematics users, thus strengthening the need to provide appropriate services for user support.

Funding. Needs for funding equipment, consumables and services required for telematics activities were generally met by research and development grants as a result of bids submitted by each project management. However, there were situations, both at Exeter and Minho, where concerns with telephone costs prevented student-teachers and teachers from a higher use of telematics. This evidence appears to suggest that problems in covering costs such as telephone, communication devices (i.e. modems), equipment up-grading and software licences, were less due to availability of funding and more related to bureaucracy, lack of budgeting or lack of decisions, such as deciding the priority to give to telematics.

A combination of various of these difficulties have certainly played an important part in preventing a larger take up of telematics by people involved or expected to be involved in telematics use at Exeter and Minho.

As explained in detail in the case study chapters, there were generally small groups of people making use of the technology available. Their activity, however, has shown interesting insights not only into the potential of telematics but also into the problems that may arise. The problems also include ways of organising activities and managing innovative projects.

2.2 Issues of people involvement and project management

The case studies involved the participation of various people and institutions. The co-ordination of the different groups, the organisation of telematics activities and project management highlighted issues which I address as follows:

- involvement of people and institutions;
- views and expectations about telematics;
- management and organisation of activities;



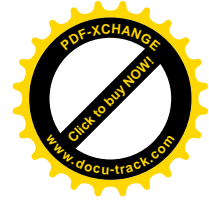
- telematics training.

Involvement of people and institutions. The case studies have shown the involvement of various groups of people, usually belonging to different institutions, interacting individually and in groups. People involved included student teachers, classroom teachers in primary and secondary schools, school teachers involved in the supervision of student-teachers, teacher educators, other lecturers and researchers.

A consequence of the involvement of a range of people was the engagement of a number of institutions and, within institutions, the involvement of different departments or services. For example, in the school-based Exeter PGCE course, the involvement of schools was central to the organisation of proper conditions for students' access to telematics (either dial up connections or ISDN links). In the Minho case, involvement of village local councils was essential in order to ensure installation and funding for telephone lines in national park schools. In more complex institutions such as the universities, other staff from various subject departments/areas and from support departments such as librarians, technicians and administrators were identified.

The participation of such a variety of people and institutions in common projects and activities highlights the sense of community suggested by the potential of telematics. However, it also represents a complex network of new inter-relations and exchanges among people and institutions with different views and experiences in relation to technology and to new modes of work and management. The development of new forms of community which may be mediated by technology and include a wide range of 'members' offers an interesting focus for study in various areas of the social sciences.

Views and expectations about telematics. Evidence collected from various people involved in the case studies and especially from Exeter student-teachers and national park primary

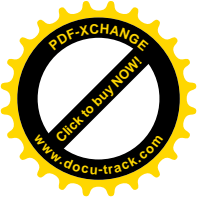


teachers, suggested that they had an expectant optimistic attitude towards their involvement in telematics. An interest in knowing more about the technology and its educational potential was evident. The idea of integrating the technology in their teaching was accepted as a normal development in a changing society. However, student-teachers were conscious of the difficulties with transferring potential to practice and expressed concerns with issues of access to networks and to training. Concerns with issues such as information overload and censorship, which are usually present in many discussions about telematics and the Internet, were also expressed.

This balanced optimistic and prudent attitude suggests that teachers are open to collaborate in innovations such as the adoption of telematics, provided the necessary requirements and support (i.e. resources, training) are in place. These attitudes appear to point out the need that in the organisation and management of telematics projects it is important to listen and find out about participants' views and expectations, during the whole process. They suggest that the implementation of technological innovations may benefit from the experience and knowledge of those expected to carry out new activities or participate in new projects. These 'grass-roots' and action-research approaches to innovations seem to value an early, active and co-ordinated involvement of both 'agents' and 'subjects' of change.

Management and organisation of activities. Project management and organisation of activities in the three case studies was a complex task. The work of project managers was made difficult by the new and fast developing technology and by the involvement of various people and institutions. Another important difficulty was the apparent lack of clear common objectives and rationales for the use of telematics.

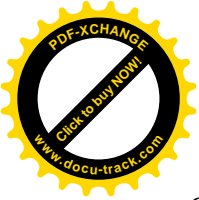
All the case studies promoted the exploration of telematics applications, including its use for tasks of project management. I would argue that this provided an additional difficulty to



project management since this is a very recent way of decision making, in which educational organisations seem to have little experience. I use my participation in the co-ordination of the telematics activities of the Minho case study as an example. It was affected by various difficulties. There were occasions of problems caused by technology but there were also a number of problems related to lack of meaningful communication, despite the use of a common language (in this case, Portuguese). The use of different equipment and software configurations, different working experiences, different attitudes towards the adoption of on-line communication to replace face-to-face modes of work, were factors affecting the development of good communication.

The relevance of this issue is particularly important in the European context where the use of telematics is being promoted as a way to enhance collaboration among academic, research and other communities, across countries, languages and cultures. If there were important technical difficulties in relation to equipment and software, there was also evidence of experiments of modes of distance communication for team working, project co-ordination and organisation development.

Telematics training. In the three case studies, there were various modes of telematics training. Students in the Exeter PGCE course were introduced to email and computer conferencing through demonstrations and hands-on practice during face-to-face seminars. Similarly, teachers from the national park attending my training sessions in June 1995 were given the opportunity to practise and develop access to a network and the use of an email application, while having the possibility to speak face-to-face with colleagues and teacher educators. Other modes of training included individual tuition and training at a distance in asynchronous or synchronous activities.



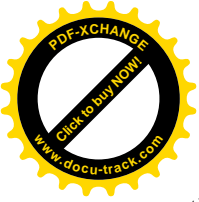
Organising training to develop telematics abilities of those involved in the case studies appears to be a process occurring over a large period of time as also suggested by Honey and Henriquez (1993). This is a process that seems to benefit from sets of short training sessions spanning relatively long periods of time (i.e. one academic year). This was highlighted by various case studies and particularly from the work with primary teachers in the national park. However, the concretisation of these suggestions appear difficult in the context of projects exploring a new field and a changing technology. Finding a correct balance between the individual needs of each user and the variety of telematics applications and modes of training proved to be an additional difficulty.

In addition to issues of access, difficulties in fully exploring the potential of telematics for teacher education and professional development include the organisation and management of activities and projects. If student-teachers and teachers were involved in a learning process of using telematics in their study and work, teacher educators, researchers and project managers were also involved in a learning experience. Discovering new grounds, charting new 'terrain' was the challenge faced by all. It was a process that provided interesting insights into the mechanisms of technological innovations and educational change.

3 Telematics for teacher education, a case of educational innovation

The degree to which the potential of telematics for teacher education can be developed further relates to the question of transferring potential to practice, a continuous concern in the area of IT in education. Authors such as Papert (1993), Cuban (1994) and Underwood (1994), have clearly highlighted the issue.

The introduction of IT in teacher education, the promotion of IT in the continuing professional development of teachers has been considered as an important aspect of the introduction of IT in education. The emergence of the field of IT in teacher education has emphasised the role of



the teacher as an agent of change. More generally, the role of the teacher in a process of innovation in education has been found to be fundamental (see Fullan, 1991; Hargreaves, 1994). These lessons from previous research informed the design and conduction of the case studies. More specifically, the case studies focused on finding ways to understand how telematics, a developing technology, could be beneficial for teachers and their professional development, in contexts of change in the educational systems of two countries.

After summarising the potential of telematics and the difficulties that may arise in the implementation of telematics in the continuing professional development of teachers, I can now relate these findings to the more general concept of educational change. Through the use of a research framework and the preparation of case studies, I achieved a better understanding of the conceivable role of telematics in teacher education. Through the understanding of the potential and difficulties of telematics I gained a deeper insight into the process of introducing innovations in education and, therefore, understanding the process of educational change. This provides my contribution to theory, which I organise as follows:

- transferring potential to practice;
- the communication potential of telematics as a motivating factor to overcome difficulties;
- development of professional communities;
- involvement of teachers in their professional development;
- development of attitudes to deal with change.

Transferring potential to practice. From the findings presented in the two previous sections of this chapter, the case studies provided evidence of the potential of telematics for teacher education. The activities that took place, the projects that were carried out, provided detailed illustrations of what can be done with various telematics applications, in all phases of the process of teacher education. The potential of telematics was shown in practice, in different



countries, and was particularly evident in the provision of new modes of communication, thus supporting McQuail's (1994) claim that telematics is a key in the 'communication revolution'. Such a potential for communication was also acknowledged by Negroponte (1995).

However, the complete success of telematics activities in the case studies was limited and sometimes hindered by a number of problems which I have presented in the previous section. The problems highlighted by the case studies reflect the problems generated by the use of a developing technology in an emerging field. If we view these difficulties from an angle where they provide challenging problems that need to be solved, then the way to fully apply the potential of telematics becomes clearer. Therefore, problems of access to telematics need to be solved and forms of project management and telematics activities organisation need to be developed.

Finding ways of solving problems of access involves the design and implementation of a technical infrastructure of telematics services. Furthermore, it implies the adoption of a holistic set of decisions and measures that cover technical specification and an embedded educational framework with a pedagogical rationale. The development of modes of management and organisation in telematics projects requires learning from all the experiences collected in the early telematics projects and activities that have been taking place. Details such as budgeting and funding appear to be as important as the definition of aims, objectives and rationales, the outlining of project plans, the provision of training opportunities and dissemination of information and documentation. These are components necessary for the successful implementation of technology innovations in education. This is an approach that may benefit from the adoption of a concept of 'educational technology leadership' as suggested by Kearsley and Lynch (1994) who argue that "leadership of one kind or another plays a very critical role in the success of instructional technology" (p. 6) and point out the "critical need to establish



formal training programs for teachers and school administrators in technology leadership" (p. 13).

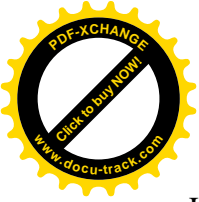
The communication potential of telematics, as a motivating factor to overcome

problems. The case studies provided evidence that participants in projects and activities were motivated to explore and benefit from the value of telematics. This was generally the case when student-teachers and teachers were questioned about their views on telematics.

Moreover, there was evidence that leads me to argue that the possibility to communicate with other people was probably one of the motivating factors to overcome technical and organisational difficulties arisen. For example, student-teachers asked for support from tutors. Teachers in small schools of the national park were willing to receive email messages from a colleague from the project team or from another school. I am also thinking of my own 'lurking' of various discussions on the Internet, especially during the initial phase of my research when I was adapting myself to a wider academic community, much larger than the one I was used.

The communication potential of telematics appears to provide the motivation to overcome problems raised by the practical difficulties. As a consequence, I would argue that these difficulties provide problem-solving challenges for teachers and educators generally which are helpful in the process of developing strategies to deal with change.

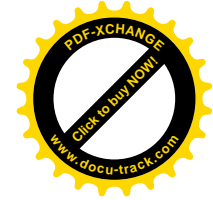
Development of professional communities. Having the means to share with peers a successful use of a technology or an excellent (or poor) teaching experience, having the means to be congratulated (or supported) by colleagues is an aspiration that telematics can, in principle, easily provide. Telematics can indeed support communities of teachers such as the services provided by the LabNetwork, a community of practice for the professional development of science teachers (DiMauro and Gal, 1994) or, in Europe, the activities around the EUN network (see <http://eschoolnet.eun.org>).



However, the creation of communities of teachers supported by telematics appears to be a phased process. Early stages of such a process seem to require the exchange of low level, even trivial content of communication, which we would find more acceptable in a social rather than academic environment. Nevertheless, these early stages are steps necessary in building and establishing a community. Other requirements also made evident on various occasions of the case studies include the combination of face-to-face activities with on-line tasks, especially when the on-line component spans long periods of time. These requirements suggest the availability of 'someone' constantly aware of participants' needs, ensuring a role of promoting, moderating and supporting the activity of the group.

Involvement of teachers in their professional development. Providing teachers with the necessary infrastructures, telematics services and required resources appears to be essential to enhance a greater exploration of the potential of telematics. In a context of change, where the role of the teacher is shifting from delivering information to creating learning environments (Moonen, 1994), teachers need continuous support. This includes telematics training in order to enable them to be involved in telematics projects. More generally, however, this includes continuing professional development in the various areas of teacher activity (i.e. subject knowledge, pedagogy, educational technology), in which good telematics services can offer important assistance.

IT and telematics are only tools which teachers and educators can explore for educational purposes. They provide excellent opportunities to stimulate the creativity of learners and facilitators of learning, they are important resources for the development of rich learning environments. Their continuous and dynamic development suggest a continuous process of research where the involvement and active participation of teachers seems to be indispensable. Questions such as how to make valuable use of the current and future telematics applications



offer interesting topics for study. Detailed research on how to develop telematics in teaching disciplines and the various levels of teaching are additional options in which teachers need to be involved and allowed to give their views and expertise. However, telematics is a developing technology that will 'fade away' and be replaced. Therefore, more than the development of teachers' telematics skills and the development of telematics uses for education, what appears to be important to learn from this research is the development of attitudes of coping with the challenges of change.

Development of attitudes to deal with change. Student-teachers and teachers in my research were aware of the challenges and many revealed motivation to deal with change. Although in small numbers, this was illustrated by student-teachers involvement in email and video conferencing activities and by the expectations, expressed by some of them, that that they would be interested in developing their use of telematics. In addition, teachers in schools (i.e. in the national park), despite various technical and access difficulties, showed an interest in the integration of IT and telematics. More importantly, I would argue, they showed an interest in improving their approaches to organise and do their teaching. The involvement of University tutors/lecturers in various activities adds to the range of educators willing to find ways to deal with innovations and change.

My research has also shown that facing the new challenges appears to benefit from a collaborative and co-ordinated effort of various groups of people and their institutions. In such a collaborative effort, the adoption of action-research methodologies (see Somekh, 1995) and the use of principled reflection about practice seems to be a helpful and essential contribution. The adoption of a participant and reflective approach is likely to develop a sense of belonging to a community. It is a process that may facilitate the development of the notion of "interactive professionalism" defined by Fullan (1991) and illustrated as follows:



I see teachers and other working in small groups interacting frequently in the course of planning, testing new ideas, attempting to solve different problems, assessing effectiveness, etc. (p. 142)

In such a scenario teachers are "continuous learners in a community of interactive professionals."

Conclusion

As a conclusion of this paper and reflecting on the evidence shown by the case studies, I would argue that teachers are able to cope with change provided education and the teaching profession is supported, i.e. is valued. Teachers can adapt to the challenges of the forces of change such as the introduction of technological innovations, provided innovative programs and reforms are meaningful to their development and the development of education and are resourced, and managed adequately.

Involving teachers in the process of designing and implementing innovation, represents giving value to the teaching profession and therefore developing quality in education. Involving teachers and valuing their professionalism will certainly help to transform education as an important changing force in society. Telematics has a valuable contribution to offer in such a process.

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