

TEACHERS AND COMPUTER-MEDIATED COMMUNICATION:

A study of the development of collegiality among
Secondary school teachers using electronic mail

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**Teachers and computer-mediated communication: a study of the development
of collegiality among secondary school teachers using electronic mail**

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ABSTRACT

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Teacher collegiality has been consistently highlighted in recent years as a crucial factor in the success of processes of educational change and professional development. Consequently, there is considerable interest both from researchers and practitioners, in investigating strategies capable of supporting collegial interactions between teachers.

Research, mostly carried out in industry, suggests that computer-mediated communication (CMC) technologies may support collegiality in a diversity of contexts. Following the technological developments of the last few years, which have driven down the costs and complexity of computers and telecommunications, CMC technologies are becoming increasingly available to schools around the world. One of the more widespread of these new communication technologies is electronic mail.

The aim of this study was to further our understanding of how collegiality might develop among schoolteachers with access to electronic mail. At the time of the work, relatively little research had been carried out into the use of electronic mail by schoolteachers, especially in Latin America.

To achieve the above aim, the communication behaviour of 75 Uruguayan secondary school teachers using electronic mail over 37 weeks was analysed. Four dimensions of communication behaviour were investigated: a) system use, b) relationship development, c) topics addressed, and d) the exchange of professional resources.

Data for the research were collected from two sources: message files automatically gathered by the computer network, and 15 in-depth interviews. The message data were analysed using statistical techniques and content analysis methods. Interview data were analysed using the method of 'constant comparative analysis'. This research design enabled triangulation of sources of data and findings. Social exchange research was the main theoretical framework guiding the interpretation of results of the study.

According to the results of this research, the development of collegiality among schoolteachers using e-mail is a complex process, influenced by a web of interacting factors related to the technology, the users' personalities and views, and the norms of the social system in which the user community is immersed. When such factors are supportive of collegiality, e-mail may indeed facilitate and amplify it. Otherwise, it may make little impact.

The overall evidence suggests that in circumstances comparable to those of Teachnet: a) only a relatively reduced share of the teachers with access to e-mail may use the system for collegial purposes in the long-run, b) e-mail may be more used for strengthening existing relations than for expanding or diversifying them, c) 'repertoire development' (i.e. the exchange of subject-specific information, opinions and materials that teachers may use in their teaching practice) may be the most popular use of the system. The latter conclusion, which suggests that e-mail may be relatively little used for discussing the inner workings of classrooms or for multidisciplinary pedagogical debate, implies that the impact of e-mail on teachers' long-held, deep-rooted assumptions and beliefs may be limited.

Findings are compared with the conclusions of a literature review that considered theories of communication and studies of the use of CMC systems by teachers. The study formulates research-based recommendations for researchers and educational planners interested in the use of CMC systems for fostering collegiality among teachers.

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CHAPTER 1

Introduction

1.1 Introduction.

Collegiality has been highlighted since the 1970s as a critical issue for teachers and schools. Teaching, especially in secondary schools, has been described as an isolated activity, with teachers lacking opportunities and mechanisms for collegial support and exchange. A number of increasingly convergent findings have pointed to the importance of collegiality in the success of processes of educational change, work satisfaction and professional development.

New communication technologies have become widely available in the last decades, especially in industry. Research, mainly carried out in non-educational contexts, suggests that one of these new technologies, computer-mediated communication (CMC), may foster the development of collegiality.

In recent years, technological developments have greatly reduced the costs and complexity of CMC technologies. As a result, these new media are rapidly becoming available to schools and teachers all over the world. The aim of this research project was to investigate the potential of a specific CMC technology, electronic mail, for supporting the development of collegiality among secondary school teachers and the extent and nature of the collegial exchanges that might take place.

The function of this chapter is to provide essential context for the main issues under investigation and for the research questions guiding this study, which are described in the next chapter.

1.2. Teacher collegiality.

A full review of the collegiality literature would fall beyond the aims of this study, which is concerned with whether and how teachers use electronic mail for collegial purposes. The sections below briefly highlight some of the key findings of international research concerning teacher collegiality in order to provide a general background to the study. First, the importance of collegiality is discussed. Second, findings of research on the extent and nature of collegiality among schoolteachers are reviewed. Finally, some of the factors that have been found to influence the development of collegial relations are identified.

1.2.1 The importance of collegiality.

A growing body of evidence highlights the importance of collegiality in the success of processes of educational change, teachers' work satisfaction and professional development. As Little concluded from her classic 1982 study of school improvement: '(successful and unsuccessful) schools are distinguished from one another by the interactions that are encouraged (between teachers)' (p. 325). Little's conclusions were corroborated by

Harasim and Johnson (1986, p. 21) in their research on Canadian schools. They found that ‘collegial exchange among teachers has a major impact on how teachers relate to their profession, to the quality of their working life and to the adoption of change’.

Zahorik (1987, p. 394) concluded from his research on collegiality in six schools in Wisconsin that ‘Schools that consist of individual teachers working alone in their classrooms waste human resources and contribute to disenchantment with teaching as a career’. Barth, in his 1990 book on school improvement, stated: ‘the professional growth of teachers is closely related to relationships ... between teacher and teacher’ (p. 50). According to Huberman (1991), extending teachers’ range of contacts with colleagues is to extend their opportunities for professional learning. As Fullan concluded from a review of research on the implementation of innovations:

‘New meanings, new behaviours, new skills, and new beliefs depend significantly on whether teachers are working as isolated individuals ... or are exchanging ideas, support and positive feelings about their work (1992, p. 77) ... what makes change work at the level of teachers is strongly related to what extent teachers interact with each other...’ (Fullan, 1991, p. 130).

McLaughlin (1992, p. 20) noted in her 3-year study with 800 secondary school teachers that teachers working in isolation ‘receive neither challenges to their conceptions of practice ... nor support for trying to do something different’. A prominent finding of Stevenson and Stiegler (1992) in their comparative study of educational practices in the U.S. and Asian countries was that successful Asian teachers spend much less time in classrooms and more interacting with other teachers. According to Raymond et al (1993, p. 154): ‘... there is evidence to suggest that, given the right conditions, contexts and processes, (collegiality and collaboration) can be very powerful supports for teacher development’. Collegiality has also been found to be important for beginning teachers (Hayes and Kilgore, 1991, Zarn, 1992, p. 178).

Research has found that not all collegial interactions may be supportive of educational change and professional development (Glidewell et al, 1983, Little, 1990, p. 517, Ellis, 1990). According to the literature, in innovative schools collegial relations are primarily used for exchanging new teaching ideas and materials and for debating pedagogical issues (Intlili, 1971). As Judith Little concluded from her seminal work with teachers of six American schools:

‘Continuous professional development appears to be ... achieved when teachers engage in frequent, continuous and increasingly concrete and precise talk about teaching practice (as distinct from teachers’ characteristics and failings, the social lives of teachers, the foibles and failures of students and their families, and the unfortunate demands of society on the school) ... In successful and adaptable schools, interaction about teaching is consciously and steadily focused on practice, on what teachers do, with what aims, in what situations, with what materials, and with what apparent results’ (1982, p. 330).

Rosenholtz (1985, p. 360) found that ‘In collaborative schools, requests for and offers of assistance far outnumber incidents of experience swapping. Instead of seeking sympathy and social support from colleagues, teachers ... seek fresh ideas’.

1.2.2. Teacher isolation.

A number of large scale studies have been carried out since the mid-1970s searching for a better understanding of teachers, teaching and schools as workplaces. One of the sociological characteristics of the work environment of teachers consistently found across all major studies, is the isolation from colleagues as sources of support and feedback.

Lortie (1975) carried out one of the most widely quoted studies on the occupational characteristics of teachers. In his study of almost 6000 U.S. teachers, he found that almost half (45%) reported having no regular contact with other teachers as part of their professional life (p. 194). House described his first year of teaching as follows: 'I was entirely alone ... Help from sources where one might have expected it ... from discussions in the teachers' lounge, from talks with a few colleagues was almost totally absent...' (House and Lapan, 1978, p. 16).

Lortie's results were corroborated by Goodlad (1984, p. 186) who found in a study of 38 schools and 1350 teachers that 'teacher-to-teacher links for mutual assistance or collaboration were weak or non-existent'. Zielinski and Hoy (1983) in their study of 417 teachers drew attention to 'the extreme degree to which elementary school teachers were isolated in their work setting'. Harasim and Johnson (1986, p. 24) similarly found in their research on the problems faced by the teachers of Ontario that:

'teachers are very isolated both within their school and their subject areas. There is no mechanism for sharing the problems they confront professionally or, more importantly, sharing the solutions...'

Flinders (1988, p. 17) similarly concluded from a review of the literature that '...past research indicates that isolation is a widespread characteristic of professional life in schools'. More recently, a team of the Appalachia Educational Laboratory (1991, p. 8) found similar patterns of isolation and lack of collegial interactions in schools. A majority of the teachers they interviewed 'felt isolated from their colleagues'.

Another consistent finding is that those relatively few collegial interactions that do take place are more likely to occur between teachers who have known each other for some time and between teachers of the same subject (Lortie, 1975, p. 193, Charters, 1976, Cusick, 1981, p. 129, Rohland, 1985, p. 74, Zahorik, 1987, Morton, 1993).

According to a Maths teacher interviewed by Johnson (1990, p. 171): 'I have interaction with the maths department, not with any other department ... We wouldn't go out of our way to talk to these English teachers...'. McLaughlin (1992, p. 14) found that 'For most of the secondary schools we studied, the (subject) department was the professional community of greatest significance...'

Thus, the literature shows highly consistent evidence, spanning more than two decades, that isolation is a widespread occupational feature of teaching. It also suggests that most teachers do not interact frequently with strangers nor with teachers of other subjects than their own. This is important because teachers who are isolated from their colleagues, especially from 'new' people and from colleagues of different subjects, may receive few new ideas and challenges to their established professional views and practices (this is discussed in Chapter 3 from the perspective of communication theory).

1.2.3. The content of collegial interactions.

The content of collegial interactions between teachers has been investigated in recent years in different countries and school levels. Reports have shown that teachers communicate with colleagues to fulfil a wide variety of social, psychological, professional and organisational needs such as empathy, praise, encouragement, tension relief, professional information, teaching materials, advice, opinions, ideas and task coordination (Johnson, 1990, p. 156, Little, 1990, p. 512, Sandholtz et al, 1991, p. 8, O'Grady, 1994).

One of the most consistent findings has been that a majority of teacher communication does not focus on teaching practice. House found that: 'the information transferred (by other teachers) tends to be more personal than professional' (House and Lapan, 1978, p. 16). Feinman-Nemser and Floden (1986, p. 509) similarly concluded that '... (teachers) avoid talking about instructional practices'. Zahorik (1987) reported from his interviewing of 52 elementary teachers in Wisconsin that a third of the time devoted to collegial talk was related to personal topics. Vonk and Shras (1987, p. 11) reported from their study of 14 secondary school teachers in the Netherlands that 'The main content of the interactions with colleagues concerned the present weather, salaries and the stupidity of the present generation of students'. Schwartz, Hollingsworth and Izsac (1987, p. 71) concluded from their research with American maths teachers that 'Almost without exception, we were told by teachers that their interactions with colleagues was administrative, bureaucratic and logistical in nature'.

Rosenholtz (1989, p. 74) found that teacher conversation was broadly social or concerned with stories about students and their parents, often at their expense. As she put it (p. 18): 'The point to be emphasised here is *not* that teachers seldom talk, but rather that informal conversation rarely centres around a codified base of technical knowledge'. Johnson (1990, p. 148) concluded from her interviews of 115 teachers in Eastern Massachusetts that 'when it occurs, conversation (between teachers) offers a diversion from teaching rather than the occasion for its deliberation'. Lieberman and Miller (1991) concluded from their research on staff development that 'teachers carry on very superficial relations with their colleagues. Conversation often revolves around griping and jousting'. As a young U.S. teacher quoted in Zarn's (1992, p. 174) doctoral dissertation reflected:

'The teachers in my school are pretty friendly, but don't seem to talk much about teaching stuff in a constructive way, or to talk much about teaching stuff at all'.

1.2.4. Factors constraining collegiality.

Many factors have been found to constrain collegial exchanges between teachers. Some are of a *logistical* nature such as teaching schedules that impede teacher meetings or building layouts that keep people far apart for most of the day; and others are of a *cultural* nature such as professional norms¹ that inhibit requesting help from colleagues (Little, 1990, Johnson, 1990).

¹ Norms have been defined as 'shared standards of behaviour to which participants are expected to conform' (Mennell, 1974).

Logistical factors.

Physical distance has been found to constrain teacher communication due to the costs involved in communicating face to face (FTF) (e.g. commuting), by telephone (e.g. long-distance rates) or by postal mail (e.g. delays) (Schwartz et al, 1987, Zahorik, 1987).

Teachers also consistently highlight their lack of time and complex schedules as major constraints to collaboration (Raywid, 1993, Newman, 1994). Teachers interviewed by Johnson (1990, p. 48) spoke of ‘the isolation they experienced with lockstep schedules that left no time to talk with colleagues’. Johnson concluded that collegial collaborations ‘are rendered impossible by schedules that isolate teachers at work in different classrooms ... non-teaching time was scheduled ineptly, leaving them free when the colleagues they needed to meet with were in class’ (p. 172).

Cultural factors.

According to research, collegiality is constrained by the ‘social costs’ introduced by prevailing professional norms such as autonomy, self-reliance, equality and privacy (Feinman-Nemser and Floden, 1986, Johnson, 1990). Such costs have been called in the literature the ‘hidden costs of sharing expertise’ (Allen, 1989). Norms strongly shape teachers’ behaviour because they are ‘those beliefs to which teachers appeal for their ultimate rationales of action’ (Rosenholtz, 1988, p. 30).

The norm of self-reliance imposes high costs on requesting professional help, because such requests suggest a failing on the part of teachers requesting assistance (Newberry, 1977). Questions from teachers to other teachers are perceived as demands for help under prevailing occupational norms (Glidewell et al, 1983, p. 190). According to Little (1990), teachers perceive that asking questions may jeopardise their professional reputation. Huberman (1993, p. 29) has argued that: ‘... requests among peers ... can be and often are construed as admissions of incompetence on the part of the seeker’. As a teacher quoted in Zarn’s (1992, p. 163) research on CMC use among beginning teachers put it:

‘It is always difficult to ask ... too many questions that show up your weaknesses ... I’m a bit paranoid about how it looks to the department head or administrator I ask for help. Do I risk looking bad in their eyes? ... does it not somehow lower their view of me as a good teacher if I keep going to them for help? I usually don’t ask for help, therefore, and struggle to make it on my own’.

According to Feinman-Nemser and Floden (1986, p. 505): ‘many teachers are reluctant to ... *offer guidance* without being asked’ due to the norm of non-interference. As Cusick (1981, p. 129) concluded from his research in two large U.S. secondary schools: ‘... it was not acceptable to openly comment on or criticise another’s teaching style or choice of materials, or to challenge another’s opinion on some pedagogical matter’. In a study of ten Chicago elementary schools, Glidewell et al (1983) similarly found that teachers perceived offering unsolicited professional suggestions to colleagues as inappropriate behaviour. As one of the teachers interviewed by Zahorik (1987, p. 390) put it: ‘All teachers know how to (teach); therefore, why discuss it? I’ll only be insulting’. According to Little (1990, p. 515), ‘most teachers expect to supply advice when asked and only when asked ...’.

Offering help or advice, even when solicited, has been found to be constrained by the norm of egalitarianism. Zahorik (1987, p. 390) found that teachers are reluctant to offer help

because they perceive giving it as 'boastful'. As one of the teachers interviewed by Zahorik put it: 'Most teachers are very private about what they do. I don't go out and brag about what I do'. A teacher interviewed by Johnson (1990, p. 168) expressed himself in a similar vein: 'I think a lot of us feel that we don't want to tell what we do for ... fear of being thought of as a braggart'. Little (1990, p. 516), noting that teaching is 'an occupation grounded in strong egalitarian traditions', concluded from a review of the collegiality literature that 'advice-giving ... emerges where local commitment to traditional norms of privacy and equal status is weak'. Huberman (1993, p. 29), citing work by Bishop (1977), argued that:

'Professional egalitarianism ... may be one of the reasons why the conversation in the teachers' lounge steers clear of instructional topics: to avoid the attribution of relative competence ... unsolicited offers of advice or technical assistance are widely interpreted as an expression of arrogance...'

In sum, professional norms have a strong impact on professional development. As Rosenholtz (1989, p. 42) concluded, citing research by Tetlock (1981), Fisher et al (1981) and Amato and Berkowitz (1985):

'Whether or not teachers seek or offer help depends in no small extent on the perceived consequences of that aid ... If help seeking is potentially embarrassing ... they will avoid self-disclosure ... unsolicited aid *by definition* ... violates school norms of self-reliance ... (and) typically elicits responses that derogate both the donor and the advice ... teachers who lay claim to classroom triumphs may suffer severe social censure from colleagues for appearing boastful'

The constraining effect of these norms on teacher development has been eloquently discussed by Fullan et al (1992, p. 55):

'When teachers are afraid to share their ideas and successes for fear of being perceived as blowing their own horns ... when teachers young or old, are afraid to ask for help because they might be perceived as less than competent ... improvement (may be limited) quite fundamentally, because ... (there is relatively little) access to ideas and practices that might offer better ways of doing things'

1.2.5. Summary.

A growing body of research highlights the importance of collegiality for educational change and improvement.

The literature suggests that not all teacher interactions may be supportive of educational change and professional development. Research has found that in innovative schools, teacher interactions occur regularly and over relatively long periods of time and focus on professional matters directly related to teaching practice. In such environments, collegial relations are primarily used for exchanging new teaching ideas and materials and for debating pedagogical issues, as opposed to social talk, gossiping about school life or administrative concerns (Little, 1982, Rosenholtz, 1985).

According to research, in most schools, teachers feel isolated from their colleagues and a majority of teacher communication does not focus on teaching practice or pedagogical issues. A number of logistical and cultural factors have been found to constrain collegiality among schoolteachers.

1.3. Computer-mediated communication and electronic mail.

This section describes the main technical characteristics of electronic mail and discusses research suggesting that it may facilitate collegial interactions in a variety of contexts.

1.3.1. Computer networks and computer-mediated communication.

One of the main technological developments in communication in recent years has been the fusion of computer and communication technologies in computer networks. CMC refers to an array of communication services supported by computer networks such as electronic mail, conferencing and bulletin boards (Metz, 1994). Electronic mail is one of the most widespread CMC technologies all over the world (Quarterman, 1994).

1.3.2. Properties of electronic mail.

Electronic mail or 'e-mail' systems are computer programs that manage the creation, storage and distribution of messages (Kiesler, Siegel and McGuire, 1984). This section briefly describes their main technical characteristics. A more detailed technical description of e-mail systems may be found in Quarterman (1994).

E-mail systems enable people to create messages (mostly in textual form although increasingly high-quality graphics, video and audio may be transmitted) and send them to other individuals (called 'private' messages) or to groups of people who share a single 'electronic address' (called 'public' messages). A 'carbon copy' feature enables sending simultaneously the same private message to several individuals.

Public messages enable e-mail users to communicate with many individuals at essentially the same cost as with a single individual (sometimes called 'broadcasting'). Thus, the cost of sending messages is independent of the number of receivers.

The cost of electronic communication has been strongly reduced in recent years, especially since the advent of the Internet network standards (Ruberg and Sherman, 1992). For all practical matters, the cost of sending messages through electronic networks is independent of distance (i.e. sending a message to the next classroom has the same cost as sending it to another country).

Electronic mail is multi-directional, in the sense that there is no pre-established direction of flow for communication, as opposed to broadcast media such as radio or television. This means that by combining public and private communication, electronic mail may be used as a private, personalised, one-to-one medium, as a less personalised many-to-many multidirectional medium or as a depersonalised one-to-many, mass communication medium.

An important feature of e-mail is its 'asynchronicity' (i.e. communicators need not be attending to the exchange at the same time). Senders may send electronic messages at the time of their need or convenience and receivers will find them the next time they access the system (also at the time of their convenience). Research on the use of CMC in industrial organisations has reported gains in productivity since people do not have to spend time trying to reach others on the telephone (Bair, 1979). Another outcome of asynchronicity is that it allows people to communicate independently of work schedules or time zones (Johansen et al, 1979). It should be noted that asynchronous exchanges imply delays in receiving responses.

1.3.3. E-mail and collegiality.

There is evidence, mainly from research carried out in industrial organisations, suggesting that e-mail may foster the creation of new relationships and forms of human collaboration that would be otherwise impossible or inefficient due to cost, time, distance or cultural or professional norms (Hiltz, 1986, Licklider and Vezza, 1988, O'Connell, 1988, Chesebro and Bonsall, 1989, Ruberg and Sherman, 1992).

As discussed before, the costs of communicating using electronic mail are independent of distance. Thus, dispersed people can establish communication based on shared interests as opposed to shared geography (Kiesler et al, 1984). As Robinson (1993, p. 112) put it: '(CMC) ... provides the technical means ... (for) the sharing of knowledge beyond the confines of a particular place'. According to Talbert and McLaughlin (1994, p. 130), when using electronic mail 'the need for physical proximity for collaboration or interdependent activities is reduced'.

As e-mail communication costs are also largely independent of the number of receivers, broadcasting information and sharing materials using e-mail is as easy with many colleagues around the world as with someone in the same building. Feldman (1987) analysed e-mail exchanges in two divisions of a large U.S. corporation and concluded that e-mail enables people to 'broadcast' their needs much more widely than other media and helps them contact individuals who they may not even know about.

Asynchronicity, coupled with the independence of distance and number of receivers, also facilitates communication, especially between individuals with incompatible schedules due, for example, to the organisation of work shifts or geographical time zones. As Bikson and Eveland (1990, p. 253) have argued: 'alleviating temporal barriers with asynchronous messaging may be much more important than is often realised'. Rice and Love have noted that: 'CMC systems remove many of the traditional limitations on communication because they are free from the constraints of time and space' (1987, p. 86).

Sproull and Kiesler (1986, p. 705) concluded from their research on CMC use at the Tandem computer company that '(electronic mail) can both add new recipients to information already being circulated ... and add genuinely new or previously uncirculated information'. They offered a psychological explanation for such communication behaviour. According to these authors, communication is regulated by the social context and people perceive the context through 'social cues'. For example, differences in status may be apparent to people through physical cues such as large offices, clothes or physical aspect. As such cues are less perceived in CMC, people may feel less restricted in communicating, for example, with strangers or people in higher hierarchical positions (social psychological approaches to communication research are discussed in Chapter 3).

Researchers have also found that communication behaviour is affected by the degree of formality of the context (Stohl and Redding, 1987)², with people communicating with fewer inhibitions in informal environments. E-mail, a medium of communication perceived as high in 'informality' (Sproull and Kiesler, 1986), should therefore lead to a 'safer' environment in which to share information (Hudson and Jablin, 1992, p. 11). Finholt (1992) studied the communication behaviour of individuals using CMC in a large multinational company and found that it differed significantly from FTF exchanges. 'Askers' openly admitted their ignorance on a given topic to large numbers of people, many of them strangers, and 'helpers' responded to requests for advice from largely unknown people.

1.4. Summary.

This chapter has briefly reviewed the research on collegiality to provide essential background to the main issues that are investigated in this project.

It has been argued that collegiality is recognised as an important issue in processes of educational change and professional development.

As technological developments have reduced the costs and complexity of new communication technologies, CMC systems, especially e-mail, have become increasingly available to schools and teachers around the world.

The literature suggests that e-mail may foster collegiality because it helps people overcome constraints to human communication such as geographical distance, incompatible schedules, duplication costs, formality or differences in social or professional status.

However, at the time of the study, most CMC research had been carried out in industry. Consequently, relatively little was known about the potential of electronic mail for fostering collegiality *among schoolteachers* or about the extent and nature of e-mail-based collegial interactions. The next chapter discusses the specific aim of, and questions guiding, this research project.

² Stohl and Redding (1987, p. 457) define 'formal' as 'identified with the organisation qua organisation'. Examples of formal contexts include offices and meeting rooms. Examples of informal contexts include parking lots and hallways.

CHAPTER 2

The Study

2.1. Introduction.

The first chapter introduced the main issues related to this investigation. This chapter introduces the research questions and discusses the justification for, and significance of, the study.

2.2. Aim of the study.

As discussed in the previous chapter, the literature on the sociology of teaching has highlighted in recent years the importance of teacher collegiality in processes of educational change and professional development. Consequently, there has been growing interest across different countries in investigating strategies to support collegiality among schoolteachers.

Research, carried out mainly in industrial contexts, has found that computer-mediated communication facilitates collegial communication. In recent years, CMC has become increasingly available to teachers and schools in many countries, including Uruguay.

Within this framework, the aim of this study was to contribute to the understanding of how collegiality might develop among secondary school teachers using a specific CMC technology, electronic mail.

The focus of this study is on e-mail-based collegiality, meaning those teacher interactions carried out *through the system*. Consequently terms such as ‘communication’, ‘collegiality’, ‘interaction’ or ‘relation’ should be understood, unless otherwise specified, as ‘e-mail communication’, ‘e-mail-based collegiality’, ‘e-mail interaction’ or ‘e-mail relation’.

2.3. Research questions.

Five research questions, which were derived from the aim of the study and a review of the literature, guided the work.

The first four questions sought to establish the communication behaviour of teachers using electronic mail. Each of these questions addressed a different dimension of communication behaviour. The fifth question aimed at explaining the results. Findings were used to formulate research-based conclusions and recommendations with regard to the potential of e-mail to support teacher collegiality and educational change. The five research questions are discussed below.

Research question I.

Electronic communication involves different actions such as accessing the system, writing messages and sending them. Patterns of activity may vary within these different actions. Users may access the system frequently to *read* messages addressed to them but *send* very few messages. Messages written may be sent ‘publicly’ (i.e. to a group of teachers) or ‘privately’ (i.e. to a specific individual) or both. E-mail may be sent to strangers or to close friends, to colleagues teaching in the same building or to others teaching at the other end of town.

Obtaining a comprehensive picture of e-mail use requires therefore analysis of all these actions. This leads to the first research question:

I) What are the main patterns of use of e-mail by teachers?

Research question II.

The second question focuses on *relations* rather than on individual behaviour. It looks at the communication flows between pairs of teachers, and attempts to establish issues such as which couples exchange messages regularly, how teachers select some individuals for regular exchanges rather than others, and the extent to which these dyadic exchanges are sustained over time.

The network approach to communication research provided a useful theoretical framework to analyse exchanges of e-mails between pairs of individuals (Rogers and Kincaid, 1981, p. 82). A group of teachers using electronic mail may be conceived of as a communication network where individuals are ‘nodes’ and their dyadic message exchanges are ‘links’³ or ‘relations’. Within the network theoretical perspective links have ‘structural’ or ‘external’ properties such as ‘intensity’ (measured in this project as the number of private messages exchanged between a pair of teachers) and ‘stability’ (i.e. the degree to which a link occurs at successive points in time).

Hence the second question asks:

II) To what extent do teachers using electronic mail develop collegial relations and what are the main structural properties of those relations?

As discussed in the previous chapter, a number of researchers have emphasised the need to look into the *content* of teacher exchanges. Judith Little, one of the most influential writers on collegiality, has criticised the ‘unexamined assumption that any interaction that breaks the isolation of teachers will contribute in some fashion to (their) knowledge, skill, judgement, or commitment...’ (1990, p. 509). A number of findings show that in innovative schools, interactions between teachers are highly focused on topics related to teaching practice and professional development as opposed to, for example, social talk, classroom stories or gossip about colleagues (Bishop, 1977, Little, 1982, Rosenholtz, 1985, Huberman, 1993). Ponticell (1995, p. 17) has argued that ‘(the impact) of collegiality is not determined by the amount of time one works with others ... (but by) the nature of interactions in which they engage’. In other words, it is not enough to analyse with whom

³ A discussion of the main concepts of network theory is included in the review of the literature. Operational definitions used in this investigation are presented in Chapter 6.

teachers communicate, how often and for how long. It is also necessary to investigate the content of the communication exchanged. This is the focus of research questions III and IV.

A long established tenet in communication research is that people address different *topics* (e.g. student behaviour, teaching approaches, learning theories) with specific *purposes*⁴ (e.g. asking questions, requesting advice, coordinating meetings, sharing information, expressing opinions) (Searle, 1969, O’Keefe and Delia, 1982, Stohl and Redding, 1987). Research suggests that *topic* and *purpose* may be studied as intertwining but separate dimensions of content (Keenan and Schieffelin, 1976, Murray, 1985, Beals, 1990).

Research question III.

The third question thus sets out to determine the main topics addressed by the teachers in their messages.

III) What are the main topics addressed by teachers using electronic mail?

Research question IV.

Research question IV is concerned with the *purpose* of teachers’ e-mail communication. The literature suggests that the exchange of professional resources is one of the crucial functions of teacher collegiality in innovative schools (Rosenholtz, 1985, p. 350, Little, 1990). Within this framework, question IV intends to establish the extent to which teachers use electronic mail to exchange professional resources and the main patterns of e-mail based professional exchanges (e.g. the professional resources they exchange, whom they select as ‘exchange partners’, how they respond to requests from colleagues).

IV) What are the main patterns of exchange of professional resources between teachers using electronic mail?

Research question V.

The first four questions seek to obtain a comprehensive picture of the communication behaviour of teachers using electronic mail. The last question attempts to draw an explanatory framework for those results (e.g. why some relations are established while others are not, why some relations are interrupted and others continued, why some requests for assistance are fulfilled while others are ignored).

⁴ The terms ‘function’, ‘purpose’ or ‘intent’ are used interchangeably in the literature.

V) How can the collegial communication behaviour of teachers using electronic mail be explained?

2.4 Research justification.

As discussed in Chapter 1, collegiality has consistently been highlighted as important in the success of processes of educational change and professional development. This has led to calls in the literature for more research directed at examining ways to support collegiality (Kusimo and Erlandsen, 1983, Lieberman and Miller 1991, p. 6, McLaughlin, 1992). Fullan et al (1992, p. 135) suggest that resources be allocated to develop mechanisms for teachers to network with each other.

CMC systems are becoming increasingly available to schools and teachers all over the world, including Uruguay. As discussed in Chapter 1, research, mostly carried out in industry, suggests that e-mail has the potential to support collegiality. However, relatively little is known about the factors affecting the development of e-mail-based collegiality *among schoolteachers*, especially in countries outside North America and Europe, or about the nature of the electronic interactions that might take place.

This is important because CMC systems, however fast and sophisticated, do not *per se* ensure meaningful and sustained communication (Riel and Levin, 1990, Riel and Harasim, 1994, Davis, 1995). As Tsui (1995), put it: ‘unless we have a good understanding (of the factors affecting user participation), we will not be able ... to fully exploit this medium for teacher support’.

CMC projects involve technical and organisational choices such as: the composition of the user community (e.g. Who is invited or allowed to use the system? Are users known to each other?), the organisation of system use (e.g. Is the system required for some specific task? Has system use clear and enforced ‘rules of use’?) or the support systems for teachers using this new communication technology (e.g. technical advice, training). It is important for educational planners interested in the use of CMC systems for supporting teacher collegiality to have research-based, context-sensitive knowledge of the likely outcomes of such choices.

In sum, although new communication technologies are becoming increasingly available to schools and teachers all over the world, their potential for supporting teacher collegiality and educational change might only come into effect if the factors affecting e-mail communication behaviour are identified and well understood. The sections below discuss some of the specific issues in need of further research.

2.4.1. CMC research in schools.

Most of the research on CMC has been carried out in industrial contexts. According to Steinfield (1992, p. 357): ‘little systematic research is being done on non-office contexts and ... educators ... are among the potential users of CMC who might benefit more from further research on applications in non-traditional settings’. As Livingston (1991, p. 4) put it: ‘the research base on the collaborative potential of computer networks (in schools) is not yet well developed’. Bruce and Rubin (1993, p.174) who pioneered QUILL, one of the first computer networks servicing teachers, argued that:

‘... (people implementing computer networks in schools) who have mainly business networks as models, need an understanding of the communication characteristics that are most likely to lead to a strong community of teachers ... investigation and elaboration of such criteria need to continue’.

CMC research in schools has focused on student activities. Few computer networks aimed specifically at supporting teacher collegiality have been systematically researched. As Riel (1990, p. 451) found: ‘There have been a number of studies that have documented the change in students ... less attention has been focused on the changes that take place when teachers work together’. More recently, DiMauro and Jacobs (1995, p. 1) similarly argued: ‘... telecommunications based teacher collaboration is a largely unexplored area of research’. Caggiano, Audet and Abegg (1995, p. 2) similarly noted that ‘limited research about networked teacher communities exists’.

2.4.2. National specificities.

Most of the published research has been carried out in North American or European contexts. Organisational differences between Uruguayan schools and educational system, and those in North America or Europe suggest the need to carry out local studies.

An important difference between countries is the role of the state. In many countries, national or local governments have financed the implementation of telecommunication networks for educational use (Bull et al, 1993, Office of Technology Assessment, 1993, Collis, 1995). As no such infrastructure for educational use of CMC is available in Uruguay, schools face relatively high telecommunication costs.

Another important difference concerns multi-employment. Many secondary school teachers in Uruguay work at more than one school. This occupational characteristic has not been given much attention by educational researchers of industrialised countries (see Cusick, 1981, p. 124 for a relatively rare example). In Uruguay, multi-employment has been found to be a major factor affecting teacher use of computers and educational change (Grünberg, 1991). It could be argued that teachers working at several urban schools are less isolated since they interact with more colleagues. However, Grünberg’s results suggest otherwise for several reasons. First, working at several schools reduces even more the time available for teachers to interact with colleagues. Second, part-timers find it difficult to establish close interpersonal relations in schools where the limited time available is of necessity task-oriented.

Other differences lie in the organisational structure of schools in Uruguay. The subject department, an organisational unit shown to be a hub for teachers’ collegial relations in international research (Fullan, 1991, McLaughlin, 1992), does not exist. Additionally, teacher education is subject-based in Uruguay, which limits teachers’ opportunities to forge ties and interact with colleagues of other subjects.

2.4.3. Computer network technology.

Many educational computer networks reported in the literature were based on ‘proprietary’ technology (i.e. technology licensed by a specific company as opposed to ‘open standards’ where rights usually belong to the public domain). Some projects used costly computer systems which are not widely available for financial or technical reasons to regular schools (Hiltz and Turoff, 1981, Kimmel et al, 1988, Ruopp, Gal, Drayton and Pfister, 1993, Tsui, 1995). This study reports research on the use by teachers of a computer network based on low-cost, non-proprietary technology, available to schools in most countries.

2.4.4. Research methodologies.

As discussed in the review of the literature, CMC research has largely relied on ‘traffic data’ such as the number of messages exchanged, and ignored communication content (see critical reviews by France, 1989, Mason, 1992, Gal, 1993a). Rice (1989) has noted that content analyses of CMC are conducted infrequently despite the advantages of having the communication transcripts available. As Stohl and Redding (1987, p. 453) put it: ‘communication specialists have generally chosen to study correlates or perceptions of message activity rather than actual messages’.

This is important because ‘traffic data’ ‘gives a useful framework ... but as the only data ...it is not only inadequate, but actually misleading’ (Mason, 1992, p. 107). As Fafchamps et al (1989, p. 222) concluded: ‘...e-mail ... should not be assessed solely in terms of number of messages contributed’. Waugh et al (1988), Mason (1992) and Gal (1993a) have argued that CMC research has to make use of qualitative techniques to complement quantitative network activity data.

The literature has also called in recent years for more research into the dynamics of communication, that is, the changes over time (Williams, Rice and Rogers, 1988, Walther and Burgoon, 1992).

Although CMC use has been studied since the early 1980s, most of the research has been carried out from a positivist approach and consists of ‘quasi-laboratory’ experiments. This has been criticised in the literature as a strong limitation in CMC research for several reasons (Finholt et al, 1990). First, the communication behaviour of individuals in laboratory-type research may be quite different from the communication behaviour of the same or other individuals when immersed in their ‘natural’ contexts and activities. Second, laboratory-type studies usually focus on very small groups, while some of the most interesting issues in CMC research involve larger ‘communities’, dispersed organisationally and geographically. Third, such research designs overlook the influence of people’s contexts on their communication behaviour. The rules and norms governing communication behaviour are not the same between army officers, scientists or schoolteachers. Moreover, communication between army officers may be quite different in peacetime in an army base than at the front line under fire (Fulk and Ryu, 1990, Rudy, 1996). This has led to calls for more ‘context-sensitive’ CMC research.

As discussed in Chapter 4, this investigation analysed the use of e-mail in a ‘field setting’ and looked into both quantitative and content data and their changes over time.

2.5. Research significance.

The significance of the study should be understood in the framework of the new challenges and demands on teachers and schools arising from rapid technological change, cultural diversification of student populations and the political and economic shifts affecting societies all over the world. Teachers face rising demands for teaching effectiveness and accountability. Programmes of technological change and curriculum reform are being introduced, in many cases mandated by national authorities. Traditional change implementation strategies have been shown to be ineffective. The literature suggests that approaches concentrating on stimulating collegiality and collaboration may be effective for tackling the problems of change (Garber, 1991, Lieberman and McLaughlin, 1992, Talbert and McLaughlin, 1994, p. 130).

Within this framework, it is important to investigate the potential of new tools such as electronic mail to support the development of teacher professional networks. Moreover, it is significant to undertake such a study in the current stage of development of computer networking technology. Several trends are creating unprecedented opportunities for teachers to use electronic mail. First, due to decreasing costs and public pressures, the number of computers in schools and homes is growing rapidly. Second, the growing acceptance of open technical standards in telecommunications has given rise to an expanding 'network of networks' popularly called the Internet, accessible, technically and financially, to schools and teachers around the world. Third, new generations of teachers have become familiar with computers in initial teacher education and in some cases even before, while they were themselves in secondary school. For these young teachers, electronic mail may become a communication medium as natural and easy to use as more traditional media such as the telephone.

Research-based findings should be of interest to teachers. A survey of North American teachers carried out by Honey and Henriquez (1993) concluded that most were interested in using new technologies to communicate with colleagues. Other studies have found that teachers expect their schools to better support collegial relations (Lortie, 1975, p. 104, Corcoran, 1988, Johnson, 1990, p. 151).

Decision makers, both at the school and national levels, would be helped by research results providing them with better knowledge of the likely consequences of their choices when planning and organising the introduction of e-mail systems for teachers. Findings based on research carried out in Uruguay should be of special value for decision makers in Uruguay and other Latin American countries who currently have to rely almost exclusively on research carried out in North America and Europe.

2.6. Summary.

This chapter has introduced the research questions guiding the study and discussed the project's justification and significance. The next chapter reviews the main streams of literature relevant to this research.

CHAPTER 3

Literature review

3.1. Introduction.

This chapter presents the main streams of literature relevant to this study. The first section relates the study of collegial interactions between teachers to the more general theoretical framework of research on human communication and discusses some of the main theoretical models for the study of media use. The second section reviews some of the main teacher-oriented CMC educational projects reported in the literature.

3.2. Theoretical approaches to the study of communication.

3.2.1. Communication research.

Collegial interactions between teachers can be seen as part of the broader field of human communication, and electronic mail as a communication medium within the array of media that teachers may use for communicating with colleagues.

The communication literature has studied factors influencing the development of interpersonal relations and the effects of these relationships on individual behaviour for many years and from different theoretical and methodological perspectives (Coleman et al, 1966, Allen, 1970, Burstein, 1976, Burt, 1978, Andrews and Kandel, 1979). However, although the communication research base has been developed for a number of years, few educational researchers have made use of this theoretical and methodological base for studying teacher collegiality (Rudy, 1996).

This section reviews some of the main streams of communication research relevant to this investigation.

3.2.1.1. Relational models of human communication.

Communication research has developed rapidly since the 1940s in response to the growth of mass media and its perceived influence on society. Most of the early studies concentrated on the effects of mass media on different audiences. These studies relied on a 'linear' model of communication, where a *source* transfers information to a *receiver* seeking certain behaviour (Shannon and Weaver, 1949). This was the general approach to most studies on the effects of advertising, political broadcasting or war propaganda for example.

These 'linear' models were criticised for conceiving communication as a series of discrete acts, instead of as a process. As Berlo (1960, p. 106) stated: 'it is dangerous to assume that (source and receiver) ... are independent of each other. This denies the concept of process, and communication is a process'.

In the 1970's, 'relational' models of communication were proposed by a number of influential authors. These models emphasise the need to consider individuals in their context to account for the interdependence between participants in the communication process. As Rogers and Kincaid (1981, p. 63) argued:

'Communication is always a joint occurrence, a mutual process of information-sharing between two or more persons ... communication always implies relationship ... what others think and do ... has important consequences on what an individual member of a system thinks and does'.

Rogers and Kincaid advocate that communication research should concentrate on communication behaviour rather than on communication effects and study *relationships* rather than *individuals*.

This section discusses two of the main relational models of human communication relevant to this investigation, the social exchange and the network models.

3.2.1.2. The social exchange perspective on communication.

The social exchange theoretical perspective argues that individuals initiate, maintain and terminate relationships on the basis of the perceived 'profits' (rewards minus costs) and 'equity' (i.e. the difference between each partner's relative 'profits') associated with those relationships (Thibaut and Kelley, 1959, Walster et al, 1976).

Rewards consist of 'resources' obtained from communication partners. The nature of the resources may be cognitive, affective or material (Foa and Foa, 1974). Costs include for example, time, money, effort and social rejection (Rolloff, 1981). According to Infante, Rancer and Womack (1993, p. 296):

'Viewed from a social exchange framework, interpersonal communication can be thought of as the process by which individuals involved in a relationship provide each other with, and negotiate for, the exchange of resources'.

Resource exchange involves two different communication behaviours: 'resource-seeking' and 'resource-giving' (Stohl and Redding, 1987).

Acquiring resources.

The literature outlines a number of strategies by which individuals seek resources: a) inquiry, b) monitoring and c) self-provision (Burke and Bolf, 1986, Morrison, 1993, Kramer, Roberts and Turban, 1995).

Inquiry consists of the initiation of overt, explicit resource requests. This strategy is generally perceived as having high social costs since it involves public disclosure of needs, may annoy the recipient of the request and may generate feelings of indebtedness when requests are answered (Greenberg, 1980, Ashford and Cummings, 1985). As Dewhirst

(1971) concluded from his research on information exchange among scientists: ‘When one person asks a colleague for information, he is making a partial admission of the intellectual superiority of that colleague. Since technical competence is a primary basis of the status of scientists and engineers, it can prove difficult for some individuals to admit their lack of knowledge’.

Consequently, individuals may avoid this strategy unless they perceive that the potential rewards may exceed the costs involved (Morrison, 1993). For example, Ashford (1986, p. 487) reported that use of inquiry was negatively correlated with tenure. He concluded that experienced individuals perceive higher costs in requesting resources because seeking ‘undermines their standing as confident and self-assured veterans’.

Miller and Jablin (1991, p. 97) have noted that the perceived costs of overt resource-seeking are not similar for all individuals. They argue that perceived costs are influenced not only by group norms but also by the relationship between the ‘requester’ and the source, and the nature of the information sought.

Monitoring consists of observing and listening to others (or in the case of CMC, reading public messages). This strategy avoids the social costs of overt inquiries but is less efficient since individuals may not have access to what they need when they need it (Morrison, 1993). Although all strategies entail costs, evidence has been reported suggesting many people (for example, newcomers) find monitoring more beneficial (in terms of the cost-benefit structure) than inquiring (Ashford, 1986). Although some researchers have argued that this strategy is perceived as without costs (Kramer et al, 1995, p. 154), others have warned that receiving unrequested contributions may be costly under some circumstances. For example, unwanted (and eventually unhelpful) assistance may impose obligations on the receiver in social contexts where reciprocity is a powerful norm. As discussed in Chapter 1, teachers have been found highly reluctant to *accept* some types of resources, such as advice or opinions, because of the high costs imposed by professional norms. Individuals using this strategy have no control over the time or format in which they receive resources.

Self-provision is the strategy of choice for individuals seeking to minimise disclosure costs and involves turning to impersonal sources (e.g. books, instruction guides, databases) for obtaining the required resources (Burke and Bolf, 1986). This strategy avoids most social costs involved in obtaining resources and may be particularly important in contexts where asking for some types of resources is discouraged (Dewhirst, 1971). This strategy has limitations, since some types of resources (e.g. personalised feedback on job performance) must be provided by other *people*.

Sharing resources.

Resource-*giving* has been much less researched than resource-seeking (Kramer et al, 1995), although social exchange theorists (Cline and Musolf, 1985, Hudson and Jablin, 1992) recognise this behaviour as an important component of professional development for several reasons. First, there is evidence showing that information giving amounts to at least 25% of total communication behaviour, even for newcomers (Jablin, 1984). Second, exchange research suggests that unilateral relations are not sustainable (Hudson and Jablin, 1992).

Hudson and Jablin (1992) reported two main strategies for sharing resources: a) responding to requests and b) unrequested sharing.

Selection of sources.

Foa and Foa (1974, p. 240) have argued that for an exchange to occur between two individuals A and B: 1) A must perceive B as a possessor of valued resources and willing to supply them to A and 2) A must possess resources of some value for B. The first condition implies that A may select B as a source but both conditions must be fulfilled for an actual exchange to occur. This implies that teachers looking for advice for example, may systematically turn to more experienced colleagues because they may feel that they are more likely than less experienced teachers to possess the required expertise.

More recent research suggests that not all exchange behaviour may be so deterministic ('I will provide *you* with something only in case you are in a position to provide *me* with something I value'). Depending on the individuals involved and the social and organisational context, people may indeed help others with no expectation of direct reciprocity. This is further discussed later in this chapter.

Communication research (Allen, 1978, Kraut et al, 1990) has found that people usually select for their exchanges individuals who are physically or professionally 'proximate' (e.g. who work in the same building or teach the same subject), have a history of prior relationships (Krackhardt, 1988) or are similar to them in some demographic variable (Zenger and Lawrence, 1989). As Constant et al (1996, p. 121) concluded from a review of the literature, 'People provide help to people they know, people they like, people who are similar, and people who have helped them'.

Types of resources exchanged.

There is no agreed taxonomy of resources in the literature. Foa and Foa (1974) define a 'resource' as any commodity that can be transferred or shared through interpersonal behaviour. They posit six types of resources: love, status, services, goods, information and money.

According to Roloff (1981, p. 22) resources can be differentiated into two main dimensions: particularism and concreteness. The former represents the extent to which the value of the resource depends on the sender. For example, we may value much more a positive opinion on our work performance from our boss than a similar opinion from a stranger. Conversely, if we obtain a book from the library or from a colleague, the value of the resource itself remains the same. Concreteness refers to the form the resource may take in the exchange. Goods, for example, are highly concrete and usually physically transferred in an exchange. Conversely, compliments or love are the least concrete since they are usually communicated symbolically and can take many different forms.

A major distinction people have been found to make is between tangible resources such as books (called 'products', 'goods' or 'possessions' in the literature) and intangible ones, drawn from experience and knowledge such as advice or technical information (called 'expertise' or 'abilities'). Products can be easily quantified and stored while expertise may not be easily valued, stored or compared with other resources. There is some evidence that people attribute different meanings to these two categories of resources, i.e. 'products' and 'expertise' (Roloff, 1981, p. 23, Feldman and March, 1981, Pfeffer, 1981). This is discussed later in this chapter.

Hudson and Jablin (1992, p. 15), building on work by Gioia and Sims (1986), have suggested that resources may be classified into two main categories: 'evaluative' and 'non-evaluative' or 'descriptive'. Evaluative messages are defined as 'all messages that contain information which expresses an opinion or judgement ... Descriptive messages include all other statements'.

Kollock (1999, p. 221) distinguishes 'gifts' from 'commodities'. The former, according to Kollock, involves a 'vague' obligation to repay, while no obligation usually exists after purchasing a commodity. Gifts are usually exchanged within established relationships while commodities may be exchanged by self-interested independent actors. According to Bell (1991) the value of gifts obtained depends on people's personal networks while the value of commodities depends mainly on their price (or cost to obtain).

Factors affecting exchange behaviour.

Requesting behaviour.

Research has found that the choice of acquiring strategy is strongly influenced by the perceived costs and benefits of the exchange (Brown and Levinson, 1978, Ashford, 1986). According to Miller and Jablin (1991, p. 113), in some cases individuals 'have *no choice* but to use a less direct information-seeking tactic, given anticipated high social costs for asking an overt question'.

The perceived costs of resource seeking are not similar for all individuals; they may be influenced by individual differences. As Miller and Jablin (1991, p. 97) put it: '... individuals differ in what they perceive as personally important rewards and costs ... although the social disapproval of peers may be too great a cost for some to incur, others may consider such a cost unfortunate but not significant enough to warrant a behavioural change'. Individuals with low self-esteem are less likely to search for resources and face the risks involved (Louis, 1990, Hudson and Jablin, 1992). Individuals with low tolerance for ambiguity use more direct tactics for acquiring resources (Ashford and Cummings, 1985, Bento, 1995).

As discussed in an earlier section, the nature of the relationship between the requester and the source has been found to affect the selection of acquiring strategy since the social costs of approaching some individuals may be lower than for others. For example the social 'costs' of contacting strangers may be higher than of contacting acquaintances (O'Reilly, 1982, Miller and Jablin, 1991).

Contributing behaviour.

Responding to requests may have higher benefits for the provider than unrequested sharing since it may generate feelings of indebtedness and 'reciprocity obligations' on the receiver (Kramer et al, 1995).

Volunteering resources to specific individuals may also lead to 'reciprocity obligations' on the receiver although it involves higher costs for 'contributors', since the contributor may be perceived as 'intruding' or 'boasting' (Kollock, 1999, p. 221). Volunteering resources to common pools from where many individuals may benefit, do not involve direct rewards for 'contributors' in incentive-free systems (such as Teachnet and most other teacher networks) since no specific individual becomes 'indebted' to the contributor.

The exchange literature has argued that ‘restricted exchanges’ (individual-to-individual) and ‘generalised exchanges’ (individual-to-group) differ in their underlying principles (Ekeh, 1974). According to Roloff (1981, p. 20), in ‘restricted exchanges’ most people are driven by a search for balance. As he put it: ‘We do not like to be obligated to others, nor do we like to have others not repay their obligations to us’. Some exchange theorists argue that for human relations to be sustainable, perceived equity must be achieved and that unilateral relations may not be sustainable (Walster et al, 1976, Nord, 1980, Miller and Jablin, 1991, p. 97). For example, it has been suggested that experienced teachers may be reluctant to contribute to beginning teachers in ‘restricted exchanges’, because beginning teachers are expected to be less able to reciprocate with valuable teaching resources of their own (Allen, 1989, Little, 1990, p. 519). Conversely, in ‘generalised exchange’ systems, Roloff argues, ‘the receiver owes not the specific giver but the overall group of people (hence, no immediate reciprocity or equity is expected)’. Public contributions (i.e. public e-mails used to send contributions) have been found to operate as ‘generalised exchange’ systems. Kollock (1999) noted that in many computer networks people contribute freely advice that they would charge for if requested and delivered using other media. As he put it:

‘Much of the help and sharing that occurs (in CMC) is actually different than traditional gift exchange. When people pass on free advice or offer useful information, the recipient is often unknown to them and the giver may never encounter the recipient again.’ (Kollock, 1999, p. 222).

Thorn and Connolly (1990), who have studied public contributions in CMC systems, found that CMC reduces the cost of sharing resources because it enables duplication and distribution to large numbers of people at essentially a fixed cost and hence sharing is facilitated. In a series of laboratory experiments, Thorn and Connolly found that contributions were directly related to the perceived value of the resources obtained and to the symmetry of benefits, and inversely related to contribution costs and group size.

Contributing behaviour in ‘generalised exchanges’ may be constrained by the social dilemma of ‘public goods’ (Barry and Hardin, 1982). A ‘public good’ is available to everyone, regardless of whether or not all individuals contributed to its provision. Public goods usually share (each to some extent) two characteristics. They are ‘non-rival’, meaning that one person’s consumption of the resource does not reduce the amount available to the others and ‘non-excludable’ in the sense that it is costly or impossible to exclude specific individuals from benefiting from the good. Public television, clean air and lighthouses are classical examples of ‘public goods’ (Rapoport, 1987). In ‘public good’ systems all benefit if everybody contributes, but each individual would profit even more if he or she was exempted from contributing. In this situation, which game theorists call ‘deficient equilibrium’, if everyone acted strictly in his or her self-interest all individuals would achieve *less* benefits. Not surprisingly, as contributors of public goods face ‘costs’, (e.g. time, duplication, distribution, risks to reputation, loss of ‘ownership’), but no direct benefit, research has shown that public goods are generally undersupplied unless contributions are ‘subsidised’ in some way (Isaac et al, 1985). ‘Subsidies’ to contributions (for example free connections to computer networks) may generate an oversupply of potentially irrelevant resources leading to information overload.

Social exchange researchers have attempted to explain voluntary contributions from different perspectives, the question for communication researchers being: ‘if maximising profit and seeking equity are the driving forces in human exchanges, why do people voluntarily and spontaneously share their resources with others, especially in situations where no incentive is provided and no direct reciprocity can be expected?’ (Constant et al,

1996, p. 121). Voluntary acts, according to Hoffman (1981), are sometimes not motivated by expectations of reciprocity but by 'psychic benefits'. For example, for individuals perceiving themselves as 'generous' such contributions may provide self-confirmation. Another source of intrinsic motivation highlighted in the literature is the sense of efficacy (Kollock, 1999, p. 228). People may contribute resources because in doing so they support their own self-image as efficacious individuals (Orr, 1989). Other people may contribute to common pools because they are motivated by a desire for social recognition (Rheingold, 1993). Although interpretations of voluntary contributing behaviour differ on theoretical grounds, all of them help explain voluntary action as a rational behaviour of people operating under personal and social forces. One important conclusion is that even purely altruistic behaviour may cease if the costs exceed the rewards the person perceives he or she obtains from the exchanges (Murnighan, Kim and Metzger, 1993, Kollock, 1999, p. 229).

The social context.

Kelley and Thibaut (1978) distinguish between contributions among individuals acting alone and among individuals immersed in a shared social and organisational context. In the former case, Kelley and Thibaut argue that exchange behaviour is mainly shaped by people's self-interests and simple reciprocity (the fundamental principles may be stated as: 'I request whatever I need' and 'I help *you* if you help *me*').

However, in the second situation, social and professional norms may affect exchange behaviour in different ways. Dewhirst (1971), Hudson and Jablin (1992) and others have found that cultural and organisational norms can lead to negative sanctions against seeking information. Kelley and Thibaut (1978), Constant et al (1996, p. 131), Kraut et al (1990, p. 747) and others have argued that social norms may drive individuals to contribute even to people who in the past have not acted positively towards them (Sproull and Kiesler, 1986, p. 686). As Constant, Kiesler and Sproull (1994) put it:

'Believing that information sharing is usual, correct and socially expected behaviour should increase information sharing, independent of the information possessor's personal feelings about his or her co-workers ... This belief could be acquired from or reinforced by organisational norms'.

Social norms may lead to apparent rewards being perceived as costs. This is the case of social contexts where receiving contributions automatically generates reciprocal obligations. The contribution may be unrequested, unwanted or unhelpful but the receiver may feel that he or she is in debt to the contributor.

The task.

The nature of the task has been consistently found to affect communication behaviour (Stohl and Redding, 1987, p. 472). As Jablin (1984, p. 636) suggested: 'the most influential factors affecting interpersonal communication patterns and relationships ... are the characteristics of the task on which they are working'.

Two features of tasks have been reported as especially influential on communication behaviour: *uncertainty* and *interdependence* (Greenberg, 1980). Individuals facing uncertainty have been found to seek information advice more than others do. Interdependency (i.e. the extent to which individuals need each other to achieve their work goals) creates a situation where people have a shared interest in ensuring that all individuals obtain the resources they need to perform their job, hence sharing is fostered. Educational researchers have noted that teaching is a ‘low interdependence task’ (Pellegrin, 1976, p. 368), hence the low incentive or need that most teachers perceive for exchanging resources with their colleagues (Lortie, 1975, Little, 1990, p. 520, Zarn, 1992).

Type of resource.

The type of resource has also been identified as a factor influencing exchange behaviour. According to Miller and Jablin (1991, p. 104): ‘From time to time newcomers also appear willing to risk potential negative consequences associated with asking overt questions when the information is considered vital’. Similarly, Morrison (1993, p. 562) concluded, from a study of 240 recently hired accountants in a U.S. company, that since technical information is crucial to job performance, individuals will face the costs of inquiry rather than face the inefficiencies (e.g. delays) involved in monitoring. According to Morrison, the type of information sought also affected the selection of sources. She found that individuals chose peers as sources of technical, normative and social feedback information while they preferred superiors as sources of referent information and performance feedback. Louis (1990) argues that people may perceive lower costs in seeking technical information, as opposed to opinions and judgements, since this type of resource does not involve feelings.

The literature suggests that sharing ‘expertise’ may bring ‘internal’ benefits that may not be obtained when sharing ‘products’, because it permits self-expression and demonstrates self-consistency. These benefits include heightening of self-esteem, prestige and social recognition (Thibaut and Kelley, 1959, Schlenker, 1985). Constant et al (1994) obtained some evidence supporting the claim that people perceive differently exchanges of ‘products’ and of ‘expertise’. They found, in a series of laboratory experiments, that individuals were more inclined to fulfil a request for ‘expertise’ from a colleague who had not been helpful in the past than a request from the same colleague for a ‘product’. They concluded that when exchanging ‘expertise’, the internal rewards (such as positive self-evaluation and demonstration of professional competence) might overcome reciprocity as the main force guiding exchange behaviour.

3.2.1.3. The network model of human communication.

The previous section described the social exchange model of human communication. This section introduces another of the main relational models of human communication, the network model. Research findings on the determinants of human communication from the network theoretical perspective are discussed. Subsequently, the influence of interpersonal relations in processes of change is presented from this theoretical perspective.

Links and transceivers.

Any given individual in a system is likely to contact some individuals and to ignore many others. Since interactions have a cost (e.g. in time, transportation costs or social

and psychological mutual adaptation efforts), individuals tend to concentrate their finite communication resources on interactions that they perceive as providing the greatest rewards. Communication theorists explain this decision-making process through the 'principle of least-effort and greatest-reward' (Zipf, 1949).

When an individual contacts another he establishes a 'link' with the other individual and both are 'transceivers' in this communication process. Links have properties such as 'intensity' (measured by a certain variable such as the number of telephone calls or number of e-mails), 'stability' (i.e. the degree to which a link occurs at successive points in time) and 'multiplexity' (i.e. the degree of diversity of content in the communications exchanged by the pair of individuals).

Network models assume that interpersonal communication choices (e.g. who communicates with whom, how frequently, the intention and content of the communication) adopt regular patterns over time. These patterns constitute a 'communication structure' which is relatively stable and predictive of behaviour (Rogers and Kincaid, 1981, p. 75). Network research studies social interaction through the properties of this communication structure.

Most early network research has been criticised for overlooking a number of the properties listed above whose importance has been highlighted in research carried out since the 1980's, especially stability and multiplexity (Rogers and Kincaid, 1981, p. 313).

Determinants of communication.

One of the major goals of communication research in general is to generate theories to explain who communicates with whom and why, or in more formal terms, to identify the main determinants of the creation of communication links between people.

Three main classes of determinants have been identified in the literature on human communication: a) physical distance, b) social distance or 'homophily' (i.e. similarity in specific characteristics of the transceivers such as profession or social class) and c) previous acquaintanceship (Rogers and Kincaid, 1981, p. 298). These classes of determinants are discussed below.

Physical distance.

A large number of research findings have established the strong influence of physical distance in the development of communication links. Network theorists argue that the longer the distance between people's homes or workplaces, the higher the costs of communication between them and hence the less likely that they will establish a stable, long-term communication link.

Festinger et al (1950) published findings of a study on the patterns of communications between students of a large university sharing a dormitory. They found that 75% of the links connected people living less than 50 feet away and no links connected people living more than 100 feet apart. Thus, physical distance was an obvious major determinant of communication.

Allen (1978) studied communication exchanges between scientists in research and development organisations. He found a non-linear relationship between physical distance and interaction. Exchange frequency decreased following a curve with a sharp drop at 50 feet.

Hagstrom (1965, p. 122) explained the importance of physical proximity in the development of relations as follows: ‘Spatial propinquity often leads to collaboration since it is likely to lead to informal communication’. Kraut, Egidio and Galegher (1990) investigated the patterns of collaboration among 500 scientists in a large U.S. corporation and found that 82% of collaborative publications had been carried out by pairs of individuals working on the same floor, even though these were only 12% of the potential pairs. They attributed the effect of physical proximity to several factors: increased likelihood of informal communication, higher communication quality (communication involving more channels) and lower costs of communication. As they put it:

‘... proximity not only enables potential collaborators to make contact with each other, but also makes it possible for them to make unobtrusive and psychologically satisfying assessments of the likelihood that they would be able to work together productively and amicably’ (Kraut, Egidio and Galegher, 1990, p. 747).

Homophily.

A basic principle in human communication research is that *exchanges are most frequent between homophilous transceivers*. ‘Homophily’ is a concept coined by Lazarsfeld and Merton (1964) and refers to the degree to which pairs of individuals who interact are similar in a certain attribute (e.g. age, gender or the subject they teach).

Communication theorists explain that when individuals share common interests, tasks or beliefs, interaction is easier and more likely to be effective and hence rewarding. Homophilous communication is thus encouraged and individuals communicate most of the time with family, friends and associates.

Many of the individuals with whom a focal person communicates are in turn homophilous with each other (‘socially proximate’ in network theory terminology). Within such an interlocked network of ties, if at least some of the individuals do not have some less homophilous ties linking them to the outside world, new ideas might not circulate. Thus, links between heterogeneous people fulfil a vital role in enabling innovations to reach groups of individuals that mostly communicate with each other. In communication theory terms, the informational strength of homophilous communication is lower than the informational strength of heterophilous communication. Granovetter (1973) was one of the pioneers in theorising on the apparent contradiction of the ‘strength of weak ties’. In his classic study of the flow of information about job opportunities in the early 1970’s in Boston, he found that most leads on job opportunities were obtained by individuals through contacts with people they seldom interacted with and who were usually from different occupations. He described ‘weak ties’ as lacking frequent contact, low in emotional closeness and with no history of reciprocal services. Rogers and Kincaid (1981, p.129) argue that weak ties should be given special attention in communication studies.

A number of studies have examined the effect of homophily on the creation of links between individuals and an almost universal finding has been that individuals tend to link with others of comparable socio-economic status (Laumann and Pappi, 1973).

Fisher et al (1977, p.63) in their study of relationships between adult males in Detroit found that respondents chose their friends on the basis of homophily in occupational and educational level, religion and age.

Kandel (1978) investigated relationships between high school students. She found that one of the most powerful determinants of communication was the use of illegal drugs. The author theorised that deviant behaviours are in greatest need of peer support and hence the powerful drive to maintain relationships with others engaging in the same behaviour (homophilous in the drug-taking variable).

Link stability.

A number of investigations have suggested some factors affecting link stability. Cohen (1977) reported from his research in an Illinois high school that 'homophilous' couples were not only more likely to establish links but also, once those links were created, they were more stable.

Hallinan (1978) studied the factors affecting friendship links between primary school students. She found that reciprocated links were more stable over time.

The content of links has been found to affect link stability. Kincaid (1972) found that among Mexican rural migrants to cities, links based on instrumental content were more stable than links based on friendship. Boissevain (1974) concluded from his research on friendship links that homophily and multiplexity were positively related to stability.

3.2.1.4. Summary of communication research.

Relational models of communication provide a strong body of theory to guide research into CMC-based collegiality.

Communication researchers have found that communication *outcomes* (perceived costs and rewards of exchanges) and *structure* (e.g. who talks to whom) affect individual behaviour and processes of change. Individuals who interact most of the time with homophiles (for example teachers of the same subject) have less access to new ideas and practices. Isolates have been found to implement fewer changes in their practices than individuals who interact with their colleagues.

Exchange theory suggests the importance of analysing the strategies used by teachers for obtaining and sharing resources, the factors affecting the selection of those strategies and what makes some collegial relations beneficial and sustainable in the long term.

Network theory according to Contractor and Eisenberg (1990, p. 145): 'provides us with a vocabulary for identifying and measuring information flow between people'. Within this framework, it is of theoretical importance to study the factors affecting the creation of links and the properties of those links.

Relatively little research has been carried out on the use of CMC by secondary school teachers from these perspectives.

The next section will discuss another stream of communication research, which concentrates on understanding how and why people use different media.

3.2.2. Media use research.

Humans use media⁵ to communicate with each other. The range of media for interpersonal communication usually includes 'face-to-face communication' (FTF), hard copy (e.g. letters, memos and faxes) and telephones. The accelerated development of new computer-based communication technology such as CMC has increased interest in understanding how people with access to new media might communicate with each other.

New media use can alter the size, range and diversity of people's communication networks. This effect may result from the technical properties of media, for example the ability of the telephone to span distance restrictions or CMC's asynchronicity, which alleviates schedule incompatibilities. New media have generally been found to increase overall communication rather than substitute for existing media.

Within this framework, a stream of communication research has concentrated in the last decade on the factors affecting media selection and use. The following sections review some of the main paradigms of media research: 'richness' theory.

3.2.2.1. Information richness theory.

Early studies of the use of CMC were based on the 'information richness' model (Daft and Lengel, 1984). 'Richness' or 'bandwidth' (Hiemstra, 1982) is defined as the capacity of a medium to carry paralinguistic, non-verbal and non-textual cues, personalise messages and provide immediate feedback (this concept is called 'interactivity' by some communication theorists).

Richness theorists argue that media can be organised in a continuum based on their 'bandwidth' (Steinfeld, 1986). FTF is considered the 'richest' medium since it is highly interactive and capable of carrying non-verbal and social cues (e.g. body language, physical appearance, clothing). Telephone conversation lacks the visual cues of FTF but still allows for interactivity. Personal letters are not interactive but allow for more personalisation than, for example, fliers.

Using media involves different costs, which are higher for 'rich' media than for more 'lean' media (e.g. meeting FTF with a colleague working in another city requires long distance travelling while a telephone exchange requires paying for a phone call). The richness approach to communication argues that individuals attempt to match the communication requirements of tasks (e.g. persuading, bargaining, coordinating a meeting) with the technical properties (e.g. ability to convey paralinguistic cues, interactivity) and cost structure of media. People are expected to rationally choose the cheapest media capable of meeting the communication requirements of tasks (e.g. individuals may not travel a long distance to coordinate a routine meeting). Rich media are presumed necessary for most interactions involving socio-emotional content or high ambiguity (also called 'equivocality').

The literature suggests that e-mail's richness is mainly defined by two technical properties: its low ability to convey paralinguistic cues and its lack of interactivity.

Kiesler, Sproull and others at Carnegie Mellon University have been some of the most influential authors in CMC research. They argue that the critical difference between CMC

⁵ In this study, the term 'communication medium' refers to established methods of communication through language, each of which uniquely bundles channels such as FTF, e-mail or the telephone. 'Channel' refers to the sensory modalities: visual, aural and tactile (Murray, 1985, p. 15).

and FTF communication is the absence of social context cues (Sproull and Kiesler, 1986). These cues include non-verbal behaviour and social indicators such as clothing and physical symbols, which jointly define the nature of the social situation and the actors' relative status. According to these researchers, CMC's lack of social cues leads to an unregulated communication environment where widely shared norms that govern FTF or telephone communication (e.g. length of delay that is tolerable between speakers in a conversation, times of the day that are acceptable for phone calls, topics that may be discussed in the staff room) are missing.

The medium's low capacity to provide interactive communication is one of the key differences between e-mail and FTF communication (Rogers, 1986, Zack, 1993). The literature identifies several important characteristics of interactivity: simultaneous exchange, continuous feedback, flexible turn-taking, ability to interrupt and ability to 'repair' (Goffman, 1967, Levinson, 1983, Schlegoff, 1992). Repair refers to clarification of meanings and intentions. Timely and flexible repair is a major resource in maintaining mutual understanding between communicators (Levinson, 1983, Zack, 1993). Electronic mail is not interruptible and senders have no way to evaluate in 'real time' how their messages are being received and are unable to 'fine tune' the mood of the message (Kiesler, 1986). Therefore, richness theory suggests that electronic mail might be inappropriate when a high level of 'repair' is required (Zack, 1993).

Electronic mail is theorised as standing in a middle position in the richness continuum and the medium of choice only for routine, task-oriented, non-ambiguous information exchanges (Ruchinskas, 1982, Rice and Shook, 1986, Trevino et al, 1987).

The 'richness' theoretical approach has been criticised in recent years. Some authors have criticised this model for concentrating too much on supposedly objective features of the medium while giving little attention to individual differences and the social context of communication (Fulk and Boyd, 1991, Steinfield, 1992, Zack, 1993 Lee, 1994). As Contractor and Eisenberg, (1990, p. 161) argued in their critical review of the richness literature: 'Clearly, characteristics of the media interact with cultural and social norms'. According to Rice (1987, p. 66):

'The extent to which a user evaluates any particular medium as having any particular characteristic naturally depends on the context. For example a CMCS (computer-mediated communication system) can be programmed to have high interactivity, while interpersonal communication between a drill sergeant and a private in boot camp is low in interactivity'.

Fulk and Ryu (1990) have argued that 'richness' should not be considered an invariant property of a medium but a social construction influenced not only by individuals' rational considerations but also by group norms and other individuals' communication behaviour.

Contractor and Eisenberg (1990) and others have criticised richness approaches for assuming that clarity (i.e. equivocality reduction) is always the objective of communicators. According to Burke (1969), messages may be intended to clarify or to create mystery.

Steinfield and Fulk (1989) found that managers acting under time pressure were more likely to use the telephone regardless of message equivocality. In other cases, managers

who needed to communicate with distant colleagues used electronic mail again regardless of equivocality. Media choice was not therefore determined by message content in the presence of such constraints.

Zack (1993) investigated communication between editorial groups at two American newspapers. He concluded that the extent to which a shared interpretative context exists between transceivers determined as much as the ambiguity of the task the appropriate medium. As Zack (1993, p. 21) put it:

‘In ongoing groups with history, culture, norms and deep, shared knowledge about each other, the ... constraints of EM (electronic mail) become less important and the bandwidth constraint is mitigated by shared code and jargon that has become elaborated over time ... Perceived richness then may be more dependent on the richness of the shared, precommunicated, tacit context not included in the message, than in the message itself’.

Besides contextual factors, some authors have found that individuals select media to convey a symbolic meaning. These authors argue that the media choice itself may carry symbolic cues beyond the literal message content. Cultural norms for media are highly dependent on the situation and the context. For example, in some organisations, formal written memos may be considered appropriate for most situations while in others only major decisions might be required to be put in writing. Rice and Case (1983, p. 132) found that 58% of respondents in their research on university administrators using CMC ‘felt that possession of a ... (computer) terminal functioned as a status symbol’. Trevino et al (1987) found that managers sometimes chose FTF to signal a desire for teamwork, to build trust or to convey informality. Telephone communication symbolised urgency and printed media was used to show authority and convey formality.

3.2.2.2. Critical mass theory.

Recent theoretical work has shifted the focus from individual choices of media to a ‘collective action’ or a ‘critical-mass’ perspective (Markus, 1987, 1990). Critical mass theorists argue that a threshold in the number of users is needed before individual users perceive the rewards of using a system as exceeding the costs. In this theoretical model of media use, the benefits do not derive only from individual choice but also from other people’s behaviour.

Oliver et al (1985) developed the early work in critical mass theory. In their work, they use the term ‘interests’ to mean the value put by individuals on the public good and ‘resources’ to what individuals must contribute to achieve the public good sought. The authors argue that a positive correlation between interests and resources facilitates the public good because a few highly interested and resourceful individuals may be able to provide the good for everyone.

Markus (1987), building on Oliver et al’s work, argued that individuals’ interests in using a certain communication medium include the benefit they might obtain from universal access. According to the author (p. 503), individuals’ interests in universal access may vary for several reasons. First, some individuals might be more efficient than others in using the resources obtained. Second, their tasks might be interdependent and require information exchanges (by contrast, when tasks are highly independent, members may have limited interest in resource exchanges). Third, their preferred counterparts might be relatively

inaccessible by other means. Markus suggested that the formation of a critical mass of users is a function of the following factors: a) reliability of technical infrastructure, b) users' skills and confidence in using the medium, c) communication discipline (e.g. predictability of the receivers reading the messages in due time and their inclination to 'reciprocate') and d) heterogeneity of resources and interests among the users. She also suggested that the presence of 'sought after' individuals should accelerate universal adoption.

Rafaeli and LaRose (1993) carried out a survey of 293 bulletin board operators and described users as 'givers', 'exchangers' or 'takers' based on the relation between their reading and writing frequencies. They found that 'takers' (i.e. individuals who accessed regularly the bulletin board but seldom contributed) more than doubled the proportion of 'exchangers' and 'givers' combined. Consistently with Markus and Thorn and Connolly (1990), they found that diversity of content and symmetry in user contributions were positively related to CMC use and contributions.

3.2.2.3. Summary of media use research.

This section has reviewed some of the main theoretical models of media use that have been utilised to investigate electronic mail communication.

Most of the research has been carried out in non-school settings, especially in industrial environments where organisational norms influencing communication (e.g. explicit emphasis on hierarchy, performance-related career structure, high role and task interdependency) markedly differ from the professional norms of teaching .

None of these models has received consistent empirical support across all contexts. It seems that the interplay of individual, technical and contextual factors determining the use of media in different communication situations may be much more complex, context sensitive and dynamic than previously theorised.

This study should provide empirical evidence to enrich our understanding of the explanatory power of these competing models in the specific case of communication between school teachers.

3.3 A review of the research on CMC systems for teachers.

The previous sections discussed some of the main theoretical approaches to the study of human communication and computer-mediated communication that are relevant to this research. The following sections review the research on CMC systems for teachers.

A number of educational telecommunications projects have been implemented and reported in the literature since the mid-1980s (Honey and Henriquez, 1993, Collis, 1995). However, many projects are insufficiently described in these accounts, quite often focusing on the technology at the expense of social and learning issues. In many cases, only descriptive information about the technology and goals is presented, with no systematic analysis of usage, user perceptions or impact on teaching practice. Reports on such projects are excluded from this review, which is limited to research-based reports. Furthermore, a large majority of the CMC projects reported in the literature is oriented towards *student* activities. As such, they are not covered in this review since the study aims at furthering our understanding of communication between teachers.

This section discusses in detail the research projects reported in the literature, which stand out for their research methods, theoretical approaches or contributions to existing knowledge.

3.3.1. QUILL: A telecommunications project in Alaska. (1983)

The QUILL long distance electronic network was set up in 1983 to support collaboration between a group of teachers in Alaska and the north-eastern U.S. involved in a language teaching project (Bruce and Rubin, 1993). It was one of the first computer networks implemented to support teacher collaboration reported in the literature.

The researchers analysed the use of electronic mail by 25 teachers using a case study methodology. They found that more than 300 messages were exchanged during the first six months, most of them broadcast to all participants. Half the teachers used the network regularly. Topics of public messages changed during the school year. First, messages concentrated on getting the project started and getting acquainted with colleagues. After the first trimester, communication focused on the specific project task (integration of word processing into the language curriculum). After six months, the variety of topics broadened and traffic increased until the end of the school year. Public message content included: 'requests for and offers of curriculum assistance, complaints and exultations about the software and hardware, personal information (job changes, budding relationships!) ... and general reporting about the progress of QUILL in their classrooms' (Bruce and Rubin, 1993, p. 159).

Access was the main factor constraining use of the network.

The predominance of public communication was explained by the shared task and experiences of the teachers. Since all teachers were involved with the same project, they assumed that most matters would be of common interest (Bruce and Rubin, 1993, p. 167). Teachers took advantage of this common background, assuming a large amount of shared knowledge when writing messages. This is consistent with Zack's (1993) results showing the importance of shared context in e-mail use.

The technical design of QUILL reflected the 'state of the technology' at the time of its implementation. One of its distinguishing aspects was that human intervention was required to transfer messages between Alaska and the rest of the U.S. This person had to read *all* messages sent from sites in Alaska to others and judge whether they had to be broadcast to all, routed to some individual receivers or even edited. According to the authors, this unusual arrangement facilitated communication between teachers in several ways. First, teachers felt that each message had a guaranteed audience. In other words, no messages would be 'lost in the wilderness' as one of the QUILL teachers expressed it. Second, teachers could rely on that person to judge how appropriate it would be to broadcast each message to all colleagues. This finding is surprising, in the sense that teachers could have resented this intervention as a form of censorship to which they would object if used in relation to the telephone or postal mail. It could be that uncertainty about the social and technical aspects of the technology override, at least at the beginning of such a project, concerns about privacy.

The authors concluded that CMC facilitated educational change 'by providing technical and curriculum resources, discussions of classroom management and pedagogical approaches, an outlet for frustration and general support' (p. 163).

3.3.2. The Science Teachers' Network (STN). (1985)

STN (later called BTCN) was implemented in 1985 by the Harvard Educational Technology Centre (ETC) to 'examine whether computer conferencing could help solve ... teachers' isolation from colleagues with whom they might exchange ideas' (West, Inghilleri, McSwiney, Sayers and Stroud, 1989, p. 1). Seventy-five secondary school Science teachers participated in this project using public and private e-mail to communicate with colleagues and with outside experts. There were no obligations or incentives for participating.

Katz et al (1987) analysed, using quantitative methods, user logons and message sending (i.e. who wrote to whom) from December 1985 to June 1986. Traffic data were collected from all participants. A sample of public messages was content analysed. Finally, all users who could be reached were interviewed to find out about their views on the computer network.

They found that half the teachers accessed the system at least once a week and a quarter at least twice a week. A quarter of the teachers wrote at least one message a week. Almost thirty percent of messages were public. There was no significant⁶ difference between the number of messages sent to known and unknown individuals although writing was positively correlated with initial personal connectedness (i.e. the number of network members personally known by teachers).

Content analysis of public communication showed that the computer network was used for: a) making inquiries, b) replying to inquiries or providing feedback to statements and c) offering unsolicited information or opinions (Katz, McSwiney and Stroud, 1987, p. 21). Almost a third of public messages fell into category a) and almost half into b).

Participation was facilitated by logistical factors, especially home computer availability. As West et al (1989, p. 63) concluded: '... in order to eliminate time and access problems, teachers should have access at home'. Social factors such as perceived tolerance of mistakes, lack of confidence in the interest of one's messages for others and the perceived costs of admissions of ignorance were also found to influence participation, especially *public* participation. As one STN teacher put it: 'you're always worried that your messages will seem ignorant or you will misspell something' (Katz, McSwiney and Stroud, 1987, p. 28). Although the authors do not discuss the literature on the occupational norms of teaching, they suggest that 'beliefs about acceptable professional ignorance' may have to change for public CMC to fulfil its potential for expanding collegiality between teachers (West, Inghilleri, McSwiney, Sayers and Stroud, 1989, p. 25). The organisation of teachers' work affected their use of the computer network. The more opportunities teachers had for FTF interactions, the less they were inclined to use CMC (West et al, 1989, p. 63). According to the interview data, receiving private e-mail was a powerful influence on teachers' use of the computer network (Katz, McSwiney and Stroud, 1987, p. 19).

Teachers perceived that 'private e-mail inquiries were almost guaranteed a response, in contrast with inquiries made in the public forums' (West, Inghilleri, McSwiney, Sayers and Stroud, 1989, p. 21).

One of the main conclusions of the investigation was that 'members' choices to continue or discontinue using the network were based mainly on whether the topics they saw there interest them ... becoming more at ease with the medium itself, or with other members of the group, was not a significant factor in continuation' (West, Inghilleri, McSwiney, Sayers and Stroud, 1989, p. 11). The authors concluded: 'the essential motivation for writing was

⁶ When 'significant' is used, it implies 'statistically significant' unless specified otherwise.

clearly an interest in communicating on the given topic (p. 29)'. The authors suggest that this may outweigh most other factors, including lack of previous acquaintanceship.

The STN research project was one of the first to concentrate on the use of computer networks for collegial interaction between secondary school teachers. As discussed in the previous section, earlier research had focused on business communications (Sproull, and Kiesler, 1986), distance education for managers (Feenberg, 1986) or college courses (Hiltz and Turoff, 1981). STN is one of the most quoted early projects in the educational CMC literature.

The project however had some limitations that should be taken into account when interpreting the reported results and conclusions. First, private e-mail was not content-analysed and therefore results had to be inferred from interviews and self-reports. As discussed in Chapter 4, the use of self-report methods in communication research has been criticised for introducing threats to validity (Bernard and Killworth, 1977). This is a major limitation since more than two thirds of the messages were private and the authors themselves recognised the importance of private e-mail in shaping teachers' communication behaviour. Second, the project lacks a firm theoretical framework guiding its definition of research questions and interpretation of results. There is no systematic discussion of the literature on human communication, teacher collegiality, media use or any other theoretical approach underpinning this study of CMC and teacher collegiality. The project seems to have been driven by the opportunities introduced at the time by the technology with no clear reference to any recognisable stream of scholarship. The atheoretical nature of many CMC research projects has been criticised by a number of authors (Metz, 1994).

3.3.3. CISCO-NET: A computer network for science educators. (1985)

CISCO-NET was established in 1985 to support science teachers in New Mexico. The purpose of the project was to provide science teachers with an opportunity to make and maintain contacts with each other and with experts and institutions across the state (Jones, 1987). Services of CISCO-NET included electronic mail and bulletin boards. In the summer of 1986 there were 127 users registered in CISCO-NET.

Jones (1987) carried out a study of CISCO-NET use by teachers to 'investigate the potential of CMC for broadening the scope of a teacher's involvement with his profession and with colleagues as yet unmet' (p. 7). Sources of data included system generated logon statistics and a user survey. The response rate for the survey was 50%.

System data showed that teachers accessed the computer network 5.38 times a month on average. Survey data showed that teachers used the computer network for exchanging information about professional events and teaching information.

There was no significant association between CMC use and age, gender, subject or experience with computers. Ownership of a personal computer and modem and perceived usefulness of the content of CMC were positively correlated with system use.

3.3.4. The Beginning Teacher Computer Network (BTCN). (1987)

BTCN was launched in 1987 for supporting new teachers during their first year in the classroom (Merseeth, 1989). Participants were novice teachers and their mentors from Harvard Graduate School of Education. Several research projects have investigated the use of BTCN using different methods.

Merseth (1991) carried out an investigation of BTCN use by 39 student teachers in 1988. She collected data from three sources: a user survey, system logs and structured user interviews. In the survey, student teachers were asked about their use of the computer network. Ten users with varying levels of CMC use (low, medium or high) were interviewed to find out about the nature of the e-mail interactions and the factors that encouraged or inhibited participation.

According to the survey data, 22% of the students accessed BTCN every day, 48% twice a week on average and 30% an average of 1.5 times a month.

Student teachers ranked the computer network as most effective for receiving moral support and keeping in touch with friends. Items related specifically to teaching, such as getting help with lesson planning or sharing teaching techniques, were ranked significantly lower. Users stressed that the technological nature of e-mail did not affect its ability to provide emotional support.

According to Merseth (1991, p. 145), ‘the limited ability of the network to provide lesson and curricular assistance ... may be the result of technical limitations’ since BTCN did not offer graphical capabilities. Also teaching materials had to be retyped for CMC distribution. Some respondents found that on-site communication with mentors was more effective than CMC because ‘(on-site colleagues) ... can read visual cues from my face and can know whether I’m upset ... So there’s a whole lot more information that an on-site mentor can have that someone on the network wouldn’t have access to’. These factors, which are related to the capacity of the communication medium to transmit different types of information, have been extensively discussed in the ‘richness’ stream of the communication research literature (Trevino et al, 1987, Schmitz and Fulk, 1991). Merseth’s failure to relate her findings to prior communication research is a limitation of her study. Asynchronicity was a facilitating factor for CMC use, with its ability to accommodate the busy schedules of student teachers. Some respondents valued the confidentiality and ‘impersonality’ offered by CMC. Beginning teachers reported feeling more comfortable expressing their needs to other novices, with whom they were previously acquainted, on the computer network than at staff meetings. The number of messages sent was associated with the cyclical patterns of the school year (e.g. the number of messages systematically decreased during holidays).

Beals (1990) analysed teachers’ use of BTCN using speech act techniques (Mehan, 1979). Transcripts of 240 public messages from a six-month period were selected for the investigation. The author identified conversational moves (i.e. units of conversation that serve a specific purpose within an exchange). She found that being a novice teacher was negatively correlated with offering information, offering opinions and eliciting discussion. Being a mentor was positively associated with offering information, offering opinions and eliciting discussion. According to Beals (1990, p. 9): ‘These patterns generally fit the goals that each group has for the network: for novices, sharing support, advice and information; for faculty members, providing information, and facilitating discussion’.

3.3.5. The Merrimack Valley Science Teachers’ Support Network (MVSTSN) (1987)

The Merrimack Valley Science Teachers’ Support Network (MVSTSN) linked a group of secondary school science teachers who participated in professional development activities coordinated by the University of Lowell.

In 1987, a computer network was set up to support teacher communication and collaboration after each in-service course. During 1988, CMC use by a group of 30 MVSTSN teachers was investigated (University of Lowell, 1989). Fifteen teachers were scheduled to attend periodic FTF encounters after the INSET course, the rest agreed to communicate between themselves using a computer conferencing system based at Lowell University. The researchers compared the extent to which both groups of teachers communicated with co-attendants at in-service courses after returning to their schools. Data was collected using personal and telephone interviews.

They found that only a third of the fifteen teachers used CMC regularly. Almost half of them declined to use CMC after the courses. As the authors put it: 'Despite the efforts of the teachers to create a supporting telecommunications network, personal and external factors have created major barriers for two thirds (of the users)' (University of Lowell, 1989, p. 15). The researchers argued that 'factors influencing the ability of participants in a wide-area telecommunications network to get on-line ... fall into two broad categories: personal attributes ... (and) external factors' (University of Lowell, 1989, p. 8).

As in previous studies, the researchers found that public communications was constrained by teachers' concerns about 'typographical errors'. Although the authors did not elaborate further on this issue they noted that this feeling was somewhat unexpected since it does not seem to constrain CMC use in the same way in non-educational contexts.

Need for CMC and perceived value of exchanges with colleagues were the main facilitating factors. Consistently with most studies of the same period (more recently, technology developments have increased ease of use), technical problems increased demands for support that when unmet constrained the use of CMC. Lack of ownership of a home computer did not influence e-mail communication when teachers received adequate school support to access the computer network (e.g. computer, telephone line, training).

3.3.6. The School Renewal Network (SRN). (1988)

SRN (Livingston, 1991) was launched in 1988 by the National Education Association of the U.S. to promote 'meaningful dialogue (between teachers and between teachers and academics) based on research and current practice' (p. 10). Twenty-six schools across the U.S., seven educational research centres and seven universities were connected to SRN as part of the Mastery in Learning Project (MIL), a school reform initiative promoting dialogue between educational researchers and practitioners and between practitioners themselves (Castle and Gillingham, 1991).

Castle et al (1991) analysed 12 months of network interaction, from January to December 1990. Data were collected from the central network computer log, to obtain the number of private and public messages sent and received. Additionally, the content of 540 public messages was coded by user, function, content and linkage. User categories included teachers and researchers. Functions included requests, resource giving (information, personal experiences and opinions), discussion and social exchange (e.g. courtesy messages). Finally, a survey of users was carried out to find out who communicated with whom and the nature of the interactions. Twenty-three teachers (85%) and 11 researchers (92%) returned the survey.

The authors found that half the public messages were sent by teachers, 35% by researchers and the rest by project staff. Less than 20% were requests, while 22% represented the sharing of experiences. Forty-three percent of public messages were linked to at least one other message. Teacher sites sent on average 1.63 and received 2.57 private messages per

week. They sent 0.93 and received 52 public messages (which the authors call 'papers') on average per week. Teachers sent on average 50% of their messages to teachers of other schools and 25% to researchers.

According to survey responses, 82% of the teachers used private messages to request information at least once, 54% to ask for personal advice, 54% for social and personal exchanges and 14% for scheduling and coordinating events and meetings. Teachers described CMC interactions as providing 'encouragement and support' (17%), ideas, information or help (13%) and social exchanges such as thanks and greetings (8%).

Teachers preferred private rather than public communication when: a) they perceived the content of the message as 'not of broad interest' (83%), b) the message was of a confidential nature (70%), c) they believed private messages would be noticed and replied to more quickly than public ones (8%) or d) self-perceived 'shyness' constrained their willingness to communicate with strangers (8%).

Lack of time, restrictions in access to the school computer, lack of a home computer and variability in the quality of the materials received were found to constrain CMC use. Teachers who had attended FTF meetings at the time the project was launched communicated more than the others, again suggesting that previous acquaintanceship facilitated the creation of electronic links. Self-confidence, a positive attitude to sharing and face to face interactions facilitated CMC interactions. 'Collegial cultures' at the schools are reported as major influences in CMC use although the authors do not discuss these social factors in depth.

Livingston (1991, p. 19) and others concluded that teachers had effectively shared teaching practices and ideas, although in a tentative, 'low-risk' style. She found these results encouraging in terms of the potential of CMC to foster reflection and collaboration between teachers. As she put it:

' Although an outsider might question the extent of reflection (in the reported examples) it is a substantial beginning for a faculty militant in its defence of privacy and individual autonomy'.

Castle and Gillingham (1991) classified users as 'information receivers' (i.e. low public and private contributions) or 'information givers' (high private and public contributions). As they concluded (p. 45): 'Participants ... conceptualise (CMC) differently, some seeing it as a forum for sharing and problem solving, others as an information source and a few finding it as no compelling source'. Livingston (1991, p.27) argues that CMC functions for different teachers as a database, a forum for exchange or a forum for dialogue, that 'new users tend to view the network as a one-way information conduit ... participation in dialogue and information sharing grows with (CMC) experience and comfort level'.

A limitation of these studies, as the authors acknowledged, was that content of private messages was not analysed. Achieving deeper understanding of CMC interactions would require such content analysis since discussions shift seamlessly from the public to the private realm (Livingston, 1991, p. 24).

3.3.7. Teacher-LINK: A computer network for student teachers. (1988)

Teacher-LINK was set up in 1988 by the School of Education of the University of Virginia to support student teachers during their first year in schools. Eskridge (1989) investigated the use of the computer network by 14 student teachers during the spring semester of 1988. All student teachers were issued portable computers and modems. They were instructed to log on at least four times a week.

Eskridge interviewed each participant twice, at the beginning and at the end of the student teaching experience. Additionally, she read all private mail exchanged between participants. Although she did not categorise this data systematically, it was used in triangulation with interview findings to strengthen the validity of the research.

Consistently with BTCN and other student teacher networks, Eskridge (1989, p. 70) found that social and personal peer support was the main use of the system. Users reported 'occasional' CMC use for sharing instructional ideas. Communication with supervisors was ranked last in terms of usefulness. The author concludes: 'There was virtually no exchange of instructional materials such as lesson plans ... and little or no discussion of classroom activities or instructional ideas among (student teachers)' (Eskridge, 1989, p. 121).

The author found that technical problems 'seemed to plague this group of students during the first few weeks of use' (Eskridge, 1989, p. 64). She reported that at least one participant 'gave up and seldom used the computer again'. Technical problems were related to telephone line unreliability and the perceived complexity of the e-mail software in use. She argued that the lack of exchange of materials may be caused by perceived technical difficulties in sending graphical information (e.g. spreadsheets, photographs) by electronic mail.

Eskridge suggested that pre-existing friendships might explain differentials in traffic volume between different users. Asynchronicity was also found a facilitating factor for CMC use although some respondents expressed worries about the delays involved in obtaining responses in asynchronous systems. Some users chose to use CMC driven by a 'personal preference for the written word' (Eskridge, 1989, p. 78). This result is compatible with Rice and Case's (1983) finding that 'media style' was directly related to CMC use. Computer anxiety was an inhibiting factor for many student teachers, especially in the first few weeks. Other inhibiting factors were opportunities for regular FTF interactions with preferred partners and personality traits (e.g. self-perception of not being sociable) (Eskridge, 1989, p. 104). As one of the low-volume users expressed: 'I'm just not very social ... and my one best friend is here in this school'.

In accord with results reported in the STN project and others, receiving messages was a powerful motivator to keep accessing the network and conversely *not* receiving e-mail (especially lack of feedback to requests) was the most discouraging factor for many users. As one of the users put it:

'If someone wrote to me I would write back ... you always respond ... but if you don't get mail, you don't want to go to the mailbox' (Eskridge, 1989, p. 96).

Eskridge (1989, p. 121) concluded that communication between student teachers was fostered to a great extent by the regular output of mail from one user which encouraged others to regularly check their mail and respond.

3.3.8. The Unified Network for Informatics in Teacher Education (UNITE). (1989)

The UNITE computer network of Kansas University was launched in 1990 to provide electronic communication services to elementary and secondary school teachers in Kansas. At the time, 300 users from 16 schools registered to use the computer network. UNITE is intended to facilitate messaging and sharing of instructional materials among educators who share content areas and interests, but who are geographically separated (Aust, 1991).

Broholm (1991) analysed private e-mail traffic in UNITE to find out: a) the degree to which communication between teachers reflected their similarities and differences of subject, grade and spatial dispersion, b) the degree to which e-mail relations represented new social contacts or continuations of existing ones and the degree to which e-mail facilitated users' continuing relations and c) the formation of 'cliques' (i.e. groups of people communicating more between them than with people outside the group).

Data were collected from system logs and a questionnaire administered to 65 users. System logs were used to establish who sent private messages to whom during a four-month period (September to December). This data were analysed using the Negopy computer software (Richards and Rice, 1981). The questionnaire was used to collect demographic data and to categorise communication content.

The author found that 42 of the 65 users (64.6%) sent or received private messages in the period of investigation (September to December 1990). Thirty-two (49%) sent e-mail and 10 only received e-mail. Twenty-two users (68.8% of the 32) sent fewer than 10 messages each. The average number of sent messages was 12.9.

One hundred and twenty-nine links were created between the 42 UNITE users who sent or received e-mail. More than a quarter (27.2%) of these links were between individuals who did not know each other beforehand.

Broholm found that subject area and grade were determinants of communication. Teachers formed significantly more links with teachers of the same subject and teachers of the same grade than with others. Similar results were found with messages sent, instead of links formed, as the dependent variable. School location was not a significant constraint on message sending or link formation. Broholm (1991, p. 175) concluded:

'It would appear computer mediated communication helped overcome the constraint of spatial distance between teachers, leaving the effect of content area significantly strong'.

In contrast with most communication research carried out in business contexts (for example Rice, 1982), shared task was *not* a determinant of communication. A group of UNITE users was involved in a teaching project called INSTEP. Broholm analysed communication between these users and did not find any significant difference between communication between them and with others. Broholm (1991, p. 178) speculated that 'the INSTEP's task focus may have been insufficiently strong to produce the expected effects on communication'.

One hundred links (77%) were characterised by the counterparts as work related. Four percent of links were characterised as purely social personal and 19% as consisting of both social and professional matters.

Access, measured as distance from usual workplace to a UNITE computer, was negatively associated with number of messages sent. Close distance was defined by Broholm as within the room or desk. There was no significant difference between isolates and participants on any variable other than proximity to a computer terminal. Consistently with most studies, lack of time was another factor inhibiting the use of CMC by teachers. Congruence of CMC with work routines seemed to explain the school librarians' significantly higher rate of CMC use in relation to classroom teachers.

This project stands out in the literature on teacher-oriented educational networks as one of the few studies carried out within the framework of communication theory. However, as Broholm acknowledges (1991, p. 185), the project had some limitations and weaknesses. First, it relied on self-reports for the categorisation of communication content. Second, its investigation period of four months was too short to allow for any meaningful assessment of stability. Another methodological consideration is its failure to collect data on previous acquaintanceship from all possible pairs of teachers. This leaves its finding that 27.7% of relations were between strangers with no comparative perspective. It would have been important to know how many of the potential relations were between strangers and compare this number with the percentage of links between strangers actually formed.

3.3.9. The Labnet project. (1989)

Labnet is one of the largest computer networks for teachers in the U.S. More than 1000 teachers from 50 states had joined the project by 1995 (Spitzer and Wedding, 1995). It was implemented in 1989 by the Technical Education Research Centre (TERC). The initial purpose of the Labnet computer network was to provide support to distant teachers in the use of projects for Science teaching. It was later expanded, with the more general purpose of promoting ongoing reflective dialogue between teachers as a strategy to support professional development and the spread of innovations in teaching practice (Gal, 1993a).

Gal (1993a) carried out in 1991 a survey of 120 teachers who had joined the project in 1990, with a response rate of 69%. They found that 74% of the respondents were using the network at the time of the survey. More than half (59%) accessed the computer network more than once a week with a median of 1.5 per week. Teachers sent on average 30 private messages per school year. Approximately a quarter (26%) did not use the network. Most of the non-users (95%) cited technical problems as the main factor impeding their use of the network.

Exchanging ideas about specific projects and requesting and giving technical support were the most highly rated uses of the computer network (90% of the respondents), followed by social exchanges with colleagues (34%) and discussing general teaching approaches (20%). These results may be influenced by the nature of the Labnet project, which was launched with the specific purpose of fostering the use of technology projects for teaching.

The authors also analysed five months of network use by teachers (September 1990 to January 1991) using data collected automatically by the computer network. Logins during that period were analysed using statistical techniques. Additionally, all public messages sent during that period (n = 409) were content analysed using qualitative techniques. These public messages were coded by categories based on sender, receiver, topic and links to other public messages.

Login analysis was consistent with survey results. Teachers accessed the computer network 1.5 times a week on average although the average among newcomers (i.e. teachers who had joined the project in the four-month period before data collection) was 0.35. Less than one third of the teachers (30%) had sent public messages since they joined the project. Labnet researchers have argued that reading messages regularly is a form of network participation that benefits teachers even if they do not contribute to the public forums (Jacobs and DiMauro, 1995).

Gal (1993a) suggests that public message content can be divided into two major categories: teaching activities and 'shoptalk'. The former refers to exchanges directly related to classroom work. The latter refers to exchanges about teaching information and materials. The author found 108 chains of interconnected public messages. Almost half the teachers (46%) had started at least one chain. More than half of these chains (57%) contained 'shoptalk' (25% teaching resources, 19% teaching methods and 13% technical assistance) and almost a third (32%) exchanges about teaching activities.

Lack of time and technical problems were major impediments to CMC use by teachers. Other factors affecting communication were: a) problems to transmit graphical information (it should be remembered that these were Physics teachers, a subject where graphics play a major role), b) lack of feedback (there was a high level of user frustration when private messages were not answered) and c) reticence to send messages to strangers.

The researchers found that private e-mail traffic was higher than public traffic. Survey findings suggested that many discussions were initiated in public forums and after some time moved to the private realm.

The teachers valued private mail because it did not clutter public forums and they did not have to worry about the extent to which their messages were of public interest. Teachers also resorted to private mail to express dissent or controversial opinions (Muscella and DiMauro, 1995).

This highlights the important role of private e-mail from the perspective of teachers. As Jacobs and DiMauro (1995) found:

'Frequently, teachers who are not comfortable writing messages that are accessible to the whole community form professional collaborations through private e-mail'.

However, private messages were not content analysed and therefore understanding of teachers' exchanges within the framework of LABNET is limited.

3.3.10. The Southern Interior Telecommunications Project (SITP). (1990)

SITP was established in 1990 to provide telecommunication services to teachers and students in the southern region of British Columbia. Services provided by SITP included computer conferencing, electronic mail and on-line databases. The project involved at the time 359 participants from 82 schools, including teachers, librarians and administrators. Almost two thirds (65%) of the users owned home computers and modems.

Teles and Duxbury (1991) analysed the use of SITP services from November 1990 to June 1991 to determine the main users, the services used and the way these services were used. Sources of data included questionnaires, interviews, system-generated statistics and content analysis of public messages. Teles and Duxbury's findings from traffic, interview and survey data are described below. SITP reports mention content analysis of public messages as a source of data but no results are reported from this data.

They found that e-mail was the most used service (88.1% of respondents). Approximately half of the 359 users (53.9%) spent more than one hour on-line in the period of investigation. Almost three-quarters (70.8%) of the users had at least one logon recorded. The average number of logons per user was 100.6 although 52% of the users had less than 50 logons.

Questionnaire data showed that teachers used the computer network for exchanging professional information with colleagues (93.5%), supporting classroom activities (93.5%) and for administrative tasks (12.9%). Exchanges with other teachers concentrated on asking for technical help (20.7% of total responses), coordinating activities (18.6%), offering help (12.9%), exchanging teaching approaches and projects (10.7%), sharing comments about the use of CMC (10%), discussing general educational issues (10%) and exchanging lesson plans (5.7%).

Survey and interview data were used by the authors to establish the main barriers to CMC use. Lack of time, lack of access to hardware, technical problems, lack of CMC training and support and lack of structured tasks for network use were identified as the main barriers to CMC use by teachers.

3.3.11. **The Electronic Educational Exchange (EEE). (1990)**

EEE was developed by the College of Education at Iowa State University to support the exchange of ideas between practising teachers, student teachers and education faculty.

Hamilton and Thompson (1992) analysed the use of EEE by 35 users to shed light on the characteristics of the early adopters of CMC. Those 35 users had been the most active during the spring of 1990.

Data was collected using a questionnaire requesting personal information, views on the computer network, usual communication counterparts and content and purpose of communications. The questionnaire was designed to collect data on the variables that innovation diffusion research has suggested as most influential. These variables were education level, social status, cosmopolitan outlook, communication media use and perceptions of the innovation.

According to questionnaire data, message content included research, teaching ideas, educational technology, classroom management and personal messages. Early adopters were significantly different from other potential users in teaching experience and attitude towards collegiality.

The authors conclude that results were in agreement with findings from research on the diffusion of innovations (Rogers, 1986). Early adopters of the EEE computer network were on average more educated, affluent, experienced, informed and risk-taking than the rest of the potential user population.

3.3.12. Teacher use of FrEdMail. (1990)

The Illinois University FrEdMail node has provided electronic communication services for elementary and secondary schoolteachers, high school students, undergraduate and graduate students and faculty at the University of Illinois since 1987. Chung (1991) analysed electronic interactions among four groups of teachers using FrEdMail between 1988 and 1990. Each group was enrolled at a University of Illinois graduate education course.

She studied the exchange of private and public messages using data collected automatically by the central network computer. Chung analysed teachers' logons, number of private and public messages sent and semantic connections between messages. Additionally, the researcher carried out a survey of all FrEdMail users to obtain their views on CMC use. The survey was sent using electronic mail and was responded to by 17 teachers. The rate of response for this survey is not reported although she mentions (Chung, 1991, p. 48) that 'there were not enough responses'. Chung (1991, p. 44) notes that research methods based on traffic data obviously concentrate on users at the expense of low-users and non-users. To address this limitation she interviewed an entire group, which included users and non-users. Finally, Chung asked these users to keep a journal during the semester-long course describing their experiences in using the computer network.

Traffic data showed that teachers exhibited yearly, weekly and daily cyclical patterns in their use of CMC. She recommends that organisers of telecommunications projects consider these variations in CMC plans. Yearly cycles are related to holidays, examination periods and other regular events of the working schedule of teachers. Weekly and daily cycles may be altered by home computer ownership because teachers may use CMC from home on weekends and evenings.

The four groups of users were classified as 'more successful' or 'less successful' based on their traffic volumes (i.e. logons and messages written). Two of the groups were successful although participants were not personally acquainted at the beginning. According to Chung (1991, p. 87), 'this result shows that previous knowledge of each other does not play an important role in establishing a network community'.

The researcher found that four categories of factors affected CMC use: technical, teaching, institution and time-delay. Technical factors included equipment malfunctions, ease of use and ease of access (i.e. how close and accessible the computer was to the place of work). Teaching factors included lack of time, especially in certain periods of the year (e.g. yearly final examinations). Response delays were one of the main inhibitors of CMC use. As one of Chung's (1991, p. 71) respondents put it: 'you have to be very flexible ... (you need the) ability of working with the time gaps'. Delays are related to the cycles discussed above. For example, longer response delays should be expected for a message sent on Friday than for one sent on Monday if users do not own home computers.

3.3.13. TENET: A statewide computer network. (1991)

The Texas Education Network (TENET) was implemented in 1991 and more than 3300 teachers (about 15% of the state's teaching force) subscribed for accounts in the first three years. Anderson (1992) carried out a survey of 300 randomly sampled users with a response rate of 66%.

The survey measured variables that were identified as influential by theories of diffusion of innovations (Rogers, 1986) and uses and gratifications (Blumler, 1979). The variables were:

- Personal attributes,
- environmental characteristics,
- perceived media characteristics,
- system usage and
- gratifications obtained.

Anderson found that only 35% of TENET users were classroom teachers while the rest were administrators (24%) or librarians (16%). More than half accessed the computer network from home (57%) and 90% of the rest had a computer and telephone line in their own classroom or office. On average, respondents accessed the computer network five times a week and regularly communicated with 1.5 people.

More than half of the respondents (60%) reported sending private messages but only 3% sent public messages. Anderson's results differed from most other research results, especially in terms of usage levels. This may be related to the composition of the user group, since two thirds were not teachers but administrative personnel whose patterns of work may be different.

More than 90% of the respondents stated that lack of time restrained their use of the computer network.

The author found that the most strongly supported gratifications obtained from TENET use were cognitive in nature. More than three-quarters of the respondents agreed TENET had helped them access teaching materials and professional development activities. Nearly two thirds said that it had enabled them to participate in discussions on educational issues and to exchange teaching ideas, information and advice.

With respect to social or interpersonal gratifications, almost three quarters of the respondents felt that TENET had helped them keep in touch with family, friends or colleagues; less than half (41%) found it helpful for coordinating meetings and 18% for social activities in general. In relation to diversionary gratifications, 60% of the respondents indicated that TENET exchanges were entertaining. Benefits obtained from using TENET for student activities were the least supported. Only 44% indicated that the computer network had been useful as a means to exchange information and work with students. Only 25% indicated working with students in on-line projects.

3.3.14. The Electronic Academical Village project. (1991)

The Electronic Academical Village project of the Curry School of Education at the University of Virginia consisted of a variety of electronic resources developed for elementary, middle and secondary school teachers. Participants were teachers across the state of Virginia who were issued personal computers, modems and dedicated telephone lines in their classrooms. During the first two years of the project, it emerged that many teachers were not using the computer network although they had been provided with training, support and home computers.

Stuhlmann (1994) selected six teachers and investigated the main factors influencing their use of CMC. Selection was based on the level of participation. Three had relatively high levels of participation and three were selected based on their lack of participation.

Individual case studies were developed for each selected user. She collected data through structured interviews at the schools of the participants from February to April 1993.

The author found that perceived usefulness of CMC influenced participation in network activities. As Stuhlmann (1994, p. 14) reports, 'Teachers who were incorporating telecommunications ... value the network and overcame barriers for its use'.

Teachers' attitudes towards change also influenced CMC use. Teachers who were 'open to new ideas and willing to try new things' were high CMC users (Stuhlmann, 1994, p. 14).

Consistently with most previous studies, lack of time was a concern for all participants. Technical problems and insufficient CMC training inhibited communication. Ease of access to the computer network was an important factor affecting use. The number of telephone lines per school was the main constraint according to the respondents. Not surprisingly therefore, it was found that teachers owning home computers were all high users.

3.3.15. The CISO⁷ project. (1992)

The CISO research project was carried out in 1992 and 1993 to investigate the potential of telecommunications to enhance teaching and learning in Dutch schools (Collis, Veen and Devries, 1993). The researchers looked at CMC use by eight secondary school teachers during a full school year. These teachers were interviewed and their on-line activities monitored and analysed. Additionally teachers were asked to keep journals of their CMC activities. Each teacher had access to a computer and modem in the school and at home.

The authors found that 'a strong feeling developed among teachers ... that (CMC) had a major value relative to serving the teacher ... not so much because of its use for developing lessons for students but by providing a communication and information channel among teachers' (p. 44).

CMC's main benefits according to the teachers were the fostering of reflective communication between peers and the efficient exchange of teaching resources such as examination questions. Most teachers felt CMC was particularly useful for establishing exchanges within their own subjects.

The researchers found that lack of time was a constraint to CMC use by teachers. They also argue that availability of a computer and modem at home may be crucial for CMC use, although this could not be verified in the CISO project since all teachers were lent home computers. The CISO report also stated that lack of feedback from colleagues discourages CMC use although no evidence is shown to support this important point.

3.3.16. CMC use by teachers in an on-line in-service course (INSET). (1992)

Grandgenett and Harris (1994) studied CMC use by a group of 23 elementary and secondary school teachers enrolled in an intensive course taught on-line in the U.S. The purpose of the research was to investigate statistical relationships between login rates and personal variables such as age, teaching experience, telecommunications experience, computer anxiety and writing apprehension.

⁷ CISO stands for the Dutch words for '(on line) communication and information systems for education'.

The authors analysed logon data collected automatically by the system during 10 of the 16 weeks of the course. Personal data were collected before the course and again after the course for the last two variables.

The average number of logins was 0.8 per week per student.

The only significant correlational relation was between login rate and teaching experience. There was no significant relation between computer anxiety and writing apprehension.

3.3.17. The Penn State Elementary Student Teacher Network. (1993)

O'Grady (1994) investigated the use of a computer network for student teachers during their 15-week school practice. The purpose of the computer network was 'to provide a collaborative peer support system' (p. 23). Eleven student teachers comprised the network group. Everyone knew each other well before using CMC with the exception of two participants. All users owned or were lent personal computers and modems. Data were collected from the computer logs, transcripts of all public messages and a user survey.

One hundred and thirty public messages were sent by the 11 student teachers in the 15-week period, an average of 0.79 public messages per user per week. According to survey data, teachers sent an average of 10 *private* messages in the same period. Seventy-four percent of the 130 public messages were replies. Sixty-five percent of messages received replies, with an average of four replies per message. The messages that did not receive replies were greetings and announcements.

Public messages were classified by O'Grady into four categories: sharing of teaching ideas (43%), social information (24.6%), support and encouragement (21.5%) and messages about CMC (10.7%). According to survey data, the student teachers used private e-mail mostly to provide support and encouragement, exchange teaching approaches and materials, and discuss social and personal issues. They rated support and encouragement exchange as the most useful benefit of the computer network. These findings suggest that private e-mail may shape teachers' perceptions of CMC more than public communication.

In accord with prior research, asynchronicity was a facilitating factor for CMC collaboration and lack of time a constraint (p. 78). Access restrictions to computers and telephone lines affected CMC use. Even student teachers who owned home computers were constrained because they had to share the telephone line with their family. This suggests that projects that provide users with home computers should consider that this might not be enough to guarantee the desired levels of access if a dedicated telephone line is not available.

The student teachers who were new to the group felt inhibited in sending public messages to strangers. As they told O'Grady (1994, p. 80):

'It was hard to write (public messages) because I didn't know anybody and everybody knew each other. I think that on a network like this it is better if everybody knows each other. I was not comfortable'.

'When you are trying to talk to people on line that you don't know, it is hard to open up. I think that you have to put more effort into communicating with someone you don't know well'.

‘I feel that knowing the friends I participated in the network with did affect our exchanges. It wasn’t just knowing them ... We had formed a relationship of support ... I knew that the people I was connecting with had helped me many times before. I knew I could count on good advice from them...’

3.3.18. TeleNex: a computer network for teachers in Hong Kong. (1994)

TeleNex is a computer network operated by the University of Hong Kong to support secondary school English teachers (Tsui, 1995). It was set up in 1994 to provide services for 150 English teachers in 30 different schools.

Tsui (1995) carried out a survey of 30 TeleNex users and 30 non-users three months after implementation.

She found that lack of training and computer apprehension hindered the use of the computer network. Previous acquaintanceship influenced teachers’ use of CMC in several ways. Firstly, when users met each other they felt they were writing ‘to a person’ instead of communicating with some anonymous, undifferentiated group. Secondly, they felt there was an obligation to respond to messages sent by people they had met. Tsui relates this effect of acquaintanceship on communication behaviour to specific characteristics of Chinese culture although she provides no evidence for this claim. In fact, similar findings have been reported from different cultures in American and European contexts as this review has shown.

According to Tsui, her findings corroborate the conclusion of Mason and Kaye (1989, p. 20) from their study of the use of CMC for distance education:

‘A group of learners who have already met each other in person ... are more likely to communicate effectively on-line because the personal meeting has provided a number of contextualising cues that would otherwise be absent from discussions held exclusively within the framework of a computer or a computer conference’.

Tsui also found that many teachers refrained from using the computer network because they feared sending messages containing grammatical mistakes in English that could detract from their professional image. Other teachers were afraid that their questions would be judged negatively by their peers. As Tsui (1995, p. 155) put it:

‘According to the teachers ... to ask questions about the English language or English language teaching, could be seen as a manifestation of incompetence as a teacher and as an English teacher’.

These teachers used the computer network mostly for requesting information but seldom contributed ideas or opinions unless they were assured by previous exchanges that their contributions were ‘really good’.

3.3.19. MATHLINE: an on-line service for Maths teachers. (1995)

MATHLINE is an umbrella organisation providing on-line services to Maths teachers in the U.S. Cole (1996) examined message content to find out about teachers' purposes in using CMC. She selected for the investigation 90 public messages exchanged between January and April 1995 in a special Algebra discussion group.

Cole found that messages were used for different purposes. She classified messages into three general categories: statements, questions and replies. Replies were all messages related to a previous one. Any message that asked a direct question was classified as a question. Messages telling stories or providing information or opinions were classified as statements.

Thirteen of the 90 messages (14%) were classified as statements. The author further divided statements into *true statements* (direct expressions of facts and opinions), *stories* (narratives of personal experiences) and *parables* (stories presented to support an opinion). Four of those messages were classified as true statements. Only one message was a story. Parables were the most popular type of statement. Cole (1996, p. 12) argues that this may be because 'teachers are uneasy about expressing opinions outright without couching them with some sort of justification ... teachers may not see a value in simply sharing stories. They tell stories to make a point...'

Five of the 90 messages were classified as questions. These questions were further classified as *pragmatic* or *programmatically* (seeking information or advice on broad educational issues). Questions sought four different types of information: particular information, personal experiences, opinions or information on schools. There was only one pragmatic question. Cole (1996, p. 15) speculates that this may be caused by 'a tacit assumption' among teachers that everyone 'knows what he is doing'.

Seventy-two messages (80%) were classified as replies, which the author further classified into seven types: follow-ups, questions, support, answers, opinions, parables and stories.

Cole's categorisation of e-mail messages is based on the goal of the communication. However, the author does not refer to the socio-linguistic theoretical frameworks that have been used to analyse human communication and CMC such as speech act theory (Searle, 1969). Topic and function are not clearly distinguished by the author. Some categories seem conceptually amorphous. For example, direct statements and proposals are both classified as true statements, but the latter have an explicit reply expectation. In this sense, proposals and questions share an important linguistic property, which they do not share with statements.

3.3.20. Comparative research.

Riel and Levin (1990) compared six different educational CMC projects looking at factors explaining 'successes and failures' in achieving sustained teacher interaction. The authors studied those networks in terms of their 'participant structures', a research strategy used to compare interaction in different educational settings. Evidence of 'success' was 'a high level of network use coupled with user reports of its efficacy' (Riel and Levin, 1990, p. 149).

Philips (1972) and other authors (Mehan, 1979, Au, 1980, Moll and Diaz, 1987) had used this research framework to help isolate features that correspond to different patterns of interaction. Philips' structures were: a) organisation of the work group, b) response

opportunities, c) response obligations and d) evaluation. Riel and Levin modified Philips' structures for examining CMC interactions as follows:

- a) organisation of the network group (e.g. who the participants were, the number of them, their pre-existing formal or informal relationships, where they were physically located),
- b) task organisation (to what extent the use of the medium was specified and goal oriented),
- c) response opportunities (e.g. ease of use, level of resource availability, training and technical support, communication costs),
- d) response obligations (i.e. tacit or formal requirements for responding to messages) and
- e) coordination and evaluation (any forms of coordination or assessment of quantity of exchanges).

The first pair of case studies compared CMC use in two university research labs. One computer network served 50 users who sent an average of one message a day. The second was used by 20 faculty members who, besides the 'local network', also used the central university message system. Some of them accessed the computer network only every few weeks.

Members of both labs worked together in project teams. The offices of the first group were scattered around several buildings while the second group worked in a single facility. Accessibility was easier for the first group because their personal computers were connected to the computer network while some of the members of the second lab had to use other people's computers. In the first lab, there was a tacit notion that it was rude not to respond to a message within 12 hours. As access was not easy for all users of the second network, important messages were usually printed out and distributed. Failure to answer mail was perceived by the first group in the same way as failure to attend a scheduled meeting. The second system was gradually abandoned by users a few months after installation although training and encouragement was provided to all potential users.

The second set of case studies included three computer networks that were launched to support the professional development of secondary school teachers. The first computer network served 11 teachers and academics working together in a research project. The second supported communication between five teachers who had participated in a summer course. The last one was used to teach an on-line university course to 20 teachers.

The director of the research project sent weekly messages to all members of the group summarising meetings and activities. No response was formally required and since they met regularly, messages and materials were usually exchanged in those encounters. Teachers in the second group shared an interest in the topic of the summer course but had no shared task about which to communicate. There was no common goal for users and no one took the lead of establishing any. The participants in the on-line course had a specific task and formal response obligations established explicitly by the instructor. Only the third computer network was 'successful' in the long term.

Riel and Levin concluded from this comparative research that a number of factors are crucial in determining the 'success' of networks, which they list as questions:

- does the group already exist?
- does this group have a need for telecommunications?
- is there a shared goal?
- will the access to the technology be easy and efficient?
- will all participants have regular patterns of mail access?
- is there a person who will facilitate group planning and work?

According to Riel and Levin (1990, p. 163): 'If the answer to all of these questions is yes, it is likely to be very easy to establish an electronic community. It is also possible ... if one or two of these factors is less than optimal, however it places a stronger weight on the other factors'. As Riel and Harasim (1994) concluded from a review of their own and related network research:

'Network communities can be created either with a group of people with established relationships seeking new ways to coordinate their collective work or with a group with no prior interactions who share a strong commitment to a specific task (p. 9)'.

The authors suggest that the social organisation of networks will be increasingly important as technology developments reduce technical barriers to CMC. As Riel (1990, p. 449) argues: 'people often approach the building of a network as a technical problem ... (but) a crowd of people which only shares an opportunity to communicate is not a group; it lacks organisation and shared purpose'.

3.3.21. Summary of the research literature.

This section has discussed some of the main research developments in the study of CMC use by schoolteachers.

Most of the research on the use of CMC has been carried out in industrial contexts or in higher education. It is only since the mid-1980s that technological changes have brought the costs of telecommunications within the reach of elementary and secondary schools. This has led to a body of research in the last decade with two main foci: studies concentrating on the use of telecommunications as a curriculum resource for teaching and studies investigating the potential of CMC for fostering teacher collegiality and professional development. The present study belongs to the latter stream of research.

The main conclusions drawn from this review of the research are set out below.

3.3.21.1. Aims and methods.

Many studies have focused on *usage levels*, as determined by some quantitative measure (e.g. number of logons, number of messages sent) and looked for personal or contextual variables facilitating or constraining use. Some of these studies employed statistical techniques to establish significant associations between a set of predetermined variables and levels of use (Jones, 1987, Anderson, 1992, Grandgenett and Harris, 1994). In other cases, researchers established levels of system use on the basis of self-reports and employed qualitative techniques to generate a set of variables influencing the use of CMC (University of Lowell, 1989, Stuhlmann, 1994, Tsui, 1995).

These studies provide only limited insight into the effects of CMC on collegiality since they concentrate on the *amount* of medium use, overlooking the *nature* and *purpose* of such use. They do not seek to know who the teachers communicate with or the intention or topic of the communication or the outcomes of these communicative acts.

A limited number of investigations attempted to establish the purpose of e-mail communication. However, the main sources of data for a majority of these studies were self-reports by the users describing their recollections of their own communication behaviour (Broholm, 1991, Teles and Duxbury, 1991). As discussed in Chapter 4, this data collection method has been criticised by communication researchers for its weak validity (Bernard, Killworth, and Sailer, 1982).

Only a few studies have analysed the communication behaviour of teachers using CMC based on the actual content of messages (Katz et al, 1987, Beals, 1990, Castle and Gillingham, 1991, Gal, 1993a, O'Grady, 1994, Cole, 1996). As Cole (1996, p. 4) concluded from a recent review of the literature: 'there was little characterisation of teacher to teacher communication on-line. Much of the literature ... did use excerpts from messages, but did not make generalisations about the character or content of messages'.

Finally, it should be borne in mind that these results mostly derive from content analysis of *public* communication. There is some evidence that private communication may be used in different ways by teachers (O'Grady, 1994). The research reported in this study is one of the first in the literature to compare function and topic of private and public communication based on actual content.

3.3.21.2. Functions of CMC.

Research has found a wide disparity of results in relation to the purposes that teachers seek to achieve when using CMC. Some projects found that obtaining professional resources was one of the primary functions of CMC (Katz et al, 1987, Teles and Duxbury, 1991, Gal, 1993a). Other investigations concluded that peer support and encouragement was the main use of the system (Eskridge, 1989, Beals, 1990, O'Grady, 1994). Exchange of instructional ideas and materials was much rarer. This result seems to be consistent in most investigations of computer networks for student teachers.

Castle et al (1991), Beals (1990) and other researchers have found individuals use CMC for different purposes based on their roles, needs and personal differences. Castle et al (1991) concluded that some teachers viewed CMC as an information source while others perceived it as a forum for exchange. Beals (1990, p. 8) argued that people's self-perceived social roles shape their communication behaviour. As she put it: 'for novices, sharing support, advice and information; for faculty members, providing information'.

Another set of research projects found that 'social cohesion' (e.g. keeping in touch with family and friends) was the CMC function most highly ranked by teachers (Anderson, 1992).

In summary, there is a wide disparity of results in relation to the nature of CMC use by teachers. These discrepancies may be in some cases a function of the research methods used or of the data selected for analysis. For example, results of research based solely on public communication may not be comparable with results of research based on private communication. Similarly, research based on self-reports may provide a very different view of CMC use than research based on 'traffic' data (Chapter 4 discusses some of the methodological implications of these alternatives).

The wide disparity of results may also reflect the social and professional differences among user communities. A community of hundreds or thousands of peers, dispersed among different states or countries may show very different patterns of use than a small group of student teachers linked to their supervisors.

3.3.21.3. Factors affecting the use of CMC by teachers.

This section summarises the main factors shaping the communication behaviour of teachers using CMC as reported in the literature.

Access to CMC, which Riel and Levin (1990) call 'response opportunities', emerged as a crucial factor in most studies ($n = 11$). This construct integrates a number of issues that determine the costs of communicating using a specific computer network. These issues include physical access to a computer, modem and phone line both in the school and at home, technical problems such as software incompatibilities and telephone line malfunctions, the levels of training received and the provision of technical support.

Lack of time was a major constraint to using CMC according to half the studies ($n = 10$). A consistent picture arose from the studies showing that teachers' workloads leave them little time to learn new technologies and communicate regularly with colleagues. A related issue is the regular cycles of the school year. Some of these studies ($n = 5$) found that teachers' workload changed during the year in regular yearly, monthly and weekly cycles. Time constraints were heavily dependent on these cycles.

Previous acquaintanceship was found to inhibit the use of CMC in six studies. Many teachers were reluctant to communicate with strangers, especially in relation to personal teaching matters. In one case, it was found that initial connectedness (i.e. the number of potential counterparts known by an individual) was associated with CMC use in the sense that the less people teachers knew FTF, the less messages they sent.

Perceived usefulness of CMC affected use of the computer network in almost a third of the 19 studies ($n = 6$). The extent to which teachers invested resources (e.g. time) in using telecommunications was related to their perceptions of the relevance and value of the exchanges.

Delays in receiving feedback discouraged CMC use by teachers in six studies. A related finding of two studies was that receiving private e-mail was a powerful motivation to keep using CMC.

There is contradictory evidence on associations between personal attributes and CMC use. *Teaching experience* was associated with communication behaviour in three research projects (STN, EEE and INSET) and ruled out as a significant variable in another one (UNITE). Similarly, *computer anxiety* was associated with use of CMC in studies of the Teacher-LINK and TeleNex computer networks but not in the MVSN and INSET projects. *Age, gender, subject taught* and *experience with computers* were ruled out as variables associated with communication behaviour by most studies. Personality traits such as attitude towards change, sociability and attitude towards sharing were found to affect CMC use in four studies (SRN, LINK, EEE and EAV).

Attributes of the communication medium affected CMC use according to many studies. *Asynchronicity*, with the time it provides for reflection and unpressured response, was perceived by teachers as a major advantage of CMC over FTF or telephone communication

(n = 6). The evidence on how teachers perceive the delays implied by this feature of e-mail is mixed. Beals (1991) found that users valued positively the time for reflection before responding. Other authors reported that delays reduced users' engagement in CMC dialogues (Chung, 1991). Reduced 'bandwidth', especially reduced graphical transmission capabilities (n = 3) and lack of non-textual cues (n = 1), discouraged the use of CMC for specific purposes such as exchanging lesson plans. In two cases, researchers found that lack of adequate *filtering* capabilities hindered teachers' capacity to cope with information overload.

Professional norms influenced the communication behaviour of users in some cases. Three studies found that teachers refrained from sending requests because they were *reluctant to admit ignorance* on a teaching matter to a group of people, including many strangers. In other cases (n = 3), teachers feared that *sending messages with mistakes* would affect their reputations. Two studies found that teachers valued electronic mail because they could discuss their needs in private.

Several factors affected teachers' choice of private or public communication. Some teachers were *reluctant to dissent in public* with colleagues (n = 2). In other cases, CMC users would send private messages because they were *not sure that their communication was of public interest* (n = 3). Two studies found that teachers used private messages for certain purposes because they thought that *private communication obtains quicker responses*.

3.3.21.4. Concluding remarks on the research literature.

The literature portrays a complex and in some cases contradictory picture of the development of collegiality among schoolteachers using CMC. Some researchers have concluded that CMC may foster teaching-specific exchanges. Other authors have argued that the most important benefit of CMC may be the provision of personal and emotional support. Some teachers seem to view CMC as a *database* to be consulted for specific needs, others as a communication *medium* to exchange work-related resources with colleagues and still others as a mechanism to provide each other with personal support.

The disparity of results may be the result of many factors. First, the literature includes projects of very different size and orientation, ranging from a dozen users in one building to many thousands in several countries. Second, findings of research looking into CMC use are difficult to compare and integrate into a wider picture since there are no agreed taxonomies for categorising e-mail communication. A number of authors (Broholm, 1991, Cole, 1996) have urged researchers to develop research-based taxonomies and categorisation systems for CMC exchanges, as have existed for many years in human communication research (for example Bales, 1950).

Most of the published research has been carried out in North American and European contexts. This should not be surprising since data communication prices are usually much lower in industrialised countries. Only one CMC project carried out in Latin America could be identified, the 'Enlaces' project in Chile (Hepp, Laval, Moenne, and Ripoll, 1994). However, 'Enlaces' concentrates on network traffic between schools and between students and as such is of limited direct relevance to this study. In some countries (e.g. Argentina) large computer networks have been recently launched with the declared purpose of supporting teacher collaboration. However, no research-based report could be found describing the use of those computer networks.

A concluding remark is related to the theoretical framework of the reported research. Most projects lack a theoretical background guiding the definition of questions and the

interpretation of results. Most research on the use of CMC by teachers seems unaware of mainstream communication research (Broholm's study of use of the UNITE computer network in Kansas is one of the few exceptions). As Ruberg and Sherman (1992, p. 8) have warned: 'it is possible that CMC enthusiasts ... have not considered each of the media research variables'. This limits the potential of those projects to add to a recognised stream of scholarship. A number of authors have noted in recent years the weak theoretical base of many CMC research projects (Fulk and Steinfield, 1990, Ruberg and Sherman, 1992, Metz, 1994). Grounding studies and interpretation in more general approaches to research on human communication would strengthen CMC collegiality research. Communication research spans most of this century and provides alternative research methods and theories for the study of communication phenomena between people.

CHAPTER 4

Research plan and methods

4.1. Introduction.

This study is based on an investigation of the use of electronic mail by 75 teachers of four secondary schools in Uruguay. This chapter starts by describing the communication system and the users. Subsequently, it reviews some of the main approaches to research communication in educational contexts. Finally the research methods used in this study are discussed.

4.2. The communication system and the users.

4.2.1. Implementation.

Teachnet, a computer network linking four secondary schools and a university in Montevideo, provided the electronic mail services used by the teachers in this investigation.

Teachnet was implemented in 1996 by a local university to provide communication, information and education services to teachers of Maths, Physics, Chemistry and Biology in four non-governmental schools. These schools are referred to in this study by the fictitious names of Herzl, Churchill, Roosevelt and De Gaulle to preserve confidentiality. The university is referred to in this report by the name of UOU.

Access to the computer network is available from staffrooms at each school or from the teachers' homes 24 hours a day, seven days a week. Use of the computer network is entirely free of charge and voluntary. There are neither mandates nor incentives to use the medium. Teachers are free to use the network to communicate with each other about any topic they choose (including non-job-related issues), as frequently as they wish and using the tone and style they see fit. A telephone help-line is available during office hours for consultation on technical problems.

4.2.2. Technical infrastructure.

Teachnet runs on UNIX 'servers'⁸ with teachers accessing the system from any PC-compatible computer with a modem. NUPOP was selected as the electronic mail 'client'⁹ with the purpose of minimising computer hardware requirements. NUPOP, which was developed by Northwestern University, runs under the DOS operating system. Thus, any teacher with a computer with at least 640k of memory can use the computer network. NUPOP enables users to *acquire* messages from a server (i.e. transfer messages from a server to their personal computer) and to *send* their messages to the server for distribution to the specified receivers.

⁸ 'Servers' are computers in charge of managing the computer network traffic and store the information exchanged. The main server is an IBM RS 6000 running the AIX version of the UNIX operating system.

⁹ A more detailed technical discussion of the computer networking technology falls beyond the aims of the study. For the purpose of this research report, it may be sufficient to say that the 'client' is the computer program governing the users' computers when interacting with a 'server'.

UOU technical staff developed a computer program to collect data on network traffic¹⁰ and store these data, as well as copies of the electronic messages. The researcher adapted this program for the purposes of the study.

4.2.3. The researcher.

The researcher is a member of UOU. He has been involved with educational technology for more than 15 years and has previously researched the use of computers by secondary school teachers. He holds a Computer Engineering degree and Master in Education by Research.

When the university decided to launch the Teachnet computer network, the researcher asked for and obtained authorisation to use the traffic and message data (if properly authorised by the teachers and the schools) collected by the network server for research purposes.

4.3. Methods for research on human interaction.

Collecting and analysing data on human interaction is a complex problem that educational researchers face (Riel and Harasim, 1994). This section discusses some of the most common approaches to research on human communication to provide some methodological background for the selection of the methods used in this research.

4.3.1. Survey sociometry.

The most frequently used method for obtaining data on human interaction is survey sociometry, an approach which basically consists of asking individuals, through questionnaires or interviews, whom they communicate with and how frequently (Rogers and Kincaid, 1981, p. 97).

Survey sociometry has been criticised for its lack of accuracy (Ettema, 1985). An interesting example can be found in Bikson and Eveland (1990, p. 278). They collected computer data on e-mail exchanges and interviewed the users about their e-mail partners. They found that almost 10% of the users failed to report contacts with people they had in fact exchanged messages with. Bernard, Killworth and Sailer (1982) studied the communication patterns of a group of individuals interacting through a CMC system at the New Jersey Institute of Technology. They compared the communication data provided by the central computer (which they called 'objective' data) with the interactions as recalled by the individuals (which they called 'subjective' data). They found the subjective data seriously flawed. They concluded from this and previous studies (Bernard and Killworth, 1977):

'We have found consistently that the assumption among communication researchers that recall is a proxy for (communication) behaviour is unwarranted' (Bernard, Killworth and Sailer, 1982, p. 63).

¹⁰ This term is used by IT professionals to refer to data such as who sends messages to whom, when and from where.

4.3.2. Observation.

An alternative to survey sociometry is to gather communication data by observation. These data are usually assumed to have greater validity since there is little doubt that an interaction took place if the researcher was present (Rogers and Kincaid, 1981, p. 112).

Some authors have stressed that the presence of the observer may distort the communication behaviour of the individuals (Denzin, 1976), for example in researching communication in intimate dyadic situations.

Other limitations to this research approach lie in the cost and effort of conducting observations for long periods of time, especially in large, physically dispersed and multidirectional systems.

4.3.3. Unobtrusive methods.

Unobtrusive methods remove the observer from the events. They combine the advantages of observation without some of its drawbacks. Data are gathered from documents (e.g. appointment calendars, memos, distribution lists, postal records or legislative roll calls) or automatic devices (e.g. telephone switching exchanges). The traffic files compiled automatically by some computer networks are examples of unobtrusive methods of obtaining data on human interactions. McCormick and McCormick (1992, p. 381) have argued that unobtrusive data collection methods are 'naturalistic observation techniques'.

Accuracy and validity in the case of automatically recorded interaction data are assured. It should be noted that the data obtained measures only the interaction that occurred *through the system* and that communications through other media are left unrecorded. Thus, when the aims of the study require a broader picture of communication, complementary methods have to be used.

Unobtrusive data collection may raise ethical concerns. Although users may not always be aware, most technology-based information systems (e.g. telephone systems, computer networks, automated bank tellers) routinely collect communication data for maintenance and other purposes. In fact, recording of communication is a widely spread practice and in some cases, researchers may wish to use those already existing records as sources of data. The ethical questions raised by the use of communication data collected *without the users' explicit consent* for research purposes should be addressed by researchers before using such data (Sullivan, 1993).

4.3.4. The computer network as a source of research data.

As argued above, unobtrusive methods are recommended in the literature for the collection of communication data because they ensure high levels of accuracy and validity. In the case of CMC, the medium itself can contribute in important ways to the study of its usage. Computer networks provide two types of data of considerable interest to educational researchers: a) traffic data and b) a verbatim transcript of interactions.

Traffic data gives the researcher an accurate and complete picture of who exchanged messages with whom and when.

Transcripts of messages can be content analysed to help establish the nature and purpose of the interactions. As Beals (1990, p. 3) argues: ‘transcripts obtained from computer network discussions ... can yield a rich portrait of network members (and) ... their purposes’. Rogers (1987, p. 299) has argued that ‘one of the most important advantages of monitoring the new electronic networks is their capacity to provide a word-for-word account of message content’. According to Finholt et al (1990, p. 321), ‘These techniques will not only allow us to collect data that have been too costly to collect in the past ... but also to collect new kinds of data’.

The following section discusses the research methods used in this study.

4.4. Overview of the research design.

This study was based on an investigation of the communication behaviour of 75 secondary school teachers with access to the electronic mail services of Teachnet. The aim was to explain human behaviour. No ‘sample to population’ generalisation of findings was sought.

A multi-method approach was used in this investigation for collecting and analysing data from different sources. This section broadly describes the overall research approach, including the methods used, the sources of data and the sampling design.

4.4.4. Research methods and sources of data.

Data were obtained from two main sources: ‘traffic files’ automatically compiled by the Teachnet central server and interview data obtained by interviewing a sample of the teachers. Traffic files included quantitative data about user logons and messages sent, and the complete text of each message.

Traffic data were analysed using statistical techniques and content analysis. Interview data were analysed using the method of ‘constant comparative analysis’ (Lincoln and Guba, 1985, Strauss, 1987). Statistical techniques were used to help clarify the relevance of certain numerical differences between variables and to better illustrate some of the results. It should be noted that analysis of the numeric data showed that normality could not be assumed in most cases. This informed the selection of the statistical tests that were used. A statistical expert, Dr. Carlos Vallarino (PhD, U.C. Berkeley, 1987), was consulted about test selection and utilisation. Dr. Vallarino assisted the researcher with the selection of the appropriate test and level of confidence for each situation. He also assisted the researcher in computing the agreement rates between independent coders to assess the level of reliability of the content analyses. Educational researchers looking at communication data should be cautious in the selection of tests. The literature shows cases where tests are used (e.g. the t-test) which assume the normality of underlying distributions with no clear evidence reported to support this assumption (Sandlin, 1985, Grandgenett and Harris, 1994). Content analysis was used to reduce the content of the messages to a discrete, manageable number of theoretically relevant categories for analysis and interpretation. Qualitative analysis of interviews was carried out to obtain teachers’ perspectives of CMC use. A table summarising the sources of data and the methods of analysis for each research question is presented below.

The triangulation of research methods and sources of data in the analysis of complex fields such as human interaction is strongly advised by researchers who have warned of the threat of over-reliance on one method or source of data (Lincoln and Guba, 1985, Cohen and Manion, 1989, p. 275). According to Holsti (1981, p. 17): ‘When two or more approaches

to the same problem yield similar results, our confidence that the findings reflect the phenomena in which we are interested, rather than the methods we have used, is enhanced'. As Patton (1982, p. 232) put it: 'triangulation is a process by which the evaluator can guard against the accusation that a study's findings are simply an artifact of a single data source'. Ronald Rice (1982), one of the most experienced CMC researchers, has noted that not even 'objective' traffic data can be considered as complete descriptions of communication events and therefore triangulation data from other sources should be used. According to Rogers (1987, p. 294):

'We need to adopt a triangulation strategy in which we compare several types of data (and methods of data analysis) about a single social phenomenon ... In past network research, scholars have displayed a seemingly blind loyalty to one ... method or another ... This is method-driven (rather than *theory-driven*) research ... scholars should follow a triangulation strategy, utilising multiple methods, wherever possible, in both data gathering, and in data analysis'.

Broholm (1991, p. 39) has similarly argued that 'a premium should be placed on finding reliable and valid methods of data collection ... from a variety of methodological perspectives'.

This study follows this advice by using a multi-method approach to the collection and analysis of data obtained from different sources. Statistical and content analysis provided independent results for many of the same phenomena studied through the interviews. Respondents' accounts of CMC use were checked against other individuals' descriptions of the same events and with traffic data compiled by the computer network.

4.4.2. Sampling.

Several levels of sampling were needed in this study as is usual in much educational research. Miles and Huberman (1994, p. 28) suggest a 'funneling sampling sequence, working from the outside to the core of a setting'. In this study the sampling sequence included:

- a) the four schools;
- b) a subset of all the teachers using Teachnet in the four schools (for the automatic collection of messages exchanged);
- c) a subset (Sample 1) of the messages sent by those selected teachers (for content analysis of messages exchanged); and
- d) a subset (Sample 2) of those selected teachers (for interviewing).

The Herzl, Churchill, Roosevelt and De Gaulle schools were selected as an 'opportunistic sample' (Miles and Huberman, 1994, p. 28). As Huberman and Miles suggest, sampling must take advantage of opportunities arising in the field. This is the case for the computer network under investigation. Teachnet is the first computer network of its kind in the country and involved only the four schools of the sample.

Sampling criteria for b), c) and d) are discussed below in the sections concerning each stage of the research.

4.4.3. Ethical issues.

Educational researchers should ensure that all research methods and reports are respectful of the rights of all people involved, directly or indirectly in the investigation (McQuillan and Muncey, 1990). These rights include the right to be fully informed of all research actions which may involve them, the right to refuse to participate (or to cancel authorisation at any time) and the right to set specific conditions of participation (e.g. confidentiality of sources and data). According to Miles and Huberman (1994, p. 291), 'consent' to participate should be 'fully voluntary and uncoerced'.

In this project, the researcher fully explained to the teachers the aims and methods of the research, that participation was voluntary and that they could withdraw at any time and demand that all data pertaining to their communication be deleted from project files. Following accepted procedures in CMC research (McCormick and McCormick, 1992), all teachers were explicitly informed about the monitoring procedures and their consent requested in writing. The researcher received a written authorisation from each of the 75 teachers involved before collecting data. No data were collected on any teacher who failed to return a written consent. Communication researchers (Rogers, 1987, p. 307) generally agree that such steps should adequately address privacy concerns. As Danowski (1983, p. 13) has argued:

'To the extent that users are aware of automated traffic monitoring, and they choose to accept it ... there is no major (ethical) problem'.

The researcher assured all participants that the anonymity of the teachers and the schools would be preserved. Anonymity, according to Miles and Huberman (1994, p. 293), means in practice that no information can be connected with an identifiable person. Once anonymity is assured to people, researchers must ensure that adequate procedures are in place to effectively ensure that no data are reported in a way that it may be connected with any identifiable person or institution. To ensure anonymity, all data and results presented in this report refer to institutions and teachers by fictitious names. All collected data were stored in safeguarded computer files by the researcher to preclude unauthorised access and threats to anonymity.

4.5. Research plan.

The research was carried out in several stages, each with its own purposes and methods. The sections below describe the purposes, sampling criteria, sources and methods of each stage. Finally, the potential threats to the validity and reliability of each specific stage are discussed (some issues concerning the validity and reliability of the study as a whole were discussed in Section 4.1).

4.5.1. Review of the literature.

A review of the literature was carried out between May 1995 and May 1996 to identify the most significant theoretical and methodological issues relevant to the study. Identification of relevant sources resulted from extensive searches using ERIC and other computerised bibliographical indexes, and personal and electronic exchanges with other researchers in the U.K., Hong Kong, the U.S., Chile, Argentina and other countries.

The review included the main relevant research developments in the areas of collegiality, communication theory, computer-mediated communication and the use of CMC in educational contexts. Subsequently, the researcher followed the literature over the time the research project took place until 1999 to account for any new relevant research developments in those fields.

4.5.2. Preliminary fieldwork.

Preliminary fieldwork was conducted in Uruguay during 1995 to establish the technical and organisational feasibility of conducting this research. Technical feasibility involved confirming that this particular computer network could provide the required traffic data statistics. Organisational feasibility involved obtaining the proper authorisations and consents from the university, the schools and the teachers.

Once technical feasibility was confirmed, the researcher held a meeting in each of the four schools with teachers of the four subjects and the principal to discuss the aims and methods of the research. These occasions were also used to hold preliminary discussions with some of those teachers who showed special interest in the subject and had some previous experience using electronic mail. These discussions helped formulate some of the interview questions for the fifth stage of the research.

In March 1996, all teachers of ‘scientific’ subjects¹¹ (i.e. Maths, Physics, Biology and Chemistry) in the four schools (87 teachers) were invited to a meeting with the researcher. A large majority (70 teachers) attended the meeting. In that meeting the researcher invited the teachers to raise any concerns they had about the research and to sign up formally for participation in the research, if they so wished, by signing a letter of consent. Teachers who did not attend the meeting were later contacted by the researcher for the same purpose. By the end of July 1996, letters of consent had been received from 75 teachers. Only communication involving teachers who signed the letter of consent was collected. A copy of the letter of consent is enclosed in Annex 2.

4.5.3. Stage 1: the teachers.

4.5.3.1. Purpose.

The first stage of the research project was carried out to obtain demographic and logistic data on the teachers and sociometric data on the relations between them (i.e. who knew whom before starting to use Teachnet). These data were needed to look for associations between the patterns of e-mail use and the characteristics of the teachers.

4.5.3.2. Sample.

From among all teachers in the four schools, the teachers of ‘scientific’ subjects were selected for a number of reasons.

¹¹ Maths, Physics, Biology and Chemistry are called ‘scientific’ subjects in Uruguay as opposed to ‘humanistic’ subjects such as History or Spanish.

	Explanations of terms	Sample	Data collection				Data analysis
			Stage 1	Stage 2	Stages 3 and 4	Stage 5	
I) Patterns of e-mail use by the teachers.	How often do teachers access the system? How many messages do they send? To whom?	The 75 teachers who signed letters of consent.	Demographic survey.	Traffic data compiled automatically.			Statistical analysis.
II) E-mail relations and structural properties.	Who creates links with whom? How many links are developed between strangers? How intense and stable are those relations?	The 1964 messages sent by the 75 teachers.	Sociometric survey.	Traffic data compiled automatically.			Statistical analysis.
III) Topics addressed by the teachers in their e-mails.	Which topics are discussed? Is content social personal or task-oriented? What is the multiplexity of the links?	The 1356 messages sent by the 20 stable participants. (Sample 1)			Message transcripts compiled automatically.		Analysis of message content.
IV) Exchange of professional resources.	To what extent do teachers use e-mail for exchanging professional resources with their colleagues? What types of resources do they exchange?	The 1356 messages sent by the 20 stable participants. (Sample 1)			Message transcripts compiled automatically.		Analysis of message content.
V) How can the communication behaviour of teachers be explained?		Fifteen of the 20 stable participants. (Sample 2)				Teacher interviews.	Qualitative analysis of interviews.

First, the National Education Authority (NEA) of Uruguay is introducing a large curriculum reform project, one of the cornerstones of which is the integrated teaching of those subjects. This has created considerable interest among schools and teacher associations in tools and techniques with the potential for supporting collaboration between science and maths teachers.

Second, studies carried out in Uruguay (CEPAL, 1994) have found serious deficiencies in science and maths learning by high school students and falling grades in examination results. Therefore, there is growing public interest in research with the potential of benefiting science and maths teaching.

Third, researchers suggest that sampling ‘intact systems’ is particularly advantageous for communication research (Rogers and Kincaid, 1981, p. 104, Sandlin, 1986, p. 51). This sampling strategy implies collecting data on *all* individuals in a system -or at least all users belonging to a certain class- instead of a fraction of the users belonging to different classes.

Fourth, it was important to select a class of users of which most members would be able and willing to participate in the research. Although teachers of all subjects could use Teachnet, the four schools involved had promoted with special emphasis the use of computers by teachers of ‘scientific’ subjects for several years (Grünberg, 1991) and at the time of project launch most of them owned personal computers and modems.

In sum, the 75 teachers who taught 'scientific' subjects at the Herzl, Churchill, Roosevelt or De Gaulle schools and signed a letter of consent were selected for investigation (only five teachers failed to return a written letter of consent). A brief summary of the key demographic data is presented below. A full report is detailed in Annex 4, Section 1.

Within the 75 teachers, the largest group taught Maths (n=37), followed by Physics and Chemistry (n=13 each) and the rest (n=12) taught Biology. A slight majority (54.7%) of the teachers was female. The group was middle aged (average age was 43.3) and experienced (average number of years of teaching experience was 19.1). Most teachers had no previous experience in the use of electronic mail (78.6%). Almost all teachers had access to a home computer (86.7%) or to a school computer (82.6%). They knew on average 18.8 teachers of the other 74 teachers (25.4%).

4.5.3.3. Data collection.

The first stage of the research project consisted of a survey of the 75 teachers. **Personal data** were collected using a self-administered questionnaire (a copy of this questionnaire is included in Annex 3). This instrument contained questions about variables shown to be of importance in previous research carried out in Uruguay and other countries concerning collegial communication and the use of technology. These variables are discussed below.

Subject taught was necessary to establish whether CMC interactions were constrained by professional homophily. Organisational tenure (measured in this project as the number of years of teaching experience) has been found to be a major influence on communication behaviour (Goddard, 1973, Ruchinskas, 1982, Sicignano, 1990, Constant et al, 1996). Prior communication research has pointed to age and gender as influential variables in CMC use (Kerr and Hiltz, 1982). Access to equipment has been consistently found to be a crucial factor in shaping the use and implementation of technological innovations (Johansen et al, 1979, Steinfield, 1983, Grünberg, 1991). Thus data were collected on the following personal variables: subject taught, school, age, gender, years of teaching experience, experience with electronic mail, availability of a personal computer and modem at home, and proximity to a school computer connected to the computer network.

Data on the existing relationships between the teachers was collected using a sociometric checklist (a copy of which is included in Annex 3). Teachers were asked to specify whether they 'knew' or 'did not know' each of the other 74 teachers. These data were needed to establish whether CMC interactions were restricted by previous acquaintanceship.

4.5.3.4. Data analysis.

Questionnaire data were analysed using the statistical computer program SPSS to establish the main characteristics of the users.

Sociometric data were analysed to establish whether or not each pair of teachers knew each other before starting to use CMC. The number of possible pairs that can be formed among the 75 teachers is 2775 [i.e. $(75*74)/2$]. Based on the sociometric data, each possible pair was assigned a 'Yes' (previously acquainted) value if they knew each other before starting to use CMC or a 'No' (not previously acquainted) value otherwise.

Discrepancies in the sociometric data (i.e. person A claimed to 'know' person B while B claimed *not* to 'know' person A) led to further inquiries. In the cases where discrepancies

could not be resolved, the minimum value was adopted. In other words, if A claimed to know B but B claimed *not* to know A, 'No' (not previously acquainted) was taken as the value for the A, B pair.

4.5.3.5. Validity and reliability.

Several measures were taken to strengthen the validity and reliability of the survey:

- the questionnaire was piloted with 18 teachers. Changes in format, length and terminology were introduced as a result of the pilot tests to ensure that it could be completed in the planned period of time and that all questions were clear and unambiguous.
- the researcher was present in the staff room of each school during lunch breaks on two successive days to assist in the self-administration of the questionnaire and check for completeness as suggested by Oppenheim (1966). Non-respondents (n=7) received the questionnaires by post at their homes and telephone assistance was offered during a personal telephone call with the researcher.
- the questionnaire was designed following the recommendations of Cohen and Manion (1989, p. 106). Among others recommendations heeded were that questions should be worded avoiding technical jargon or expressions unfamiliar to teachers and that the graphical appearance of the form should be 'clear, simple and inviting'.
- the confidential nature of the data provided was emphasised.
- data were obtained for all 75 teachers who had signed letters of consent. This is important because a very high return rate is required for sociometric surveys. In survey sociometry, a response rate of 90% -which would be considered satisfactory for most surveys- may distort the communication structure in important ways. In this project, a 100% return rate was achieved.
- the validity of the sociometric data was strengthened by gathering data from both individuals in each dyadic link. Reciprocity provides a validity check on the collected data.
- the sociometric checklist followed the 'roster model' recommended by Rogers and Kincaid (1981, p. 99) where individuals have the opportunity to describe their links with *all* other individuals in a system (as opposed to 'open models' where people are asked to recall who they usually interact with). Roster studies are generally considered highly reliable (Bernard and Killworth, 1977).

4.5.4. Stage 2: patterns of e-mail use and link development.

4.5.4.1. Purpose.

In stage 2, traffic data compiled automatically by the computer network was analysed for the following purposes: a) answering research questions I and II, b) guiding the sampling of teachers for the subsequent stages of the research and c) providing quantitative evidence to help answer research question V.

4.5.4.2. Sample.

The entire set of messages exchanged between the 75 teachers in the period under investigation (n= 1964) was selected for statistical analysis in this second stage of the research. This set constitutes an 'intact' sample in the sense that *all* messages of the class are included. As discussed before in this chapter, communication researchers recommend this sampling strategy (Rogers and Kincaid, 1981, p. 104, Sandlin, 1986, p. 51).

4.5.4.3. Data collection.

The computer network records all user log-ons and messages sent. These data are compiled continuously by the computer network and can be extracted at any point.

For each log-on, the computer network records date, time, user and location from where the person is calling (i.e. school or home). For each message sent the system records: date, time, sender, receiver(s) and text. Receivers may be one or more individuals, 'groups' (i.e. sets of users with a common e-mail address) or combinations of persons and groups.

Data were collected for 37 weeks, from August 1996 to May 1997. This period was expected to be long enough for the teachers to overcome initial technical or organisational problems in using the computer network, according to similar projects reported in the literature (Spitzer and Wedding, 1995). Two successive points in time were selected to collect traffic data: December 30, 1996, for the period August 8, 1996 - December 27, 1996 (Period 1) and May 18, 1997 for the period January 22, 1997 – May 18, 1997 (Period 2). It was important to collect traffic data at more than one point for analysing the stability of communication exchanges. The interruption between December 27, 1996 and January 22, 1997 corresponds to the yearly summer vacation of teachers in Uruguay.

4.5.4.4. Data analysis.

In this stage of the research, traffic data were analysed to establish the main patterns of e-mail use by the 75 teachers, the e-mail links created among them and the structural properties of those links. E-mail use indicators were: the number of system accesses, the number of messages written and the number of messages sent. As discussed below, the structural properties analysed were 'intensity' and 'stability'.

System access.

Logon data were used to determine the main patterns of system access by the teachers (e.g. number of logons, day of the week, place of call).

Message writing and sending.

CMC use has been measured using indicators such as time on-line or number of characters written. Time on-line is not an adequate indicator in computer networks such as Teachnet where most users write their messages 'off-line' and only access the computer network to send their messages. The number of characters per message has been found to be highly correlated with the number of messages (Winkelmans, 1988, Thompson, 1989). As the number of messages is easier to count and verify, it is usually used in CMC research as an adequate measure of the volume of CMC use (Harasim, 1989).

Written messages may be sent 'publicly' (i.e. to groups) or 'privately' (i.e. to individuals).

This means that a few messages *written* may be *sent* to a large number of receivers and viceversa. Thus it is important to analyse *writing* and *sending* behaviour as separate variables describing communication behaviour. Messages written measures the number of originals composed and eventually sent by each teacher to at least one of the 74 potential individual receivers or to at least one group. Messages sent measures the total number of public and private messages sent by an individual to teachers or groups included in the investigation. For example, if teacher A writes a message and sends it to teachers B and C and to the Physics group, he has *written* one message and *sent* three messages, two private and one public.

Traffic data were analysed to establish the main patterns of message writing and sending (e.g. the number of messages written and sent, to whom messages were sent, relative use of public and private communication).

E-mail 'relations'.

As discussed in Chapter 3, flows of communication between pairs of people are modelled by network theorists as 'relations' or 'links'. However, not every communication flow should be considered a 'link'. In some cases an intensity threshold is required (e.g. a minimum of minutes of communication per week) to consider that a pair of people have established a 'link'. As Danowski (1983, p. 1) put it:

'... the analyst ... makes certain choices as to the parameters for filtering automated records and setting thresholds as to what constitutes a meaningful interaction. For example, in network records of telephone calls, should calls of duration less than one minute be counted? Less than 10 seconds?'

Link definition according to network theorists should be derived from the aims of the study and explicitly reported (Richards and Rice, 1981). In e-mail systems, three communicative outcomes are possible between pairs of people using electronic mail during a period of time: a) none of them sends a private message to the other, b) one of them sends at least one private message to the other but the other never reciprocates and c) each of the two individuals sends at least one private message to the other.

As the aim of this research focused on collegial *exchanges* between teachers, it was decided that reciprocity would be required for defining the creation of a 'link' between a pair of teachers. In other words, there was a 'link' or 'relation' between a pair of teachers if each of them received at least one private message from the other in the period of study.

The 'intensity' of a link established between a pair of teachers in a given period was defined as the number of private messages the two teachers sent to each other during that period. Given a link between teachers T_1 and T_2 , where I_1 is the number of private messages sent by T_1 to T_2 and I_2 the number of private messages sent by T_2 to T_1 , intensity was computed as $I_1 + I_2$.

A link was defined as 'stable' if the two teachers sent at least one private message to each other in each of the two periods of study.

For determining which pairs of teachers had created a 'link' or 'relation' between them, as well as their intensity and stability, the number of private messages exchanged in the period of study between each of the 2775 pairs that could be formed among the 75 teachers

was computed using a computer program. Those pairs for which the number of messages received from each other was greater than or equal to one were counted as having created a 'relation'. The criteria used for counting links are described in detail in Annex 4, Section 2.

Each link established had the following data recorded: *initiator* (i.e. the person sending the first private message between the two), *counterpart* (the generic name for both is 'transceivers'), *intensity* in P1 (i.e. the number of private messages exchanged between the two in the first period), *intensity* in P2 (i.e. the number of private messages exchanged between the two in the second period), and *date of creation* (date of reception of the first private message by the counterpart).

4.5.4.5. Validity and reliability.

No major issues threaten the reliability of this stage of the research since all procedures are automatic. The following sections discuss some potential threats to the validity of communication data and how they were addressed in this stage of the research.

Accuracy of communication data.

Validity in communication research is dependent on the accuracy of the data obtained regarding the communication links. As discussed in a previous section, a number of research studies have questioned the validity and reliability of communication research based on individuals' recall of their own communication behaviour (Bernard, Killworth and Sailer, 1982, Ettema, 1985).

Communication data for this study was collected automatically and unobtrusively by the computer network. This method, which is not dependent on the accuracy of self-reports, is recommended by Danowski (1983) as being 'objective', physically verifiable, unobtrusive and complete (i.e. all interactions are recorded). Danowski refers to networks based on 'objective' data of this kind as 'objective networks'. Huff and Rosenberg (1989, p. 169) have also recommended automatic collection of traffic data since it 'provides ... an easier method of ... constructing maps of electronically constituted social networks'. Rogers (1987, p. 296) has especially recommended automatic data collection for its ability to provide data on 'weak ties' as well as the more visible 'strong ties'.

Distortions in communication behaviour.

Another potential threat in communication research is that the conditions of the study itself may distort the communication behaviour of individuals. For example, Rogers and Kincaid (1981, p. 112) found that investigating communication on taboo subjects (e.g. abortion in South Korea) was difficult due to the reluctance on the part of some respondents to speak freely about the subject.

In this study, communication content could be distorted due to an eventual reluctance or shyness on the part of the teachers to express some feelings or opinions because of the access granted to the researcher to examine the content of some messages. This threat to naturally developing communication behaviour should not challenge the validity of the study because of several factors.

First, the eight-month period of study should be long enough for the teachers to 'adjust' to the monitoring. As Danowski (1983, p. 3) argued: 'although ... users know about monitoring they may not behave reactively because of the transparency of monitoring and its constancy over time'.

Second, previous studies using similar methods have not reported such distortions (e.g. Eskridge, 1989, Sproull and Kiesler, 1991, p. 42). As Huff and Rosenberg (1989, p. 168) found: ‘most people were at least not actively thinking of the study when they sent or received messages’.

Third, anonymity was explicitly guaranteed to all teachers when reporting the results of the research.

Fourth, evidence was found that some of the teachers used the medium for exchanges of a highly personal and intimate nature.

Lastly, no media can be considered totally secure against breaches of privacy. Electronic mail in particular is technically vulnerable unless expensive encryption technology is used even when no monitoring process is in place. Thus, users may feel that risks to privacy are somewhat inherent to electronic communication in any case.

It should be noted that, as discussed before, even if some distortion in communication data is unavoidable when using unobtrusive collection methods, the methodological alternatives to examining communication behaviour (e.g. self-reports, observation) have been found to produce highly inaccurate data (Bernard, Killworth and Sailer, 1982).

The identity problem.

Another threat to validity in research based on automatically collected communication data is the identity problem. In CMC research, this problem arises when users access the system using another person’s password. As Rogers (1987, p. 307) noted, ‘... computer-recorded data might be inaccurate because of problems in connecting individuals to their computer accounts’. Danowski (1983, p. 14) has noted that ‘In automated data capture, there is typically no fully tractable procedure to verify node identity’.

In this project, several measures were taken to minimise this threat to validity. First, access to the computer network required a personal, unique secret password. The teachers could change their passwords at any time. Second, teachers were explicitly and repeatedly warned of the potentially negative consequences *for them* of password misuse since people could be communicating with others *in their name*. Finally, the researcher explained in the general meetings to the teachers that communicating under another person’s identity compromised the validity of the research data.

4.5.5. Stage 3: topics of messages.

4.5.5.1. Purpose.

When people communicate, they address different *topics* (e.g. student behaviour, teaching approaches, learning theories) with specific *intents* or *functions* (e.g. asking a question, offering an opinion). As Beals (1990, p. 335) explains:

‘Message writers attempt to address a topic with the intent to do something about it; for example, express an opinion or feeling about the topic, challenge another’s opinion, provide information about the topic or offer advice’.

Sociolinguistic research suggests that topic and intent can be studied as separately identifiable agendas of interaction (Keenan and Schieffelin, 1976, Murray, 1985, p. 82).

To answer the third research question, in this stage of the research the content of a sample of the messages was analysed in order to establish the main topics addressed by the teachers using electronic mail.

4.5.5.2. Sample.

To study the content of communication in the third and fourth stages of the research, it was necessary to select a sample of messages, since the effort required for analysing *all* messages would have exceeded the available resources. This is the case in most communication research. As Holsti (1981, p. 127) put it: ‘Often the choice can be reduced to two alternatives: obtain the data by sampling or don’t obtain it at all’.

First, it was decided, in order to strengthen the validity of the content analysis, to analyse ‘*whole links*’ (i.e. *all* messages exchanged within a relation) instead of *isolated messages* pertaining to different links (this is discussed below under ‘Validity and reliability’). In the second stage of the research it was found that the 75 teachers created a total of 121 links in the period of study. A subset of these 121 links had therefore to be selected to analyse communication content.

As the aim of the research was to understand and explain rather than to draw ‘sample to population’ generalisations, ‘theoretical’ rather than random samples were selected (Glaser and Strauss, 1970, p. 106). Sampling for qualitative analysis is, according to Miles and Huberman: ‘... decidedly *theory driven* ... Choices of informants, episodes and interactions are being driven by a conceptual question, not by a concern for “representativeness” ’ (Miles and Huberman, 1994, p. 29). Sampling criteria, according to the literature, should reflect the aims of the study and be based on theoretical relevance (Glaser and Strauss, 1970, Chein, 1981).

This research aimed at furthering our understanding of the potential of electronic mail for fostering collegiality between secondary school teachers. This is important because a growing body of evidence highlights the importance of collegiality in the success of processes of educational change and professional development. However, according to research, not all collegial interactions are equally supportive of educational change and professional development. The literature emphasises the special importance of *sustainable, stable relations* because they support ‘strong’ forms of collegiality which have been found to have an impact on teaching practice and educational change (Little, 1982, 1990). In other words, according to collegiality theory and research, it was particularly important to shed light on the content of the ‘stable relations’¹² created by the teachers because those links were the most likely to have an impact on their practice. This led to the selection of the 24 stable links created during the period of study for content analysis. These 24 links were created by 20 of the 75 teachers (they were called ‘stable participants’ in this study because they maintained at least one stable e-mail relation with one of the other 74 colleagues).

The research aimed also at understanding why some relations continued over time while others were interrupted. Consequently, it was important to analyse the content of some *unstable* links. Of the 77 *unstable* links created during the period of study, the 20 ‘stable

¹² Those relations where messages were exchanged in both periods of study were called ‘stable’ relations. As discussed in Section 4.5.4.3., the first period covered August 8, 1996 - December 27, 1996 (Period 1) and the second period covered January 22, 1997 – May 18, 1997 (Period 2).

participants' created 26. These 26 unstable links were also selected for content analysis because, as they were created *by the same people in the same period of time as the 24 stable ones*, they had the highest potential to help understand and compare the nature of stable and unstable relations and the factors that might affect people's decisions to interrupt some e-mail relations while maintaining others.

Another aim of the third and fourth stages of the research was to further our understanding of why people might choose to use public or private communication to achieve their communication purposes. Consequently, a subset of *public* messages had to be selected for content analysis in addition to the private messages exchanged in the 50 links defined above (24 stable and 26 unstable). Again, it was important to analyse the content of public and private messages sent *by the same people during the same period of time* since this would allow for meaningful comparison of the topics and purposes for which each type of communication was used. Thus, all the public messages sent by the stable participants were selected for content analysis (n= 293).

In summary, Sample 1 consisted of 1356 messages sent by the 20 stable participants. It included all *private* messages exchanged between them within stable or unstable relations (n = 1063) and all the *public* messages they sent (n = 293).

As discussed above, the sampling strategy chosen for the analysis of communication content in the third and fourth stages of the research was to analyse in-depth the overall communication behaviour of a special class of users: the stable participants. The communication data analysed included their private messaging within both stable and unstable relations, as well as their use of public messaging. This approach provided a coherent and integrated body of data, highly consistent with the recommendation of communication researchers that 'intact samples' should be selected whenever possible since they strengthen the validity of content interpretation (Rogers and Kincaid, 1981, p. 104).

As recommended in the literature, sampling was guided by the potential of individuals to help shed light on the issues under investigation. As Merriam (1988, p. 77) has argued: 'in this type of research the crucial factor is not the number of respondents but rather the potential of each person to contribute to the development of insight and understanding of the phenomenon'. The 20 stable participants not only constituted an 'intact sample' but also were - as a group- in an excellent position to shed light on the key issues under investigation in these stages of the research. They sent more than three-quarters of *all* messages (public and private), created two thirds of the links and were the *only* teachers who maintained both stable and unstable relations during the period of study.

Thus, although this sampling approach restricts the applicability of results to the stable participants, the view taken was that these teachers constituted a valid and useful sample for helping to understand the processes involved in the creation, continuation and interruption of e-mail relations.

4.5.5.3. Data collection.

The 1356 messages were extracted from the computer network and transferred to a computer file for content analysis using the ATLAS computer program (Weitzman and Miles, 1994).

4.5.5.4. Data analysis.

The 1356 messages included in Sample 1 were content-analysed to obtain data on the topics addressed by the teachers using electronic mail. Content analysis techniques are widely used in communication research to transform communication content ‘through objective and systematic application of categorisation rules, into data that can be summarised and compared’ (Paisley, in press). According to Holsti, (1981, p. 95) researchers using content analysis techniques need to decide:

- ‘How is the research problem defined in terms of *categories*?’
- What *unit* of content is to be classified?
- What system of *enumeration* will be used?’

Category development.

As recognised by most communication theorists, no universal taxonomy of topics has yet emerged to classify human communication (Stohl and Redding, 1987, p. 454). As a result, researchers in many cases face the task of constructing categorisation systems to fit their particular aims and contexts (Grawitz, 1987, p. 161). According to Holsti (1981, p. 104), topic categories ‘are usually developed specifically for the problem at hand’.

Thus, in this stage of the research, a set of categories was developed for describing the topics addressed in messages in a valid and theoretically meaningful way. The literature points to some general principles of category construction (Stacks and Hocking, 1992, p. 250) that are presented below. Categories should:

- reflect the purpose of the research;
- be exhaustive (i.e. all units of content to be coded must be capable of being placed into a category);
- be mutually exclusive (i.e. no unit can be placed into more than one category);
- be independent (assignment of a unit to a category should not affect the classification of any other unit) and;
- derive from a single classification principle.

Categories of topics were developed inductively in an iterative coding process, moving back and forth from theory to data, testing the usefulness of tentative categories and then modifying them in light of data. At first, message content was categorised according to the explicit, ‘ostensibly displayed’ topic (Stohl and Redding, 1987). For example, a fraction of a message requesting advice on how to deal with bullying would be coded as ‘student behaviour’. In successive steps, categories were combined into increasingly more abstract ones. For example, a message sending information about a forthcoming in-service course for Maths teachers coded as ‘Course for Maths Teachers’ and another message containing an opinion about a recent conference for Biology teachers coded as ‘Conference for Biology Teachers’ would have their codes combined into ‘Teacher Development Events’.

The ATLAS computer program was used to support the coding process. ATLAS facilitates coding by providing graphical tools to select blocks of text (called ‘quotations’) and assign them to new or existing codes. Code assignments can be changed and listed easily.

Relations can be established between codes in ‘semantic networks’. For example, a code for ‘Syllabus’ may have a sub-code called ‘Physics Syllabus’ and another ‘Maths Syllabus’. An inquiry of the ATLAS database asking for all quotations coded as ‘Syllabus’ would yield all quotations assigned to the sub-codes as well as all quotations assigned to ‘Syllabus’.

The literature and the aims of the study provided a general framework for category development. Research on collegiality highlights the importance of distinguishing two main topics in teacher communication: talk about ‘personal issues’ and talk about ‘teaching’ (House and Lapan, 1978, Little, 1982, 1990, Ponticell, 1995). Communication research has similarly identified ‘social personal’ communication and ‘task-oriented’ communication as two key families of topics (Rice, 1982, 1987, Steinfield, 1983, Walther and Burgoon, 1992). Thus, ‘Social Personal’ and ‘Teaching’ were first defined as the two main categories for coding topic.

As the study is concerned with the development of professional relations it was felt that no further splitting would be needed for social and personal content. In the case of teaching-related content it became apparent that at least two categories would be needed to obtain a valid representation of teacher communication. Many messages addressed issues related to the life of teachers (e.g. Contractual Issues) but were not directly concerned with teaching or pedagogy. Such content was assigned to a new category, ‘Professional Life’, while content directly related to teaching practice and pedagogy was assigned to the ‘Teaching’ category’. This is consistent with research into collegiality which has found that a large proportion of teacher talk focuses on professional matters not related to teaching or pedagogy (Schwartz, Hollingsworth and Izsac 1987, Vonk and Shras, 1987). It should be noted that the point here is not the comparison of research results but the fact that the categories developed from the Teachnet data are firmly grounded both in collegiality and communication research.

The category development process described above led to the development of 20 categories for coding topic grouped for aggregate counting purposes into three main families (‘Non-professional’, ‘Professional Life’ and ‘Teaching’). The complete list of categories is presented in Chapter 7. Once a category system is defined, the researcher must specify, for each category, the indicators that determine whether a given item falls within that category. This is crucial for the coders to produce reliable judgements (Holsti, 1981, p. 95). A list of all categories, with each category illustrated by transcripts of messages assigned to it, is included in Annex 7.

Unit of analysis.

Content analysis requires defining the *unit of analysis*, that is the specific segment of content that is to be placed into one and only one of the categories.

In this stage of the research, the *message* appeared at first as the ‘natural’ unit of analysis since its boundaries are clearly defined (Finholt et al, 1990, p. 306) and indeed it has been used as such by many CMC researchers (West et al, 1989, Castle et al, 1990, Zarn, 1992). However, analysis of message content data showed that messages were used as *physical* vehicles of transmission, their boundaries defined not by topic or intent of communication but by factors such as available time to write. Many messages were not sent with the intention to perform a single, discrete function (as, for example, party invitations or legal notifications usually do) but many different functions (as phone calls or personal letters usually do). For example, the same message could request information about a Maths book (topic: ‘Bibliography’), express thanks for some teaching advice previously received about evaluation (topic: ‘Evaluation’) and invite the receiver for dinner (topic: ‘Social Personal’). In sum, many messages addressed more than one topic. This finding is consistent with most published research on e-mail message content (France, 1989, Beals, 1990, Zarn, 1992, Dzuba, 1994).

Defining the electronic message as the unit for content analysis would have therefore led to messages being assigned to more than one category (hence violating the mutual exclusiveness principle) or to the dismissal of some of the topics contained in a message. Thus, although selecting the message as the unit of analysis greatly reduces the costs and complexity of coding electronic mail content, it may compromise the validity of the results. It is not uncommon to find in the literature projects where the message is used as the unit of analysis. Although this decision is justified in different ways, many researchers fail to discuss the threat to validity involved. Zarn (1992, p. 21) for example, in her investigation of e-mail use by beginning teachers explains:

‘After much thought, I decided to use messages as the unit of analysis. Although some messages contained more than one topic, I chose to maintain the integrity of the message unit and did not code segments of messages, only whole messages’.

Once the message was discarded as the unit of analysis based on the multi-topic nature of many messages, it was decided that *segments* of messages addressing a single topic or ‘thematic units’ would be coded. This is a common approach for the analysis of communication content when large volumes of data are involved (France, 1989, p. 244, Stacks and Hocking, 1992, p. 257).

‘Thematic units’ are more difficult to code than grammatical units of analysis (e.g. words), physical vehicles of communication (e.g. letters, messages) or whole items (e.g. books) since their boundaries are not predetermined. Coders need to reduce their data to thematic units in a process that involves training and judgement. This process is sometimes called ‘unitizing’ in the literature (Holsti, 1981, p. 117, Weisband, 1989). However, the extra costs involved in unitizing and the potential threats to reliability are compensated by the greater validity of the research results. The literature suggests that researchers should be careful of not reducing validity in the search for high levels of reliability. According to Holsti (1981, p. 142): ‘high reliability can be achieved (when) coding is a mechanical task ... as units of analysis become more complex, they may yield results that are ... more useful and less reliable’.

Thus, in this stage of the research the text of each message of the sample was divided into segments addressing a single topic. Each segment was coded as an ATLAS ‘quotation’ and assigned to one of the 20 topic categories.

System of enumeration.

Once all quotations were identified and assigned to one of the 20 categories, the ‘counting’ or ‘enumeration’ system had to be decided. Content analysis techniques require defining carefully the enumeration system to be used (Holsti, 1981, p. 121). The presence of a certain theme in a text can be counted as one ‘appearance’ regardless of the number of words or lines, or weight may be given to this appearance based on some metric.

Would the results of the analysis of Teachnet messages be expressed in ‘number of *quotations* per category’ or would it be more accurate to differentiate between quotations based on their length for example? Would it be reasonable to count as equals a 10-word quotation and a 1000-word quotation? There are assumptions associated with each alternative. Researchers who decide to give weight to appearances are assuming, for example, that the intensity of a belief is directly associated with the number of words or lines used to express it. According to Holsti (1981), the enumeration system should be defined considering factors

such as the aims of the research and the costs involved. This is a complex decision around which there is considerable debate. Obviously, assigning weight to units of content raises the effort required for the coding process (since for example the number of words of text, or minutes of talk or any other appropriate measure for each quotation has to be counted). There should be valid theoretical reasons for justifying such a decision.

In this project, it was decided to assign weight to each quotation based on the number of words and therefore to count the ‘number of *words* per category’ rather than ‘the number of *quotations* per category’¹³. The reason for this was that it was important to establish not only the topics that teachers addressed when using electronic mail but also to have a valid measure of the proportion of their communication addressing each topic. It was felt that a quotation including 10 words could not be counted equally with a quotation including 1000 words. For example, if we found that three-quarters of the total number of quotations were assigned to the ‘Social Personal’ category we could reach the conclusion that the medium was *not* being used to communicate for professional matters most of the time. However, weighting each quotation by the number of words could suggest very different results if social personal quotations were systematically shorter than the others.

Another reason for counting *words* rather than *quotations* was that the number of words written is a direct measure of the amount of time that teachers devote to communicate about each topic. As time is a crucial variable in general in the life of teachers and has been highlighted in the literature as a major variable influencing collegiality it was important that the metric chosen reflected this variable (Hargreaves and Wignall, 1989, Hargreaves, 1992, Raywid, 1993).

4.5.5.5. Validity and reliability.

Analysis of message content is recommended as a valid method for understanding what is shared by individuals using CMC (Rogers and Kincaid, 1981, Rogers, 1987, Williams, Rice and Rogers, 1988). As Kuehn (1994) argues, ‘Content analysis can provide answers about the types of messaging content and the longitudinal evolution’.

Content analysts recommend looking at messages ‘within an ongoing stream of interaction’ rather than as isolated, de-contextualised units of communication (Stohl and Redding, 1987). Following this advice, the researcher analysed messages with a holistic approach, examining the content of all messages exchanged between each pair of stable participants to ensure that message intent was interpreted within the context of the ongoing exchanges rather than in isolation.

Less than 0.5% of the quotations were coded as ‘miscellaneous’. This figure enhances our confidence in the category system as a valid representation of content.

The literature suggests (Brownell, 1993, p. 89, Stohl and Redding, 1987, p. 492) that a major threat to content analysis research is low interrater reliability. According to Holsti (1981, p. 4), ‘the test ... (in content analysis) is: can other analysts, following identical procedures with the same data, arrive at similar conclusions?’

In this project, agreement rates were computed for each of the independent processes carried out with the data (i.e. unitizing, coding and weighting). A second coder participated in the coding process for this purpose. Agreement rates were considered acceptable based

¹³ Some CMC researchers have used different counting systems to account for the presence of more than one topic in a message which were not judged as adequate for the Teachnet research. These approaches are discussed in Annex 4, Section 3.

on Krippendorff's (1990) recommendation of a minimum reliability of 80%. The statistical data on agreement rates for each of the three processes is detailed in Annex 4, Sections 3 and 4.

4.5.6. Stage 4: exchange of professional resources.

4.5.6.1. Purpose.

Intent is one of the key concepts in communication research. People communicate to fulfil certain needs and achieve specific purposes (O'Keefe and Delia, 1982, Stohl and Redding, 1987). John Searle (1969) wrote that to understand language one must understand speakers' intentions. According to O'Keefe and Delia (1982), message contents are generated in relation to purposes. As Stohl and Redding (1987, p. 452) put it: 'When we regard messages as purposeful rather than random acts, messages must be explicable in terms of the functions they purportedly serve'.

According to collegiality research, teachers create and maintain collegial relations to fulfil different functions. They may look to colleagues to fulfil their social and psychological needs (e.g. empathy or praise), relieve tension from work, obtain encouragement for new roles (especially in the case of beginning teachers), trade information, gossip, anecdotes and opinions about colleagues, students or school authorities, exchange teaching tips, advice or materials, or collaborate on teaching or organisational activities such as school trips, teaching projects with other schools or syllabus reform projects (Johnson, 1990, Little, 1990, Sandholtz et al, 1991, O'Grady, 1994).

Collegial relations can be analysed from the social exchange theoretical perspective. This approach to communication research argues that interpersonal communication can be conceived as a process whereby individuals seek, obtain and provide resources from and to each other. Resources exchanged may be cognitive, affective or material and include information, advice and affection. Social exchange theorists believe that individuals initiate, maintain and terminate relationships on the basis of perceived rewards and costs associated with the resources they obtained in their exchanges (Foa and Foa, 1974, Roloff, 1981, Infante et al, 1993). Although exchange theory has seldom been used to analyse CMC exchanges between teachers, collegiality is discussed by some authors as a process of exchange of professional resources. According to Rosenholtz (1989, p. 137), the importance of collegiality for teachers lies in that 'they request and offer technical assistance to each other'. Nias et al (1989) in their study of teacher cultures in primary schools in England highlighted 'sharing and discussion of ideas and resources' as main influences in school cultures. Fullan (1992, p. 109) has argued that the basis of collegiality is 'mutual sharing and assistance'.

Research question IV is concerned with the use of e-mail for the exchange of professional resources (i.e. information, advice and materials of specific and direct relevance for teacher development and teaching practice). To help answer this question, it was important to determine the extent to which teachers used the medium to exchange professional resources and the main patterns of exchange (e.g. what types of resources were exchanged, to whom were requests and contributions addressed, how did teachers respond to the requests they received). This was the purpose of the fourth stage of the research.

4.5.6.2. Sample.

To achieve the aims of the study, topic and intent of the *same* messages had to be analysed. Consequently, Sample 1 was used for analysing communication *intent* in this stage of the research.

4.5.6.3. Data analysis.

The 1356 messages included in Sample 1 were content analysed to determine the main patterns of exchange of professional resources by the 20 stable participants. As discussed above, researchers using content analysis techniques need to decide:

- ‘How is the research problem defined in terms of *categories*?’
- What *unit* of content is to be classified?
- What system of *enumeration* will be used?’

Category development.

No universal taxonomy of communication intent has yet emerged in the literature (Stohl and Redding, 1987, p. 454). Consequently, researchers analysing human communication need to develop their own categories. In this stage of the investigation, four categories of communication intent drawn from the social exchange literature were adapted to fit the aims and context of this research: *requests*, *solicited contributions*, *unsolicited contributions* and *coordination* (Kram and Isabella, 1985, Miller and Jablin, 1991, Hudson and Jablin, 1992, Morrison, 1993). Chapter 8 discusses in detail the theoretical underpinnings of these four intent categories and provides examples and coding rules for each.

As discussed above, teachers may exchange cognitive, affective or material resources (e.g. information, advice or affection). Based on the aims of the study this research concentrated on the exchange of *professional* resources, defined as resources of direct and concrete relevance for teaching and teacher development. A set of 23 categories was developed from the data itself to account for the resources exchanged by the teachers using electronic mail (the complete list of categories is presented and discussed in Chapter 8).

Unit of analysis.

As discussed in Section 4.5.5.4, the electronic message was not an adequate unit for coding communication purpose, since many messages were used for multiple purposes. Although this issue was overlooked in many early CMC research projects, it has been acknowledged in recent years by some authors (Fafchamps et al, 1989, France, 1989).

Thus, it was decided to select *segments* of messages, or ‘quotations’, (each with a single communication intent) as units of analysis. This approach complies with the rule of mutual exclusiveness if each of these segments of content is assigned to one and only one category of purpose. As discussed in Section 4.5.5.4, using segments of content is a common approach for the analysis of communication content (Holsti, 1981, p. 116, France, 1989, Stacks and Hocking, 1992).

According to Foa and Foa (1974), resource exchanges are communication processes that may involve one or more ‘exchange actions’ or ‘exchange acts’. For example, an exchange may be initiated by a teacher requesting an opinion from a colleague on a new book (first act), prompting the receiver of the request to send a reply containing the requested opinion (second act). A contribution sent spontaneously to a colleague (first act) may lead to the receiver expressing gratitude (second act). An ‘exchange act’ is therefore a unit of communication with a single intent, which is part of an exchange process. In sum, in this stage of the research, the ‘exchange act’ was selected as the unit of analysis.

System of enumeration.

As discussed previously, content analysis requires deciding the ‘counting’ or ‘enumeration’ system (Holsti, 1981, p. 121). The presence of a certain theme in a text can be counted as one ‘appearance’, or ‘weight’ may be given to each appearance based for example on its number of words or lines. Assigning weight to ‘quotations’ raises the effort required for the coding process. Thus, there should be valid theoretical reasons for justifying such a decision.

The focus of this stage of the research was on the *intentions* of teacher e-mail communications. The aim was to shed light on teachers’ use of e-mail to obtain or share professional resources and the main factors influencing those exchanges. As such, it was felt that there was no compelling theoretical reason for assigning weight to ‘exchange acts’. There were no theoretical grounds to assume that for example a 10-word request should be counted differently than a 50-word request. Consequently, in this stage of the research, no ‘weight’ was attached to ‘quotations’ for counting purposes.

Coding process.

The coding process consisted of the stages set out below (coding criteria are detailed in Chapter 8).

1. Identifying all ‘exchange acts’ in the 1356 messages and assigning each of them to one of the three main intent categories (‘request’, ‘contribution’, or ‘coordination act’).

For each message, all segments of text, if any, intending to *request* a professional resource, *contribute* a professional resource or *coordinate* the exchange of a professional resource were identified. Each of these segments of text was called an ‘exchange act’ and coded as an ATLAS ‘quotation’. Each exchange act was assigned to one of the three initial intent categories: ‘request’, ‘contribution’, or ‘coordination act’.

2. Determining the outcome of each of the 627 *requests* received (i.e. ‘answered’ or ‘ignored’) and differentiating ‘unsolicited contributions’ from ‘solicited contributions’:

For each *request* R received by teacher T₂ from teacher T₁ on day D, all *contributions* (identified in the first stage) sent by T₂ to T₁ on or after day D, were analysed. If any contribution C intended to provide an answer to R, then C was coded as ‘solicited’ and R was coded as ‘answered’ by T₂. Otherwise R was coded as ‘ignored’ by T₂. This technique, which some authors call ‘intermessage analysis’, has been recommended in the literature as an appropriate approach for understanding the patterns of CMC use (Levin, Kim and Riel, 1990, Ahern, Peck, and Laycock, 1992).

In sum, at the end of this stage, each request *received* was coded as ‘answered’ or ‘ignored’ by the receiver and each contribution *sent* was coded as ‘unsolicited’ or ‘solicited’ based on whether it was sent in response to a request or spontaneously.

3. Determining the type of resource of each exchange act:

Each of the ‘exchange acts’ was assigned to one of the 23 resource categories.

4.5.6.4. Validity and reliability.

Validity.

A major threat to validity in research on communication content is the ‘observer inference problem’ (Stohl and Redding, 1987, p. 492). Categorisation of message purpose usually derives from an inference of a researcher based on the *literal* content of the message (the ‘ostensibly displayed’ message). However, the real intention of the sender (the ‘internally experienced’ message) may not be obtainable from this source of data. According to Murray (1985, p. 141):

‘For any linguistic event, there are at least three interpretations: those of the speaker, those of the hearer and those of the eavesdropper (or analyst) ... As analysts, the most we can do is use triangulation and/or apply consistent principles for our own interpretations.’

As Stohl and Redding (1987, p. 461) put it: ‘functions must be *inferred* by the process of constructing a sensible interpretation of what a message is saying and why it was exchanged’. Stohl and Redding acknowledged that there is no practical solution to this potential weakness and concluded by recommending that researchers present concrete samples of messages and any additional data used in the inferential process. These recommendations were followed in this research, which combined the analysis of message content with interviews of a sample of the teachers sending those messages. Message transcripts and interview excerpts are included in Chapters 8 and 9.

Murray (1985), Stohl and Redding (1987), France (1989) and others have also recommended looking at messages ‘within an ongoing stream of interaction’ rather than as isolated units of communication to strengthen the validity of the coding process. Following this advice, whole sets of messages linked by their topic (Murray called such message groupings ‘conversations’ and France ‘dialogues’) were analysed, rather than individual messages, to ensure that message intent was interpreted within the context of the ongoing exchange.

Reliability.

As discussed in a previous section, reliable content analysis requires high levels of agreement between coding decisions taken by independent coders. In this stage of the research, agreement rates were computed for each of the independent processes carried out with the data. A second coder participated in the coding process for this purpose. Agreement rates were judged acceptable in this research in accordance with the literature (Krippendorff, 1990). Statistical data on agreement rates is detailed in Annex 4, Section 4.

4.5.7. Stage 5: teachers' perspectives concerning CMC use.

4.5.7.1. Purpose.

In the last stage of the research, a sample (Sample 2) of teachers was interviewed to obtain their perspectives on the use of e-mail for collegial purposes and identify the main factors affecting their use of the medium, and hence help answer research question V.

4.5.7.2. Sample.

For the reasons discussed in Section 4.5.5.2, the 20 'stable participants' were selected for interviewing in the fifth stage of the study. Of the 20 stable participants, five could not be located for interviewing. Thus, Sample 2 consisted of 15 teachers. Professional and personal data on these teachers is presented in Chapter 9.

It should be noted that the teachers selected for interviewing were the authors of the messages whose content was analysed in Stages 3 and 4. This sampling strategy enabled the triangulation of the results obtained from the interview data and from the message content data. In other words, it was possible to compare teachers' descriptions of their own communication behaviour (obtained in the interviews) with the actual content of their communication (obtained in the content analysis carried out in stages 3 and 4). As discussed before, triangulation is strongly advised by communication researchers (Holsti, 1981, Patton, 1982, Rice, 1982, Lincoln and Guba, 1985, Rogers, 1987, Cohen and Manion, 1989).

4.5.7.3. Data collection.

Data were collected in individual semi-structured interviews conducted by the researcher in July 1997. Interviews were selected as the data collection method for the last stage of the research because they provided access to the teachers' perceptions of CMC. As Patton (1982, p. 196) put it:

'We cannot observe how people have organised the world and the meanings they attach to what goes on in the world – we have to ask questions about those things. The purpose of interviewing, then, is to allow us to enter into the other person's perspective'.

Interviewing is an effective method for obtaining data. According to Jackson (1990, p. 31), interviews have 'the major advantage of ... their capability to follow up interesting but unexpected responses and ... eliciting more complete responses ... by probing superficial or incomplete responses'.

Each of the fifteen interviews lasted on average one hour. They were carried out in Spanish using an interview schedule, taped with the authorisation of the interviewees and transcribed verbatim. The interview schedule is enclosed in Annex 10. The interviewer attempted to remain sensitive to emerging issues and pursued those issues that seemed of importance to the respondents whether or not they were included in the interview guide. The researcher did not adhere to the strict order of topics as listed in the interview guide in order to leave the exchange as unrestricted as possible. However, the researcher ensured at the end of

the interview that all topics included in the guide had been discussed. The interviewer's approach was to set as few constraints as possible in the elicitation process, encouraging respondents to use their own terms and definitions.

Before each interview the researcher reminded the teachers that all data would remain strictly confidential and anonymous. A few minutes of social talk took place before each interview to serve as an 'ice breaker' as recommended by Bogdan and Milken (1982, p. 135). During the interview, the interviewer made marginal notations to register specific gestures that could be important when analysing the interview data. These notes were analysed jointly with the interview transcripts.

The literature and a series of discussions with teachers provided guidelines on the key issues to be discussed in order to obtain the teachers' perceptions and views on the use of electronic mail for collegial purposes (Rice and Case, 1983, Rice, 1987, p. 77, Rosenholtz, 1989, p. 30). Once the key areas of discussion were defined, specific questions were formulated, piloted and refined as discussed below. The interview included four sets of questions, each addressing one of the following issues:

- teachers' views on teaching and collegiality;
- teachers' feelings towards computer-mediated communication and towards technology in general;
- teachers' descriptions of their own and of their colleagues' e-mail collegial behaviour; and
- their views on the potential of electronic mail for supporting professional development.

The first set of questions was useful to help understand the extent to which e-mail use by the teachers reflected their views on the importance of collegiality and on the nature of teaching. For example, teachers may decline to develop e-mail relations with colleagues because they just do not believe collegial exchange is important for teaching. Clearly, an interview schedule focusing exclusively on the technology could miss such factors that may be crucial for understanding collegial use of e-mail.

Teachers were asked about their own views on the importance of collegial relations and were stimulated to reflect on the level and nature of collegiality among Uruguayan secondary school teachers in general. This interviewing technique is recommended by Patton (1982) to help the respondent 'detach' himself or herself from the issue being discussed. This is useful when the respondent might feel that his answer might jeopardise his status in any way (Leithwood, Steinbach and Raun, 1993). For example, teachers may be reluctant to state that *they* do not welcome colleagues' comments on their teaching practice but they may be more open to admit that this is the case among teachers in general.

This first set also included some questions concerning the teachers' *existing* (FTF) collegial interactions. It should be emphasised that there was no attempt to study existing collegiality *in-depth*, since this was not a specific aim of this research project. A full-scale investigation of collegiality in Uruguay would require a different array of research methods and would constitute a project on its own. The investigation looked at teachers' use of electronic mail for collegial purposes, an area that had been scarcely researched before, especially in schools and almost not researched *at all* in Latin-American schools. The inquiries into the nature of existing collegiality aimed only at providing more background for the reader about the context in which the Teachnet project took place.

The second set of questions sought to obtain data on teachers' attitudes towards technology in general and towards communication mediated by computers. The literature has highlighted that the use of new technologies may be shaped by people's feelings towards technology in general (Clarke, 1991). This set of questions helped distinguish those factors affecting the teachers' communication behaviour that were inherent to teachers' feelings about technology in general from those that were specific to electronic mail.

The third set of questions addressed the key issue of this stage of the research: understanding, from the perspective of the teachers themselves, their use of electronic mail for collegial purposes. To achieve this purpose, the teachers were first asked about their own patterns of use of the medium as well as that of their colleagues. It should be noted that 'objective' traffic data had been already collected in the previous stages of the research (i.e. quantitative data collected automatically and showing who sent messages to whom and when). Thus, these teachers' self-reports about their communication behaviour provided a 'subjective' view of CMC (Danowski, 1982), which enabled the triangulation of findings. The interviewer also elicited teachers' reflections on why they thought they used the medium in the way they described and under which circumstances they might use it differently. In this way, teachers were invited to reflect on the factors that may have shaped the level and nature of their use of electronic mail for collegial purposes.

Finally the interviewer sought the teachers' views on CMC and its potential to benefit teachers in the future. This last set of questions were intended to help the teachers transcend their on-going experience with e-mail and think more generally about the issue of the potential of computer-mediated communication to support teacher collaborations.

4.5.7.4. Data analysis.

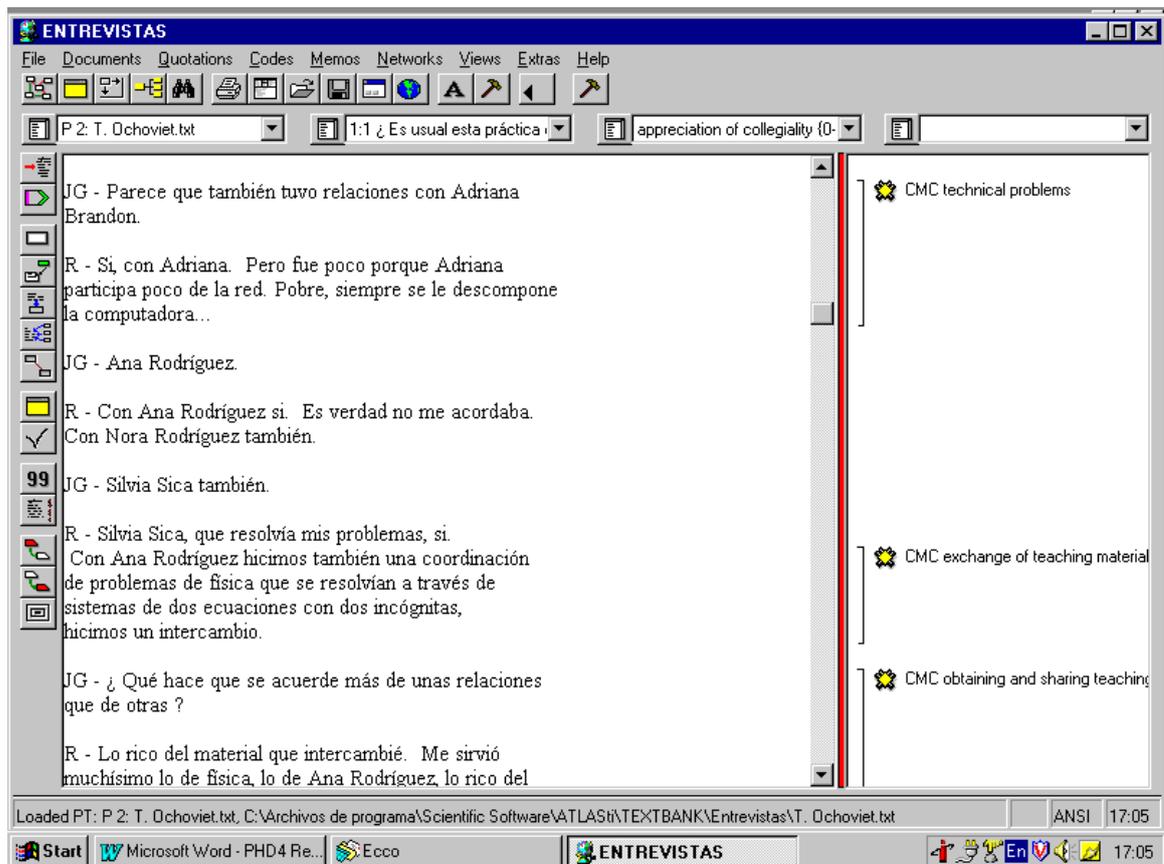
Interview transcripts were transferred to a computer file for computer-assisted analysis using the ATLAS computer program (Weitzman and Miles, 1994). Data analysis was carried out using the method of 'constant comparative analysis' (Lincoln and Guba, 1985, Strauss, 1987) following the grounded theory approach (Glaser and Strauss, 1967). This method consists of the construction of interpretative categories to account for the phenomena under investigation (in this case the collegial behaviour of teachers using electronic mail). The process is described below.

The researcher first read all interview transcripts to obtain a holistic overview of the data. Then, interview transcripts were analysed one by one in depth to identify concepts and themes bearing on the issues underlying the sets of questions discussed above. For each theme, a code (or category) was created. As recommended by Miles and Huberman (1994, p. 284), themes were coded as present for an informant 'if mentioned repeatedly or with strong effect during the interview'. Since the aim was to *explain*, rather than to *describe*, teachers' communication behaviour, the focus of the coding process was on the search for patterns and regularities across cases, the threads tying together fractions of the data, rather than on summarising each case separately.

Once initial categories were outlined, data were repeatedly analysed and new categories created to reflect new themes, or existing categories merged into overarching ones when it was decided that the difference between two or more categories was not theoretically warranted. This process was repeated until a set of categories was 'saturated', that is until

all additional cases could reasonably fit into the categories thus developed. In successive steps, categories were combined into increasingly more abstract ones. Thus, data analysis consisted of an iterative process moving back and forth from theory to data, testing the usefulness of tentative categories and then modifying them in light of new data.

The use of ATLAS facilitated this iterative process of category development and interpretation. As mentioned before, this computer program facilitates coding by providing graphical, word-processor type tools to select segments of text (called ‘quotations’) and assign them to new or existing codes. Codes are visible in the right margin of the computer screen as shown in the figure below. Code names can be easily changed and counting of ‘quotations’ per code is done automatically. Merging two or more codes into a new one or dividing a code into two or more subcodes is possible with relatively little effort. Code assignments can be changed and listed flexibly.



Besides facilitating coding, ATLAS supports interpretation by drawing conceptual links between codes. This visual aid to data analysis is recommended by Miles and Huberman (1994, p. 70) to help establish the main relations between categories and support interpretation. The coding example presented below shows how ATLAS supports visualisation of codes and their relations in visual networks.

To illustrate the dynamics of the coding process, the development of a specific category (‘Richness’) is discussed below. Quotations from the interviews were translated into English by the researcher for reporting purposes, trying to preserve the tone used by the respondents. One of the aims of this stage of the research was to understand why teachers chose to use (or not to use) e-mail for obtaining professional resources. Thus when a maths teacher

argued (see the quotation below) that he did not find e-mail useful for sharing exercises with his colleagues because 'sending symbols and graphics was too cumbersome', a code ('Lack of Graphics') was created and this segment of text assigned to that category. Similar references to this issue were assigned to the same category.

'A: You can't really explain things over the computer network.

Q: Why?

A: Because you can't write a mathematical equation with the proper symbols in an e-mail message, you can't show a physical experiment in motion.

Q: A computer network capable of transmitting graphics and video would be more useful?

A: Most certainly. At the moment, people can *tell* us about teaching materials and devices but if we want to *see* them we have to go to the Physics laboratory ... with an e-mail capable of transmitting graphics we could have all this on-line'.

Some teachers explained that they were reluctant to use e-mail because they felt that they risked being misunderstood, since messages lack the verbal and visual cues that can be transmitted FTF as shown in the following quotation.

'Q: You were afraid? What were you afraid of?

A: Of making mistakes. Of offending somebody unwillingly.

Q: Has it happened to you?

A: ... I sent a message which included some material as an example of what I *disagree* with and some people misunderstood it ... they thought this represented my actual belief. The problem is that often the meaning of a sentence changes according to the tone of voice you use ... and (in e-mail communication) you can't emphasise or use intonation to make sure people understand that what you say is a joke for example'.

Other teachers were not enthused to use e-mail because they felt they could not 'fully express' themselves with the medium, again because messages lack the verbal and visual cues that can be transmitted FTF.

'Q: How do you feel when you receive messages from strangers?

A: I don't mind. However, e-mail communication is less expressive (than FTF) and one feels less interested in initiating a dialogue.

Q: Why is that?

A: Because it lacks expressiveness; words by themselves do not convey emotions'.

To reflect the common thread between these two themes (illustrated in the above two boxes) a category ('Lack of Paralinguistic Cues') was created and both quotations and others referring to the same theme were assigned to it.

It was also found that some teachers felt that e-mail communication required a large amount of 'preparation' (e.g. facts checking, formatting, proof-reading) because once they sent a message they 'lost control' of it. The reader is alone in reading and interpreting the message and any mistakes or confusing statements cannot be corrected in 'real time'. Conversely, they thought, FTF communication enables the immediate 'repair'¹⁴ of any conflicting situation that may arise, deriving from unintended interpretations of the meaning or intention of messages. This theme, which is illustrated by the quotations below, was coded as 'Lack of Interactivity'.

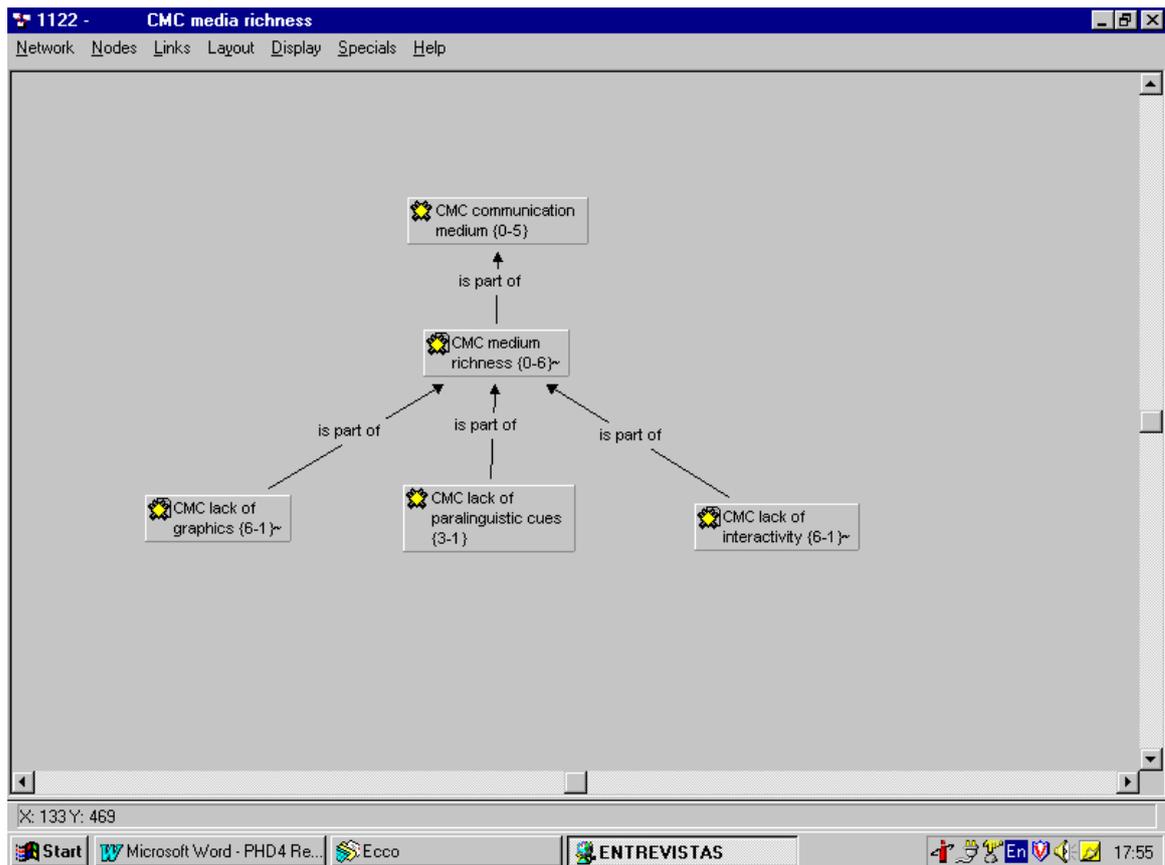
'I take my time before replying ... (in e-mail communication) you don't have the opportunity to explain yourself immediately if something you say is unclear or misinterpreted ... you really have to be careful about what you write as you don't get the nods and expressions that you get in a conversation to help you feel whether you are being understood correctly (10:19)'.

'... on the phone I may make a mistake in a dialogue with you and become aware of it on the spot ... If I send a message containing a mistake I would only find out much later after you and many other people may have read it ... I definitely see repairing (sic) mistakes in e-mail as more delicate than in FTF exchanges (8:17)'.

In sum, three of the many codes that were created in the initial iterations were: Lack of Graphics, Lack of Paralinguistic Cues and Lack of Interactivity. When analysing the initial codes, an effort was made to move to a higher level of abstraction, away from description and closer to theory. As Miles and Huberman (1994, p. 69) argue, 'Just naming or classifying ... is usually not enough'. The aim was to define more meaningful and inferential codes, encapsulating the results of the initial stages in a smaller number of theoretically relevant categories.

When analysing the initial codes within the framework of communication research, it became apparent that the above three codes could be seen as different dimensions of the 'richness' of the medium, that is the number of channels transmitting data in a medium. Thus the three codes were merged into a more abstract one (i.e. Richness), reflecting the theoretically consistent conclusion that, in many cases, use of e-mail was shaped by teachers' perception of e-mail's richness. This conceptual linking of codes to more abstract ones was carried out by drawing 'conceptual networks' using ATLAS as shown below.

¹⁴ As discussed in Chapter 3, communication theorists define 'interactivity' as the degree to which a certain medium supports interaction that resembles FTF conversation. (Rogers, 1986). One of the key characteristics of interactivity is the ability to repair, that is to respond in a timely and flexible manner to clarify meanings and intentions.



4.5.7.5. Validity and reliability.

Validity.

Validity in qualitative research refers to ‘the appropriateness, meaningfulness and usefulness of the specific inferences researchers make based on the data they collect’ (Fraenkel and Wallen, 1990). Appropriate inferences must be relevant to the purpose of the study. A meaningful inference must be a warranted conclusion from the collected data, a conclusion that interprets the observations and gives meaning to them. Useful inferences are the ones that help researchers make a decision related to their questions. A number of strategies were followed to enhance validity: respondent validation, data collector bias control and instrument refinement. These strategies are discussed below.

Respondent validation.

Following the suggestion of Lincoln and Guba (1985), the researcher carried out member checks to clarify any confusing interview data and obtain the respondents’ input on the categories and conclusions. The researcher’s interpretations of interview data were shared with six of the respondents to obtain their feedback on the extent to which his interpretations fairly reflected their viewpoints. This procedure is strongly recommended by authors such as Elliot (1990) who argued that ‘...accounts can only be validated by an appeal to the participants’. The feedback obtained from the respondents reassured the researcher that the categories developed and his interpretations were grounded in the teachers’ views.

Data collector bias control.

An effort was made to ensure that the study was not prejudiced with any prior conceptions of the researcher about the role of CMC. This is a crucial control when using qualitative methods, where the researcher is an instrument of research. As Dobbert (1982, p. 43) has argued:

‘(It is crucial) to separate the data-gathering and conclusion-making processes ... a researcher must learn to separate those processes which are automatically joined in ordinary life ... this means that any assumptions ... that arise in the early stages are considered questions, not answers, and that data are sought for their disconfirmation as well as their confirmation’.

Qualitative researchers are primarily interested in perspectives and it is their obligation to present an honest account of how informants actually view themselves and their experiences (Taylor and Bogdan, 1984). In this project the researcher tried to be conscious and vigilant of possible preconceptions about the teachers either individually or as a group. In particular, no assumption was made in contacts with teachers or when analysing data about the possible role of CMC in schools. As teachers were unknown to the researcher, a possible source of bias, deriving from personal knowledge of past behaviours and personalities, was avoided. Every effort was made to ensure that inferences and conclusions were drawn strictly from the collected data rather than from personal views or knowledge.

Instrument refinement.

The interview schedule was piloted with two teachers in July 1997 to ensure that all questions and terms were clear and unambiguous and that the length of the interview would be appropriate for extremely busy teachers. Pilot tests suggested a few changes that were introduced to avoid repetitive questions and ensure that the interview would not exceed an hour.

Reliability.

Reliability refers to whether the results of the present study could be replicated in future studies. However, reliability in this traditional sense is not achievable for this stage of the study (Huthchinson, 1988, p. 131). As Merriam put it:

‘Because what is being studied in education is assumed to be in flux, multifaceted and highly contextual (and) there is no benchmark by which one can take repeated measures and establish reliability, achieving reliability in the traditional sense is not only fanciful but impossible’ (1988, p. 170).

Qualitative research does not seek to establish stable causal laws but to ‘explain the world as those in the world interpret it’ (Merriam, 1988, p. 170). In qualitative research, it is left to the reader to decide the extent to which the findings may apply to other situations (Walker, 1980, Elliott, 1990). As Cronbach (1971) has argued: ‘The ultimate issue is the validity of the interpretation, which only the reader knows for sure, the audiences must assume considerable responsibility (for interpretation)...’.

According to Miles and Huberman, in qualitative research, the issue underlying reliability is ‘whether the process of the study is consistent ... We can, in effect, speak of “quality control” ... Have things been done with reasonable care?’ (Miles and Huberman, 1994, p. 278). They recommend that all procedures and paradigms used in the research should be clearly explained and documented. This advice is consistent with Patton’s recommendation that researchers report their qualitative results ‘in such a way that (others) ... can verify and validate the findings ... for themselves’ (Patton, 1982, p. 236). As Shimahara (1988, p. 76) put it:

‘Measures to enhance reliability (of qualitative research) ... involve a complete description of the research process, so that independent researchers may replicate the same procedures in comparable settings. This includes a delineation of the physical, cultural, and social contexts of the study ... and a complete description of the methods of data collection and analysis’.

In this study, extensive transcripts of messages illustrating the basis for the researcher’s inferences are provided to help the reader judge and assess the applicability of the results of this stage of the research to other contexts. All theoretical frameworks and research methods utilised are fully documented. Additionally all results are compared with findings obtained in research carried out in other contexts and alternative or competing explanations discussed whenever possible. Finally, a critical discussion of the social and cultural context in which the Teachnet project took place is included in Chapter 11.

CHAPTER 5

Medium use

5.1. Introduction.

This chapter reports the results of the quantitative analysis of e-mail use by the teachers. The findings are used to answer research question I. Three dimensions of e-mail use are analysed: system access, message writing and message sending.

System access measures the number of times that a teacher ‘logged’ into the system to read his or her incoming messages or to send messages.

Message writing measures the number of original messages composed and eventually sent by each teacher to at least one of the 74 potential individual receivers (i.e. private messages) or to at least one group (i.e. public messages).

Messages sent measures the total number of public and private messages sent by an individual to teachers or groups included in the investigation. For example, if the same message was sent to teacher X, to teacher Y and to the ALL group, one message was counted as *written* and three messages were counted as *sent* (two privately and one publicly).

Based on the traffic data, the *number of system accesses* and the *number of messages written* were determined and their degrees of association with several variables established (i.e. school, subject taught, age, gender, teaching experience, previous experience with electronic mail, access to a home computer and proximity to a school networked computer). Chapter 4, Section 5.3 discusses those variables.

Sending messages involves two decisions: a) the type of communication to be used (i.e. private or public) and b) the ‘message recipient’ or ‘communication partner’ (i.e. to whom the message will be sent). Human (FTF) communication research has shown that *partner selection* is influenced by some properties of the pair formed by the two persons involved in a communication exchange. For example, people have been found to be much more likely to communicate with acquaintances than with strangers (O’Reilly, 1982, Miller and Jablin, 1991) and with persons who are similar to them in some social or professional variable such as socio-economic status, occupation, religion (Lazarsfeld and Merton, 1964, Laumann and Pappi, 1973, Fisher et al, 1977) or, in the case of schoolteachers, subject taught (Charters, 1976, Cusick, 1981, Rohland, 1985, McLaughlin, 1992). As discussed before, these constraints to partner selection are important because teachers who contact relatively few ‘new’ people and whose exchanges mostly involve subject colleagues may gain access to few new ideas and challenges to their established professional views and practices. For these reasons, this research set out to establish the extent to which e-mail may help teachers communicate with previously unknown colleagues and with teachers of different subjects (in other words, the extent to which partner selection is influenced by previous acquaintanceship and professional homophily).

Associations between variables were analysed using statistical techniques. When ‘significant’ is used in this report it should be understood as ‘statistically significant’ at the 0.01 level or lower unless specified otherwise. All tables and statistical analysis for this chapter are given in Annex 5.

5.2 Patterns of use of the medium by the teachers.

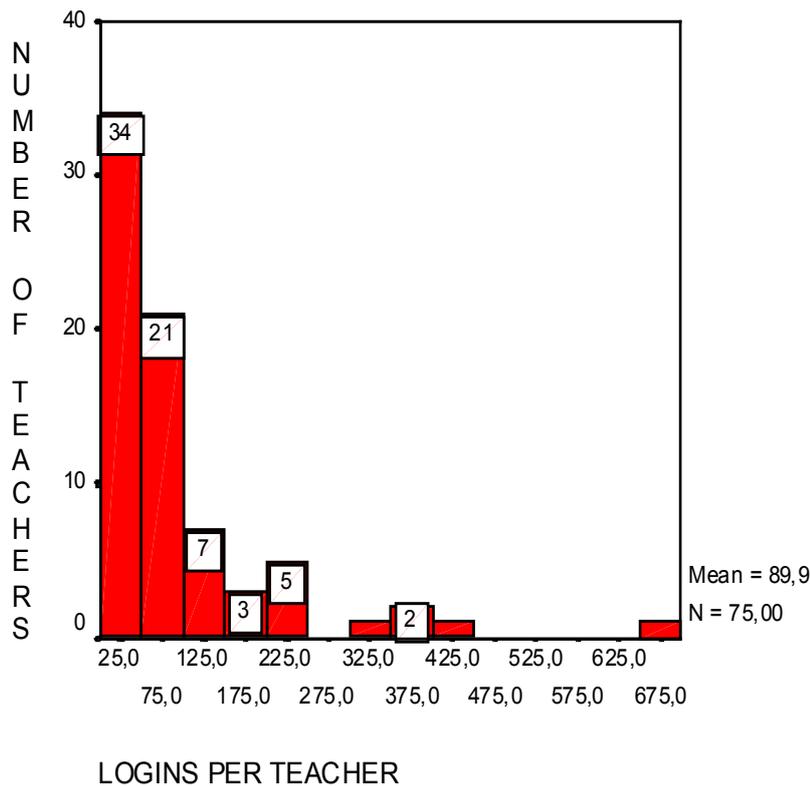
5.2.1. System access.

Teachnet users had to access the computer network to read or send messages. This section describes the main patterns of system access by the 75 teachers participating in the project. Statistical data are detailed in Annex 5, Section 1.

5.2.1.1. Access rate.

All 75 teachers accessed the system at least once. The average login rate over the 259 days of the study was 2.43 logins per teacher per week. The figure below shows the number of logins per teacher. As usual with most communication variables (Rice,1982) the distribution is strongly asymmetrical, with a large proportion of the users with low levels of activity and a few individuals with very high numbers of logins.

Histogram of logins per teacher.



5.2.1.2. Point of access.

Teachers accessed the computer network mostly from their homes (81.7% of the 6744 logins were 'home' logins and 18.3% were 'school' logins). The access rate from school (0.78 logins per week counting only the 137 weekdays during the period of investigation when the school buildings were open and in session) was significantly lower than the access rate from home (1.99 per week).

5.2.1.3. Days of access.

Teachers accessed the computer network significantly more on weekdays than on weekends (the login rates per teacher per day were 0.380 between Monday and Friday and 0.265 during the weekend). Among the 5509 logins from teachers' homes, there was no significant difference between login rates on weekdays (0.291 per day) and login rates on weekends (0.265 per day). This result suggests that teachers were not inclined to spend more of their time on e-mail use during weekends, when they have more free time, than during weekdays. The implications of this finding are discussed later in this chapter.

5.2.1.4. Factors affecting access rates.

The existence of significant associations between access rates and the personal characteristics of teachers (i.e. school, subject taught, gender, age, teaching experience and previous experience with electronic mail) and between access rates and the logistic variables related to teachers' access to networked computers (i.e. availability of home computer and proximity of school computer) were studied using statistical techniques. The results are summarised below (statistical data for all tests are presented in Annex 5, Section 1):

- no significant associations were found between the login rates and the personal characteristics of the teachers;
- teachers who owned a home computer logged into the system three times more often on average than those who lacked one. There was almost a two-to-one difference in the login rates from school in favour of those who had close access to a networked school computer.

5.2.2. Message writing.

This section considers the number of messages written by teachers during the period of study.

5.2.1.2. Number of messages written.

The rate of message writing was 0.64 messages written per teacher per week. In common with system access, the histogram of the number of written messages per teacher reflects a very skewed, non-normal distribution. The histogram is included along with the statistical data for this section in Annex 5, Section 2.

5.2.2.2. Factors affecting message writing.

The existence of significant associations between the number of messages written and the personal characteristics of teachers, the logistic variables related to teachers' access to networked computers and system use variables (i.e. logins and messages received) were studied using statistical techniques. The results are summarised below (statistical data for all tests are presented in Annex 5, Section 2):

- no significant associations were found between the number of messages written and personal variables;
- teachers with home computers wrote 21 times more messages on average than those who lacked one, a significant difference;
- the more times teachers accessed the system, the more messages they wrote (the correlation coefficient between the number of system accesses and the number of messages written was 0.81); and
- the number of messages *written* was correlated with the number of messages *received* (the correlation coefficient was 0.63) and more strongly correlated with the number of private messages received (the correlation coefficient was 0.95).

5.2.3. Message sending.

Once messages are written, teachers may send them publicly or privately to one or more electronic addresses.

The rate of messages *sent* was 0.7 per teacher per week. Most teachers (81%) sent at least one message during the period of study. Teachers sent, on average, relatively few messages; close to half (41.3%, n=31) sent less than 5. The following sections describe the main patterns of private and public messaging. All statistical data related to this section are presented in Annex 5, Section 3.

5.2.3.1. Public communication.

Number of public messages sent.

The rate of public messages sent was 0.14 per teacher per week. More than two thirds (69.3%, n= 52) of the teachers sent less than 5 public messages during the period of study, including 26 teachers (34.7%) who did not send any. The histogram is given in Annex 5, Section 3.

Receivers of public messages.

As discussed before, a number of 'distribution lists' were available to teachers for sending public messages. One (ALL) included the 75 teachers. Others included all teachers in each subject area (SUBJECT groups such as MATHS) or each school (SCHOOL groups such as HERZL), and others the intersection of these two (e.g. all maths teachers at the Herzl school).

More than half of the public messages (54.7%) were sent to the ALL group. Approximately a third (32.5%) were sent to SUBJECT groups and only 1.4% to SCHOOL groups. The remainder (11.3%) were sent to SCHOOL-SUBJECT groups.

Number of public messages sent and sociometric variables.

According to the data collected in this investigation, there was no evidence of the proportion of strangers within the Teachnet audience affecting the use of public communication. The correlation coefficient between the number of public messages sent by teachers and the number of Teachnet participants they were previously acquainted with was 0.16, with $p=0.18$, meaning there was effectively no linear association between them.

5.2.3.2. Private communication.

Number of private messages sent.

Three-quarters of the teachers (74.7%, $n=56$) sent at least one private message during the period of study. The rate of *private* message sending was 0.56 messages sent per teacher per week. A histogram showing the number of private messages sent per teacher is included in Annex 5, Section 3. This means that, on average, the teachers sent four times more private messages than public messages.

Receivers of private messages.

The 75 teachers sent 1556 private messages in the period of study. Although each teacher previously knew on average a small minority of the other 74 teachers (25.4%), a significantly large majority (69.7%, $n=1085$) of the messages were sent to previously known colleagues.

Among these same 1556 private messages, 1098 or 70.6% were sent to subject colleagues (i.e. teachers who taught the same subject as the sender). On average, each teacher had 23.7 subject colleagues participating in the study, which out of 74 means 32%. The percentage of messages sent to subject colleagues (70.6%) was significantly greater than could have been expected by chance (32%).

5.2.3.3. Comparing public and private communication.

Most messages were sent privately (79.2%, $n=1556$). The average proportion of public messaging among the 44 teachers who sent more than 5 messages (and who accounted for 98.2% of the 1964 messages sent), was 25%.

The number of *public* messages teachers sent over the period of study and the number of *private* messages they sent over the same period were strongly correlated. The correlation coefficient was 0.86, with p less than 0.001, meaning there is a strong linear association between the two variables.

5.3. Answering research question I: patterns of use.

This chapter has addressed research question I:

“What are the main patterns of use of e-mail by teachers?”.

To answer this question, three dimensions of system use were investigated based on the traffic data: system access, message writing and message sending. The following sections interpret the relevant findings and discuss them in relation to the research literature.

5.3.1. Amount of use.

A common finding across all three dimensions of e-mail use was that the amount of use was unequally distributed, with a large proportion of the teachers showing low levels of activity and a few teachers being highly active. This finding is compatible with results reported in the literature (Kerr and Hiltz, 1982, Rice and Case, 1983, p. 136, France, 1989, p. 298, Carley and Wendt, 1991, p. 433, McCormick and McCormick, 1992). As Steinfield (1983, p. 52) reported from his research of e-mail use in a large industrial corporation: ‘All of the usage statistics ... are skewed by heavy users’. Katz et al (1987, p. 27) concluded: ‘The major finding of these indices is the wide variation among members. On each index, about a quarter of the teachers were very active participants while the others were occasional users’. Broholm (1991, p. 160) found that 9% of the individuals were responsible for 83% of the message sending. Bikson and Eveland (1990, p. 273) found that a quarter of the users accounted for three quarters of the messages sent.

The literature reports higher levels of activity in industrial contexts. For example, Steinfield (1983, p. 52) found that employees of a large corporation sent on average 12.2 private messages a week (compared with the 0.56 private messages per week sent on average by the teachers using Teachnet). Results from research carried out in educational contexts are more consistent with the ones found in this investigation. Jones (1987), reported a login rate of 1.26 times a week on average, Katz et al (1987), 1.31, Gal (1993a) 1.5, O’Grady (1994) 1.63, Chung (1991) 2.82 and Teles and Duxbury (1991) 3.35 (Teachnet reported 2.43). Castle et al (1991) reported a weekly average of 0.36 messages sent, Bruce and Rubin (1993) 0.48, Broholm (1991) 0.75, Gal (1993a) 0.78 and O’Grady (1994) 1.45.

A full analysis of the differences between organisational variables in schools and industry that may explain the higher levels of e-mail use in industry falls beyond the aims of this study (Steinfield, 1983 and Kaye, 1992 provide useful reviews). An important difference may be the level of ‘task interdependency’ (i.e. the extent to which individuals need each other to achieve their work goals). As discussed in Chapter 3, this task feature has been reported as influencing communication behaviour. Interdependency creates a situation in which people have an interest in ensuring that all individuals obtain the resources they need to perform their job, hence sharing is fostered. Educational researchers have noted that teaching is a ‘low interdependence task’ (Pellegrin, 1976, p. 368). Conversely, in industry, collegial exchange is in many cases essential for task completion and supported by formal and informal rules and by the organisation of work (for example, office layout and people’s schedules are usually designed to ensure that people needing to work together are physically close and their time tables are compatible) (Greenberg, 1980). Another difference between educational and corporate contexts may lie in the level of access to the technology: most workers in industry have much easier access to computers and telephone lines than the average school teacher. This is further discussed in Chapter 11.

It was also found that the amounts of use in the different dimensions of communication behaviour were highly correlated. The number of system accesses and the number of messages written were positively correlated. Likewise, the number of public messages sent and the number of private messages sent were strongly correlated. These findings suggest that most teachers did not perceive e-mail as a single purpose medium such as:

- *radio or TV* (both unidirectional media) which would imply a focus on *receiving* messages as opposed to *writing* them;
- *bulletin board systems* which would have led to a predominant use of *public* messaging (in fact the opposite result was found: *private* messaging was predominant); or

- *the telephone* (or any other media designed mainly for conducting private, bilateral exchanges) since teachers would have used e-mail *only* for private messaging.

In sum, the teachers did not seem to assimilate e-mail to any of the existing media but recognised the versatile nature of the new medium. This finding contradicts results of prior research discussed in Chapter 3, which described distinct classes of users, some who use CMC as a database and mainly ‘take’ from the community (i.e. they actively access the system but seldom send messages) and others who predominantly ‘give’ to the community. This discrepancy may derive from the fact that most early CMC research focused on public communication, thus overlooking the effect of private messaging on communication patterns. Some of the studies collected data from bulletin board systems (e.g. Rafaeli and LaRose, 1993) and others, while investigating e-mail systems, analysed only *public* messages (e.g. West et al, 1989). One of the implications of these findings is that researchers should be critical of studies that overlook the differences between different types of CMC systems when drawing conclusions on CMC behaviour.

5.3.2. Time and place of access.

Although most teachers had access to a networked computer at school, they accessed the computer network predominantly from their homes. This suggests that ensuring access to the system does not necessarily lead to e-mail use. The interview data, which is discussed in Chapter 9, helped identify some inhibiting factors explaining this pattern of behaviour. For example, it was found that teaching schedules rendered it very difficult for many users to spend time writing messages at school. It is also possible that the non-private nature of staff rooms led teachers to avoid accessing the system and reading messages from school. A conclusion that may be drawn from these results is that educational planners should not expect increases in the number of networked computers to lead, *per se*, to higher e-mail use if factors of a different nature constrain their communication behaviour.

Teachers did not use e-mail from home more during weekends than during the working week (i.e. Monday to Friday) although during the weekends they have more time available which they routinely use for professional purposes (e.g. preparing evaluations, reviewing teaching materials, grading)¹⁵. This finding suggests that e-mail use may not be a simple function of the time available. While teachers may not use e-mail if they lack the time (in fact, lack of time has been found to inhibit educational changes in a large number of studies¹⁶), more time might not lead to higher levels of e-mail use. A reason for this is that teachers may attach higher priority or higher professional value to other activities (e.g. reading books, lesson planning, preparing teaching materials) than to collegial exchange. This is further discussed in Chapter 10.

5.3.3. Recipient selection.

According to the data, *previous acquaintanceship* and *professional homophily* constrained recipient selection. Teachers sent significantly more messages to acquaintances than to strangers and to colleagues of the same subject than to teachers of other subjects.

The fact that the teachers were reluctant to send private messages to strangers is consistent with some prior research (Eskridge, 1989, Gal, 1993b, Tsui, 1995) but contradicts the results of other projects carried out in educational (Katz et al, 1987, p. 29, Chung, 1991) or industrial settings (Kiesler, 1986, Finholt, 1992). These discrepancies may be related to

¹⁵ Teachers’ use of their non-teaching time is a complex, heavily researched issue, of which a full discussion would fall beyond the aims of the study. Grunberg (1991), Hargreaves (1992b) and other authors provide a review of prior research and evidence of their own investigations on this issue.

¹⁶ See for example Fullan (1991).

the fact that many of those research projects had focused on *public* communication. The Teachnet investigation found some evidence suggesting that public communication may be less constrained than *private* communication by previous acquaintanceship. It was found that while teachers were reluctant to send *private* messages to strangers, they were ready to send *public* messages to those same colleagues (they sent more than half of their messages to the ALL group, although on average three-quarters of the receivers were strangers) and there was no correlation between the number of public messages sent by teachers and the number of participants they were previously acquainted with. This result suggests that public communication may play an important role in helping teachers meet 'new' (i.e. previously unknown) colleagues.

The finding that professional homophily constrained private communication is compatible with most published CMC research on educational contexts (Castle et al, 1991, Broholm, 1991, p. 175, Collis, Veen and Devries, 1993). As discussed in Chapter 11, this may be explained by the characteristics of teaching in Uruguay. Within the organisation of the Uruguayan educational system, while teaching the same subject involves sharing common interests and needs, teachers of different subjects share few professional rules, needs and interests.

5.3.4. Using public or private communication.

As discussed before, most early CMC research focused on public messaging. One of the contributions of this research project is that it analysed the private and public messages exchanged *by the same users within the same period of time*. It was found that most messages were sent privately (79.2%). This result is compatible with previous research carried out both in educational (West et al, 1989, Castle et al, 1991) and non-educational contexts (Steinfeld, 1983). In most studies where public and private communication were considered (a small minority of the investigations), private communication was the overwhelming choice of users.

It was found that the more messages teachers *received*, the more they *wrote*. However, when looking separately at the public and private messages received, it was found that this was true only for *private* messages (the number of messages *written* by the teachers was strongly correlated with the number of private messages *received* but not correlated with the number of public messages *received*). This result suggests that teachers are not 'engaged' in the same way by receiving public, collective messages as they are by receiving private, 'exclusive' communications.

5.4. Summary.

A common finding across the three dimensions of e-mail use was that while most teachers used the system, usage levels varied widely. Most teachers used e-mail only sporadically (on average they accessed the system once every three days and wrote a message every eleven days). Only a small kernel of users seemed to adopt it for regular communication with their colleagues (less than 5% of the 75 teachers used the system daily). The usage levels found in this investigation are compatible with those found in prior research in educational contexts although they are lower than levels found in industrial contexts.

Logins were carried out mostly from teachers' homes rather than from school. Teachers did not use their free time during weekends for using e-mail more than on weekdays although research has found that they routinely use weekend time for professional tasks. These

findings put into question the speculations by some collegiality researchers (see Chapter 1) that teachers would engage in higher levels of collegiality if only they had more time and suitable media. This is discussed in detail in Chapter 10.

Teachers used e-mail both for receiving and sending messages publicly and privately suggesting that they perceived e-mail as a versatile medium, useful for fulfilling diverse communication needs rather than for specific purposes, for example a database to obtain information or a telephone for bilateral, private exchanges.

No evidence was found suggesting that e-mail might help teachers expand their professional networks (teachers' private communication was strongly biased towards colleagues they already knew before starting to use e-mail). The evidence suggests that e-mail based collegial networks (i.e. those colleagues with whom a given teacher communicates using e-mail) may be largely professionally homophilous (significantly fewer private messages were sent to teachers of different subjects than to subject colleagues). Public communication seemed less constrained by previous acquaintanceship than private communication. This suggests that public communication may play a key role in helping teachers meet 'new' (i.e. previously unknown) colleagues. However, most messages were sent privately, which suggests that it should be important for educational planners interested in helping teachers meet 'new' colleagues to find ways to promote the use of public communication.

CHAPTER 6

Development of collegial relations

6.1. Introduction.

The previous chapter discussed the main patterns of system access, message writing and message sending by the teachers using Teachnet. These three dimensions of e-mail use have in common that they are ‘unilateral’ behaviours in the sense that they depend on the will and the choices of one individual. This chapter analyses the development of dyadic ‘relations’ (i.e. reciprocal exchanges of private messages between pairs of individuals). This is a ‘bilateral’ or ‘relational’ behaviour in the sense that for the creation and development of relations, the wills and choices of two persons must concur (i.e. it is not enough for *me* to wish to have a relation with you for such a relation to be established; *you* have to wish the same and act in accordance).

As discussed in Chapter 4, flows of communication between pairs of people are modelled by network theorists as ‘links’ or ‘relations’. A ‘link’ was defined as having been created between a pair of teachers if each of them received at least one private message from the other in the period of study. Among the 75 teachers, 2775 pairs could be formed $[(75*74)/2]$ and each of these pairs could, in theory, establish a link.

The literature on collegiality emphasises that not all relations between teachers have an impact on practice. As discussed in the first chapter, collegiality research has found professional development to be associated with regular and stable relations (Little, 1982, 1990, Huberman, 1993). As discussed before, communication and collegiality research have found that the impact of communication on behaviour is highly (albeit not exclusively) dependent on the frequency and duration of exchanges. The issue of link ‘stability’ has been overlooked in most communication research, partly due to the complexity and costs involved in gathering network data. Researchers have emphasised the importance of studying the stability of links over time (Rogers and Kincaid, 1981, p.313). It was therefore important, to fulfil the aims of this study, to look not only into the *creation* of links but also into their ‘structural properties’, especially their ‘intensity’ and ‘stability’.

For the reasons discussed in the previous chapter, it was also important to establish the extent to which two couple properties, previous acquaintanceship and professional homophily, constrained the creation and development of e-mail relations.

In sum, in this stage of the research the e-mail relations developed by the 75 teachers during the period of study were analysed from the network theoretical perspective and findings used to answer the second research question. The aims of the analysis can be summarised as follows:

- a) to find out which of the 2775 pairs of teachers established e-mail relations;
- b) to determine the main structural properties of those relations (i.e. ‘intensity’ and ‘stability’);
- c) to establish the existence of significant associations between the properties of couples (i.e. previous acquaintanceship and professional homophily) and the creation and development of relations between those couples; and

- d) to determine the main changes in the above findings over time (i.e. the dynamics of the network).

This chapter summarises and discusses the findings. All tables and detailed statistical data can be found in Annex 6.

6.2. Definitions.

As defined in Chapter 4, Section 5.4, 'intensity' refers to the *amount* of communication taking place in a relation and was measured as the number of private messages exchanged between the pair (thus, by definition the intensity of a relation is greater than one).

'Stability' refers to the persistence of communication between a pair of people over time. Determining the stability of a link requires at least two consecutive measurements. A link was defined as 'stable' if the two teachers sent at least one private message to each other in each of the two periods of study (P1 from August to December 1996 and P2 from January to May 1997).

The 'connectedness index' (CI) measures the ratio of the number of links established to the maximum number of links that may be established.

6.3. The number of links created and their properties.

Two thirds (65.3%, n=49) of the teachers maintained at least one relation. More than a third of the teachers (34.7%, n=26) did not maintain any relations (i.e. they were 'isolates' in network theory terms). Almost two thirds maintained three or less relations (65.3%, n=49) while seven teachers (9.3%) maintained at least 10 relations each (a histogram of the number of relations maintained per teacher is included in Annex 6, Section 1).

One hundred and twenty-one relations were created among the 75 teachers during the period of study. The connectedness index was computed by dividing the number of relations that were created (121) by the total number that *could* be created (2775). Thus the connectedness index was 4.4%, meaning that less than 5% of the 2775 couples that could be formed among the 75 teachers using Teachnet established e-mail relations.

The intensity and stability of those 121 links established among the 75 teachers during the 37 weeks of the investigation are discussed below.

6.3.1. Intensity.

A total of 1412 private messages were sent by the teachers involved in the 121 relations, for an average intensity per relation of 11.7 and a median of 5. The distribution of the number of messages per link is highly asymmetrical and skewed to the left with close to half of the relations (43.8%, n=53) exchanging less than 5 messages and 2.5% (n= 3) of the relations accounting for almost a third (32.7%, n=462) of total intensity (a histogram is given in Annex 6, Section 2).

6.3.2. Stability.

The number of relations created during P1 was 101. Of those, 24 were stable, meaning that a large majority (76.2%) of the 101 relations established in P1 were *unstable*.

The stability of the 20 relations created in P2 could not be determined since network activity was measured at only two points in time.

6.4. Couple properties and the creation and development of links.

This section examines the degree of association between previous acquaintanceship and professional homophily and the creation and development of e-mail links among the 75 teachers using Teachnet.

First, link *creation* is considered as the dependent variable. The 121 couples who established a relation are compared with the 2654 pairs of teachers who did *not* establish a link to determine if there were significant differences in previous acquaintanceship and professional homophily. Subsequently, stability is considered as the dependent variable and the 24 couples who maintained stable relations are compared with those who maintained unstable relations.

6.4.1. Couple properties and link creation.

The degree of association between previous acquaintanceship and professional homophily, and link creation was analysed using statistical techniques (statistical data for all tests are presented in Annex 6, Section 3).

It was found that teachers established significantly fewer relations with strangers and with teachers of different subjects than could have been expected by chance. Thus, according to the evidence, previous acquaintanceship and professional homophily were significant constraints to the creation of e-mail relations between teachers.

6.4.2. Couple properties and link stability.

The degree of association between previous acquaintanceship and professional homophily and the stability of the 101 links created in P1 was analysed using statistical techniques. The stability of the 20 links created in P2 could not be analysed for lack of a third point of measurement.

The main result was that neither previous acquaintanceship nor professional homophily was associated with link stability (statistical data for all tests are presented in Annex 6, Section 4).

6.5. Network dynamics.

Researchers have emphasised since the 1970's the importance of analysing the dynamics of networks, that is how communication roles and link properties change over time, instead of relying on static 'pictures' of communication networks at single points in time (Stern, 1979, Rogers and Kincaid, 1981, p. 313).

As described before, data were collected on network activity during two periods of time: P1 (August to December 1996) and P2 (February to May 1997). This section presents the main findings of the comparative analysis of the state of the network at the end of each period (statistical data for all tests are presented in Annex 6, Section 5). The results were as follows:

- the rate of link creation strongly decreased over time. In the first, 20-week, period, 3.6% (n= 101) of the 2775 possible relations were established, an average of 0.18% per week; in the second, 17-week, period, 0.75% (n=20) of the 2674 links that had not been created in P1 were established, an average of 0.04% per week. In other words, the rate of link creation declined by almost 80% (from 0.18% per week to 0.04 per week);
- a majority of the relations that started in P1 became null in P2. The number of isolates increased from 28 to 47 from P1 to P2; those relations which continued significantly decreased their intensity;
- *professional homophily* was associated with link creation in P1 but not in P2. This suggests that the constraining effect of professional homophily on link creation may 'fade' over time (the degree of association between *previous acquaintanceship* and link formation during P2 could not be established and compared with P1 because it was not certain that those teachers who were not acquainted in August 1996 had not met by February 1997).

6.6. Answering research question II: the development of e-mail relations.

Research question II asked:

“To what extent do teachers using electronic mail develop collegial relations and what are the main structural properties of those relations?”

To answer this question, traffic data were analysed as discussed in the previous sections. The following sections interpret the relevant findings and discuss them in relation to the research literature.

6.6.1. The relational behaviour of the teachers.

According to the evidence obtained in this stage of the research, a majority of the teachers used the system to maintain relations with their colleagues (65.3% of the 75 teachers maintained at least one relation and 34.7% were 'isolates' during the period of study). It is difficult to compare this result with prior research since the evidence is scarce in the literature on the communication roles of teachers. According to Rohland (1985, p. 2): 'few researchers have studied communication roles ... and none are available which focus upon schools'.

There were large disparities in the number of relations established per teacher. Most teachers established none or very few relations while a few built relatively large 'personal networks'. These results are compatible with most published communication research and with the findings reported in the previous chapter (Rice and Case, 1983, p. 136, Steinfield, 1983, p. 52, Broholm, 1991, p. 160).

Overall, less than 5% of the 2775 pairs of teachers established e-mail links in the 37 weeks of the study.

6.6.2. Couple properties and the creation and development of links.

6.6.2.1. Previous acquaintanceship.

One of the aims of this stage of the research was to determine the extent to which teachers used e-mail to create 'new' relations (i.e. relations with colleagues they did not know FTF before starting to use e-mail). As discussed in the previous chapter, this is an important issue because reluctance to communicate with strangers has been shown to be one of the main barriers to the development of collegiality.

According to the evidence, the teachers used e-mail significantly more to establish e-mail relations with acquaintances than with strangers. This finding gives support to Crook's (1985) theoretical speculation that e-mail links might reproduce existing relations rather than support the creation of new ones and is compatible with prior CMC research in educational contexts. Of 19 projects reviewed as part of the Teachnet investigation, previous acquaintanceship was found to restrict communication in a third (BCTN, SRN, LABNET, LINK, PENNEST, TeleNex). It is also consistent with results from research carried out in industrial and university contexts (Kerr and Hiltz, 1982, Hiltz, 1984, Rice and Love, 1987, McCormick and McCormick, 1992). Carley and Wendt's (1991, p. 435) conclusion may be shared: '(electronic mail) does not stimulate new relationships ... (e-mail) will probably serve to enhance the impact of (existing) ties ...'.

Thus, although e-mail facilitates *public* contacts with strangers (as discussed in Chapter 5, people seem less reluctant to communicate with strangers publicly than privately), most of these contacts do not seem to lead to the creation of relations. This conclusion suggests that if one's aim is to foster new relations, it should be important to help people meet FTF before they start using electronic mail. This is further discussed in Chapter 11.

An interesting result was that 'new' relations, although less likely to be created, were as stable as those established with acquaintances. In other words, once relations were created, their stability was not significantly affected by whether or not the couple knew each other before starting to exchange messages. As 'new' relations involved teachers of different schools, this result suggests that the sustainability of e-mail relations might not significantly depend on physical proximity.

6.6.2.2. Professional homophily.

As discussed before, cross-subject relations, as 'weak ties', may be of special importance for the diffusion of innovations in processes of educational change (Granovetter, 1973). Thus, it was also important to investigate the extent to which e-mail would support the development of cross-subject collegial relations.

It was found that teachers were significantly more inclined to maintain e-mail relations with colleagues of the same subject than with those of other subjects. This result is consistent with prior CMC research carried out in schools (Castle et al, 1991, Broholm, 1991, p. 175, Collis, Veen and Devries, 1993). It contradicts findings from CMC research carried out in industrial contexts which found evidence of 'multidisciplinary activity' (Bikson and Eveland, 1990). As discussed in Chapter 10, such discrepancies may be related to the differences in the nature of the tasks and the organization of work between industrial contexts (usually hierarchical and with strongly interdependent tasks where collaboration is often vital and in some cases mandated) and schools (Lortie, 1975, Pellegrin, 1976, p. 368, Little,

1990, p. 520, Zarn, 1992). In sum, the evidence suggests that, in circumstances comparable to Teachnet's, e-mail may support the development of significantly fewer cross-subject than within-subject relations.

Professional homophily was not associated with the stability of links. These findings suggest that a shared professional interest (such as teaching the same subject) might facilitate the *creation* of e-mail relations but may not influence their *development*. In other words, within-subject relations may be more likely to be created but not necessarily more durable in the long term than *cross-subject* relations.

6.6.3. Dynamics of the development of collegial relations.

As discussed below, the evidence suggests that teachers using e-mail may rapidly establish a network of collegial e-mail relations involving a majority of them (about two thirds of the 75 teachers maintained at least one relation). However, several findings suggest that this network might be of low stability.

First, a large majority of the 101 links created during the first period of study (76.2%) were not active in the second period (i.e. they were unstable).

Second, link creation slowed down over time. The rate of link creation (i.e. the number of links created per week divided by the number that had not yet been created) decreased by almost 80% from P1 to P2.

Third, over time, the number of links created may be lower than the number of links *dropped*, possibly leading to higher numbers of 'isolates'. The number of links created in P2 (n=20) did not compensate for the number of links created in P1 that become null in P2 (n= 77). And the number of isolates jumped 68% (from 28 to 47) from P1 to P2.

In sum, the picture portrayed by the overall evidence is one of an initial 'big bang' period, where a large share of the teachers create e-mail relations (although the number of relations they create may vary widely as discussed before). After that initial, 'expansive' period, most relations are dropped (and many teachers may become 'isolates') and link creation seems to slow down significantly. Although more research is needed to determine the patterns of stability over longer periods (the Teachnet research covered 37 weeks), these results suggest that in circumstances comparable to Teachnet's, only a relatively reduced 'core' of users and relations may remain active in the long run.

An implication of these results is that those couples that do not establish relations in the initial period may remain unconnected in the long run (in other words, that the non-cumulative likelihood that a relation may be created may diminish over time). A large majority (83.5%) of the 121 links were established in the first twenty weeks. This result is compatible with Bikson and Eveland's (1990, p. 274) conclusion that e-mail communication patterns seem to stabilize early on. Thus, educational planners interested in using e-mail to foster the development of collegial relations should pay special attention to those 'launching periods' which seem to shape the long term impact of the system on collegial relations. The literature reports different strategies to promote early e-mail use such as concentrating technical support or promoting FTF meetings between people who are not acquainted with each other.

Another implication is that users with few links may be more likely to be excluded from the network of collegial relations over time rather than to strengthen their connection with the community. Network administrators should therefore pay special attention to such users (called ‘peripherals’ in the communication literature) as a population ‘at risk’ of being excluded from the network of collegial relations. This result is compatible with Rice’s (1982) conclusion from his research into the use of a bulletin board that there was a strong tendency over time towards the isolate role.

The significant reduction in connectedness from one period to the next may reflect teachers’ willingness to use e-mail (since it facilitates the logistics of communication) in order to engage in tentative exchanges with a relatively large number of colleagues they might consider potentially valuable collegial partners. After a period of time, they may decide which of these relations are worth pursuing and interrupt the rest. This interpretation is consistent with Riel’s (1992) observation that in many CMC educational projects, teachers engage in initial tentative, mostly social exchanges with each other. Most of these initial exchanges according to the author do not lead to regular contact.

6.7. Summary.

This research found that although a majority of the teachers used electronic mail to maintain relations with their colleagues during the period of study, most of them maintained very few. Overall, less than 5% of the couples created e-mail relations and most of those relations were weak and not sustained. Link creation significantly diminished over time, with teachers creating in the second period of study fewer links than the number they interrupted. The overall evidence suggests that in a community of school teachers using e-mail, only a small number of relations among a limited number of highly motivated users may remain active in the long run.

E-mail links largely reproduced existing (FTF) relations. This finding implies that teachers may use e-mail more for strengthening than for expanding their collegial networks (i.e. those colleagues with whom they communicate regularly).

The teachers created significantly more relations with subject colleagues than with teachers of other subjects. This finding suggests that, in circumstances comparable to Teachnet’s, the potential of e-mail for supporting multidisciplinary interactions and collaboration may be limited.

Neither previous acquaintanceship nor professional homophily affected the *stability* of the links established between teachers. It is not possible to compare this finding with prior research since no investigation could be located in the literature looking at the stability of *e-mail* relations between teachers. In other words, although ‘new’ and cross-subject relations were less likely to be established, they were as likely to be continued over time as relations with acquaintances or subject colleagues .

CHAPTER 7

Communication content

7.1. Introduction.

The last chapter discussed the *structure* of the communication network established by the 75 teachers using electronic mail. Traffic data were analysed to determine the communication behaviour of the teachers based on the number of messages they sent, when they sent them and to whom. Results were used to establish which pairs of teachers created electronic relations and the main structural properties of those relations.

Research on collegiality highlights the importance of investigating the *content* of collegial relations in addition to their structural properties. As reviewed in Chapter 1, a number of findings show that in innovative schools, interactions between teachers are highly focused on teaching practice as opposed to, for example, social talk, classroom stories or gossip about colleagues (Bishop, 1977, Little, 1982, Rosenholtz, 1985, Huberman, 1993, Ponticell, 1995). Furthermore, collegiality researchers have argued that high levels of collegiality (in terms of the amount of communication exchanged) with a low degree of professional content may have a *negative* impact on processes of educational change and professional improvement (Hargreaves, 1984, Little, 1990, p. 509). Thus, collegiality research suggests that the *content* of collegial interactions must be analysed to account for the impact of collegiality on teaching practice and professional development.

Communication theorists argue that communication content may be analysed in terms of the *topics* people address in their messages¹⁷ and the *functions* (e.g. seeking information, requesting advice, sharing personal experience, transferring materials) *they* seek to perform with those messages (Keenan and Schieffelin, 1976, O'Keefe and Delia, 1982, Murray, 1985, Stohl and Redding, 1987, Beals, 1990). This chapter is concerned with the *topics* addressed by the teachers in their e-mails.

Network theory argues that, in addition to 'external' or 'structural' properties, links have 'internal', content-related properties that are important for understanding communication behaviour. One of the key 'internal' properties of communication links is their 'multiplexity', a measure of the diversity of their content. Relations may involve different types of content. For example, in friendship or family links, social and personal content may predominate, while in formal, professional links, content may be mostly task-oriented. In most human relations, more than one type of content is exchanged (even in highly hierarchical, formal relationships a modicum of social talk is exchanged). *Multiplexity* has been highlighted as an important property because it has been found to be strongly associated with *stability* (Boissevain, 1974, Rogers and Kincaid, 1981, Wellman, Salaff et al, 1996)

Within this framework, the content of a sample of the messages sent in the period of study was analysed with the following purposes:

¹⁷ The term 'message' should not be understood here as 'electronic message'. The term is used in the general sense used in human communication research. Stohl and Redding (1987, p. 452) define 'message' as 'An identifiable unit of oral or written discourse, emitted in a context leading one or more observers to believe that, in all probability, the utterance is related to some sort of conscious intent on the part of the message sender.'

- a) to determine the main topics addressed by the teachers in their messages;
- b) to quantify the absolute and relative amounts of communication per topic;
- c) to establish the ‘multiplexity’ of the links created between the teachers; and
- d) to examine the influence of the properties of couples (i.e. previous acquaintanceship and professional homophily) on the content of links (i.e. on the topics addressed and on multiplexity).

Results are used to answer research question III. All tables and statistical data are given in Annex 7.

7.2. Categories of topics.

As discussed in the fourth chapter, a set of 20 categories was developed inductively from the data to account for the different topics addressed by the teachers in their e-mails. These 20 categories were grouped in three main families (i.e. ‘Non-professional’, ‘Professional Life’ and ‘Teaching’) which reflect the most relevant cleavages in topic content highlighted by the literature.

The table below lists the 20 categories for coding topics (labelled T1, T2, ... ,T20), the three main families (‘Non-professional’, ‘Professional Life’ and ‘Teaching’) and the six subfamilies (‘Social Personal’, ‘Other’, ‘Job and Context’, ‘Teacher Production and Development’, ‘Pedagogy’ and ‘Teaching Practice’).

Categories of topics.

Family 1: Non-professional
Subfamily 1: Social Personal
• T1 - Social Personal
Subfamily 2: Other
• T2 – General Interest
• T3 – CMC and Teachnet Project
• T4 – Miscellaneous
Family 2: Professional Life
Subfamily 3: Job and Context
• T5 – Job and Career
• T6 – Students
• T7 – Colleagues, Collegiality and Professional Contacts
• T8 – Educational System
Subfamily 4: Teacher Production and Development
• T9 – Teacher Production
• T10 – Professional Plans and Projects
• T11 – Teacher Development Events
• T12 – Teacher Education
Family 3: Teaching
Subfamily 5: Pedagogy
• T13 – Educational Theory and Opinions about Learning
• T14 – Teaching Philosophy and Teacher Attitudes
• T15 - Evaluation
• T16 - Syllabus
Subfamily 6: Teaching Practice
• T17 – Teaching Materials, Scientific Info and Bibliography
• T18 – Teaching Approach
• T19 – Teaching Activity or Project with Students
• T20 – Course Planning and Development

Transcripts of messages are used below to illustrate the nature of the content assigned to the main categories. A more complete set of examples, illustrating all 20 categories is included in Annex 7, Section 1. The translation attempted to retain the tone, style, terminology, and punctuation used in the original Spanish language version of the message, even when these are grammatically incorrect (in some cases syntax and grammar resemble more oral than written communication as is commonplace in electronic mail). Whenever a message referred to someone by name, a fictitious name was assigned in the translation to preserve the anonymity of all persons involved.

The 'Non-professional' family categorises e-mail content unrelated to teaching and schools. The largest category within this family (i.e. the one including more words) is Social Personal, which is devoted to the personal life of the users and their families. Also included in this family are the General Interest, and CMC and Teachnet Project categories. The former refers to conversations about matters of public interest such as politics or history. The latter refers to issues related to electronic mail in general or to the Teachnet project, especially requests for and provisions of technical advice about the use of the computer network.

(T1 Social Personal) "How did Bobby spend his birthday? Eddie had his birthday yesterday too."

(T1 Social Personal) "So Jackie. Are we going out to celebrate New Year's eve this year? I don't think it's worth it, do you? Things aren't going so fantastic that we can pretend nothing's wrong and go out, right?"

'Professional Life' categorises communication that refers to the profession but not specifically to teaching or pedagogy. This category is divided into two main subfamilies: Job and Context, and Teacher Production and Development. Job and Context categorises communication about jobs (e.g. salaries, course assignments, time tables), students (e.g. student behaviour), colleagues (e.g. promotions, attitudes towards co-operation and sharing) and the educational system in general (e.g. criticism of authorities, designation procedures). Teacher Production and Development includes Teacher Production (e.g. books, lesson sheets), Professional Plans (e.g. enrolment in a Master's programme), Teacher Development Events (e.g. in-service courses, conferences) and Teacher Education (e.g. content of initial teacher education).

(T6 Students) "Regarding your students of the Charlemagne school, I will later give you more detailed impressions of each one if you want. It's a very heterogeneous group, which this year added 2 or 3 new students ... You have very good kids and others that are troublesome. But very good things can be accomplished with them. I would like to talk it over with you."

(T8 Educational System) "Hello. I wanted to ask you what ought to be in your view the immediate strategies to be implemented in our country to bring us to the same level as other countries with respect to education in Mathematics."

(T9 Teacher Production) "I wanted to let you know that the collection of problems for the first three years of secondary school that me and my colleagues have produced is now ready. It consists of 171 problems with their corresponding comments and a separate set of solutions. It is available to you in case you want to 'check it out'."

(T10 Professional Plans and Projects) “I found out yesterday through Nancy, the psychologist, chatting in the staff room that you are travelling to Brazil for a Maths workshop. What is it? Where are you going? What will you be doing? Why didn’t you say anything? I’m always in limbo. When do you leave? Who else is going? Greetings. See you later. Patricia the uninformed.”

(T11 Teacher Development Events) “On Nov 5 and 8 an Argentinean lecturer is coming to give two conferences on Mathematics teaching at 8:30 AM.”

The third family, ‘Teaching’, focuses on pedagogy and teaching practice. The Pedagogy subfamily of categories refers to discussions about teaching and learning including academic or personal theories of learning and views about teacher attitudes. Teaching Practice refers to concrete, specific situations and issues. This includes exchanging information and opinions about teaching materials (e.g. books, exercises, educational software) and approaches to teaching, coordination and implementation of teaching activities, and projects with students and course planning.

(T13 Educational Theory) “What you assert is correct regarding mediations, from a cognitive point of view, I think the explanation can be understood from several points of view: as you know for Piaget one of the basic cognitive functions is classification, the children classify first within identical categories, which is later applied in arithmetic operations, first they calculate $4 + 4$ or $3 + 3$ then $3 + 5$.”

(T15 Evaluation) “... I realise that I have been very wrong in attempting to evaluate thinking processes with tests for my poor students. A process is longitudinal and cannot be evaluated from a cross section. That’s why I always remember your words or misgivings about how we manage to evaluate aptitudes and attitudes.”

(T17 Teaching Materials, Scientific Info and Bibliography) “There is a specific book on what you need, the author is Matila Gica (I don’t know how to spell it). I don’t have it, I know M. Williams has it, you can ask her details about the author etc ... Hope this helps. Pat”

(T18 Teaching Approach) “We start with movement, for example we tell them to draw the letter L (double) and later repeat it somewhere else on the page. From there we deduce the movement, properties, vector, etc. We also define parallelograms and demonstrate their properties through movement. We try to stress constructions with ruler and compass. We review triangles again since that’s presented earlier, and we also ask that they move the triangle notable points. Sometimes we have done free movement projects on figures and have exhibited them. I hope this short scheme is useful to you”.

(T19 Teaching Activity) “I was told that you have already presented the potato problem in the first year class; I am sorry because until now our students don’t know the pair of coordinated axes. So, what will happen? You will have to explain to them a topic that is not in *your* subject. Or what will happen, is that they will consult *me*. I thought that we were going to *coordinate* an activity that would take place during our modules, for that reason, I expressed enthusiasm; this way, I don’t think it will be as useful, from the mathematical point of view, of course.”

(T20 Course Planning) “I already finished spatial geometry. I even assigned the construction of the 5 regular polyhedrons to a group of students, find out who Euler was and research Euler’s relation to polyhedrons. I already started with the equation for a straight line and I am on the parallelism condition. I had honestly forgotten about financial maths. But I will leave it for the end, for the last few weeks when they don’t want to see anything else.”

7.3. The sample.

The sample consisted of 1356 private and public messages. The private set included all the private messages exchanged in the 50 stable and unstable relations established among the 20 stable participants (n= 1063) and the public set included all the public messages sent by the same 20 teachers (n= 293) during the period of study.

It should be stressed that while Chapters 5 and 6 discussed the communication behaviour of the 75 teachers, Chapters 7 and 8 focus on the communication behaviour of a more reduced ‘core’ of highly committed users: the 20 teachers who maintained at least one stable relation or ‘stable participants’. Sampling criteria are discussed in detail in Chapter 4.

7.4. Definitions.

As discussed in Chapter 4, the first step of the coding process was to divide each message into ‘quotations’ (i.e. segments of text addressing a single topic). No segment of text could be included in more than one quotation. Secondly, each quotation was assigned to one and only one of the 20 categories. As the length of the quotations showed strong variations (from a few words to dozens of lines), it was decided that the number of *quotations* per category could misrepresent the actual share of content of each category. Thus, it was decided to weight each quotation by the number of words it contained. The rationale for this decision is discussed in Chapter 4. In sum, the amount of communication assigned to each of the 20 categories was computed as the total number of *words* per category.

As discussed before, network theorists define link ‘multiplexity’ as the degree of diversity in content. In this research ‘multiplexity’ measured the number of *families* that were addressed in a link (i.e. Non-professional, Professional Life and Teaching). For example, if a pair of teachers wrote to each other only about teaching issues (meaning that all the words contained in the messages of the link were assigned to categories included in the ‘Teaching’ family) the value of multiplexity would be ‘1’ for that link. If they wrote only about non-professional issues its value would also be ‘1’. If the pair wrote to each other about non-professional issues and about teaching the value of ‘multiplexity’ would be ‘2’.

This definition is consistent with the collegiality literature, which highlights the importance of distinguishing three main families of topics in teacher communication: personal and other non-professional issues, professional matters not related to teaching or pedagogy, and pedagogy and teaching practice. Collegiality researchers argue that distinguishing between these families of topics is important to account for the differential impact of collegial interactions on educational change and professional development (House and Lapan, 1978, Little, 1982, 1990, Schwartz, Hollingsworth and Izsac, 1987, Vonk and Shras, 1987, Ponticell, 1995). This is discussed in greater detail in Chapter 4.

In sum, the value of ‘multiplexity’ for each link was equal to the number of families that were addressed in that link. The range of values for multiplexity was: 0, 1, 2 or 3. The zero

value may seem odd, but it is logically consistent and one link had a multiplexity value of 0, meaning that the two teachers failed to send at least one message *to each other* addressing the same category (for example, one teacher sent only messages about students while the other only wrote with gossip about colleagues). Links with a multiplexity value of ‘1’ are called ‘uniplex’. A computer program was used to determine the value of multiplexity for each of the 50 links. Criteria for determining the value of multiplexity are detailed in Annex 7, Section 2.

The literature provides little guidance in terms of quantitative analysis of multiplexity, especially in CMC research (Rogers and Kincaid, 1981, chapter 5) but it was felt that this definition was adequate to help answer the research question, compatible with the theoretical underpinnings of this concept which are discussed in the review of the literature, and consistent with the definition of relation used in the previous chapter (which establishes that reciprocity was required for a pair to establish a relation).

7.5. Content of private communication.

This section analyses the content of private communication based on the content of the 1063 messages included in the 50 stable and unstable links created among the 20 stable participants.

First, the proportion of each link’s content devoted to each of the families of categories, subfamilies and topics is analysed. Second, the ‘multiplexity’ of links is discussed. Finally, the existence of significant associations between previous acquaintanceship and professional homophily, and the content of the links established is examined.

7.5.1. Content of links.

7.5.1.1. Topics addressed in the 50 links.

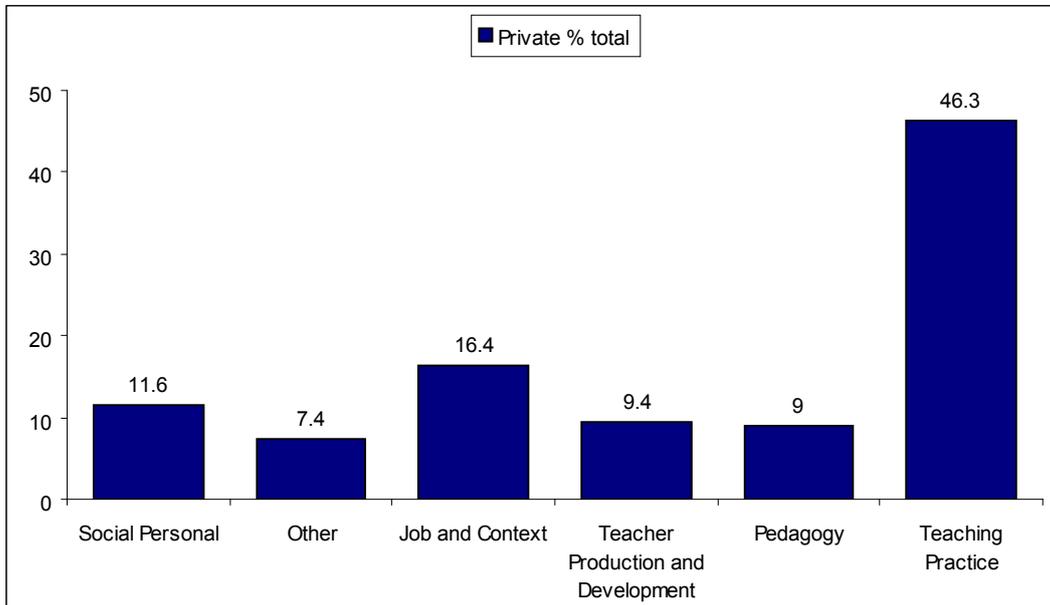
A total of 116 688 words were sent by the 20 teachers in the 50 relations. This section discusses the shares of this total number of words that were assigned to each category. Results are aggregated at different levels to facilitate analysis and interpretation. The highest level of aggregation consists of the three main families of categories (i.e. Non-professional, Professional Life and Teaching). The second level consists of the six subfamilies (i.e. Social Personal, Other, Job and Context, Teacher Production and Development, Pedagogy and Teaching Practice).

The table below details the number of words per family. The main result is that more than half of the communication (55.3%) was included in the Teaching family. This is an important finding since collegiality researchers have found that for collegial relations to have an impact on professional development, exchanges must focus on issues directly related to teaching practice.

Number of words per family in private communication.

	NON-PROFESSIONAL. (T1–T4)	PROFESSIONAL LIFE. (T5–T12)	TEACHING. (T13–T20)
Sum	22 027	30 147	64 514
Percent	18.9 %	25.8 %	55.3 %

Looking at a finer breakdown, it was found that the Teaching Practice subfamily of categories contained almost half (46.3%) of the overall teacher private communication. The second largest was Job and Context (16.4%) and the third was Social Personal (11.6%). Excluding Other, the least used topic subfamily was Pedagogy (9%). Results are detailed in the following graph.



At the category level, Teaching Materials (T17) was the largest with 27.7% of the total number of words. General Interest (T2), Professional Plans (T10) and Course Planning (T20) were scarcely discussed privately by the teachers of the sample, each of them corresponding to approximately one percent of the total number of words. Tables with the number of words for each of the categories are given in Annex 7, Sections 3 and 5.

7.5.1.2. The multiplexity of the 50 links.

Average multiplexity was 2. A third of the links (34%, n=17) were ‘uniplex’, meaning that the pair had used the link to discuss matters related to only one of the three families of categories. Another third of the links had the highest multiplexity value of three, meaning that these links were used to communicate about multiple matters ranging from the social and personal to concrete teaching and pedagogical issues.

In each of the 17 uniplex links, by definition all words were assigned to one family of topics. As the table below shows, of the 17 uniplex links only one concentrated on Professional Life. The other 16 were split between Non-professional (n=9) and Teaching links (n=7).

	Non-professional	Professional Life.	Teaching.
Uniplex links (17).	9	1	7

In sum, although word totals for Professional Life were higher than for Non-professional (25.8% vs. 18.9%), almost no links concentrated *exclusively* on Professional Life. These results show that teachers did not create links just for the purpose of discussing Professional Life matters although multiplex links included relatively large amounts of content related to their professional lives.

7.5.2. Content and couple properties.

This section looks at the degree of association between previous acquaintanceship and professional homophily, and the content of links (i.e. distribution of words per category and multiplexity).

7.5.2.1. Topics addressed and couple properties.

The existence of significant differences in the distribution of words among families based on previous acquaintanceship and professional homophily was analysed using statistical techniques. The main results are summarised below (statistical data are reported in Annex 7, Section 4):

- the percentage of non-professional content among previously acquainted couples (23%) was much higher than among strangers (12%);
- couples teaching the same subject devoted a much larger proportion of communication to Professional Life topics than couples teaching different subjects (29% and 9% respectively); and
- couples teaching the same subject discussed topics related to teaching about as much as couples teaching different subjects.

7.5.2.2. Multiplexity and couple properties.

The degree of association between previous acquaintanceship and professional homophily and the multiplexity of links was analysed using statistical techniques (statistical data are reported in Annex 7, Section 4). The main result was that none of these couple properties was significantly associated with link multiplexity.

7.5.3. Content and stability.

7.5.3.1. Topics addressed and stability.

The literature suggests that the content of links may influence stability (Rogers and Kincaid, 1981, p. 322, Steinfield, 1983, p. 97, Gabarro, 1990, p. 93). The distributions of words per family of the 24 stable relations and the 26 unstable relations were compared to establish the existence of significant differences.

	Non-professional.	Professional Life.	Teaching.	Total.
Stable relations (24).	18177, 18% (19540)	26747, 26% (26743)	58588, 56% (57229)	103512
Unstable relations (26).	3850, 29% (2487)	3400, 26% (3404)	5926, 45% (7285)	13176

As the table above shows, stable relations contained significantly more teaching content than unstable relations (56% and 45% respectively). These differences were strongly significant (the Chi-square statistic was 1128 and $p=0$). This finding suggests that a heavier emphasis on task content may be associated with higher stability of teacher relations. In other words, teachers may value more (and hence be more inclined to pursue) those relations bringing them benefits of a *professional* nature. Corroborating evidence supporting this interpretation was obtained in the interview data and is discussed in Chapter 9.

7.5.3.2. **Multiplexity and stability.**

The relation between the multiplexity of links and their stability is an issue that has been highlighted in the literature as lacking research and of theoretical importance for understanding the development of human relations (Boissevain, 1974, Rogers and Kincaid, 1981, Garton et al, 1997).

The multiplexity distribution of the 24 stable relations was compared with the multiplexity distribution of the 26 unstable relations as shown in the table below. A test was carried out grouping the links as ‘uniplex’ (links with multiplexity values of 0 or 1) or ‘multiplex’ (links with multiplexity values of 2 or 3). As the Chi-square test statistic totalled 15.2 with one degree of freedom, with $p= 0.0001$, it was concluded that there was a statistically significant association between multiplexity and stability among these 50 relations. In other words, according to the evidence, multiplex relations were significantly more stable than uniplex ones. This is an important result, which adds to theory development in CMC research in the sense that it corroborates in the CMC realm a consistent finding of FTF communication research.

	Uniplex (expected).	Multiplex (expected).
Stable relations (24).	2 (8.6)	22 (15.4)
Unstable relations (26).	16 (9.4)	10 (16.6)

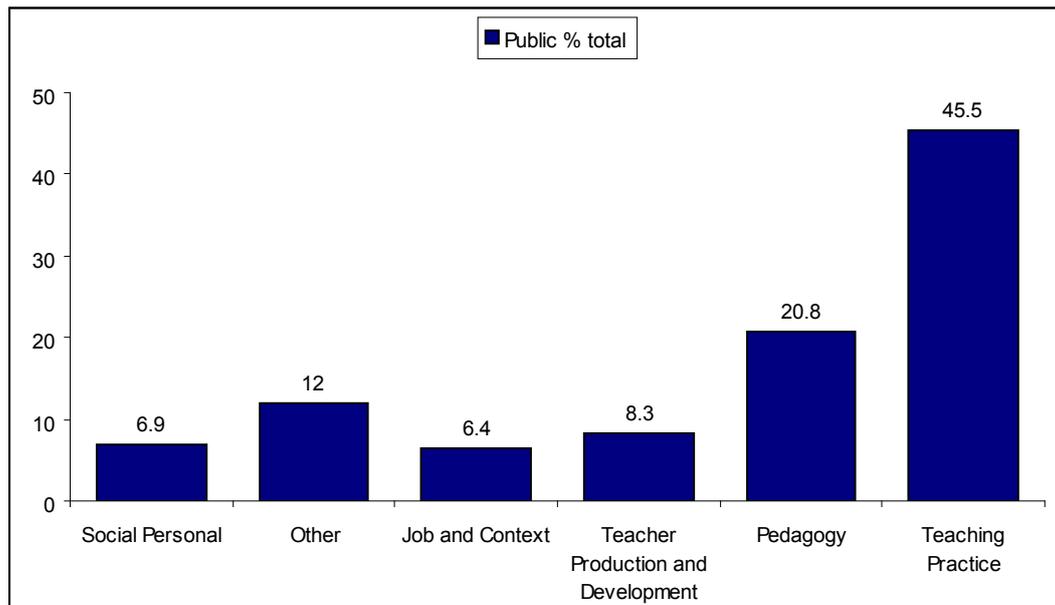
7.6. **Content of public communication.**

The content of the 293 public messages sent by the 20 stable participants in the period of study was analysed to determine the topics discussed publicly by the teachers. This section reports the main results.

As shown in the table below, almost 43 000 words were sent publicly by the 20 stable participants (compared with almost 120 000 private words in their 50 stable and unstable links). Two-thirds of public communication was related to teaching.

	Non-professional.	Professional Life.	Teaching.	Total.
Public messages (293).	8137, 19%	6334, 15%	28508, 66%	42 979

A breakdown per subfamily (see graph below) showed that, similarly to private communication, almost half (45.5%) of teachers’ public content was related to teaching practice.



At the category level, Teaching Materials (T17) was the largest category with more than a third of the total number of public words sent (37.4%). The category with fewest words assigned was Course Planning (T20), which none of the teachers mentioned in their public messages. This finding suggests that teachers consider their course planning a subject to be discussed (if at all) only in private. A table detailing the number of words of each of the 20 categories is enclosed in Annex 7, Section 5.

7.7. Comparing the content of public and private communication.

The distribution of words per family among the 293 public messages sent by the 20 stable participants and the distribution of words per family in the 1063 private messages contained in the 50 relations were compared to determine the existence of significant differences between the content of public and private communication. The main results are summarised below (statistical data and results by subfamily and category are detailed in Annex 7, Section 6):

- public messages contained significantly more Teaching content (66.3% and 55.3% respectively);
- private messages delved more into Professional Life than public messages (25.8% and 14.7% respectively);
- the share of Non-professional content was similar in public and private communication (19%); and
- teaching Materials (T17) was by far the largest category both in public and private content. Three of the five largest categories in private communication were also among the five largest in public communication: Teaching Materials (T17), Social Personal (T1) and CMC (T3). It was also found that three of the *least* used categories in public and private communication were the same in public and private communication: Teacher Education (T12), Professional Plans (T10) and Course Planning (T20).

7.8. Answering research question III: the topics addressed.

Research question III asked:

“What are the main topics addressed by teachers using electronic mail?”.

To answer this question, 1356 messages sent by the 20 stable participants during the period of study were analysed. The following sections interpret the relevant findings and discuss them in relation to the research literature.

7.8.1. Content of e-mail communication.

7.8.1.1. Topics addressed by the teachers in their e-mails.

One of the main conclusions of the content analysis is that a majority of communication (58.3%) was related to teaching. Not only was the ‘Teaching’ family the largest but also, within that family, concrete issues of teaching resources and techniques (as opposed to more general concerns about pedagogy) were a large majority. These are important findings since as discussed in Chapter 1, collegiality research has found that change and development are facilitated in collegial environments where teacher interactions concentrate on concrete ‘talk’ focusing on teaching practice (in contrast to more abstract pedagogic issues or non-task, career and social concerns).

However, although a majority of communication focused on teaching issues, it largely excluded direct discussions of the teachers’ own classrooms or of teachers pedagogical beliefs. The content of teachers’ e-mail exchanges may be conceived along a spectrum of increasing abstraction. At the most *concrete* extreme, teacher exchanges revolved around day-to-day, course and project management issues. At the most *abstract* extreme they involved general issues involving the educational system, pedagogy and learning theories. Between these two extremes and constituting a large majority of the use of electronic mail, exchanges focused on teachers’ professional ‘repertoire’, that is, the methods and tools that teachers ‘own’ and may use in their teaching practice. Based on these findings, one of the main conclusions of this investigation is that ‘repertoire development’ was, by far, the preferred purpose of e-mail communication among the 20 stable participants. In sum, this research suggests that, in circumstances comparable to those of Teachnet, a majority of teacher e-mail communication may be *task-oriented* and, more specifically, oriented towards ‘repertoire development’. However, the teachers’ reluctance to discuss specific incidents related to their own classrooms and to engage in more general discussions of learning and pedagogy, may limit the potential of the system to support ‘higher’ levels of professional development (i.e. changes involving deep-rooted opinions and views on teaching and pedagogy).

However, while a majority of content was task-oriented, a sizeable share of communication was not task-oriented (adding up the Non-professional and Professional Life families). Thus, Rice and Love’s (1987, p. 101) conclusion that ‘Even a professionally oriented CMC system involving users who (for the most part) do not know each other can support a reasonable amount of (non-task) content’ can be shared¹⁸. These results are also consistent with previous

¹⁸ It should be noted that the two studies are not fully comparable since Rice and Love’s content analysis is based on Bales’ (1950) Interaction Process Analysis coding scheme for FTF interactions. As the use of Bales’ IPA category system has been judged inadequate for analysing the content of CMC (Walther and Burgoon, 1992, p. 55, Walther, 1992, p. 64), it was not used in this research.

research of e-mail use by schoolteachers. Investigations of the TENET computer network in Texas, the PENNEST network in Pennsylvania and the UNITE computer network in Kansas, found that 18%, 24.8% and 23% of content respectively was of a social or personal nature. As Merseth (1991, p. 145) concluded: 'the technological nature of e-mail did not affect its ability to provide emotional support'.

7.8.1.2. Multiplexity of links.

Multiplexity has been highlighted as an important property of human relations since it has been found to be strongly related to the *stability* of relations (Boissevain, 1974). There have been calls in the literature for research capable of shedding light on the degree of multiplexity that should be expected of CMC relations (Feldman, 1987, Garton et al, 1997, p. 5).

Some researchers have theorised that CMC, as a low bandwidth medium, may be unable to support multiplex relations (Wellman et al, 1996, Kling, 1996, Kollock and Smith, 1996), hence leading to 'one-issue', specialised relations. Others have sustained that CMC's ability to 'broadcast' may counterbalance this effect leading over time to 'broader' (i.e. covering a wider range of topics and purposes) relations (Feldman, 1987, Wellman and Gulia, 1997). Little research has been published on this issue in the literature (Rogers and Kincaid, 1981, p. 321). As Garton et al (1997, p. 5) concluded from a recent review of the literature: 'As yet there has been little research into the extent to which specialised, on-line, single relations grow into multiplex ties over time'.

This research found that a large majority of the links was multiplex (almost two thirds of the links were multiplex and a third had the highest multiplexity value of '3'). This is important because multiplex relations have been found to be more stable than 'specialised' ones. This finding suggests that e-mail may have the potential to help people forge 'broad based' interpersonal relations capable of providing personal and moral support to teachers as well as professional resources.

7.8.2. Couple properties and content.

7.8.2.1. Couple properties and topics.

One of the aims of this stage of the research was to establish whether previous acquaintanceship and professional homophily were significantly associated in any way with link content.

It was found that the share of Non-professional content in links between strangers was much lower than in links between previously acquainted teachers (12% and 23% respectively). This finding contradicts results found in open, large electronic groups (see for example the review by Wellman et al, 1996) where total strangers have been found to discuss matters of a highly personal and intimate nature extensively. These results again point to the influence of the nature of the user community (especially of the motivations driving people to join networks) on communication behaviour. User communities sharing a professional identity, such as the one investigated in this project, may behave in different ways than large-scale mostly anonymous CMC communities where one of people's goals when joining is meeting new people. This is discussed in Chapter 10.

Couples teaching the same subject discussed topics related to teaching about as much as couples teaching different subjects (55% and 56% respectively). This is an interesting result pointing to the potential of electronic mail for supporting multidisciplinary collaborations. Thus, and as discussed in Chapter 6, although professional homophily was a constraint to the *creation* of links, it was not associated with the transceivers' disposition to communicate about teaching.

Teachers of the same subject devoted a much larger proportion of communication to Professional Life topics (29% vs. 9%) than teachers of different subjects. This finding is not surprising. Teachers of the same subject are usually involved in similar organisational arrangements and career paths and they are usually interested in the same development events.

7.8.2.2. Couple properties and multiplexity.

No significant associations were found between the multiplexity of links and the properties of couples (i.e. previous acquaintanceship and professional homophily). These results are compatible with the conclusions of the last chapter. As shown in that chapter, while some couple properties were associated with the *creation* of links, none of them had any significant effect on *stability*. This conclusion may be now extended as follows: the overall evidence suggests that couple properties influence the *creation* of links but do not seem to affect the external (e.g. stability) or internal (e.g. multiplexity) properties of those links.

7.8.3. Content and stability.

The literature suggests that the content of links may influence stability (Rogers and Kincaid, 1981, p. 322, Steinfield, 1983, p. 97, Gabarro, 1990, p. 93). The distributions of words per family of the 24 stable relations and the 26 unstable relations were compared to establish the existence of significant differences.

	Non-professional.	Professional Life.	Teaching.	Total.
Stable relations (24).	18177, 18% (19540)	26747, 26% (26743)	58588, 56% (57229)	103512
Unstable relations (26).	3850, 29% (2487)	3400, 26% (3404)	5926, 45% (7285)	13176

As the table above shows, the distribution of words per family was significantly different between stable and unstable relations: stable relations contained more teaching content (56% vs. 45%) while unstable relations delved more into non-professional topics (29% vs. 18%). These differences were strongly significant (the Chi-square statistic was 1128 and $p=0$).

The fact that stable relations contained significantly more teaching content than unstable relations suggests that a heavier emphasis on task content may be associated with higher stability when the user community has a common professional identity such as the Teachnet community. In other words, although non-teaching content may be appreciated, teachers' *professional* exchanges may be the overriding factor when deciding to continue e-mail relations. This is discussed in Chapter 10.

Communication researchers have theorised (although research evidence is scarce in the literature) that multiplexity may be positively related to stability (Boissevain, 1974, Rogers and Kincaid, 1981, p. 322, Garton et al, 1997, p. 5). In other words, that multiplex links may be more stable than uniplex links. This research found strong evidence of such association between multiplexity and stability: among the 24 *stable* relations, only 2 or 8.3% were uniplex, while of the 26 *unstable* relations, 16 or 61.5% were uniplex. This finding supports a long line of theoretical assumptions regarding the importance of multiplexity in the stability of human relations. Relations with a 'broader' basis are more likely to be continued over time while relations based on a single type of content or purpose may be more vulnerable to changes in context, personal interests or working conditions. This result suggests that strategies oriented towards increasing the multiplexity of communication between teachers may support the stability of collegial relations.

7.8.4. Public and private communication.

Two of the six subfamilies, Job and Context and Social Personal were mostly addressed in private (87% and 82% respectively). There was only one subfamily, Pedagogy, where close to half of the words were sent publicly (46%).

At the category level it was found that Course Planning (T20) was *only* discussed in private. As discussed before, teachers may have little motivation to use e-mail to communicate about their courses *at all*, let alone discuss them in *public*. Job and Career (T5), Students (T6), Colleagues (T7) and Teacher Production (T9) were also discussed almost exclusively in private. Job and Career (T5) was used to trade information about job openings that were intended to benefit only friends. Colleagues (T7) is a topic with a large share of 'gossiping' (informal, usually critical, sometimes intimate information about colleagues). Teacher Production (T9) involved mostly requests for support from trusted colleagues for the production of some teaching material or book. This may explain why teachers were reluctant to use public messages to address these topics. Conversely, Teacher Development Events (T11) was more discussed in public. This topic was mostly used for categorising the 'broadcasting' of information about in-service courses and seminars. This explains why it was mainly used in public messages.

The overall evidence suggests that while teachers may be reluctant to discuss private or sensitive concerns in public (if at all), when they seek to distribute information on a time sensitive issue (for example for announcing a coming conference), the logistical advantages of public communication may make it the type of communication of choice. This issue is further discussed in Chapter 8.

7.9. Summary.

One of the main findings was that a majority of e-mail communication (58.3%) was related to Teaching (as opposed to Non-professional or Professional Life topics). When looking at a finer breakdown of the Teaching family it was found that 78.9% of the content was related to Teaching Practice and 21.1% to Pedagogy. These are important findings since, as discussed in Chapter 1, collegiality research has found that change and development are facilitated in collegial environments where teacher interactions focus *on teaching practice*. Thus, the evidence obtained in this research suggests that e-mail may support those forms of collegiality that have been found to support professional development, at least among the core of most committed users of the system.

Within the Teaching Practice subfamily, it was found that Course Planning (T20) was the least addressed topic with 2.3% of the 73 435 words and Teaching Materials (T17) the largest with 65.9% (Teaching Materials was by far the largest of all 20 categories with 30.3% of the total number of words). This finding suggests that while teachers may use e-mail extensively to communicate about the ‘tools of the trade’ (i.e. Teaching Materials) they may not be ready to discuss the inner workings of their courses and classrooms nor to engage in discussions of learning and pedagogy. This may diminish the potential of e-mail to support changes in teachers’ deep-rooted professional beliefs and hence limit professional improvement to a more ‘instrumental’ level.

This research found that electronic mail supported the creation of multiplex relations (almost two thirds of the links were multiplex). This is an interesting finding because ‘bandwidth’ theorists have argued for some time that ‘low bandwidth’ media (such as e-mail) may not be capable of supporting the development of multiplex relations, hence leading to ‘one-issue’, specialised relations (Wellman et al, 1996, Kling, 1996, Kollock and Smith, 1996).

One of the aims of this stage of the research was to establish the extent to which there were significant differences in the content of links based on previous acquaintanceship and professional homophily. It was found that the share of non-professional content was much lower in links between strangers than in links between previously acquainted teachers. Regarding professional homophily, it was found that teachers of the same subject devoted a larger proportion of communication to Professional Life topics (29% vs. 9%) than teachers of different subjects. It was also found that same subject teachers discussed Teaching topics about as much as couples teaching different subjects. This is an interesting result pointing to the potential of electronic mail for supporting multidisciplinary collaborations. This is discussed in detail in Chapter 8.

The overall evidence discussed so far in Chapters 6 and 7 suggests that although couple properties may constrain the *creation* of links, they do not seem to shape how links are used once they are created.

There were relatively few differences in the content of private and public communication at the family level. Teaching was the largest family in both. At the subfamily level, besides Other, only Pedagogy represented a larger share in public than in private communication (20.9% and 9.1% respectively). At the category level it was found that Job and Career (T5), Students (T6), Colleagues (T7), Teacher Production (T9) and Course Planning (T20), were discussed almost exclusively in private. The main topics whose shares of public communication were larger than those of private communication were Teaching Materials (T17) (37.4% and 27.7% respectively), Teaching Philosophy (T14) (10.2% and 3.6% respectively) and Teacher Development Events (T11) (6.6% and 2.1%).

CHAPTER 8

Exchange of professional resources

8.1. Introduction.

Chapters 5 and 6 discussed the *structure* of the communication network created by the 75 teachers using electronic mail. Chapters 7 and 8 are concerned with the *content* of the messages exchanged between the teachers using electronic mail.

As discussed in the previous chapter, communication content may be analysed in terms of the *topics* people address in their messages and the *functions* they seek to perform with those messages (Keenan and Schieffelin, 1976, O’Keefe and Delia, 1982, Murray, 1985, Stohl and Redding, 1987, Beals, 1990). The previous chapter looked at the *topics* addressed by the teachers using electronic mail. This chapter analyses the *functions* that teachers sought to achieve with their e-mails. From the social exchange theoretical perspective, one of the key functions of collegial relations is to enable people to acquire and share ‘resources’ that may be important for carrying out their tasks, increasing professional satisfaction and supporting professional development (Burke and Bolf, 1986, Morrison, 1993, Infante, Rancer and Womack, 1993, p. 296, Kramer, Roberts and Turban, 1995).

Collegiality research suggests that not all teacher communication may be supportive of educational change and professional development. While the importance of social and personal exchanges has been well documented in the literature (Little, 1987, Nias, Southworth, and Yeomans, 1989), it is mainly the exchange of *professional* resources (i.e. resources of specific and direct relevance for teaching practice) that have been found to support educational change and teacher development (Little, 1982, Schwartz et al, 1987, Zahorik, 1987, Fullan, 1991). As Rosenholtz (1989, p. 137) concluded: ‘In collaborative schools ... Instead of seeking sympathy and social support from colleagues, teachers ... seek fresh (teaching) ideas’.

According to the literature, powerful logistical and cultural forces constrain professional exchange within organisations (Dewhirst, 1971, Hudson and Jablin, 1992). Research, carried out mainly in industry, suggests that CMC exchanges may be less constrained by such forces (Finholt, 1992, Rice, 1993, Sproull and Kiesler, 1994, p. 116). Within this framework, the content of the 1356 messages of Sample 1 was analysed in this stage of the research to determine:

- a) the extent to which the stable participants used e-mail to exchange professional resources;
- b) the types of professional resources they exchanged;
- c) whom they selected as ‘exchange partners’ (i.e. from whom they sought professional resources and to whom they contributed them);
- d) the type of communication they used (i.e. public or private) to conduct those exchanges; and
- e) the outcome of resource seeking actions (i.e. whether teachers’ requests were replied to by their colleagues).

Results were used to answer research question IV.

8.2. Analysis of message content.

As discussed in Chapter 4, content analysis requires defining: a) the variables to be ‘categorised’, b) the categories for each variable and c) the ‘unit of analysis’ (i.e. the unit of content to be assigned to each category). The following sections discuss these definitions as well as the coding rules and criteria.

8.2.1. Unit of analysis.

As discussed in Chapter 4, the ‘exchange act’ (segment of message with a single exchange purpose such as ‘requesting’ or ‘providing’) was selected as the unit of analysis.

8.2.2. Variables and categories.

A number of theoretically meaningful variables were coded for each ‘exchange act’. These variables are listed in the table below. The theoretical justification for each of these variables and the categories used for coding them are discussed in the following sections.

Variables coded for each exchange act.
Intent.
Type of resource.
Type of communication.
Type of exchange partner (only for private acts).
Outcome (only for requests).

8.2.2.1. Intent.

Communication theorists argue that collegial exchange is driven by two different communication behaviours: *resource-seeking* and *resource-giving* (Stohl and Redding, 1987, p. 466, Hudson and Jablin, 1992, p. 1). The former refers to communication with the purpose of *acquiring* resources and the latter to communication with the purpose of *contributing* resources. According to the literature, this is an important distinction since communication research has shown that people’s attitudes towards *requesting* may differ markedly from their attitudes towards *sharing* (Kram and Isabella, 1985, Morrison, 1993). As Pallas and others (1991, p. 9) put it:

‘Receiving and sharing information are independent activities ... For example, teachers... may be more likely ... to share information with others than to receive it ... individuals may have more control over the sharing of information with others than over the receipt of information from others’.

Most of the research on resource exchange using CMC has so far concentrated on resource *seeking* with little attention paid to resource *giving* behaviour (Hudson and Jablin, 1992, Kramer et al, 1995). Thus, the intent of the ‘exchange act’ was defined as a variable with two main categories used for coding it: ‘requests’ and ‘contributions’.

Exchange acts whose purpose was to *prepare* or *facilitate* a resource transfer were considered 'functional equivalents' to the resource itself. Functional equivalents to the actual transfer of a resource using e-mail were for example: offering the resource, promising to deliver the resource or preparing for physical delivery of the resource. These criteria reflect the fact that e-mail is not always a suitable delivery mechanism for certain types of resource. For example, it is neither easy nor practical (it might not even be legal) for teachers to deliver a book over a computer network, while it is a highly cost effective mechanism for providing information or a personal opinion, for example. The view taken was that when the medium was used to commit the sender to provide the resource, coding these resources as 'functional equivalents' would fairly reflect teachers' communication *intent*.

Resources may be contributed spontaneously or as a result of receiving a request from a colleague. It was important to differentiate between these two communication purposes since exchange research has found that people perceive differently the costs and rewards of giving spontaneously and giving 'on demand' (Kram and Isabella, 1985, Morrison, 1993). Thus, the 'contribution' category was split into two: 'solicited contributions' and 'unsolicited contributions'.

Another category, 'coordination', was added once coding had started. The reason for this was that data analysis showed that teachers used some of their messages to coordinate and schedule physical meetings in connection to some planned exchange of professional resources. The view taken was that counting such messages into any of the previous categories would give a distorted account of the actual number of exchanges that took place (the coordination of a single meeting involved in some cases more than a dozen messages).

In summary, exchange acts were coded for intent into four different categories: 'requests', 'unsolicited contributions', 'solicited contributions' and 'coordination'.

8.2.2.2. Type of resource.

Most social exchange research has discussed the transfer of 'information' as an undifferentiated resource. However, in recent years, researchers have emphasised the need for richer descriptions of the types of resources exchanged by people, since it has been found that exchange behaviour is influenced by the nature of the resource that is being sought or provided (Stohl and Redding, 1987, Hudson and Jablin, 1992, p. 14, Kramer et al, 1995, p. 166). For example, teachers may be ready to share with colleagues the date of a conference but be more reluctant to share a personal opinion on how a colleague teaches the Pythagorean theorem.

In sum, two different issues were of interest to this research: a) the types of resources exchanged by the teachers using e-mail and b) the extent to which exchange behaviour differed based on the type of resource being sought or provided. Regarding the first issue, a set of 23 categories to describe the types of resources exchanged by the teachers was developed inductively from the data. The process of category development and a complete list of categories are presented below. To investigate the association between exchange behaviour and resource type, two overarching categories of types of resources were defined: 'products' and 'expertise'. These two overarching categories are discussed later in this section.

Category development consisted of an iterative process similar to the one used to develop the set of categories for topics. First, each exchange act was carefully read and a short descriptive summary was stored in the ATLAS database (two examples are presented below).

Message.

Summary.

<p>“Jackie ... I liked very much your idea of producing a brochure. In order to encourage group mingling, I think we could suggest to both groups that whoever wants to work in the production of the brochure should come forward. We could form a group of, say, 6 students, three from my 3rd year group and three from yours, who could work on the brochure.</p> <p>What do you think? If you agree, let me know, so that we get the brochure Production guidelines out and give them to the kids. OK? ”</p>	<p>Amar seeks Jackie’ s opinion on her idea of forming student groups for producing a brochure for the fair.</p>
<p>“I went to the fair and was very pleased. There were several students in charge of the stand (they felt it was theirs)... There were heaps of people putting the cube together and requesting their certificates (that was a good idea) ...</p> <p>To sum up, we achieved:</p> <ol style="list-style-type: none">1. Student participation2. Maths research3. Student ideas for the implementation of the stand4. Active participation of those who attended the fair5. A meaningful brochure to spread the word among teachers and those who wish to own a didactic game. <p>I think we should be pleased.”</p>	<p>Toch expresses her opinion to Amar on the achievements of the science fair project.</p>

Second, the entire set of descriptive summaries was read several times and a few initial tentative categories for coding resources were created. Resource descriptions were then considered one by one and assigned to one of those initial categories. Whenever a resource would not reasonably fit into any of the existing categories a new one would be created. When two categories seemed, in the light of the data, to reflect the same resource, they would be merged. Categories that were left with little or no assignments were discarded or merged with larger ones. For example, in the first stages, a ‘Lesson Material’ category was created to describe the exchange of lesson plans and other lesson-specific materials. Another ‘Computer Software’ category was created to describe the exchange of educational software and a third one named ‘Exercises’ was used to categorise those exchanges that were used to transfer exercises or solutions of exercises. At a later stage it was decided to merge these three categories into a new one called ‘Teaching Materials’ since this was the conceptually important resource and no theoretical or research interest was advanced by further subdivisions. This process was iterated until all categories were ‘saturated’, that is until all additional resources could reasonably fit into the categories thus developed.

The literature provided a general framework for category development. Little (1982) identified a set of ‘critical practices’ in processes of educational improvement, namely exchanges of: teaching materials, advice for teacher production, opinions on teaching approaches, educational theories and teaching philosophy, and information about opportunities for teacher development. Schwartz et al (1987, p. 53) concluded from their research on collegiality among maths teachers that they shared ‘teaching materials,

opinions, philosophies, knowledge, and teaching methods'. Zahorik (1987) found that teachers exchanged help about teaching materials, teaching activities, teaching approaches, lecturing techniques, evaluations, the objectives of education, student discipline and motivation, and learning difficulties.

This process led to the development of the 23 categories listed in the table below (a complete list of the categories used in the process of category development and how they were merged into the ones shown below can be found in Annex 8, Section 1).

Categories of professional resources exchanged.

INFORMATION.	MATERIALS.	OPINIONS.
Info on Bibliography and Teaching Materials.	Bibliography and Teaching Materials.	Opinions on Bibliography and Teaching Materials.
Info on Teaching Approach or Use of Teaching Materials.	Teaching Approach.	Opinions on Teaching Approach or Use of Teaching Materials.
	Scientific Data.	
Info on Teaching Project.	Materials for Teaching Project.	Opinion on Teaching Project.
Info on Course Development.		Opinion on Course Development.
Info on Students.		Opinion on Students.
		Opinion on Pedagogy and Teacher Attitudes.
		Opinion on Educational System.
Info on Syllabus.		Opinion on Syllabus.
Info on Teacher Development Event.		Opinion on Teacher Development Event.
Info on Teacher Production.	Teacher Production.	Opinion on Teacher Production.

As discussed above, this investigation sought not only to describe the types of resources exchanged by the teachers using e-mail but also to determine the extent to which exchange behaviour differed based on the type of resource being sought or provided. To study the latter it was important to define a limited number of theoretically meaningful overarching categories to further group the 23 shown above. These overarching categories had to reflect the key cleavages among professional resources discussed in the literature. There is no single, agreed taxonomy for classifying types of resources in the literature. Some of the main taxonomies are discussed in Chapter 3 and summarised below.

'Particularism'. Roloff (1981, p. 22) has argued that resources can be differentiated based on their degree of 'particularism', which he defines as the extent to which the value of the resource depends on the sender. For example, a teacher may value more (from a career point of view) a positive opinion on his teaching from the principal than from a colleague. Conversely, if we obtain a book from the library or from a colleague, the value of the resource itself remains the same (this is not to deny that we may psychologically appreciate more a book that is a present from a friend; the point is that the professional usefulness of the resource remains the same).

'Products' and 'expertise'. A major distinction people have been found to make is between 'objective' resources such as technical information, books or computer programs (called 'products', 'goods' or 'possessions' in the literature) and 'subjective' ones, drawn from experience and knowledge such as advice or opinions (called 'expertise' or 'abilities') (Roloff, 1981, p. 23, Feldman and March, 1981, Pfeffer, 1981, Constant et al, 1996).

'Evaluative' and 'descriptive' resources. Hudson and Jablin (1992, p. 15), building on work by Gioia and Sims (1986), have suggested that resources may be classified into two main categories: 'evaluative' and 'descriptive'. Evaluative messages are defined as 'all messages that contain ... an opinion or judgement ... Descriptive messages include all other statements'. Hudson and Jablin's categories largely overlap the 'product' (descriptive) and 'expertise' (evaluative) taxonomy. Research suggests that the perceived costs and rewards of exchanging *evaluative* resources may differ from the perceived costs and rewards of exchanging *descriptive* resources (Morrison, 1993, Constant, Sproull and Kiesler, 1996).

'Gifts' and 'commodities'. Kollock (1999, p. 221) distinguishes 'gifts' from 'commodities'. Gifts are usually exchanged within established relationships while self-interested independent actors may mostly exchange commodities (Bell, 1991).

From this literature, two overarching categories for 'type of resource' were drawn: 'products' and 'expertise'. The first refers to all 'descriptive' resources (e.g. information on conferences, exercises) and the second refers to resources that incorporate personal views of the sender such as opinions, recommendations or advice. The eight types of resource listed in the Information column and the five listed in the Materials column were assigned to the 'products' category. The ten types of resource listed under Opinion were assigned to the 'expertise' category.

'Expertise' resources are high in the particularism dimension (for example a teacher may trust more an opinion from a highly experienced colleague than from a beginning teacher) while 'products' are perceived as low in particularism (i.e. the professional usefulness of a computer programme is not dependent on who handed it to the receiver). 'Expertise' and 'products' could be viewed as 'gifts' and 'commodities' respectively. For example, a teacher may approach the closest (i.e. lowest cost) available colleague (among the ones who are expected to possess the resource) to obtain a 'product' such as a book. However, a teacher who needs 'expertise' (e.g. advice) on a teaching approach, may turn to his or her most trusted colleagues even if they are not the most easily reachable.

8.2.2.3. Type of communication.

According to the CMC literature discussed in Chapter 3, communication behaviour is subject to different constraints and incentives in the public and private realms. Educational researchers have called for more research into the differences between public and private collegial exchanges. As Zahorik (1987, p. 394) asked: '...are teachers more willing to

exchange information about their classroom behaviour in private one-to-one settings than in lunchrooms or other public places?'. Therefore, the variable type of communication (i.e. 'public' or 'private') was defined and used to discriminate between exchange acts carried out using public and private messages to better understand the forces shaping exchange behaviour.

8.2.2.4. Type of exchange partner.

The nature of the relationship between exchange partners (or 'couple properties') has also been found to affect exchange behaviour since the social costs of requesting from, or contributing to, some individuals may be lower than for others. Previous acquaintanceship and homophily have been identified in previous research as variables affecting exchange behaviour (O'Reilly, 1982, Watson, 1982, Morrison, 1993, Kramer et al, 1995).

From this literature and given the aims of the research, two variables were used to categorise the nature of the relationship between exchange partners: previous acquaintanceship ('yes' if the exchange partners were acquainted with each other at the time they started using Teachnet and 'no' otherwise) and professional homophily ('yes' if the exchange partners taught the same subject and 'no' otherwise).

8.2.2.5. Outcome of requests.

When an individual (the 'requester') sends a request to another, the receiver of the request may thereafter behave in two different ways from a communication point of view: a) he or she may 'ignore' the request or b) 'reply' to it¹⁹ (Gabarro, 1990). Research has found that lack of feedback may reduce people's willingness to use CMC (Johansen et al, 1979, Kerr and Hiltz, 1982, Tombaugh, 1984, Merseth, 1991, Chung, 1991). In other words, if people fail to obtain what they perceive as adequate responses to their requests (where both the *nature* of the reply and the *delay* in receiving it may be important) they may discontinue their use of the medium, at least for professional purposes.

CMC has been theorised as a medium where many requests may be left unanswered (or where intervals between requests and replies would be lengthier) since 'it is easier to ignore comments or questions than when communicating FTF' (Kerr and Hiltz, 1982, p. 145). Research on resource exchange *using CMC* has so far overlooked the outcomes of seeking (Stohl and Redding, 1987, p. 466, Morrison, 1993, p. 584). Consequently it was important to establish the number of replies received to each request and the delay in receiving the first reply.

Thus, the outcome of requests was analysed using the following variables: number of replies received and delay in obtaining the first reply. The first measures the number of receivers that sent at least one reply to the 'requester'. The second is computed as the number of days between the date of the request and the date the first reply is sent (it is not applicable if no replies are received).

¹⁹ As discussed in Chapter 4, this research focused on the e-mail communication exchanges between the teachers. From a general communication perspective, a message may be replied to using a different medium than was used to send it. For example, an e-mail may be replied to FTF or by telephone. However, based on the aims of the research, only *e-mail* replies were considered in this investigation.

8.2.2.6. Summary of variables and categories.

The following table summarises the variables and categories for coding each ‘exchange act’. Definitions and coding criteria are presented in the following section.

Variables categorised for each exchange act.	Categories for coding the variable.
Intent (of the exchange act).	Request, Unsolicited contribution, Solicited contribution, Coordination.
Type of resource.	23 categories.
Type of resource (only the two overarching ones).	‘Product’, ‘Expertise’.
Type of communication.	Public, Private.
Type of exchange partner (only for private exchange acts):	
Previous acquaintanceship.	Yes, No.
Professional homophily.	Yes, No.
Outcome (only for requests):	
Number of replies received.	‘0’ or ‘1’ for private requests. A number from ‘0’ to ‘19’ for public requests.
Delay in obtaining the first reply.	Number of days between the date the request was sent and the date the first reply was sent.

8.2.3. Definitions and coding criteria.

The following sections present the definitions for each variable and category. Transcripts of messages are included to better illustrate coding criteria. Whenever a message referred to someone by name, a fictitious name was assigned in the translation to preserve the anonymity of all persons involved. The English (translated) version is consistent in its name references, so if someone was referred to more than once, the same fictitious name was used in each instance. The translator strived to retain the tone, style, terminology, and punctuation used in the original Spanish language version of the message, to the extent of using syntax and grammar more closely resembling that of oral communication than formal written documents, as is commonplace in electronic mail. Coding and counting rules and criteria are discussed in detail in Annex 8, Section 2.

8.2.3.1. Exchange acts.

Exchange act. This is defined as any segment of text seeking to *obtain* a professional resource from a colleague, to *transfer* a professional resource to another teacher (either spontaneously or ‘on demand’) or to *coordinate* a FTF meeting related to a professional exchange.

It should be noted that only exchange acts where the resource sought or provided was of direct and concrete relevance and usefulness for teaching practice or professional development were counted. Exchanges of a social and personal nature were excluded along with exchanges related to teachers’ working lives but with no direct bearing on teaching practice or teacher development. The following examples illustrate the difference between professional resources and the others.

(Professional) “Please don’t forget to take the 4th year test with you as I will be setting it in one of the groups next week.”

(Professional) “A fellow physics teacher has put forward a wonderful exercise, which I suggested she put on the network (the problem was presented to her by her son, who every now and then brings back to Uruguay a gold medal won at some maths Olympiad).

As a week later she hasn’t put it on the network, and to me the problem was one of the really good ones (in the Analysis area, not Algebra, at last), I take the liberty to do it myself:

‘Prove that, except in the case of 2+3, the addition (‘a’) of two consecutive prime numbers admits at least three factors, different from 1 and ‘a’”.

(Non-professional) “If you know where to get disposable diapers at a good price pass it on.”

8.2.3.2. Intent of the exchange act.

Request. This is defined as any communication (message or fraction of a message) explicitly or implicitly seeking to obtain a professional resource.

“Do you think you might have some practical exercise on rational functions for the fourth grade that is unrelated to the area of a rectangle or to the Boyle-Marriott law? I need it for the student teacher and in the books there are practically no practical exercises.”

Unsolicited contribution: This is defined as any communication with the purpose of sharing or transferring spontaneously (i.e. not in response to a specific request) a professional resource or a functional equivalent.

“In case you like these kinds of problems, should a solution be found, if necessary with assistance, they often passionately search for a way to find them all in

THREE
+ TWO
=====
FIVE

(Especially if it involves the decoding of a message our spies intercepted from the enemy.)”

Solicited contribution: This is defined as any communication with the purpose of sharing or transferring a professional resource or a functional equivalent with the intention of fulfilling a specific request from a colleague. The examples of solicited contributions presented below include the corresponding request that the contribution intends to answer.

(Private request) “I need to know the date of publication of the book you lent me about scientific education.”

(Private solicited contribution; one day later). “I confirm from home, as the computer has been repaired. Proceedings from the colloquium ‘The objectives of a Scientific Education’, 28 and 29 April 1990, Palaiseau (with one ‘s’), (Ecole Polytechnique), organised by the Scientific Education Interest Group. (February 1991 edition).”

Coordination: This is defined as any communication whose function was to coordinate or schedule a meeting in connection to some planned exchange of professional resources.

“To be able to somewhat plan my time and the future agenda for the material I would appreciate a little information on how the heck we’re doing with the photocopying of the three EVAPM. I think on Wednesday, at school, I should receive back the Premiere level ... (at that point, we can meet and I can hand you a copy). Take care, regards and all the best.”

Requests and unsolicited contributions are called in this study ‘*active*’ acts. Solicited contributions are called ‘*reactive*’ acts since they take place as a result of a previous act (i.e. a request) performed by another teacher. It is useful to distinguish ‘*active*’ from ‘*reactive*’ acts because, as discussed before, exchange research has found important differences between the two (for example, teachers have been found to be much more reluctant to share professional resources spontaneously than ‘on demand’).

8.2.3.3. Types of resources exchanged using electronic mail.

Once a category system is defined, the researcher must specify, for each category, the indicators that determine whether a given item falls within that category. This is crucial for the coders to produce reliable judgements (Holsti, 1981, p. 95). Definitions and examples are presented below. Coding criteria and examples for each of the 23 categories for type of resource are included in Annex 8, Section 2.3.

Information: the exchange consisted of facts or data such as the name of a book, the announcement that a certain book is now available in the school library, the outcome of using a new computer program in class, a progress report on a teaching project or the date of a conference.

(Public contribution, Info on Bibliography and Teaching Materials) “Beginning 7 or 8 years ago, in France, the Public School Math Teachers Association (APMEP), proposes national tests to evaluate the effectiveness of different programs in the subject, leaving the decision of a group’s participation up to each teacher. Nowadays the population affected is in the order of 120 000 students per course. APMEP, under the name EVAPM, later publishes the tests, for each exercise or problem the percentage of correct solutions, and pertinent comments ... these publications on Seconde, Quatrieme and Sixieme-Cinquieme, fairly equivalent to our 4th, 2nd and 1st year of high school respectively, are now in Montevideo.”

(Private unsolicited contribution, Info on Course Development). “Hi Rose: ... Are you just now teaching cinematics? How or when do you plan to use sum of forces in cinematics? I started with Force, resilience, then displacement, velocity and acceleration. Before the holidays we worked some on the life and works of Galileo and Newton. July and August, Newton’s principles.”

(Private request, Info on Course Development) “I would like to know what topics you have already covered in second year.”

Materials: when the actual resource (e.g. an exercise, excerpts from a book or a full article) was contained in the message (as opposed to information or opinions *about* the resource) the exchange was assigned to one of the five Materials categories.

(Private solicited contribution, Bibliography and Teaching Materials) “Here are the problems:

An urn contains 10 balls numbered from 1 to 10. Three are drawn. What is the probability that the product of the numbers on the balls is a multiple of 8?

Using only a ruler determine the midway point of a segment. Discuss according to whether the length of the segment is greater, smaller or equal to the length of the segment.”

(Public unsolicited contribution, Teaching Approach) “I do not define at this level what a system of equations is, either. I simply state a problem that gives rise to two equations in two unknowns that are related and I say that when I have a set of two equations and I look for the intersection of the solutions, I have a system of equations.”

(Public request, Scientific data) “I heard yesterday that there is research being carried out on mosquitoes and their influence on the transmission of some diseases, as we know. The term ‘Vector’ appeared associated with this subject; apparently meaning transmitter. I would like to know if ‘our’ vector has an equivalent or similar meaning, or different. Do you know?”

Opinion: Exchanges carrying personal views of the sender such as opinions, recommendations or advice were assigned to one of the Opinion categories. These included for example bibliographic recommendations, evaluative comments on the usefulness of computer programs and advice on how to use an exercise to help explain a certain topic.

(Private unsolicited contribution, Opinions on Bibliography and Teaching Materials) “About the ‘cross’ problem ... I find it interesting because: a) very unlikely that they don’t finish successfully; b) it demands they search for strategies to attack it (discover what characteristics the number ‘intersection’ must have) c) it has more than one solution, which contributes to the destruction of the concept we often teach them that the solution must be unique; d) it ‘softens’ them as much in mental calculations (in the end, the tables), as in decomposition in sums..”

(Private unsolicited contribution, Opinion on Students) “About the second year class let me tell you two or three things: a) they are extremely noisy and disorderly, b) there is a good number of students with good potential and an enormous desire for very good grades, c) they are very anxious and they require the teacher’s personal attention, it doesn’t matter if he is giving help or an explanation to a classmate, d) there is a group of several chatty girls, spread out who generally interrupt the healthy development of the class...”

(Private unsolicited contribution, Opinion on syllabus) “... second degree EQUATIONS. Personally I think it’s a topic that makes no sense to address it in the curriculum for the first three years of secondary school with its current objectives...”

8.2.3.4. Type of communication used to perform the exchange act.

Two categories were used for coding the type of communication of exchange acts: ‘public’ and ‘private’. This was an automatic process. Exchange acts included in public messages were assigned to the ‘public’ category and exchange acts included in private messages were assigned to the ‘private’ category.

8.2.3.5. Type of exchange partner.

As discussed before, two variables were used for analysing the relationship between exchange partners: previous acquaintanceship and professional homophily. This process was carried out automatically based on the characteristics of the exchange partners. If the two were acquainted before starting to use Teachnet, ‘previous acquaintanceship’ was ‘yes’ and otherwise it was ‘no’. ‘Professional homophily’ was ‘yes’ if both teachers taught the same subject and otherwise it was ‘no’.

8.2.3.6. Outcome of requests.

The outcome of requests was analysed using two variables: number of replies received and delay in obtaining the first reply.

Given a request R sent by teacher T to receivers T_1, T_2, \dots, T_N , the number of replies received was computed as the number of receivers who sent T at least one reply to request R. In the case of private requests the value of this variable was therefore ‘0’ or ‘1’ while for public requests the value could be any number from 0 to N where N is the number of stable participants within the recipients. For example the ALL public address includes 75 recipients but only the 20 stable participants in the sample are counted as potential ‘repliers’.

If a request R was *sent* on day D1 and the first reply was sent (not necessarily *received*) on day D2, the delay in obtaining the first reply was computed as the number of days between D1 and D2.

8.3. Results of the exchange analysis.

8.3.1. Messages used to exchange professional resources.

An important share of e-mail use was for exchanging professional resources. According to the data, almost half (48.4%, n= 656) of the messages sent by the stable participants were used to participate in professional resource exchanges. The proportion was higher for private communication (49.3%) than for public communication (45.1%) but this difference was *not* statistically significant (see Annex 8, Section 3).

8.3.2. The resources exchanged by the teachers.

The table below presents the number of exchange acts assigned to each of the 23 categories. A table with additional quantitative information is included in Annex 8, Section 4.

	Information.	Materials.	Opinions.
1	Info on Bibliography and Teaching Materials (138).	Bibliography and Teaching Materials (201).	Opinion on Bibliography and Teaching Materials (99).
2	Info on Teaching Approach or Use of Teaching Materials (19).	Teaching Approach (29).	Opinion on Teaching Approach or Use of Teaching Materials or (68).
3		Scientific Data (26).	
4	Info on Teaching Project (20).	Material for Teaching Project (7).	Opinion on Teaching Project (30).
5	Info on Course Development (17).		Opinion on Course Development (2).
6	Info on Students (9).		Opinion on Students (8).
7			Opinion on Pedagogy and Teacher Attitudes (45).
8			Opinion on Educational System (27).
9	Info on Syllabus (7).		Opinion on Syllabus (14).
10	Info on Teacher Development Event (28).		Opinion on Teacher Development Event (10).
11	Info on Teacher Production (10).	Teacher Production (3).	Opinion on Teacher Production (18).
	(248)	(266)	(321)

Overall, 835 exchange acts (248 + 266 + 321) involving the transfer of professional resources were found in the 1356 messages of the sample (72 coordination acts were excluded from this count because by definition they do not involve professional resources, and five solicited contributions were excluded because the type of resource was unintelligible to the researcher and to the independent coder). Three-quarters (75.6%, n=635) were ‘active’ acts (i.e. requests or unsolicited contributions) and a quarter (24.4%, n= 205) ‘reactive’ acts (i.e. solicited contributions).

Teachers initiated exchange processes in order to seek or share ‘products’ (61.9%) significantly more than expected (50%). Of the 635 ‘active’ acts, 393 involved ‘products’ and 242 ‘expertise’. ‘Reactive’ acts were excluded from this count because they are *by definition* expected to involve the same of type of resource as the request that they respond to. Consequently, including them in this count would lead to overrepresentation of the types of resources involved in requests at the expense of the types of resources involved in spontaneous contributions.

The main professional use of the medium was to exchange teaching materials, bibliography, scientific data and teaching approaches as well as information and opinions about such resources (corresponding to rows 1 to 3 of the table above). Almost three-quarters (69.5%, $n= 580= 138+19+201+29+26+99+68$) of the 835 exchange acts involved these types of resources (grouped in Annex 8, Section 4 as 'Teaching Methods and Resources'). The largest single category was Bibliography and Teaching materials ($n= 201$).

The teachers also used Teachnet to exchange information, opinions and materials related to their courses, students and teaching projects (rows 4, 5 and 6). These uses accounted for slightly more than a tenth of all exchanges (11.1%, $n= 93= 20+17+9+7+30+2+8$). Most of these exchanges (grouped in Annex 8, Section 4 as 'Course and Project Management') were used to keep each other informed (mostly in private) about the progress of their courses and projects.

A similar share of teachers' exchanges (11.1%, $n= 93= 7+45+27+14$) was used to exchange resources related to more general and abstract educational matters (rows 7, 8 and 9). These resources included the organisation of the educational system and issues of pedagogy, learning theories and teacher attitudes. Virtually all these exchanges expressed opinions as opposed to information or materials. They are grouped in Annex 8, Section 4 as 'Pedagogy and Educational System'.

The rest of the exchanges (rows 10 and 11) involved two main issues: 'Teacher Development Events' and 'Teacher Production'. Exchanges assigned to the former were used to spread (mostly publicly) information on upcoming events (e.g. conferences, in service courses, seminars) and to share opinions on the usefulness of such events by some of the teachers who attended. The latter were mostly used to obtain help and feedback on professional projects such as writing books or compiling exercise banks.

8.3.3. Use of e-mail for the exchange of professional resources.

8.3.3.1. Intents, partners and type of communication.

Intents and type of communication of exchange acts.

The content analysis of the 1356 messages of the sample found that the 20 stable participants performed 912 exchange acts: 238 requests (26.1%), 397 unsolicited contributions (43.5%), 205 solicited contributions (22.5%) and 72 coordinations (7.9%).

Thus, the largest share of the exchange acts (43.5%) was used to contribute resources spontaneously. Adding spontaneous and requested contributions the total share of contributions amounted to two thirds of all exchange acts (66%, $n= 602$). In sum, the stable participants used the medium much more for contributing than for requesting resources (66% and 26.1% respectively). The average stable participant performed 30 contributions and 12 requests.

As the table below shows, most exchange acts were performed using private messages (81.5%, $n= 743$). Adding solicited and unsolicited contributions, there was relatively little difference between public and private communication: approximately two thirds were contributions (64.5% for private communication and 72.8% for public communication) and a quarter requests (26.2% for private communication and 25.4% for public communication). The main differences between public and private communication involved *solicited* contributions (97.1% were private) and coordination acts (95.8% were private).

	Private.	Public.	Total.
Requests.	195 (26.2%)	43 (25.4%)	238 (26.1%)
Unsolicited contributions.	280 (37.7%)	117 (69.2%)	397 (43.5%)
Solicited contributions.	199 (26.8%)	6 (3.6%)	205 (22.5%)
Coordinations.	69 (9.3%)	3 (1.8%)	72 (7.9%)
Total number of exchange acts.	743	169	912

Intents, partners and type of communication of ‘active’ acts.

As shown in the table below, three quarters of the 635 ‘active’ acts were private (74.8%, n= 475).

Among the 635 ‘active’ acts, contributions were also a significant majority (62.5% of the ‘active’ acts were spontaneous contributions and 37.5% were requests). The stable participants initiated significantly more exchange processes with the purpose of *sharing* resources than for *obtaining* them. This difference was larger for public messaging, with more than two thirds of messages (73.1%, n= 117) used for contributing resources to colleagues.

	Private.	Public.	Total.
Requests.	195 (41.1%)	43 (26.9%)	238 (37.5%)
Unsolicited contributions.	280 (58.9%)	117 (73.1%)	397 (62.5%)
Total number of ‘active’ exchange acts.	475	160	635

Most of the 475 private ‘active’ acts were carried out with teachers of the same subject (85.3%, n= 405) and slightly more than half (57.9%, n= 275) were sent to colleagues with whom the teachers were previously acquainted. The percentage of private ‘active’ acts sent to acquaintances (57.9%) was significantly *below* the expected one (68%) while the percentage sent to subject colleagues (85.3%) was significantly *above* the expected one (60%) (the statistical data are given in Annex 8, Section 4).

Public acts were excluded from this count since they do not involve the selection of partner since they are sent to groups rather than individuals. ‘Reactive’ acts were excluded because the exchange partner is by definition the ‘requester’.

8.3.3.2. Outcome of requests.

Two dimensions of feedback were analysed in this research project: a) whether a given request was answered or not and b) the delay between the date of the request and the date the first reply was sent. It was found that a large majority (70%, n= 161) of the 230 requests sent were answered²⁰ (i.e. received at least one reply).

Looking separately at the private and public requests *sent* in the period of study it was found that private requests were significantly more answered than public ones (see Annex 8, Section 5 for the statistical data). The percentages of requests that were answered was 72.1% for *private* requests and 44.2% for *public* requests.

²⁰ Although the total number of requests sent was 238, percentages are computed for the 230 requests that *could* be answered. Eight requests could not be answered because they were not received in the period of study.

Looking at the requests *received* (this number is different from the number of requests *sent* because public requests are received by several people) it was found that the percentage of public requests received that were answered by the receiver was 7.2% while this percentage was 72.1% for private requests received. In other words, teachers answered less than a tenth of the public requests they received while they replied to almost three-quarters of the private ones.

The waiting time to the first reply for each of the 161 requests that were answered in the period of study was analysed. The median first answer arrived *one* day after the request was sent out. Almost a third (29.6%, n= 68) of the requests received an answer on the same day the request was sent out, and more than half (57.8%, n= 133) within one day (the day it was sent or the day after). The percentage of *private* requests answered within one day was 62% and of *public* requests 39%. Two thirds (67%, n=154) of the requests received their first answer within seven days of being sent out. For *private* requests this percentage was 71.4% and for *public* requests 46.3%.

8.3.4. Factors associated with exchange behaviour.

The following sections look separately at three exchange behaviours: *requesting*, *unsolicited sharing* and *solicited sharing*.

The first two behaviours involve at least two decisions by the teachers using electronic mail. When seeking a resource using electronic mail people need to decide: a) *whom* to ask for the resource ('source selection' in exchange theory terms) and b) *how* to communicate their interest in the resource (i.e. 'publicly' or 'privately'). When contributing a resource spontaneously people need to decide: a) to whom the contribution will be sent ('recipient selection' in exchange theory terms) and b) how to send the contribution (i.e. 'publicly' or 'privately'). Solicited sharing involves one key decision for each request received: whether to answer it or to ignore it. The fraction of requests received that were answered is called the 'response rate'.

The existence of significant associations between a number of variables derived from the literature and these communication decisions is discussed in the following sections. The table below summarises these decisions and variables.

Exchange behaviour.		Variables whose association with exchange behaviour was analysed.
Requesting.	Number of requests sent.	Level of feedback received to requests sent.
	Type of communication used for requesting.	Type of resource sought (i.e. 'product' or 'expertise').
	Source selection (only for private requests).	Type of resource sought (i.e. 'product' or 'expertise'), Type of partner.
Unsolicited sharing.	Number of unsolicited contributions performed.	Number of contributions received.
	Type of communication used for contributing.	Type of resource shared (i.e. 'product' or 'expertise').
	Recipient selection (only for private contributions).	Type of resource shared, Type of partner.
Solicited sharing	Response rates.	Type of communication used to send the request, Type of resource sought, Type of 'requester', Contributing behaviour of 'requester'.

In each case, the ‘observed’ results were compared with the ‘expected’ ones to establish the existence of differences of statistical significance. The ‘expected’ percentages are discussed below.

Teachers could use private or public messaging for exchanging resources. As there were no special organisational or technological incentives for using either of the two, the ‘expected’ percentage of exchange acts performed privately (or publicly) was 50% (meaning that teachers were equally likely, from a system point of view, to send their requests or contributions privately or publicly).

Two overarching categories for coding the type of resource were defined earlier: ‘products’ and ‘expertise’. As each request or contribution could involve either ‘products’ or ‘expertise’, the ‘expected’ percentage of exchange acts involving ‘products’ (or ‘expertise’) was 50%.

As discussed above, potential exchange partners were classified according to two variables: ‘previous acquaintanceship’ and ‘professional homophily’. Within the 50 links of Sample 1, the percentage between previously acquainted individuals was 68% (34 of the 50 links) and between subject colleagues, 60% (30 of the 50 links). Therefore the ‘expected’ percentage of exchange acts sent to previously known colleagues was 68% and to subject colleagues 60%.

8.3.4.1. Factors associated with resource seeking.

The existence of significant associations between each of the variables detailed in the second column of the table below and the communication choices detailed in the first column were analysed using statistical techniques and the results are summarised in the third column and below (statistical data are presented in Annex 8, Section 6).

Requesting behaviour.	Variables whose association with requesting behaviour was analysed.	Results.
Number of requests sent.	Level of feedback received.	The more teachers’ requests were ignored, the fewer requests they subsequently sent.
Type of communication used for requesting.	Type of resource sought (i.e. ‘product’ or ‘expertise’).	No association.
Source selection (only for private requests).	Type of resource sought (i.e. ‘product’ or ‘expertise’).	No association.
	Type of partner:	
	Previous acquaintanceship.	No association.
	Professional homophily.	Preference to send requests to teachers of the same subject.

- A significant majority of the requests (60.9%) sought ‘products’.
- Most of the requests were sent privately (81.9%).
- The number of requests sent was strongly associated with the level of feedback received. The more teachers’ requests were ignored, the fewer requests they sent in the future.
- The type of communication used for seeking was not associated with the type of resource sought.
- Source selection was not associated with the type of resource sought (i.e. ‘product’ or ‘expertise’).
- Source selection was associated with *professional homophily* (teachers were more likely to address their requests to subject colleagues than to teachers of other subjects). No evidence of a significant association with *previous acquaintanceship* was found.

8.3.4.2. Factors associated with unsolicited sharing.

The existence of significant associations between the variables detailed in the second column of the table below and the communication choices detailed in the first column were analysed using statistical techniques. The results are summarised in the third column and below (statistical data are presented in Annex 8, Section 7).

Unsolicited sharing behaviour.	Variables whose association with unsolicited sharing behaviour was analysed.	Results.
Number of spontaneous contributions sent.	Number of spontaneous contributions received.	The more private contributions teachers received, the more contributions they sent spontaneously.
Type of communication used for contributing.	Type of resource shared (i.e. ‘product’ or ‘expertise’).	‘Expertise’ less contributed in public.
Recipient selection (only for private contributions).	Type of resource shared (i.e. ‘product’ or ‘expertise’).	No association.
	Type of partner:	
	Previous acquaintanceship.	More contributions to strangers.

	Professional homophily.	More contributions to subject colleagues.
	Contribution behaviour.	The more a teacher contributed in private to another in the past, the more likely that he or she would be selected as recipient.

- A significant majority of the unsolicited contributions involved ‘products’ (63%).
- Most of the unsolicited contributions were sent privately (70.5%).
- Teachers preferred to share ‘expertise’ privately rather than publicly.
- The more private contributions teachers *received*, the more they *sent* spontaneously.
- There was no significant association between the type of recipient and the type of resource contributed (i.e. ‘product’ or ‘expertise’).
- The selection of recipient was significantly associated with *previous acquaintanceship* and *professional homophily*. Teachers shared their professional resources spontaneously significantly more with previously unknown colleagues and with subject colleagues.
- The number of spontaneous contributions *sent* to a teacher was strongly correlated with the number of private contributions previously *received* from that teacher.

8.3.4.3. Factors associated with solicited sharing.

Once a teacher received a request, he or she could ignore it or reply to it. As discussed before, replies could take many forms such as providing the requested resource, referring the ‘requester’ to another source or requesting more information about the request itself. This is an important clarification since it implies that teachers could reply to their colleagues *even if they lacked the desired resource*. In other words, response behaviour did not measure the *capability* to fulfil a demand but rather the *will* to collaborate.

The 20 stable participants received a total of 627 requests for professional resources from the other 19 stable participants, for an average of 31.4 each.

The existence of significant associations between the variables detailed in the table below on response rates (i.e. number of requests received that were answered divided by the total number of requests received) was determined using statistical techniques. The results are summarised in the second column of the table and below (statistical data are detailed in Annex 8, Section 8). It should be noted that in the NUPOP e-mail system, message receivers know whether the message has been sent to them ‘privately’ (i.e. to their private e-mail address) or ‘publicly’ (i.e. the message was sent to a public address which includes the receiver among other people).

Variables whose influence on response behaviour were analysed.	Results.
Type of communication used to send the request.	Private requests were significantly more answered than public requests.
Type of resource sought (i.e. 'product' or 'expertise').	No association. Teachers were as likely to reply to requests for 'products' as to requests for 'expertise'.
Type of 'requester'. Previous acquaintanceship.	Requests from known people were significantly more answered than requests from strangers.
Type of 'requester'. Professional homophily.	Requests from subject colleagues were significantly more answered than requests from teachers of other subjects.
Contribution behaviour of 'requester'.	The more a teacher contributed privately to another before sending a request, the more likely that his or her requests would be answered.

- Of the 627 requests received, more than two thirds (68.9%, n= 432) were *public* (i.e. received as a member of a group). Slightly more than half (53.9%, n=338) were received from strangers. More than two thirds were received from subject colleagues (69.9%, n= 438).
- Teachers ignored almost three-quarters (72.4%, n= 454) of the 627 requests they received. The overall response rate was 27.6% (173/627).
- Private requests were answered ten times more than public requests (response rates were 72.8% and 7.2% respectively).
- Requests for 'products' were answered about as frequently as requests for 'expertise'.
- Requests from strangers were answered significantly *less* than requests from known colleagues.
- Requests from subject colleagues were answered *more* than requests from teachers of other subjects.
- Teachers 'rewarded' 'generous'²¹ colleagues. The more a teacher contributed to another before sending a request, the more likely the other was to answer his or her requests. This result was *not* true for *public* contributions.
- The 'symmetry' (i.e. a measure of the difference between the number of contributions received by each of the two persons maintaining a relation) of stable links was significantly higher than the symmetry of unstable ones (see Annex 8, Section 8.4). This result is consistent with social exchange theory's claim that people decide to continue or discontinue their relationships on the basis of the perceived 'equity' of exchanges and that unilateral relations may not be sustainable (Walster et al, 1976, Nord, 1980, Miller and Jablin, 1991, p. 97, Hudson and Jablin, 1992).

²¹ Terms such as 'generosity', 'altruism' or 'gift giving' are used in the exchange literature to describe high levels of contributing behaviour (see for example Rheingold, 1993).

8.3.5. Comparing exchange behaviours.

8.3.5.1. Requesting and unsolicited sharing.

As discussed earlier in this chapter and in the review of the literature, research has shown that people's *requesting* behaviour may differ from people's *sharing* behaviour.

In this stage of the research, both behaviours were compared along the dimensions detailed in the table below, using statistical techniques. The main results are summarised below. Statistical data are presented in Annex 8, Section 9.

Requesting.	Unsolicited sharing.	Results.
Number of requests sent.	Number of unsolicited contributions performed.	No significant correlation.
Type of communication used for requesting.	Type of communication used for sharing.	Requests significantly more likely to have been sent privately
Type of resource sought (i.e. 'product' or 'expertise').	Type of resource provided (i.e. 'product' or 'expertise').	No significant difference between the type of resource requested and provided.
Source selection (only for private requests).	Recipient selection (only for private contributions).	More contributions than requests to strangers.

- The number of requests and the number of unsolicited contributions performed were not significantly correlated.
- Although both requests and contributions were more likely to be sent in private, requests were significantly more likely than unsolicited contributions to have been sent privately. There was no significant difference between the type of resource *requested* and the type of resource *provided* (i.e. 'product' or 'expertise').
- Teachers addressed strangers for *requesting* resources significantly less than for *contributing* resources to them.
- There was no significant difference between the number of requests and contributions sent to subject_colleagues and to teachers of other subjects.

8.3.5.2. Unsolicited and solicited sharing.

Solicited and unsolicited sharing were compared along the dimensions detailed in the table below using statistical techniques. The main results are summarised below. Statistical data are presented in Annex 8, Section 10.

Unsolicited sharing.	Solicited sharin	Results.
Number of contributions performed spontaneously.	Number of solicited contributions.	Correlated.
Type of communication used for sharing spontaneously.	Type of communication used for solicited sharing.	Unsolicited contributions more likely to be sent publicly.
Type of resource provided spontaneously (i.e. 'product' or 'expertise').	Type of resource provided 'on demand' (i.e. 'product' or 'expertise').	No significant difference.
Recipient selection for spontaneous sharing.	Recipient selection for sharing on demand.	No significant difference.

- A large majority of the contributions were performed *spontaneously* (66.5%).
- The numbers of solicited and unsolicited contributions were strongly correlated.
- Significantly more solicited contributions were sent *privately* than unsolicited contributions.
- There was no significant difference between the type of resource contributed spontaneously and the type of resource contributed 'on demand' (i.e. 'product' or 'expertise').
- No significant association was found between the type of recipient (i.e. previously known or stranger; subject colleague or teacher of a different subject) and the type of contribution (i.e. unsolicited or solicited).

8.4. Answering research question IV: the exchange of professional resources.

This chapter has addressed research question IV:

“What are the main patterns of exchange of professional resources between teachers using electronic mail?”.

For answering this question, the chapter analysed the use of e-mail for the exchange of professional resources by the 20 stable participants. Four exchange behaviours were investigated: resource seeking, unsolicited resource sharing, solicited resource sharing and coordination. Results were used to establish the extent to which teachers used e-mail for exchanging professional resources, the types of resources sought or shared, the type of communication used to perform the exchanges (i.e. public or private) and the outcomes of resource seeking acts (i.e. whether requests were replied to or ignored).

The following sections interpret the relevant findings and discuss them in relation to the research literature.

8.4.1. Using electronic mail for the exchange of professional resources.

As discussed before, teachers communicate with colleagues to achieve a variety of social, psychological, professional and organisational purposes (Johnson, 1990, p. 156, Little, 1990, Sandholtz et al, 1991, O'Grady, 1994). According to collegiality research, professional development is supported by collegial interactions focusing *on the exchange of professional resources* (Little, 1982, Rosenholtz, 1985, Huberman, 1993, Ponticell, 1995). It was therefore important to find out the extent to which teachers would use e-mail for such purpose.

One of the main findings of this stage of the research was that the new medium was actively used by the stable participants for the exchange of professional resources. Almost half of the messages they sent were used for professional exchange purposes. This finding is compatible with Livingston's (1991, p. 19) conclusion from his research on the School Renewal Network project: '(teachers used e-mail to share teaching practices and ideas) ... it is a substantial beginning for a faculty militant in its defence of privacy and individual autonomy'. In other words, the evidence suggests that e-mail may support professional exchange between schoolteachers, at least among those who use the system regularly.

According to the literature, teachers may use CMC systems with a 'utility' focus emphasising information searching and dissemination or a 'community' orientation emphasising professional exchange and collaboration (Bruce and Rubin, 1993, p.173, Office of Technology Assessment, 1993). This is worth noting because much of the literature on CMC in industrial contexts (and more recently popular and research reports on the use of the Internet) stress the role of CMC systems as a 'source' for obtaining information, products or services rather than their potential impact on human communication and collaboration. According to the evidence, teachers did not perceive Teachnet mainly as a database or a 'help line' to be used for unilateral benefit. On the contrary, they used electronic mail significantly more for *contributing* than for *requesting* resources. In sum, the results of this research suggest that a computer network might have the potential to support the formation of *communities* where teachers share their teaching resources with each other.

Spontaneous contributions were the largest single use of the system with 43.5% of all exchange acts. The numbers of solicited and unsolicited contributions performed were strongly correlated and there were no significant differences between the types of resources contributed spontaneously and the types of resources contributed 'on demand'. These results suggest that e-mail may support spontaneous sharing of professional resources and that teachers may feel as comfortable sharing resources spontaneously as 'on demand'. These results are important because spontaneous contributions play a key role in the development of collegiality among teachers using e-mail. According to the results of prior research discussed in Chapters 1 and 3 and corroborated by interview evidence presented in Chapter 9, many teachers are reluctant to explicitly *ask* for help from colleagues because of the professional costs involved. Consequently, those teachers usually rely on receiving *spontaneous* contributions, especially public contributions, to obtain professional resources (this strategy is called 'monitoring' in the exchange literature). The larger the number of resources spontaneously contributed, the more that teachers who resort to 'monitoring' will find e-mail an effective mechanism to obtain professional resources.

CMC was a fairly effective medium for obtaining resources by inquiry. Close to three-quarters of the requests were answered (70%). Answers were relatively prompt; more than half of the requests (58%) was answered within one day of being sent and two thirds within seven days. The fact that teachers contributed spontaneously and that a majority of requests

were replied to led to a high ratio between receiving and giving professional resources. According to the data, an average of almost a hundred contributions were received by each stable participant during the period of study (97 i.e. 1939/20), three times the average number of *requests* received (31.4 i.e. 627/20).

In sum, the overall evidence suggests that groups of committed e-mail users may form communities in which seeking and sharing professional resources (and especially spontaneous sharing) are accepted behaviours. This is an important finding, since collegiality research has consistently found the exchange of professional resources as one of the key forms of collegiality supporting professional development.

These results are broadly consistent with findings of prior research carried out both in educational contexts (Katz, McSwiney and Stroud, 1987, Beals, 1990, Teles and Duxbury, 1991, Castle and Gillingham, 1991, Livingston, 1991, Bruce and Rubin, 1993) and in industry (Finholt, 1992, Rheingold, 1993, Constant et al, 1996, Kollock, 1999). All of these authors found that relatively large fractions of electronic messaging were used for the exchange of professional resources and that people used the system as much (or more) to *share* as to *obtain* resources.

However, as discussed in the review of the literature, most prior CMC research has looked at *public* messages (since it focused on computer conferences and electronic bulletin networks rather than on electronic mail). Those investigations therefore left unanswered the question of whether private messaging would be used in similar ways. The research reported in this study is one of the first to look at the content of public and private communication *by the same individuals and during the same period of time*. This is important in light of the finding that professional exchange was mostly conducted in private (81.5% of all exchange acts were private). An implication of the fact that teachers performed most of their exchanges of professional resources in private is that any research project which overlooks private communication risks obtaining highly distorted results. This is discussed in Chapter 11.

The evidence showed that teachers used private and public messages for broadly similar exchange purposes. They used *private* messaging for exchanging professional resources as much as *public* messaging (49% and 45% of all messages respectively). Contributions were also a majority of the private exchange acts (64%) and private spontaneous contributions outnumbered private solicited ones. These are interesting results since researchers have argued that private exchanges may be less dominated by 'task-oriented' exchanges than public ones. The reason for this, according to these authors, is that mutual knowledge and trust between people who have known each other or collaborated for some time may compensate for the reduced 'bandwidth' (Zack, 1993).

8.4.2. Type of communication used.

One of the main findings of this stage of the research was that teachers performed privately most of their exchange acts (81.5%). This was true for all types of exchange acts: 81.9% of *requests* were performed privately, 79.6% of *contributions* (70.5% of the spontaneous contributions and 97.1% of the solicited ones) and 95.8% of *coordinations*.

The fact that almost a third of the unsolicited contributions were public is positive for collegiality because, as discussed above, social exchange research has found that 'monitoring' is one of the main strategies used to obtain professional resources in contexts (such as schools) where inquiries may entail high professional costs (Ashford, 1986,

Morrison, 1993). Thus, the larger the number of resources in the public realm, the more useful teachers may find e-mail. Research has found that unsolicited public contributions may be constrained in the long run by the social dilemma of 'public goods' (Barry and Hardin, 1982). As discussed in the review of the literature, public goods have the characteristic that everyone benefits from them *but the 'contributor'*. Unsurprisingly, as 'contributors' face costs (e.g. time, risks to reputation, loss of 'ownership') but no personal benefit, public goods may be undersupplied (Isaac et al, 1985)²². This suggests that it should be important for educational planners interested in fostering professional exchange to introduce incentives for teachers to contribute publicly their resources. This is further discussed in Chapter 11.

Teachers performed almost a fifth of their requests (18%) in public. This is also positive for collegiality because it enables other teachers to become aware of the issues of interest to their colleagues and focus their attention on the replies that 'requesters' may obtain and whose content may be of general interest (it should be noted that teachers other than the 'requester' may know about these replies only if they are sent publicly or copied to them for some reason). This result is compatible with previous research, which concluded that e-mail enables people to 'broadcast' their professional needs much more widely than other media (Feldman, 1987, Kraut et al, 1990, p. 166, Constant et al, 1996). However, those researchers paid scarce attention to the *outcome* of requests. There was no attempt to determine whether and how (i.e. publicly or privately) requests were replied to. Hence their capability to contribute to the understanding of exchange processes was limited (as Foa and Foa argued in their seminal 1974 book, exchanges should be understood as *processes* rather than discrete acts). Moreover, as discussed in the review of the literature, most prior research looked only at one type of communication, *public* or *private*. Consequently, it was unable to analyse exchange processes taking place partly in public and partly in private.

Most solicited contributions were sent privately (97%). In other words, teachers decided to reply *privately* to virtually all requests, even to those they received *publicly*. Thus, while many exchange processes were initiated in public, they subsequently moved to the *private* realm. In fact, most 'new' relations (i.e. relations between strangers) were initiated in this way, with teachers responding *privately* to *public* requests from strangers.

This pattern of 'privatisation' of professional exchanges (i.e. *public* requests eliciting *private* answers) may diminish the potential of electronic mail for supporting professional development. The reason for this is that as resources are sent privately to 'requesters', and hence out of the reach of others, those teachers who resort to 'monitoring' to obtain professional resources may find few useful resources in the public realm. Hence they may discontinue their use of the system, at least for professional purposes. As discussed in Chapter 11, changing this 'privatisation' pattern may require establishing formal rules or offering social incentives for conducting professional exchanges in public.

8.4.3. Types of resources exchanged.

The main professional use of the medium was to exchange *teaching materials, bibliography, scientific data and teaching approaches* as well as information and opinions about such resources (69.5% of the 835 exchange acts). Information, opinions and materials related to *teachers' courses and classrooms* accounted for slightly more than a tenth of all exchanges (11.1%). An equal share of teachers' exchanges (11.1%) was related to more *general pedagogical matters*. The largest single type of resource exchanged by the teachers was

²² As discussed in Chapter 10, the 'public goods' dilemma may not equally constrain everyone's disposition to contribute to common pools. Some people may put a high value on 'intrinsic' psychological rewards of sharing which may override the perceived costs mentioned above.

Bibliography and Teaching materials. This result suggests that in spite of the technical limitations of the electronic mail service provided by Teachnet²³, teachers found it a useful medium to exchange materials.

Teachers' professional concerns may be conceived along a spectrum of increasing abstraction. At one extreme, teacher exchanges revolved around day-to-day, concrete and specific course and teaching project management issues. At the other extreme they discussed abstract and general issues involving the educational system, pedagogy and learning theories. Between these two extremes and constituting most of the use of electronic mail, exchanges focused on teachers' professional 'repertoire', that is those resources (e.g. teaching approaches, exercises) that teachers 'own' and may use in their teaching practice. Thus, one of the findings of this stage of the research was that 'repertoire development' was by far the preferred function of e-mail communication among the 20 stable participants. In other words, e-mail may be more effective for supporting 'repertoire development' (e.g. exchanging books, exercises) than 'higher' levels of professional development, involving more exposure of the inner workings of teachers' classrooms and changes in deep-rooted conceptions of teaching (e.g. arguing about evaluation theory).

As discussed before, the 23 categories of resources were classified into two overarching ones: 'products' and 'expertise'. Overall, the teachers initiated exchange processes to obtain or share spontaneously 'products' significantly more than expected (61.9%). This suggests that teachers may perceive higher 'value' (i.e. costs minus rewards) in using e-mail to exchange 'products' than in using the system to exchange 'expertise'. This is discussed in the next section.

8.4.4. Partner selection.

As discussed before, it was important to determine whether and how exchange behaviour was affected by the nature of the relationship between the participants in exchange processes. The evidence concerning this issue is discussed below.

8.4.4.1. Previous acquaintanceship.

According to the data, the stable participants did not limit their private exchanges to those colleagues with whom they were acquainted before starting to use e-mail. The percentage of private exchanges that the teachers initiated (i.e. the number of requests and unsolicited contributions they performed) with acquaintances (57.8%) was significantly *lower* than expected (68%). Teachers addressed their private *requests* as much to previously unknown colleagues as to others and *contributed* spontaneously even more to previously unknown colleagues than to acquaintances.

Thus, *once teachers established e-mail relations with colleagues*, the fact that they did not know some of them before starting to use the system did not constrain their selection as exchange partners. From these results and those discussed in Chapter 6, it may be concluded that although teachers may be reluctant to create links with strangers, once they do, this initial reluctance may 'fade away' and not adversely affect professional exchange.

²³ Teachnet's graphical capabilities, for example, were limited. Chapter 9 discusses teachers' perceptions of these technical limitations and how they influenced communication behaviour.

In sum, the results of this stage of the research suggest that e-mail may support the formation of a (relatively reduced) community of highly committed users where previous acquaintanceship does not constrain the exchange of professional resources. This means that although teachers using e-mail may incorporate relatively few new colleagues to their 'collegial networks' (i.e. those colleagues with whom a teacher regularly communicates), those few that are incorporated may become new sources (and recipients) of professional resources.

It should be noted that this result might not be true for non-professional exchanges. It is possible that while previous acquaintanceship does not constrain the exchange of *professional* resources it may constrain communication on more personal matters. In other words, people may prefer to keep to their 'old' acquaintances when they conduct highly personal exchanges. Indeed, the evidence of the analysis of topics reported in Chapter 7 suggests that this may be the case (the share of non-professional content was significantly higher in 'old' than in 'new' relations). No data on this issue was collected in this stage of the research, which focused on the exchange of *professional* resources.

8.4.4.2. Professional homophily.

Professional homophily (i.e. teaching the same subject) significantly constrained the exchange of professional resources. The percentage of private exchanges that the teachers initiated with subject colleagues (85.2%) was significantly *higher* than expected (60%). Teachers sent significantly more of their *requests* and spontaneous *contributions* to colleagues teaching the same subject.

Building on the results reported in Chapter 6, it may be concluded that not only did the teachers create significantly less cross-subject relations but those which were created were significantly less used for professional exchange. In sum, the evidence suggests that in the absence of special rules or incentives, teachers may use e-mail significantly less for cross-subject than for within-subject professional exchange.

These results contradict findings of CMC research carried out in industrial contexts. For example, Bikson and Eveland (1990) found strong evidence of 'multidisciplinary interaction' between users of CMC in a large corporation. Such discrepancies may be related to the strong differences between work in industrial contexts (where collaboration is often vital and in some cases mandated) and *teaching*, which, as discussed earlier in this study, has been consistently described as a task with low levels of 'interdependency', especially between teachers of different subjects (Pellegrin, 1976, p. 368, Greenberg, 1980, Little, 1990, p. 520, Zarn, 1992). This is discussed in detail in Chapter 11.

The fact that e-mail exchanges were bound by professional homophily may reflect the organisation of teaching in Uruguayan secondary schools, where teachers have little incentive or need to interact with colleagues of other subjects. A curriculum reform is currently under way in Uruguay, which contemplates the integrated teaching of science. Under such a system, teachers of what are now independent subjects (e.g. Physics, Biology) would teach an integrated syllabus. It is conceivable that under such arrangements teachers may perceive colleagues of other subjects as capable of delivering valuable resources to them and hence alter the patterns of their partner selection and response behaviour. Further research could determine whether such arrangements lead to an attenuation of the effect of professional homophily on exchange behaviour.

8.5. Summary.

The results of this stage of the research suggest that e-mail may support professional exchange among secondary school teachers who regularly use the system. This is important since collegiality research has consistently found that professional development is fostered in social contexts where teacher interactions focus on the exchange of *professional* resources.

Teachers used e-mail mostly for 'repertoire development' (i.e. exchanging concrete resources, useful for lesson planning and classroom teaching) rather than for discussing more abstract theoretical or pedagogical concerns. As a whole, 'expertise' was significantly less exchanged than 'products', especially in public. These results suggest that e-mail may be less effective in supporting changes in teachers' deep-rooted assumptions, views and opinions about teaching and learning than for enriching their 'professional repertoire'.

The evidence suggests that teachers may not perceive e-mail as a database to be used for unilateral benefit. The stable participants used the system significantly more for *sharing* than for *requesting* professional resources and a majority of the contributions were spontaneous. This is important because many teachers are reluctant to explicitly *ask* for professional resources (if all that teachers receive when they access the system are *requests*, they may find little rewards in using e-mail).

The teachers conducted the overwhelming majority of their exchanges in private. Furthermore, most of the exchange processes that were initiated in public were followed in private. This 'privatisation' of communication may diminish the system's usefulness because few resources may remain in the public realm for those teachers who prefer to obtain professional resources by 'monitoring' other people's exchanges. Special incentives may be needed to keep a larger number of teachers' exchanges in the public realm.

Exchanges within established relations were not bound by previous acquaintanceship. In other words, teachers may be reluctant to create e-mail relations with strangers, but once they do, they may turn to them as much as to 'old' acquaintances for seeking or sharing resources. Private exchanges were however bound by professional homophily. The teachers used e-mail significantly less for *cross-subject* than for *within-subject* professional exchange. This means that teachers may not only create significantly fewer relations with teachers of other subjects but also the ones they do create are significantly less used for the exchange of professional resources.

In sum, the overall evidence suggests that e-mail may support the formation of a relatively reduced community of highly committed users where seeking and sharing (especially *spontaneous* sharing) professional resources are accepted behaviours and where exchanges are not constrained by previous acquaintanceship. A majority of the exchanges may involve teaching resources and take place in private, between teachers of the same subject. Special incentives may be needed to ensure the sustainability of professional exchange in the long run, especially to foster public sharing.

CHAPTER 9

Factors affecting CMC behaviour

9.1. Introduction.

In previous chapters, the use of electronic mail by the Teachnet teachers was described through analysis of data collected using automated techniques. Chapters 5 and 6 analysed the *structure* of the communication network established by the teachers and their e-mail relations. Chapters 7 and 8 examined the *content* of those relations to determine the topic and purpose of teachers' communication. Overall, these four chapters provide a comprehensive account, firmly grounded in the data itself, of the communication behaviour of a group of teachers using electronic mail.

The stage of the research reported in this chapter provides further insights into the communication behaviour of the teachers. The goal was to understand their own perspectives on the use of electronic mail for collegial purposes and identify factors that seemed influential in shaping such behaviour. The findings were triangulated with the results obtained in the previous stages (which used different sources of data and different methods of analysis) to strengthen the validity of the research. The results are used in Chapter 10 to help answer research question V.

9.2. Data collection and analysis.

A sample of fifteen teachers, all of them stable participants, was interviewed to collect data on teachers' perceptions of the use of e-mail for collegial purposes (sampling criteria are discussed in Chapter 4). Data were also collected concerning the level and nature of existing collegial interactions for reasons discussed in the last section of this chapter.

Analysis of the data consisted of the construction of interpretative categories to account for the collegial behaviour of teachers using electronic mail. Data were categorised using the method of 'constant comparative analysis' (Strauss, 1987). The Atlas software program (Miles and Huberman, 1994) was used to support the categorisation process. The methodology used in this phase of the research is discussed in detail in Chapter 4.

When Italics are used in quotations, they reflect an emphasis made by the respondents themselves in their statements. When underlining is used, it indicates an emphasis added by the researcher to highlight the most relevant words or sentences. At the end of each quotation, the Atlas interview and code numbers are indicated. For each category, the number of interviews where it was mentioned is shown in brackets.

The following table details the teachers interviewed in this stage of the research. The names used are fictitious to protect the privacy of the respondents.

Name.	Subject.	School.
1. Mr. Pleh	Maths	De Gaulle
2. Mr. Skri	Maths	De Gaulle
3. Ms. Abar	Physics	De Gaulle
4. Mr. Rpit	Physics	De Gaulle
5. Mr. Odia	Biology	Churchill
6. Mr. Hdea	Maths	Churchill
7. Ms. Jrod	Biology	Herzl
8. Ms. Pszt	Physics	Herzl
9. Mr. Eega	Physics	Herzl
10. Mr. Joli	Physics	Herzl
11. Ms. Bbes	Biology	Roosevelt
12. Ms. Jcab	Maths	Roosevelt
13. Ms. Abra	Maths	Roosevelt
14. Ms. Toch	Maths	Roosevelt
15. Mr. Erod	Maths	Roosevelt

9.3. Factors affecting CMC behaviour.

A number of factors (each corresponding to one of the categories discussed above) influencing use of CMC were identified through analysis of the teacher interviews. Certain factors were related to the personal characteristics of the teachers using the system, their personalities, views on teaching and professional improvement, and attitudes towards technology. Other factors were dependent on the communication system, including how its use was organised, its technical properties, and how teachers actually used it, especially the types of topics they addressed and the level and type of feedback they provided to their colleagues. Finally, another set of factors was related to the community²⁴ of users, its social structure, professional norms and working conditions. The table below lists the main groups of factors. As discussed above, these results are used in the following chapter to answer research question V.

Factors affecting e-mail use by teachers.
The teacher.
Personality traits.
Views on teaching and professional improvement.
Attitude towards technology.
The communication system.
Organisation of system use.
Properties of the communication medium.
Thematic content of public dialogues.
Social response.
The community.
Professional norms.
Social structure.
Working conditions.

²⁴ A community is a group of individuals with some common interest and stronger communication flows than across its boundaries (Markus, 1987).

9.4. The teacher.

Certain characteristics of the individual teacher affected collegial communication behaviour. According to the data, some self-perceived personality traits *constrained* communication with colleagues (e.g. timidity) while others *facilitated* it (e.g. collegial duty). It was also found that some teachers held views on teaching, professional improvement and technology that may clash with CMC, generating powerful barriers to the use of e-mail. The table below lists the factors related to the individual teacher. The number of respondents is shown in brackets in all tables.

The teacher.
Personality traits (8).
Timidity and sociability (7).
Collegial duty (6).
Self-esteem (6).
Views on teaching and professional improvement (10).
Attitude towards technology (6).

9.4.1. Personality traits.

More than half of the respondents (8) related their communication behaviour to self-perceived personality traits such as timidity, sociability, sense of collegial duty and self-esteem. These traits are discussed below.

This result is consistent with the literature (McCroskey, 1977, Richmond and McCroskey, 1985, Knapp and Vangelisti, 1995). Individuals with low self-esteem are less likely to search for resources and face the risks involved (Louis, 1990, Hudson and Jablin, 1992). Rosenholtz (1989, p.42) found that teachers refrained from collegial exchanges because they felt threatened by how other teachers would value their contributions. Hayes and Kilgore (1991, p. 16) similarly described 'lack of self-confidence' as an inhibiting factor to collegial interactions and professional development.

9.4.1.1. Timidity and sociability.

Self-perceived timidity affected e-mail use, especially the use of *public* messaging and communication with strangers (7).

These respondents seemed to perceive *public* communication with the same levels of anxiety as the ones associated with speaking to an audience. Ms. Pszt described her feelings about using public communication in the following terms:

'I did not send public messages. I do not really know why. It is stronger than I am ... It might be because I am timid or reserved (5:6)'

In some cases, timidity especially constrained communication with strangers. As Mr. Skri explained:

‘I send messages only to ... people I know. It is a personal thing; I am a reserved person. I don’t open myself up very easily (14:13)’.

Mr Erod showed similar feelings:

‘... communication takes place mainly between people who know each other. At least this is what happens with me and I believe with most people. Some people are different. They are more open. Ms. Toch for example, I know that she communicates with everybody. She is less timid ... It is a personality problem really (12:36)’.

Sociability was highlighted as a factor facilitating the use of e-mail for collegial purposes:

‘I did not develop many (‘new’ CMC) relations ... Truth is, I am not a sociable person (Mr. Odia, 3:17)’.

‘I did not expand my circle of colleagues (by way of using CMC) ... I am not too sociable I suppose ... I guess you need more initiative on your behalf to reach out to people (Ms. Jcab, 9:19)’.

9.4.1.2. Collegial duty.

Teachers’ attitudes towards sharing determined in many cases their contribution behaviour (6). These teachers felt that responding to colleagues’ requests was a ‘duty’:

‘ I reply to *each* message I receive. It is a courtesy duty. You have to show respect (Mr. Odia, 3:10)’.

‘ I would reply even to silly queries. It is a question of good manners (Ms. Bbes, 15:25)’.

‘... (when) one had opportunities to learn important new things, I believe you have the duty to share them (Mr. Hdea, 1:34)’.

9.4.1.3. Self-esteem.

Some teachers (6) were unwilling to communicate (especially with strangers) because they were unsure about how the receivers would feel about their messages. Mr. Erod, who restricted his e-mail communication to two close friends, told the interviewer:

‘It is difficult for me to send messages to strangers.

Q: Why is that?

A: I don’t know, I just can’t ... It might be because one thinks that what you have to say is not very important ... (4:13)’.

9.4.2. Views on teaching and professional improvement.

Teachers' views on teaching and professional improvement affected their communication behaviour (10). Some teachers held views on the nature of teaching that put a low value on collegial assistance, hence decreasing the perceived need for professional resources. Other teachers did not perceive their own learning as a professional priority. These views are discussed below.

Some respondents (3) perceived teaching as not 'time-critical'. They argued that teachers seldom need assistance from colleagues as a matter of urgency for their daily tasks. Hence, e-mail's capability to facilitate obtaining advice from a large pool of people, which is highly valued in industry (Finholt, 1992), was not perceived as particularly useful by those teachers:

'When you practice veterinary medicine you find urgent and complex cases ... there is a real urgency to find somebody able to help ... In teaching ... kids' questions usually do not really challenge you ... and there is no urgency in answering anyway. I just honestly tell them that I don't know the answer ... and later on with more time I look for a book ... (Mr. Odia, 3:3)'

'In clinical psychology this (the low levels of collegial exchange) could never happen ... If you need some advice and fail to get it, situations can get out of control (Ms. Jcab, 9:38)'

Other respondents (4) felt that teachers are not under pressure to seek help because teaching problems have low visibility. As Ms. Jcab put it:

'(Within the teaching profession) risk is measured differently. If I have a problem with a specific group of students, I may leave it unsolved because it is self-contained. Unless it is something big, people will not know about it. Students will endure the consequences and that will be it ... (9:38)'

Some teachers (4) perceived teaching as lacking a 'technical' or 'objective' basis to favour choice of one pedagogical approach or type of teaching material over another. They felt teaching is an uncertain activity where there are no objective criteria to establish the most appropriate practices for each situation. Thus, they saw little benefit in debating the relative merits of different teaching approaches or materials. The perceived futility of collegial dialogue is compounded by the egalitarian norm that pervades secondary schools. According to this norm, all teachers are professional peers and their views should be publicly treated as having equal merit. There is no authoritative source capable of discriminating between effective and mediocre teaching approaches. As Ms. Bbes put it:

'I respect the others' opinions ... evaluating teaching is very difficult. As you know, there are so many different teaching approaches ... You may achieve good results in so many different ways! (15:14)'

Ms. Abar described collegial exchange within the group of Physics teachers at her school in the following terms:

‘There is little debate really.

Q: There are no conflicting views on evaluation for example? I have heard this is an issue where there are many different positions among teachers.

A: Evaluation? I believe it is a such a complex issue for *everybody!* Nobody really knows what is the best approach (10:39)’.

In some cases (2), teachers held views on teaching that put a low value on collegial communication. Ms. Bbes for example felt that the ‘essence’ of teaching has little to do with materials and techniques. In her view, teaching is a ‘heart’ activity. As she argued:

‘Pedagogy is about the heart and all the rest are fairy tales ... If you find a child’s heart you can teach him whatever you want (15:17)’.

These findings are highly compatible with previous results from collegiality research (Lortie, 1975, p. 159, Zahorik, 1987, p. 390, Little, 1982, p. 339, Huberman, 1993, p. 30). Rosenholtz (1989, p. 43) has argued that the lack of collegiality in some schools is associated with the belief that good teaching is an innate ability rather than a goal that teachers may help each other to attain. Zarn (1992, p. 168) concluded from her review of collegiality research: ‘... teacher isolation is embedded in notions such as that good teaching is best learned on one’s own’.

Teachers’ attitudes towards professional improvement affected their perception of the importance of collegial exchange. Those teachers who did not put a high priority on their professional improvement attributed little value to the potential of e-mail to support the exchange of new ideas and materials.

‘We (teachers) may know that some of our approaches and materials are far from perfect but we keep using them. It is standard practice for teachers to use the same exercises for 10 or 20 years (Mr. Skri, 14:28)’.

‘CMC is definitely very useful ... but some people did not know how to make the most of it, or maybe they were unwilling to do it.

Q: Why do you think this happened?

A: It all depends on one’s demands upon oneself. Some people, like me for example, are eager to try new teaching approaches, new materials, anything new. However, other people just stay passive. They don’t care (Ms. Toch, 2:31)’.

9.4.3. Attitude towards technology.

The attitudes of teachers towards CMC or computers in general influenced their use of CMC for collegial communication in more than a third of the cases (6). Mr. Eega described his closest colleague’s refusal to use CMC in the following terms:

‘He declined to join Teachnet ..._he does not have sympathy for computers (8:9)’.

Mr Skri discussed his preference for FTF communication as follows:

‘Q: How often did you use CMC to request those comments and opinions?’

A: I’ d rather argue my points of view face to face...

Q: Why do you prefer FTF communication?’

A: ... I just believe people relate better to each other when they see each other personally ... I am not the only one ... many people dislike machines ... or at least communication mediated by machines (14:45)’.

The findings reported in this section are compatible with previous research. Teachers’ attitudes towards technology have been found to affect computer uptake in Uruguayan schools (Grünberg, 1991) and U.S. schools (Clarke, 1991). Black, Levin, Mehan and Quinn (1983) found that individuals having negative attitudes towards computers self-select themselves out of CMC projects whenever possible.

9.5. The communication system.

The development of collegiality among Teachnet users was influenced by the organisation of system use, by the technical properties of electronic mail, by teachers’ perceptions of the value to them of the content of public communications and by the level and nature of the feedback they received. The table below lists the main groups of factors related to the communication system.

The communication system.
Organisation of system use (10).
Task organisation (7).
Response opportunities (7).
Communication discipline (6).
Properties of the communication medium (13).
Functionality (13).
Richness (8).
Thematic content of public dialogues (10).
Social response (9).
Level of feedback (7).
Nature of feedback (7).

9.5.1. Organisation of system use.

The Teachnet project provided a group of secondary school teachers with unrestricted access to electronic mail for free and voluntary use. There were no incentives for teachers to use CMC, no specified purposes or tasks to be undertaken and no formal or tacit rules defining communication ‘obligations’ (for example, how often people should read their messages). As opposed to many projects described in the literature (e.g. Castle et al, 1991, Bruce and Rubin, 1993, Grandgenett and Harris, 1994) the Teachnet system was not introduced to support the implementation of a specific innovation or project nor did it have clearly stated aims and ways of using it.

Two thirds of the interviewees (10) felt this highly unstructured environment inhibited sustained use of CMC.

9.5.1.1. Task organisation.

Seven teachers felt that a more structured approach to CMC use could foster higher levels of sustained collegial communication. This evidence suggests that communication between teachers does not necessarily follow spontaneously from the mere availability of the CMC medium. As Ms. Jacob and other teachers put it:

‘Availability of the communication medium is not enough Knowledge will not circulate spontaneously ... it has to be organised in some way (9:33) ‘.

‘I believe CMC should be introduced with specific functions and more concrete applications (Mr. Erod, 12:35)’.

‘The computer network should have clear objectives and guidelines for its use ... One has to find it some concrete use ... if e-mail use had been more focused I may have found the time to use it even under all the work pressures (Mr. Skri, 14:25)’.

CMC relations seemed to develop naturally when a specific collaborative task needed to be accomplished with clear deadlines and guidelines:

‘When some specific task is planned with clear objectives and deadlines I regularly check my messages until the task is accomplished (Mr Skri, 14:2)’.

‘I sent messages to other teachers when there was something of interest to all of us ... (for example) a Maths contest where everybody would suggest exercises ... (Mr Pleh, 13:5)’.

This result is compatible with the findings of prior research (Riel and Levin, 1990, Riel and Harasim, 1994).

9.5.1.2. Response opportunities.

Logistical factors influenced the level and nature of CMC use by the teachers. Insufficient training and technical problems caused, for almost half the teachers interviewed (7), considerable disruption of their use of electronic mail.

Technical problems.

Almost half the teachers interviewed (7) mentioned technical problems as a cause in decreases or interruptions in use of e-mail. There were technical problems with the teachers’ home computers, with the computers at school and with telephone lines.

The impact of many of these malfunctions seemed disproportionate to the magnitude of the actual technical failure. This is due to the fact that the schools did not provide computer support for the teachers. Consequently, even minor technical glitches required that teachers spend their own money and time to solve them. Because of these factors, relatively minor technical malfunctions could disrupt teachers’ use of e-mail for long periods. Mr Odia described such a disruption in his electronic communication in the following words:

‘ ... I used to access the network almost every day ... then I changed the modem of my home computer and for some reason could not access the network anymore. I therefore had to rely on the school computer but it broke down and was out of order for three months! (3:8)’.

Mr Pleh moved to a new house and was unable to re-connect his computer to the telephone line on his own. Consequently, he was unable to use the network for months:

‘Q: How frequently do you access the network?’

A: I *used* to access the network.

Q: You don’t read your messages any more?’

A: No. I moved to a new house and did not manage to connect all these hardware and cables yet (3:1)’.

Training

A few teachers (2) felt their level of technical training prevented them from exploiting the full collaborative potential of CMC. Ms. Abar and Ms. Jrod, explained their self-perceived technical limitations in the following terms:

‘ There are a number of things that I do not know how to use yet ... CMC use may become more intense and efficient once one learns more ... I am limited to exchanging messages but if I have to download a file, I can’t do it (Ms. Abar, 10:27)’.

‘... we now have the technology available but we do not really know how to use it (Ms. Jrod, 4:7)’.

9.5.1.3. Communication discipline.

According to communication research, human communities share a set of rules, expectations and agreements for communicating with each other (Markus, 1987, Rafaeli and Larose, 1993). These agreements establish, among others, ‘reading obligations’ (i.e.. how often communicators are expected to read their messages in asynchronous systems) and ‘response obligations’ (e.g. the extent to which participants feel an obligation to give feedback to messages received). In some contexts, obligations are defined by formal rules. In the absence of formal rules, agreements may be established based on feelings of moral duty, peer pressure or tradition. Communication theorists refer to these sets of obligations as ‘communication discipline’.

As discussed above, there were no formal rules for the use of Teachnet. This research found that the communication behaviour of several Teachnet users (6) was shaped by this lack of ‘communication discipline’ in different ways. One is related to their ‘response expectations’, the other to the standing ‘rules for broadcasting’. These factors are discussed below.

Response expectations.

As discussed in Chapters 5 and 8, the level of feedback received by teachers to their messages was an essential factor in determining their satisfaction and continued use of CMC. The more teachers' requests were ignored, the less they used e-mail for obtaining professional resources. Even more generally, the fewer private messages they received, the fewer messages they wrote. Corroborating evidence, which is discussed in this chapter under 'Social response', for these results was found in the interview data.

There was also evidence that low *expectations* of obtaining feedback constrained e-mail use by some teachers (2), especially for time-sensitive communication. In other words, some teachers did not use the system because they believed the time their messages would be read was too uncertain. As Mr. Pleh explained:

'... the problem is ... that you never know when the other person will read your message and when he or she will reply ... This is the biggest drawback of CMC ... If you want to be sure that the person receives your message you have to use the phone... we need a rule making sure people read their messages every day (13:8)'.

This finding is in accordance with results of prior research (Riel and Levin, 1990, Chung, 1991). As Eskridge (1989, p. 125) recommended: 'Expectations must be made clear to all participants in regard to the necessity of regular use of the mail system'. An implication of this finding is that educational planners interested in fostering collegiality between teachers using e-mail should consider strategies for reducing these uncertainty levels.

Rules for broadcasting.

Reading e-mail messages is a 'costly' process, involving connection costs and time for downloading and reading and interpreting messages. The resources that teachers 'obtain' when using e-mail should offset those costs, otherwise they may discontinue their use of the medium. This means that the larger the proportion of messages received by teachers whose content is perceived as irrelevant, the lower the perceived rewards of using e-mail.

According to six teachers, some Teachnet users 'misused' or 'abused' public communication by 'broadcasting' messages of interest to only a fraction of the receivers. This eroded interest in using e-mail since teachers were forced to read large numbers of unsolicited messages, of which only a few were useful (this problem was partly caused by Teachnet's lack of a 'filtering' tool, as discussed below under 'Functionality'). The following excerpts from the interviews help illustrate this issue.

'Public communication was abused by many colleagues ... sometimes you would receive messages that were sent to everybody when they were clearly of interest to only one person. It was not a technical problem, it was misuse ... very often you received messages of a personal nature when you had nothing to do with the matter being discussed. This was a real problem ... (Ms Jcab, 9:3)'.

‘Most messages were sent to everybody! ... This was one of the main shortcomings of Teachnet ... It created a message overload of which a large proportion was unnecessary or uninteresting ... When I accessed the computer network I would find 60 messages or more of which 45 would be of no interest to me whatsoever ... it took so long to download and read all these messages with the prospect of finding very little of value that I just would not do it (Mr. Erod, 12:8)’.

‘Too often there are public messages of very little interest ... Some Maths teachers send messages to everybody automatically even if they are wishing a happy birthday to someone ... You then access the computer network to find 50 messages of which five are important because all the others were sent to everybody for no valid reason (Mr Pleh, 13:28)’.

9.5.2. Properties of the communication medium.

Teachers’ perceptions of electronic mail shaped their communication behaviour. These perceptions were categorised into two main groups: a) technical properties of electronic mail or ‘functionality’ and b) ‘richness’ (i.e. capacity to convey non-verbal cues and personalise messages).

9.5.2.1. Functionality.

Most teachers (13) mentioned different technical features of electronic mail as affecting their collegial use of the system. Some of these features *facilitated* e-mail use while others *constrained* it. The following table presents those technical features.

Functionality.
Asynchronicity (8).
Broadcasting capability (5).
Lack of message filtering capabilities (4).
Lack of privacy (3).
Written expression (10).

Asynchronicity.

Face-to-face or telephone communication requires ‘simultaneity’ (i.e. transceivers must attend the exchange at the same time). Simultaneity is costly for teachers, with their scarce time and complex teaching schedules. Electronic mail communication is asynchronous (i.e. people need not attend simultaneously to the communication exchange).

Asynchronicity was perceived as beneficial by many teachers (8) since it freed them from the need for ‘simultaneity’ and immediate response (that characterise for example FTF or telephone communication).

Some teachers felt that by using electronic mail they could send messages at any time without intrusive telephone calls to colleagues’ homes. As Mr. Eega put it:

‘... with this (e-mail) you just send your message and the other person reads it whenever it is convenient for him ... If when I come home tired in the evening some colleague calls me to ask me something, I am not pleased since I want to spend time with my family (8:15)’.

Ms Jrod concurred:

‘(e-mail) facilitates co-ordination ... Since I have access to electronic mail I have the chance to pursue some of the discussions initiated in those meetings ... sometimes I would have an idea at 11 PM and I could communicate it straight away (4:15)’.

Asynchronicity was also important to some teachers since it allows the receiver time to reflect before replying. As Mr Pleh argued:

‘(With CMC) I can reflect more on my reply without the pressure you feel if somebody is waiting on the line ... (13:34)’.

Broadcasting capability.

E-mail’s capability to send copies of a same message to multiple recipients was attractive to several teachers (5), especially when they were interested in the diffusion of information they perceived to be of ‘collective interest’, such as courses, lectures or seminars.

‘One of the main benefits (of e-mail) is that it gives you the chance to communicate with one, two or six persons at the same cost (Mr Joli, 6:42)’.

‘For us, working in the Science field, having a (computer) screen ... is an invaluable tool ... it is a real time saver ...you are able to discuss a project or evaluate an initiative in a few minutes sitting down (in front of the screen). Otherwise you would have to organise a seminar to exchange opinions with your colleagues (Ms. Bbes, 15:21)’.

Lack of message filtering capabilities.

Some teachers (4) felt that the specific electronic mail system used in the project did not provide adequate tools for filtering unwanted messages or at least grouping them in ways meaningful to the reader (e.g. social messages separated from professional). As Ms. Jcab put it:

‘... (messages) had no discernible order ... I had no idea where to look for the information of my interest ... You were forced to read the whole lot ... and this is difficult when time is scarce ... If messages were grouped according to content ... (e-mail) would be easier to use (9:21)’.

Ms Abra explained why one of her colleagues would not use the system:

‘He felt that it was a waste of time downloading so many messages when he only was interested in information related to the subject he taught (11:28)’.

Lack of privacy.

The nature of teachers’ e-mail exchanges was affected by their perceptions of the level of privacy ensured by the system (3). The teachers’ main concern was that students could somehow gain access to the content of their exchanges. It should be noted that none of these teachers was able to recall a specific instance of unauthorised access to TEACHNET. This perception, which is technically not groundless, might have been fuelled by popular press accounts of teenagers gaining unauthorised access to computer networks and databases²⁵.

This perception led teachers to avoid exchanging or discussing ‘sensitive’ materials (e.g. exams) by e-mail even when they found it useful from a logistical point of view:

‘you feel limited because students may gain access to the computer network ... and know about an exercise which is scheduled to be used as an exam (Mr. Rpit, 7:17)’.

‘Q: Did you exchange teaching materials?’

A: Not too much because we were afraid that students would be able to get hold of an exam before it took place... (Mr. Erod, 12:5)’.

This result is consistent with the findings of the analysis of communication content. As discussed in Chapter 8, although teachers used e-mail for exchanging teaching materials they seldom used it for coordinating or discussing specific instances of course planning such as exams.

Written expression.

Teachnet only allowed written expression. This technical characteristic of the system inhibited its use by some people for different reasons. Some teachers perceived higher mechanical costs (e.g. time to type) and psychological costs (e.g. writing apprehension) in typing than in *talking*. Other teachers perceived that the written word implies a higher level of personal accountability than verbal communication since messages may be forwarded to others or read and interpreted out of context. Consequently, they found communicating by e-mail more time consuming than communicating FTF since it needed to be more carefully written, presented and edited.

²⁵ An issue related to privacy is the intellectual property of e-mail content. Although this is far from a settled issue, especially in the framework of global use of the Internet, it is interesting to note that it has been highlighted as a factor constraining scientists from using electronic mail to disseminate new scientific information (Carley and Wendt, 1991, p. 436).

Writing apprehension.

As mentioned above, some teachers (4) were reluctant to use e-mail because they preferred to talk rather than write:

‘It takes longer than a phone call ... you have to type, read and review before sending an e-mail ... (Mr Eega, 8:16)’.

‘I’ d rather telephone people.

Q: Why is that?

A: Because ... It is definitely easier to *talk* to people (Mr Rpit, 7:18)’.

‘It is always better to talk to people. Isn’t it? (Ms. Abar, 11:42)’.

Formality.

Some teachers (7) were not apprehensive about writing, *per se*, but felt that as e-mail is registered in writing (and eventually subject to unauthorised dissemination to others), message content needed to be carefully edited and presented²⁶, and relevant to *all* receivers:

‘... (e-mail) content must be higher (sic) than verbal communication ... it must be clear that whatever I am sending using electronic mail is important for the others to receive ... this is not the case in FTF communication because whoever is listening may just not pay attention (Mr Joli, 6:7)’.

‘Accessing the computer network does not take much time but reading carefully, thinking and preparing answers take *a lot* of time (Ms. Abar, 11:20)’.

‘Q: Why don’t you use CMC any more?’

A: Due to lack of time.

Q: Is it very time consuming to send e-mail messages?’

A: It depends. It is very easy to say ‘hello’ to people but coordinating a teaching activity is a different matter’ (Ms Jrod, 4:9)’.

9.5.2.2. Richness.

It emerged from the interview data that teacher perceptions of the ‘richness’ of e-mail were a major factor influencing the use of CMC in many cases (8). The main dimensions of CMC’s richness discussed by the teachers are listed in the table below (the ‘richness’ theoretical construct is discussed in detail in Chapter 3).

²⁶ It should be noted that little evidence was found, when analysing message content, corroborating such attention to formal presentation. Although this research did not analyse systematically teachers’ writing from a language point of view (e.g. style, genre), it was apparent from basic inspection of content that syntax was in many cases closer to spoken than to written language. Indeed this result is compatible with most CMC research. Murray (1985) for example describes e-mail writing as a ‘form of orality’.

Richness.
Lack of graphics (5).
Lack of interactivity (4).
Lack of paralinguistic cues (2).

Lack of graphics.

Most teachers mastered very rapidly the transmission of textual information. However, sending graphical information (video, pictures, graphs or mathematical symbols) was beyond the reach of some teachers due to inadequate home equipment or to insufficient CMC training. As a result, a number of teachers (5) felt that e-mail was a medium for the communication of *text*. This restricted, in their eyes, its usefulness for supporting collaboration. As Mr. Pleh put it:

‘Exchanging teaching materials would be very useful, but in Maths you can’t write an exercise without mathematical symbols. Can you? (13:13)’.

According to Mr. Rpit:

‘I believe it would be very different if teachers, when communicating by e-mail, could use drawings. Particularly in Physics, if you want to discuss an idea or an exercise it is usually done using drawings. I strongly believe this is very important since it does restrict tremendously what you can do with electronic mail (7:20)’.

Lack of Interactivity.

As discussed in Chapter 3, communication theorists define ‘interactivity’ as the degree to which a certain medium supports interaction that resembles FTF conversation (Rogers, 1986). One of the key characteristics of interactivity is the ability to repair, that is to respond in a timely and flexible manner to clarify meanings and intentions.

E-mail’s lack of interactivity was perceived by some teachers (4) as an important factor inhibiting them in their use of this medium, specially when communicating with strangers. Ms. Abar explained her reticence to communicate using e-mail as follows:

‘... (in e-mail communication) you don’t have the opportunity to explain yourself immediately if something you say is unclear or misinterpreted ... you really have to be careful about what you write as you don’t get the nods and expressions that you get in a conversation to help you feel whether you are being understood correctly (10:19)’.

Mr Eega explained his preference for telephone communication for similar reasons:

‘... on the phone I may make a mistake in a dialogue with you and become aware of it on the spot ... If I send a (e-mail) message containing a mistake I would only find out much later after you and many other people may have read it ... How do you go about explaining to a lot of people that your mistake was only a misspelling and not a conceptual error ... I definitely see repairing (sic) mistakes in e-mail as more delicate than in FTF exchanges (8:17)’.

Lack of paralinguistic cues.

E-mail filters out most paralinguistic cues (e.g. intonation, body language) and this for some teachers (2), was an inhibiting factor to their electronic communication with colleagues. As Mr. Eega put it:

‘I sent a message which included some material as an example of what I *disagree* with and some people misunderstood it ... they thought this represented my actual belief. The problem is that often the meaning of a sentence changes according to the tone of voice you use ... and (in e-mail communication) you can’t emphasise or use intonation to make sure people understand that what you say is a joke for example (8:25)’.

9.5.3. Thematic content of public dialogues.

Through the unsolicited public messages they receive, teachers may ‘follow’ multiple ‘many-to-many’ dialogues. In some cases, they may ‘participate’ in such dialogues by contributing a message of their own.

This investigation found that the degree of affinity between the thematic content of such public dialogues (i.e. the topics of the public unsolicited messages they received) and the teachers’ professional interests strongly influenced their communication behaviour. The more message content diverged from teachers’ interests, the less they were inclined to use e-mail. As Ms. Abra stated:

‘Topics are the main thing! You use the computer network as much as the number of interesting topics you find (11:36)’.

A majority of the teachers (10) felt that the real value of CMC consisted in fostering exchanges and debates on issues of general educational significance as opposed to routine teaching matters. As Ms. Jcab put it:

‘I was interested in ‘heavy’ (sic) topics and as far as I could see there was little of that ...

Q: What was dialogue about?

A: ... there were some exchanges about teaching matters but they were too much oriented towards routine, practical things such as examinations ... I am not interested in that sort of thing, the sort of thing which deals with tomorrow’s lesson (9:8)’.

Mr. Erod was disappointed with the content of CMC exchanges for similar reasons:

‘I would have preferred discussions about educational research but there were none ... this would have been one of the main potential benefits of the computer network (12:16)’.

Mr. Skri argued that he expected e-mail to be specially useful for pedagogical discussion but:

‘It did not happen ... only two or three people contributed valuable opinions and reflections ... (14:39)’.

The content analysis of messages largely corroborated the reports of these teachers. As discussed in Chapter 8, a large majority of e-mail exchanges was related to teaching materials and other resources of direct relevance to teaching practice, while only a small share of communication was used to conduct more abstract pedagogical discussions.

Some teachers (7) felt that public messages should *not* be used for social purposes or routine announcements. Ms. Jacob explained why she reduced her frequency of access to the computer network as follows:

‘Q: Why did you reduce your frequency of access?’

A: Mainly because my personal interests were not fulfilled. My expectations were professionally oriented not social ... use of the computer network concentrated in a high proportion on social talk. I have no quarrel with that ... but it is not my personal interest ... I can’t spend my time reading that stuff (9:2)’.

Mr Pleh similarly told the researcher:

‘Sometimes I was very motivated, but at other times the messages just got the best of me. I lost my motivation to access the computer network.’

Q: What sort of messages?’

A: Stupid, irrelevant messages. People congratulating other people for their birthdays or marriages or whatever (13:15)’.

Ms. Bbes thought that e-mail should be used for ‘important’ communication:

‘... the screen should not be used to wish happy birthdays ... I believe we should give this thing (CMC) the real importance it deserves ... (15:2)’.

These teachers’ reports seem inconsistent with the findings of the analysis of topics of teachers’ messages. As reported in Chapter 7, less than 7% of public content addressed social and personal topics. This discrepancy may be a function of the research methods used in the different stages of the research. In previous stages, the content of messages was analysed while in this stage data was obtained through self-reports. It should be emphasised that both sources of data are valid although they reflect different phenomena. The results reported in this section show that in some cases, people’s *perceptions* of communication might be more influential in shaping their communication behaviour. Such discrepancies have been reported before by researchers who caution against overreliance on self-report methods for analysis of communication (Bernard and Killworth, 1977).

9.5.4. Social response.

According to the data, the level and nature of feedback received by teachers affected their use of e-mail for collegial purposes in a majority of cases (9). Teachers *expected* feedback from their colleagues using Teachnet. As Ms. Abar put it: ‘...when I send a ... message I always expect some answer ... (10:4)’. When they failed to obtain such feedback, their inclination to use e-mail was reduced.

These results are consistent with prior communication research (Fedor, Rensvold and Adams, 1992, Morrison, 1993, Infante et al, 1993, p.33). As Eskridge (1989, p. 122) concluded: '(teachers) who did not get mail named that as another important factor discouraging (CMC) use'.

Ms. Toch's discussion of two contrasting situations is illustrative. In the first, Ms. Toch explains why she developed CMC relations with some colleagues while in the second one she explains why she *failed* to establish links with others.

'Q: Why did you establish CMC relations with them?

A: They answered my requests ... Not only that. Their answers were of value and they showed they had given thought to my opinions and my questions (2:15)'

'Some teachers would not share *anything*...I asked (them) for ... the solution to a simple Maths exercise ... and they never replied! (2:37)'

9.5.4.1. Level of feedback.

Almost half the respondents (7) related their changes in communication behaviour to their 'disappointment' or 'frustration' with the lack of feedback to their requests and proposals. As Ms. Abra complained:

'You propose some topic, send a provocative opinion and *nobody* replies! (11:21)'

Ms. Bbes explained why she stopped sending messages after a few months:

'Q: Did you receive any replies to your proposals?

A: No.

Q: How did you feel about that?

A: Very frustrated. I thought it might be a personal thing, that people were rejecting me personally or maybe my line of work...

Q: What happened next?

A: Nothing because I did not write any more messages (15:3)'

Ms. Toch described her similar feelings:

'I am disappointed. I sent many proposals and nobody paid attention ... At this point I would not send any more public proposals ... In view of this general indifference why should I keep suggesting activities? (2:5)'

9.5.4.2. Nature of feedback.

Feedback is often called 'positive' or 'negative' in the communication literature (Infante et al, 1993). Positive feedback consists of those responses that are perceived as rewarding by the receiver (e.g. praise). Negative feedback consists of messages perceived as not rewarding (e.g. criticism).

Almost half the respondents (7) expressed the view that their communication behaviour had changed after receiving negative feedback from colleagues or because they *feared* receiving disapproval or criticism from their colleagues:

‘ There is a big difference between last year and now. Last year I would access the computer network twice every day ... now it is twice a *week*.

Q: Why this change?

A: Why? Because they told me I talked too much (she laughs) ... I used to be fascinated with Teachnet ... but some people made me feel embarrassed. Some time ago a friend of mine mentioned my name to another teacher and he said: “Toch? A real pain in the neck. She can’t stop sending messages...”.

Q: How did you feel about these comments?

A: They reduced my motivation ... I felt censored (Ms. Toch, 2:2)’.

‘The teaching profession is very jealous and aggressive. We are very quick to label people ... We are afraid to disclose our opinions, to express ourselves freely, because we fear peers’ judgement (Ms. Abar, 10:7)’.

‘We are sometimes afraid to disclose what we do, for example our examination questions. What are the others going to think? “Look at his questions. They are silly” ... I believe this inhibits most people (Mr Odia, 3:4)’.

‘Q: When you obtain some interesting material or information, do you let your colleagues know about it?

A: No, I don’t, but not out of selfishness ... There is no habit of sharing. I believe this happens because of apprehension. I may tell people about something I find superb and find that they disagree with me. They may question my professional judgement. Why should I put myself on the line? (Mr. Eega, 8:4)’.

The evidence suggests that negative feedback (and the fear of it) may be a function of the professional norms prevailing in the community, which are discussed under ‘Professional norms’ in the following section.

9.6. The community.

The literature has emphasised in recent years the need to study people’s communication behaviour within their social and organisational contexts (Feenberg and Bellman, 1990, Schmitz and Fulk, 1991, Zack, 1993). This investigation found that e-mail use was influenced by factors related to the Teachnet community’s professional norms, social structure and working conditions. The following table lists those factors.

The community.
Professional norms (14).
Self-reliance (14).
Privateness and non-intervention (6).
Egalitarianism (3).
Social structure (13)
Homophily (12).
Acquaintanceship (9).
Professional partnership (11).
Working conditions (14).
Lack of time for CMC (12).
Opportunities for FTF interaction (9).

9.6.1. Professional norms.

This study found in almost all interviews (14) that the norms of self-reliance, privateness and egalitarianism constrained the use of e-mail for collegial purposes. These results corroborate previous collegiality research (Lortie, 1975, Little, 1982, Rosenholtz and Kyle, 1984), which has found that teachers hold norms on what constitutes legitimate and rewarding collegial interaction and that their collegial behaviour is affected by such norms (see Chapter 1).

These results, shedding light on the professional norms held by this group of teachers and their effect on collegial behaviour, were also useful because they provided important insights into the *existing* patterns of collegiality among Uruguayan teachers. Although this was not a specific aim of this research project, it was helpful to corroborate the extent to which the findings of international research are applicable to the local context. This is discussed in the last section of this chapter.

9.6.1.1. Self-reliance.

According to the collegiality literature, teachers strongly value the norms of autonomy and non-intervention whereby colleagues are expected not to ‘interfere’ (e.g. provide unsolicited comment or advice) with their teaching. In return, teachers perceive that self-reliance is expected of them.

The interview data (14) suggested that such norms influenced the communication behaviour of the Teachnet teachers. Communication behaviour was constrained by the teachers’ need to preserve their professional reputations. As Ms. Jrod put it:

‘It seems that you close the door of the classroom and you have to be omnipotent and take care of every conceivable issue. You are expected to be a multidisciplinary team. You have to be a sociologist, a psychologist, a biology teacher ... teachers are expected to solve everything on their own (4:24)’.

Mr. Eega concurred:

‘... I do not turn to colleagues for help.

Q: Why is that?

A: It is about professional pride. As a teacher, you are supposed to know everything. My wife is a physician and she and her colleagues have much more interaction than us ... In the case of teachers, for some reason we are expected to know everything we need (8:40)’.

Many teachers felt that requesting assistance implied a public acceptance of low resourcefulness, which challenged the self-reliance norm and threatened their professional reputations.

‘One has the impression that by requesting assistance, one is projecting an image of ignorance about the “tricks of the trade”. Therefore, one is afraid of asking anything. I believe this is true for most people (Mr. Erod, 12:26)’.

‘Many people do not ask for help because they do not want to admit to others that they have problems ... People do not openly admit needing support (Ms. Jcab, 9:35)’.

‘I believe (teachers) are afraid of being wrong in what they say or of admitting that they do not know (Ms. Toch, 2:18)’.

This influenced the teachers’ selection of resource seeking strategies. Social exchange research suggests a number of general methods by which individuals acquire resources: a) inquiry, b) monitoring, and c) self-provision (Burke and Bolf, 1986, Morrison, 1993). Interview data showed that many teachers preferred strategies b) and c) because they did not require public disclosure of needs.

‘Technet gives me a useful means to keep an eye on what is being said and done ... All this may provide me with new ideas (Mr. Skri, 14:24)’.

‘Many people avoid making requests.

A: How do they obtain the information or advice they need?

...

Q: They observe, they listen, they read messages ... This is very common with teachers. It is a mechanism to obtain information without actually asking for it (Ms. Jcab, 9:35)’.

‘I have more than a thousand Physics books at home ... I do not usually need to look elsewhere or consult with anybody (he laughs) (Mr. Joli, 6:35)’.

‘If there is anything I need to know more about I just go downstairs, to the library (Ms. Pszt, 5:15)’.

‘We’d rather use other sources (rather than e-mail), less “public” sources, books mainly. ... The computer network forces you to conduct your affairs publicly while with books everything remains discrete (Mr. Odia, 3:25)’.

9.6.1.2. **Privateness and non-intervention.**

As discussed in Chapter 1, privateness and autonomy have been described by educational sociologists as major professional norms among secondary school teachers (Lortie, 1975, Smylie, 1989, McTaggart, 1989). Within this professional ethos, many teachers feel that classroom teaching is mostly a private, individual activity and that they have the *right* to keep their practices closed to peers' opinions.

Interview data showed that some teachers (6) felt constrained in their use of e-mail for professional exchange by these norms. These teachers perceived practice-focused collegial exchanges as infringing the 'right' to unexamined practice:

'I believe it is *unethical* to comment on somebody else's teaching. It is not my role (Rpit, 7:28)'

'Frankly... I would not tell another teacher that his or her teaching approach is not the best, I just don't do it'

Q: Why is that?

A: Because I did it when I started teaching and the results were horrible.

Q: What do you mean?

A: They lashed at me. Teachers do not accept others to just come and criticise their teaching. I soon realised that this is not done' (15:19).

9.6.1.3. **Egalitarianism.**

Egalitarianism is a strong cultural norm in the teaching profession (Lortie, 1975, Lieberman, 1988, Smylie, 1989). According to the interview data, the egalitarian norm constrained the use of Teachnet for professional exchange (4). As Ms. Toch put it:

'I would not offer unsolicited advice to anybody. We all have the same rank. I have no authority to judge anyone's teaching ... This is the principals' and inspectors' role' (2:45).

Some teachers felt that unsolicited sharing of ideas or materials amounted to 'boasting'. They were afraid of being perceived as 'arrogant' (Ms. Bbes, 15:12). According to Ms. Pszt:

'You sometimes choose not to share something new ... because you are afraid people will see you as being too self-satisfied with yourself (5:52)'

Other teachers refrained from public e-mail communication because they felt that their views diverged from the community's. Some communication theorists have called this attitude 'social alienation' (Infante et al, 1993, p. 153). This was the case of Ms. Bbes who told the interviewer:

‘There is a community of teachers (related to the Teachnet project) ... I don’t share the predominant views on the main topics and I can’t disagree with everybody ... It is unethical to push your own views against the current (15:5)’.

9.6.2. Social structure.

As discussed in Chapter 3, from the network theoretical perspective, interaction patterns (e.g. who talks to whom, who exchanges resources with whom) within a community are defined by ‘physical determinants’ (e.g. who works near whom) and ‘social determinants’ (e.g. who knows whom, who is a trusted source of advice for whom). ‘Physical determinants’ define a community’s ‘physical structure’ and ‘social determinants’ define its ‘social structure’.

According to the interview data, three social determinants influenced the use of Teachnet by the stable participants: a) *previous acquaintanceship*, b) *professional homophily*, and c) *professional partnership*. In other words, teachers preferred to communicate using e-mail with colleagues they knew (rather than with strangers), with teachers of the same subject (rather than with colleagues teaching different subjects) and whenever possible, with their ‘preferred partners’ (i.e. those teachers with whom they had established a collaborative relationship over some time).

9.6.2.1. Acquaintanceship.

A majority of the teachers (9) were reluctant to communicate with strangers. This result is highly consistent with the quantitative findings reported in the previous chapters. Teachers created almost six times more relations with acquaintances than with strangers.

‘Q: How often do Maths teachers consult each other about teaching matters?’

A: Not very often but it happens. Mostly when there is a long standing relationship between them ... I guess we are used to having to know people before asking or giving anything to them (Mr. Erod, 12:7)’.

‘Communication between colleagues depends on who knows whom. I would not consult any stranger about anything related to my teaching ... I fear how a stranger could feel about me (Mr. Eega, 8:47)’.

‘I used e-mail to communicate with four or five colleagues who were the same persons that I usually communicate with (Ms. Jcab, 9:4)’.

‘Exchanges happen between people who are close ... This is because we know that a certain topic will be of mutual interest. (Mr. Hdea, 1:4)’.

‘Sometimes, we the teachers are afraid of expressing ourselves in front of strangers (Ms. Abar, 10:7)’.

9.6.2.2. Professional homophily.

The interview data showed that professional homophily (i.e. teaching the same subject) also affected the development of e-mail relations (12):

‘Communication takes place mainly between teachers of the same subject. There is a tendency to confine yourself within your little group. I mean Maths, Biology, Physics whatever your subject is, it becomes your whole group (Mr. Joli, 6:28)’.

‘There is no real exchange between teachers of different subjects. It never occurs to me to discuss my teaching with the Maths teacher. The space between subjects is a lonely place (Ms. Jrod, 6:29)’.

‘We all admit that teaching should be an interdisciplinary endeavour ... but it does not happen that way ... We were educated following a model of compartmentalised subjects ... How could we now behave in a different way ? (Ms. Abar, 10:21)’.

This result is also highly consistent with the findings of the quantitative and content analyses reported in the previous chapters. As discussed in Chapters 6 and 8, teachers were much more likely to send private messages to, create relations with, and reply to subject colleagues than to teachers of other subjects. In fact, the overall evidence showed that subject boundaries tightly delimited the contours of e-mail based collegiality.

9.6.2.3. Professional partnership.

According to the interview data, eleven teachers declined to use e-mail for exchanging professional resources because their ‘preferred partners’ did not belong to the Teachnet community (i.e. they were ‘outsiders’²⁷).

‘...We share some professional interests because she is a psychiatrist and has a strong interest in Science learning problems ... We usually talk a lot, we see each other every day and we started using the computer network to talk even more but again, it happens because we share some professional interests (Ms. Jcab, 9:26)’.

‘(For me to rely more on electronic mail) I would like to have in Teachnet some ‘personalities’ ... such as Mr. Pablo, Mr. Carlos or Mr. Mario (but none of them use Teachnet) ... (Mr. Joli, 6:13)’.

‘The person with whom I most need to communicate does not participate in Teachnet (Mr. Eega, 8:35)’.

‘When I need assistance in my teaching I turn to colleagues of my subject of high repute whom I am familiar with because they were my teachers in the Teaching College... However, there are none in the computer network ... I have to contact them on the telephone (Mr. Erod, 12:37)’.

²⁷ The term ‘outsider’ refers to any individual who does not belong to the user community. The definition of ‘outsider’ depends on the boundaries defined for each network. Therefore, findings may look different with boundary changes (e.g. if a fifth school joins Teachnet many ‘outsiders’ may become part of the user community). The ‘outsider’ status may change with time. For example, a Teachnet user who stops accessing the system becomes an ‘outsider’.

9.6.3. Working conditions.

This research found that the organisation of teachers' work affected their use of e-mail in several ways. Lack of time constrained their use of the system for collegial purposes. Teaching schedules, meeting facilities and the physical layouts of the schools determined how easy it was for teachers to meet FTF (and hence how necessary e-mail was for them).

These results are consistent with previous research. The literature on the sociology of teaching and educational change has documented for many years the impact of teachers' perceptions of their working conditions on what they feel able to do (Schwartz et al, 1987, Little, 1990).

9.6.3.1. Lack of time for using e-mail.

In accordance with much of the literature on educational change (Fullan, 1992, Schwartz et al, 1987, Johnson, 1990), this investigation found that for most teachers (12), lack of time was a major constraint to collegial use of CMC.

'My free time is scarce. I mean really scarce ... Sometimes I even forget that I have a computer at home (Ms. Jrod, 4:20).'

'I'd love to communicate much more with my colleagues ... but I can't find the time ... The computer network works just fine from home and from school but my problem is time, time ... (Ms. Pszt, 5:40).'

'Time is the main problem. Non-teaching time, time for using e-mail for example, is virtually not available to us (Mr. Rpit, 7:21).'

In some cases (9), teachers argued that their lack of time for collegial communication was the result of their personal commitments rather than an unavoidable consequence of the amount of workload defined by their schools. The important issue here is that these teachers perceived time restrictions as a function of individual choices *under their own control*. As Mr. Jrod and Mr. Eega explained:

'I had two phases in terms of using electronic mail. Last year I read my messages every day and wrote a lot ... This year my work situation has changed and I am very little at home ... At the end of last year I accepted a teaching position at the National Teaching College and that changed everything because this involves 24 more hours a week! (Mr. Jrod: 4:1).

'At the beginning of this year, a colleague of mine invited me to join a team to write a book for grade 3. Therefore, this year I have spent many hours a week using the computer but not accessing the computer network. At most I quickly read my messages but I have no time to answer any of them (Mr. Eega, 8:4).'

9.6.3.2. Opportunities for FTF interaction.

According to the data, many teachers (9) chose to communicate FTF with colleagues *whenever possible*, irrespective of communication intent or content. Therefore, the more opportunities these teachers had for FTF interaction, the less they used e-mail.

‘We (the Churchill school Biology teachers) do not need the computer network to communicate among us ... We work together from 8 to 5 PM ... (Mr. Odia, 3:5)’.

‘I meet half of (the Teachnet Physics participants) daily or at least weekly ... This chance for direct contact reduces the need for CMC, doesn’t it? (Mr. Rpit, 6:9)’.

Ms. Pszt maintained an e-mail relation with Mr. Eega for many months. The exchange was interrupted abruptly at a certain moment. The respondent explained this interruption as follows:

‘We had no quarrel. Not at all (she laughs). In the second semester of the year, my teaching schedule changed and we coincided for an hour a week where we could coordinate everything we needed (5:20)’.

9.7. Summary of results.

In this stage of the research, a number of factors affecting the use of e-mail for collegial purposes were identified through qualitative analysis of data obtained from 15 in-depth interviews of teachers who used Teachnet and triangulation with the results obtained in the previous stages of the research.

This set of interacting, personal, technological and social factors consists of some factors that *constrain* and others that *facilitate* e-mail use. The stronger the constraining factors in relation to the facilitating ones, the less collegiality will develop. Although these factors are interrelated, it is important to recognise that they operate at different levels. Changes emphasising factors at *some* of these levels may fail to make a sustainable impact on collegiality in the presence of powerful inhibiting factors operating at different levels. For example, increases in telecommunications speed, in the graphical capabilities of the e-mail system or in the number of teachers with home computers may fail to increase collegiality in the presence of powerful occupational norms setting high professional costs for seeking advice.

These results are used in the following chapter to help answer research question V:

‘How can the collegial communication behaviour of teachers using electronic mail be explained?’.

The main findings from the interviews, relevant to this research question, are summarised below. These factors operated at different levels: a) the individual teacher b) the communication system and c) the user community. The table below lists the factors in each level.

Factors affecting e-mail use by teachers.	
The teacher.	
	Personality traits.
	Views on teaching and professional improvement.
	Attitude towards technology.
The communication system.	
	Organisation of system use.
	Properties of the communication medium.
	Thematic content of public dialogues.
	Social response.
The community.	
	Professional norms.
	Social structure.
	Working conditions.

The first group of factors was related to the individual teacher: a) personality traits (e.g. timidity, sociability), b) views on teaching and professional improvement (e.g. no need for immediate advice, inherent uncertainty of teaching), and c) attitude towards technology. The following table details the factors associated with the teacher.

Factors related to the individual teacher.	
Personality traits (8).	
	Timidity and sociability (7).
	Collegial duty (6).
	Self-esteem (6).
Views on teaching (10).	
Attitude towards technology (6).	

The second group of factors was related to the communication system, its technical properties, how its use was organised and the content of communication: a) Organisation of system use (e.g. support services, contribution rules), b) views on electronic mail (e.g. functionality, 'richness') and c) content of CMC exchanges (content of public messages, social response). The table below lists the factors related to the communication medium.

Factors related to the communication system.	
Organisation of system use (10).	
	Task organisation (7).
	Response opportunities (7).
	Communication discipline (6).
Properties of the communication medium (13).	
	Functionality (13).
	Richness (8).
Thematic content of public dialogues (10).	
Social response (9).	
	Level of feedback (7).
	Nature of feedback (7).

The third group of factors depended on the user community: a) professional norms (e.g. self-reliance, privateness, autonomy), b) social structure (e.g. homophily, acquaintanceship) and c) working conditions (e.g. teaching schedules, lack of time). The next table lists these factors.

Factors related to the community.
Professional norms (14).
Self-reliance (14).
Privateness and non-intervention (6).
Egalitarianism (3).
Social structure (13).
Homophily (12).
Acquaintanceship (12).
Professional partnership (11).
Working conditions (14).
Lack of time for CMC (12).
Opportunities for FTF interaction (9).

9.8. Collegiality among the teachers using Teachnet.

Some data on the existing patterns of collegiality were collected in the interviews (e.g. how often did these teachers communicate with colleagues, what was the purpose of their collegial interactions).

The study of existing collegiality in Uruguayan schools was *not* an aim of this research project (which sought to further our understanding of how and why collegiality may develop among teachers *using e-mail*) and therefore there was no attempt to investigate it *in-depth*. As discussed in Chapter 4, Section 5, the reason for collecting these data was that it was thought useful for enriching the readers' understanding of the context in which the research took place.

The results suggest that, in broad terms, collegial patterns in these four Uruguayan schools may be compatible with those established by research in other countries. According to the data, the interviewed teachers usually conducted few and sporadic interactions with colleagues and few of those interactions were teaching-related. In accord with international findings, teaching was repeatedly described as a 'solitary' activity. Teachers highlighted their acute lack of time, incentives and opportunities to work with colleagues. They also described how the professional norms of teaching in Uruguay, as they perceived them, shaped their collegial behaviour. The interview evidence concerning the existing (FTF) collegiality among the teachers using Teachnet is included in Annex 9.

These results, suggesting that collegiality among Uruguayan teachers may be very limited in extent and nature, are compatible with anecdotal evidence obtained in discussions with teachers of the four schools during preliminary fieldwork. As mentioned in Chapter 4, in the initial meetings with teachers of the four schools, the researcher discussed the issue of collegiality as described by international research. One of the aims of those meetings was to obtain teachers' opinions about the importance of investigating strategies for fostering collegiality between secondary school teachers. The overall impression left on the researcher was that those teachers felt that the main results of international collegiality research were fully applicable to the Uruguayan situation.

These results are also compatible with some findings from related research carried out in Uruguayan secondary schools. These investigations, although not focused on collegiality, have outlined a number of features of the organisation of teaching in Uruguayan schools that have been identified elsewhere as constraining collegiality (Grünberg, 1991, Chiappe, 1997). First, Uruguayan secondary schools are not structured in subject-specific departments

(unlike, for example, schools in the UK). This is important because research (Lieberman, 1988, 1990) has consistently identified the subject department as one of the main contexts for collegial interactions between secondary school teachers. Second, each group of students in Uruguayan secondary schools remains in one classroom and *teachers* have to move from one classroom to the other during the school day (unlike countries where some subjects have their own classrooms and *students* move). According to research, the time required for these movements from one classroom to the other, especially in large buildings, constrain teachers' opportunities to have contacts with colleagues (teachers literally speak of 'running all day' from one classroom to another). A third factor is multi-employment. Most secondary school teachers in Uruguay work at more than one school. Grünberg's 1991 results suggest that working in several schools reduces the time available to teachers for interacting with colleagues and reflecting on practice, and that part-timers find it difficult to establish close relations with colleagues.

In sum, evidence obtained in the fifth stage of the research suggests that the main patterns of existing collegiality among the teachers in this study were broadly consistent with the international literature. Anecdotal evidence and results of related research carried out in Uruguayan schools support this conclusion.

CHAPTER 10

Explaining communication behaviour

10.1. Organisation of this report: the route to research question V.

Five research questions guided this study. The intention of the first four questions was to establish the communication behaviour of teachers using e-mail. The fifth question sought to develop an explanatory framework for those results.

Each of the first four research questions addressed a different dimension of communication behaviour and was answered in a separate chapter as shown in the table below.

Research question.	Chapter.	Dimension of communication behaviour.
I	5	E-mail use (system access, message writing, message sending).
II	6	Creation and development of e-mail collegial relations.
III	7	Topics discussed using e-mail.
IV	8	Exchange of professional resources using e-mail.

The fifth and final research question is answered in this chapter. Explanations for each of the above four dimensions of communication behaviour are presented in turn, drawing upon data from all stages of the research, especially the interviews discussed in Chapter 9, and relevant literature. Detailed statistical data can be found in Annexes 5, 6, 7 and 8.

10.2. Explaining e-mail use.

One of the key findings of the second stage of the research was that **while a majority of the teachers used the system, usage levels varied widely**. Most of the teachers used the system sporadically with only a small kernel using it daily.

As discussed below, the traffic data provided relatively little evidence to explain these large differences in system use.

E-mail usage was not associated with demographic factors such as gender, age or teaching experience. Thus electronic communication does not seem to be dominated by young teachers or predominantly adopted by more experienced, self-confident veterans. This finding is compatible with most prior research (Kerr and Hiltz, 1982, Steinfield, 1983, p. 106, Sproull and Kiesler, 1986, p. 698, Jones, 1987, Beals, 1990, Broholm, 1991, p. 164). Neither was usage affected by professional affiliation factors such as school or subject taught. The former may be explained by the relative similarity of the four schools, all of them urban, private and relatively affluent. It is possible that an investigation of e-mail use in rural or public schools could find different patterns of e-mail usage. A possible reason for the latter is that all teachers taught science or maths. Previous research in Uruguayan (Grünberg, 1991) and U.S. schools (Broholm, 1991) suggests that teachers of other subjects (e.g. language, history, literature) may show different usage patterns of a technology-based communication system such as e-mail.

Of the quantitative variables, the *number of private messages received* was the most useful for discriminating between long-term and short-term users. The fewer private messages teachers *received*, the fewer messages they *wrote*. This finding, which points to the feedback received as a critical factor for sustained e-mail use, was strongly corroborated, as discussed in Chapter 9, by the findings of the interview data and is consistent with the literature (Ashford, 1986, Eskridge, 1989, Morrison, 1993). Explanations for the impact of the level and nature of the feedback received on communication behaviour are discussed later in this chapter under 'Explaining the exchange of professional resources'.

Writing was correlated with the number of *private* messages received but this was not true for the number of *public* messages received. This finding gives some support to 'richness' theories of media use. According to 'richness' theorists, the level of 'personalisation' of the media used to address people affects their communication behaviour. For example, people may feel more compelled to read (and to answer as discussed under 'Explaining the exchange of professional resources') a private letter than a leaflet sent to thousands of people (Steinfeld, 1986). As public messages are not personalised in form or content for any particular receiver, receivers may feel less compelled to provide feedback to public messages than to private ones. This may also explain why teachers were less reluctant to send *public* messages to strangers than *private* ones. Teachers may feel that public messages create lesser 'feedback obligations' on receivers, who therefore may not 'resent' receiving public unsolicited communication in the same way they may 'resent' the 'obligations' unwillingly imposed on them by *private* unsolicited communication.

The level of access to the system was associated with the amount of e-mail use. Teachers with home computers logged into the system three times more often and wrote 21 times more messages on average, than those who did not have access to a home computer²⁸. This result is consistent with most prior research (Johnson and Johnson, 1987, Katz et al, 1987, Castle et al, 1991, Broholm, 1991, Chung, 1991, Teles and Duxbury, 1991, Bruce and Rubin 1993, Collis, Veen and Devries, 1993, Stuhlmann, 1994, O'Grady, 1994). As Steinfeld (1983, p. 103) concluded: '... no matter what the nature of a person's job or orientation to electronic mail, without access to the system ... uses of electronic mail are quite unlikely'. It should be noted that although access to the system seemed to be a prerequisite for system use, it did not *ensure* it. For example, teachers seldom sent messages from school, although most of them had access to computers in their staffrooms. The implications of this finding are discussed later in this chapter.

As discussed in Chapter 9, the interview data helped identify a set of other factors, besides the level of access and the number of private messages received, affecting e-mail use, which help explain the large differences in e-mail use between the teachers. These factors are discussed below.

Some of these factors were related to the individual teacher: personality traits (i.e. timidity, low self-esteem, sociability and collegial duty), views on teaching and professional improvement, and attitudes towards technology (some teachers 'dislike' or 'distrust' computers). These results may be interpreted from the social exchange theoretical perspective. The stronger the intensity of teachers' self-perceived timidity, low self-esteem and 'dislike' of computers, the higher the psychological *costs* of using e-mail for communicating with colleagues (especially with strangers and especially using public messages). Conversely, the stronger the intensity of teachers' self-perceived sociability and

²⁸ Proximity to a school computer was associated with system access but was not associated with message writing. This suggests that reading messages and sending them may require different access conditions. As West et al (1989, p. 63) concluded: 'While a teacher might have time to log in from school, there is little time after reading messages to think through and write a response'.

sense of collegial duty, the higher the perceived psychological *rewards* of communicating with colleagues. Such rewards were also related to the extent to which teachers held views that put a strong value on professional exchange. For example, those teachers who believe that teaching is based on innate ability may perceive low rewards in engaging in collegial interactions since they perceive that their colleagues can (or indeed *should*) contribute relatively little to their own professional goals. These results obtained from the interview data were highly consistent with the results from the quantitative analysis of the traffic data, which strengthens the validity of the findings. For example, those teachers who expressed strong feelings of 'duty' towards their colleagues (e.g. Hdea, Toch) performed significantly more unsolicited contributions than the rest, and more generally, made a more intense and sustained use of the system.

It is important to note that, as these factors operate at the psychological level, their effects on communication behaviour are unlikely to be modified by technological or organisational changes. For example, if people do not send messages to strangers because of timidity, it is unlikely that they would do so with a faster e-mail system. Similarly, if some teachers do not engage in collegial communication because they believe that teaching should be a private 'teacher-student' activity, altering such behaviour requires first changes in those views. This is surely a complex, long term endeavour, unless special compulsory arrangements (such as team teaching) are put in place, in which technology may have little or no impact (see Fullan, 1990 for a discussion of the importance of teachers' beliefs in processes of change).

The psychological traits of teachers interacted powerfully with some technical properties of e-mail leading to important differences in system usage. One of the key issues was the need to communicate in writing. Many teachers perceived that the written word implies higher levels of personal accountability than verbal communication since messages may be forwarded to others or read and interpreted out of context. Consequently, they found CMC needed to be carefully written, presented and edited. Otherwise, the image of the author may suffer among his or her peers for careless writing. Another consequence of the need to communicate in writing was the lack of paralinguistic cues. According to Goffman (1967), 'glances, gestures, positionings, tone of voice' conveyed during FTF encounters constitute part of the essence of communication. Meaning and intention can be interpreted very differently with small differences in voice, eye contact or body language. As written communication filters out most of these paralinguistic cues, some teachers perceived that their messages could be misunderstood and hence generate negative feedback. Another technical property of e-mail affecting communication behaviour was its lack of interactivity. As an asynchronous medium, e-mail lacks the capability to interact in 'real time'. Consequently, e-mail lacks the ability for 'repair', that is, to respond in a timely and flexible manner to clarify meanings and intentions. Some teachers felt that this also implied higher risks of misunderstandings and conflicts with colleagues. This result is compatible with previous research which has found that e-mail might be perceived as inappropriate when a high level of 'repair' is required (Zack, 1993). In sum, some teachers may have made little use of e-mail because they perceived it as more time consuming and 'risky' (i.e. more prone to misunderstandings and conflict) than FTF communication. It should be noted that although these technical properties of e-mail are the same for all users, their *effects on communication behaviour* may be very different, since they interact with personality traits. For example, while some teachers, timid or with low self-esteem, may find the risk of generating negative feedback an unacceptable cost of using e-mail, others may be relatively indifferent to it. As Miller and Jablin (1991, p. 97) put it: '... although the social disapproval of peers may be too great of a cost for some to incur, others may consider such a cost unfortunate but not significant enough to warrant a behavioural change'.

The working conditions of the teachers also affected their use of e-mail. In accordance with much of the literature on educational change (Fullan, 1992, Schwartz et al, 1987, Johnson, 1990), it was found that lack of time was a major constraint for most teachers to the use of e-mail. However, the evidence suggested that e-mail use might not be a simple function of the time available (with more time available leading to more e-mail use). It was found that teachers used e-mail as much on weekends as on weekdays although they have more time available during weekends, which they routinely use for professional purposes such as planning lessons or grading²⁹. Teachers' views on teaching and professional improvement may explain this result. According to the interview data, some teachers attach higher value to other professional activities (e.g. reading books, planning lessons, preparing teaching materials, talking to students out of class) than to collegial exchange or collaboration. In sum, low levels of e-mail use may be the result of teachers' choices between competing uses of their limited time (based on their professional views and beliefs) rather than an unavoidable consequence of crowded schedules. An implication of this interpretation is that even if there were more time available, teachers may use it for other purposes than collegial exchange. Indeed there is some evidence from research carried out in Canada that this may be the case (Hargreaves and Wignall, 1989). This is not to minimise teachers' lack of time as a constraint to collegiality, but to emphasise that even teachers with tight schedules may engage in e-mail collegial exchanges if their professional views and beliefs put a high value on collegial exchange and collaboration.

Another contextual factor affecting e-mail use was the level of training and technical support available. According to the interview data, insufficient training and technical problems disrupted the use of e-mail by many teachers. Physical access to equipment is not enough to ensure that teachers use the system. Equipment must work properly, and when it breaks down, an adequate level of technical support is needed. Last but not least, teachers should be trained in all key functions of the system. A number of authors have documented in the CMC literature the importance of careful logistic planning for sustained CMC use, specially the adequate provision of training and support (Riel and Levin, 1990, Chung, 1991, Riel and Harasim, 1994).

Besides their private exchanges with colleagues, teachers participated in public, many-to-many, 'dialogues' through the public messages they sent and received. Such participation was an important part of their CMC experience since, on average, 83% of the messages received were public. According to the interview data, the degree of affinity between the thematic content of public dialogues and teachers' professional interests, strongly affected e-mail use. Teachers had diverse professional interests and hence different expectations about the content of the messages they received. For example, some teachers felt e-mail should be used for pedagogical discussions of interest to all teachers while others felt its main value was to support exchanges of teaching materials with subject colleagues. The evidence suggests that those teachers who found communication content of little or no relevance to them may have discontinued their use of the system. A conclusion that may be drawn from this evidence is that the more public content diverges from teachers' professional interests, the less they may use e-mail for collegial purposes. These findings are highly consistent with the expectations of social exchange theorists that the communication behaviour of people is influenced by the 'perceived usefulness' of the resources they obtain as part of communication processes (Alavi and Henderson, 1981, Abelson and Levi, 1985).

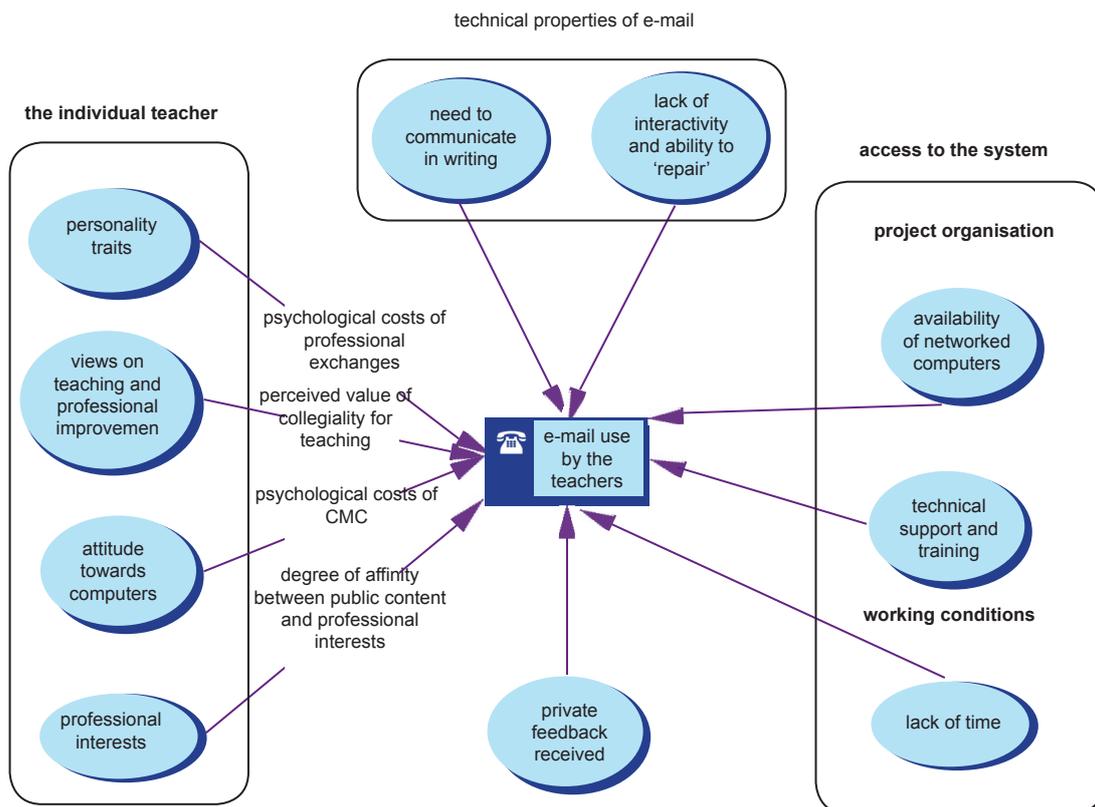
In sum, according to the evidence, there were individual differences between the teachers, based on their psychological traits, professional beliefs, professional interests and level of

²⁹ Teachers' use of their non-teaching time is a complex, heavily researched issue, of which a full discussion would fall beyond the aims of the study. Grunberg (1991), Hargreaves (1992b) and other authors provide a review of prior research and evidence of their own investigations on this issue.

access to the system (which combines a number of different variables such as availability of a home computer, time for communication, training and technical support) which help explain the important differences in usage levels found in the traffic data. The graphical representation below summarises the above-discussed factors affecting e-mail use.

In the second stage of the research **it was found that most messages were sent privately** (79.2%). This result is compatible with previous research carried out both in educational (West et al, 1989, Castle et al, 1991) and non-educational contexts (Steinfeld, 1983). Indeed, in most studies where public and private communication were considered (a small minority of the investigations), private communication was the overwhelming choice of users. This pattern of behaviour is discussed extensively under 'Explaining the exchange of professional resources'.

An interesting finding was that **private messages were seldom sent to strangers**. This finding, discussed in detail in the following section, is important because it suggests that the potential of e-mail to support an *expansion* of teachers' collegial networks (i.e. those colleagues with whom a teacher regularly communicates) may be very limited (this is not to say that no contacts were made with strangers, the point is that teachers' private communication was strongly biased towards colleagues they already knew before starting to use e-mail). However, the evidence suggests that *public* communication may help overcome, at least in part, this limitation. According to the data, **public communication seemed less constrained by previous acquaintanceship** than private messaging. Teachers sent a majority of their messages to the ALL group although, on average, three quarters of the receivers were unknown. And there was no correlation between the number of public messages sent by teachers and the number of participants they were previously acquainted with. In fact, the evidence suggests that one of the key roles of public communication in e-mail systems may be to facilitate contacts between strangers. This result is compatible with Sproull and Kiesler's (1986, p. 698) finding that '97% of all messages whose partner was unknown were group messages'. These findings give some support to 'reduced cues' theories of CMC (Sproull and Kiesler, 1986). Sproull and Kiesler argue that when people send public messages, receivers are 'hidden' under a collective address. Consequently, over time, senders may become psychologically less 'aware' of the differences, in status and other variables, between themselves and the receivers, hence supporting a more 'unregulated' communication environment.



10.3. Explaining the development of e-mail relations.

This research found that the 75 teachers created 121 relations between them during the period of study (4.4% of the 2775 possible relations), most of which were unstable. The traffic and interview data helped identify a number of factors affecting link creation and development and explain why some relations were created and maintained over time while others were not created or were discontinued after some time.

One of the main factors was the 'social structure' of the community. According to the interview data, some of the teachers did not use Teachnet because their 'preferred partners' (i.e. those colleagues they especially trusted or respected and with whom they had an existing collaborative relationship) were not 'reachable' through the system. According to research, relations with 'preferred partners' have frequently been established for many years and people find changing or expanding these networks a slow process involving costly psychological and social processes such as building trust and confidence and mutual recognition of professional competence (Markus, 1987, Rafaeli and Larose, 1993). Thus, a conclusion that may be drawn is that the larger the number of teachers' 'preferred partners' that can be reached using e-mail, the more likely it is that they will use the system for collegial exchange. These results give some support to the 'critical mass' theoretical approaches to research on media use. Markus (1987) found evidence that some people perceived low benefits in using CMC because many of their preferred counterparts were not reachable while others perceived higher rewards because their preferred counterparts were relatively inaccessible by other means. Shaerfermeyer and Sewell (1988), Steinfield (1986) and Schmitz and Fulk (1991) similarly concluded that 'unreachability of peers' or 'access to relevant co-workers' were the strongest predictors of use.

The ‘physical structure’ of the community (e.g.. who works near whom) was also an influential factor in the development of collegial relations. According to the data, many teachers preferred to communicate FTF with colleagues *whenever possible*, irrespective of communication intent or content. Thus, the more opportunities they had for FTF interaction, the *less* they felt the need or motivation to use e-mail to communicate with their colleagues. For example, some e-mail relations were initiated or interrupted depending on changes in teachers’ schedules. When their teaching schedules impeded regular FTF meetings, they used e-mail to communicate; when they facilitated them, the couple suspended their use of e-mail for communicating with each other. This was also the case for teachers working in distant buildings, who seemed to rely more on e-mail than teachers working in the same building. It should be noted that it was not only physical distance that constrained FTF interactions. According to the evidence, many teachers working in the same building faced strong barriers to meet FTF such as incompatible schedules or the lack of privacy in available meeting places. In sum, these results suggest that e-mail may be more used in communities where teachers have few opportunities for FTF interaction because of physical distance, incompatible work schedules or lack of adequate meeting facilities. Eskridge (1989, p. 123) found from her research of e-mail use among student teachers that ‘The majority of students ... did not feel a need to communicate (using e-mail) with clinical instructors because of the amount of time spent together during the school day’.

These results seem to contradict the expectations of ‘richness’ theorists who argue that people choose ‘rich’ media (e.g. FTF meetings) for complex or ambiguous tasks and less ‘rich’ ones (e.g. electronic mail) for clear and structured tasks requiring less immediate feedback (Trevino et al, 1987, Russ et al, 1990). As discussed in Chapter 9, a majority of the teachers interviewed seemed to prefer FTF for communicating with other teachers *for all purposes*. This discrepancy may be due to the fact that most ‘richness’ research has been carried out in industrial contexts, not in schools. Teacher communication with colleagues is, unlike in most industrial contexts, largely a voluntary process with little perceived bearing on work performance (Johnson, 1990, p. 172, Little, 1990a, Little and McLaughlin, 1993). It is possible that groups of teachers with specific collaborative tasks to achieve and schedules to meet (i.e. with higher ‘task interdependency’) might resort more to e-mail for ‘efficiency’ reasons, leaving FTF for situations in which ‘simultaneity’ and ‘interactivity’ are indispensable. This was somewhat indirectly suggested by those teachers, quoted in Chapter 9, who argued that e-mail use would be higher in a more ‘structured’ environment. This is discussed in Chapter 11.

One of the findings of the third stage of the research was that **previous acquaintanceship and professional homophily significantly constrained the creation of e-mail relations** (i.e. significantly more relations were created with acquaintances than with previously unknown colleagues and with subject colleagues than with teachers of different subjects). In other words, the overall evidence suggests that the potential of e-mail to help teachers expand their collegial networks and support cross-subject interactions and collaboration may be limited.

The evidence obtained in this research suggests that the creation of e-mail relations may be constrained by previous acquaintanceship for several reasons. First, strangers are unable to recognise similarities between themselves by ‘external signs’ such as their clothes or accent because electronic mail does not convey paralinguistic cues. Strangers meeting FTF may rapidly recognise similarities between themselves and hence communication is facilitated. Second, because e-mail lacks interactivity, teachers are not able to repair misunderstandings in ‘real time’. Hence they may perceive the risks of communicating with acquaintances as lower than those of communicating with strangers because they are more informed about their personality traits, professional interests and opinions and have

more ‘shared context’ with them (Zack, 1993). A third reason why teachers might perceive lower risks in communicating with acquaintances is that they may feel more confident that their messages (which may imply ‘admissions of need’, controversial opinions or mistakes in form or content) will not be forwarded to other people without their consent.

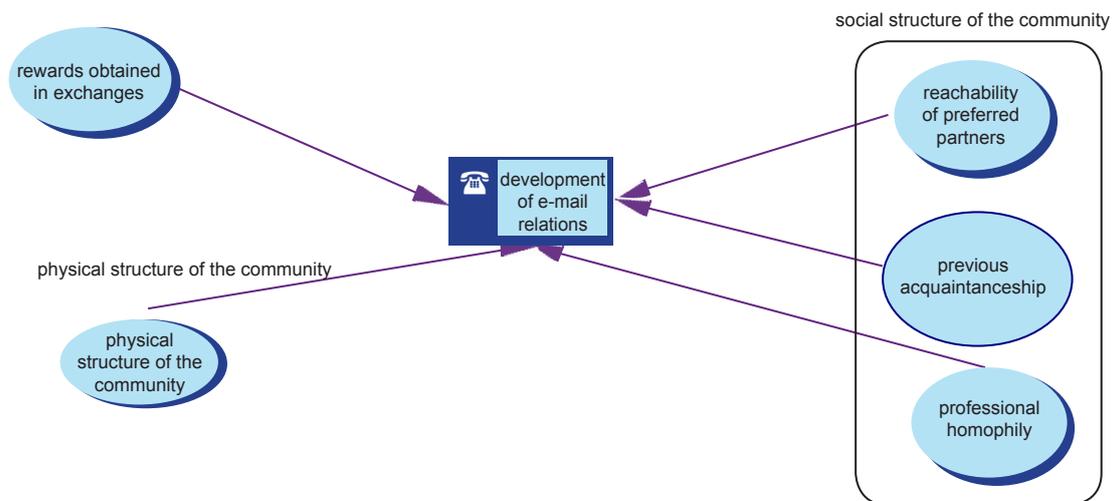
The fact that professional homophily constrained private communication may be related to the organisation of Uruguayan secondary schools. In Uruguay, teaching the same subject involves sharing common interests and needs. Thus, from a social exchange perspective, teachers may be more inclined to approach their subject colleagues than teachers of other subjects, because they perceive them as more likely to possess the professional resources (e.g. information, teaching materials, professional contacts) they need the most.. This is further discussed later in this chapter under ‘Explaining the exchange of professional resources’. Additionally, initial teacher education is organised along strictly separate paths based on subjects, allowing for little communication between student teachers of different subjects that could lead to future cross-subject collegial relations in professional life. These results highlight the importance of looking at the context in which the user community is embedded to understand communication patterns. In communities such as Teachnet’s, embedded in systems where the organisation of work creates few incentives or needs for cross-subject communication, one should expect link creation to follow disciplinary or subject lines. In sum, although e-mail reduces the logistical costs of communicating with teachers of other subjects, teachers may not do so unless special activities, incentives or rules are in place (for example, mandatory cross-subject projects with students).

Neither previous acquaintanceship nor professional homophily affected the stability of links. These results suggest that a shared professional interest (such as teaching the same subject) might facilitate the *creation* of e-mail relations but may not influence their *development*. This evidence suggests that the basis for deciding which e-mail relations are worth pursuing seems to be their content rather than the nature of the relation between the communicants (e.g. whether they teach the same subject). It should be noted that this is not a self-evident result. In many social contexts, relations might be preserved for reasons other than their content. For example, students may be forced to continue their relationships with lecturers even if they find the content of lessons of little interest because of formal rules and couples may stay together because of social pressure. This interpretation is supported by the evidence discussed in the previous section, and in Chapter 9, showing that the degree of affinity between the content of the communication received by the teachers and their professional interests was a key factor in their continued use of the system. These results give some support to social-psychological approaches to CMC research, which argue that as CMC ‘attenuates’ the effects of personal attributes on the development of communication it ‘tends to ... (focus) on the content of messages rather than on the attributes of senders and receivers’ (Garton et al, 1997, p. 5). They also give support to exchange theories of communication which posit that ‘a relationship will develop if doing so increases personal outcomes’ (Gabarro, 1990, p. 89). In social exchange terms, teachers seem to ‘adjust’ their initial *expectations* of the rewards they might achieve in a relation based on the *actual* benefits they obtain in the exchanges, and then decide on the continuation of each relation. For example, teachers may be more inclined to start relations with subject colleagues because they *expect* them to be more rewarding communication partners. However, once such relations start, teachers may decide to continue them on the basis of the *actual* rewards they obtain. This would explain the emergence of some intense, long-standing non-homophilous relations in spite of the strong constraining effect of professional homophily on link creation.

Another finding of the third stage of the research was that link creation rates **significantly diminished over time** (i.e. fewer relations were created in the second period than in the first period). The initial ‘launching period’ seems to be of special importance since

a disproportionate number of relations may start in those first weeks. This may be the result of the ‘sudden’ decrease in the logistical costs of communication introduced by e-mail (possibly coupled by a ‘novelty’ effect that may drive people to ‘try’ the new communication system). As e-mail attenuates the logistical costs of communication, a relatively large proportion of users may use it to create relations with colleagues who were previously difficult to reach for geographical, scheduling or other reasons, and whom they *expect* to be potentially rewarding communication partners. After some time, teachers may stop sending messages to people with whom exchanges are no longer rewarding and focus on a selected few relations. This interpretation is consistent with Riel’s (1992) observation that in many CMC educational projects, teachers engage in initial, tentative, exchanges, most of which do not lead to regular contact. This result suggests that e-mail may indeed *provide opportunities* for exploring new relations and that many teachers may be ready to do so. However, the availability of e-mail, *per se*, should not be expected to lead to sustained professional relations if there is no genuine *mutual* interest and benefit to both people involved. The fact that benefits of collegial relations should be perceived by *both* communicants is important since, as discussed later in this chapter, the evidence showed that unilateral relations might not be sustainable in the long run. This research collected data over 37 weeks. Further research, covering longer periods, may help determine whether rates of link creation keep diminishing over time or stabilise after the ‘launching period’.

The influence of the above-discussed factors on the creation and development of e-mail collegial relations is summarised in the following graphic representation.



10.4. Explaining the content of e-mail communication.

One of the main findings of this research was that **a majority of e-mail communication between stable participants was related to teaching.** Within this topic, concrete issues of teaching resources and techniques (as opposed to more general concerns about pedagogy) constituted a large majority of the content. These results give some support to ‘social presence’ theorists who have argued that the narrow bandwidth of CMC may lead to more ‘task oriented’ than ‘social personal’ use of the medium (Johnson et al, 1987, Hiemstra, 1982, Kraemer and Pinsonneault, 1990). However, as discussed in Chapter 7, it was also found that a sizeable amount of communication was used for non-task purposes. Hence, such support for ‘bandwidth’ theories must be considered partial and tentative at best. It was therefore important to look beyond e-mail’s bandwidth to explain the predominance of ‘task oriented’ communication.

Comparing these results with the literature some important discrepancies were found. Merseth (1991) reported that student teachers using the BTCN computer network ranked the exchange of 'moral support' as the most popular use of the system. Items related specifically to teaching, such as 'getting help with lesson planning' or 'sharing teaching techniques', were ranked significantly lower. Similarly, Eskridge (1989, p. 121) found that personal support was the main use of the Link system by student teachers and that 'There was virtually no exchange of instructional materials such as lesson plans ... and little or no discussion of classroom activities or instructional ideas'. The results of Merseth and the others, which run counter to the expectations of 'bandwidth' theorists, may be explained by the specific nature of the student-teaching experience. These teachers are in transition from full-time students to full-time teachers. As the literature on beginning teachers (a review can be found in Merseth, 1989) emphasises, new teachers facing for the first time the heavy demands of the classroom, are usually physically distant from family, friends and teachers, and encounter difficulties in finding sources of emotional and social support within the school. Therefore, a user community composed mainly of student teachers may view CMC first and foremost as a communication tool to provide each other with such support. These results suggest that the content of e-mail communication might be more influenced by the nature of the user community and the motivation of users to join it, than by the technical properties of the medium (i.e. its 'bandwidth'). While people who join a network for social reasons might communicate to achieve social purposes, communities organised around a common professional identity might focus on task-oriented communication. This is further discussed in Chapter 11. These findings give some support to critics of 'bandwidth' approaches such as Rice and Love (1987), McCormick and McCormick (1992) or Zack (1993) who argue that media use is shaped by a range of social factors rather than by invariant properties of media.

As discussed in Chapters 7 and 8, teacher e-mail communication **largely excluded discussions of the inner workings of their classrooms and of their pedagogical beliefs**. 'Repertoire development' (i.e. exchanging concrete professional resources, useful for lesson planning and classroom teaching) was, by far, the preferred purpose of e-mail communication among the 20 stable participants. The paragraphs below discuss the possible reasons for this communication pattern.

These results may be understood from the social exchange theoretical perspective. The evidence discussed in Chapter 8 suggests that teachers perceived lower costs in communicating about certain topics than about others. In particular, they seemed to perceive the exchange of teaching resources (e.g. books, computer programs, and exercises) as less 'costly' than discussion of the inner workings of their classrooms or debating on more abstract issues of learning and pedagogy. Overall, the teachers used e-mail significantly more to exchange 'products' than 'expertise'. A reason for this might be that teaching resources can be used and adapted in different ways by each teacher. Thus, teachers may share them without being perceived as 'advocating' specific teaching strategies or approaches. They may feel they are just helping colleagues to enlarge their 'repertoire', not trying to influence their teaching practice, a behaviour that would challenge the norms of egalitarianism and non-intervention.

Discussing (especially in public) specific issues and incidents related to their own classrooms might be 'costlier' for teachers since the conduct of courses (especially syllabus coverage and student behaviour problems) is the key element for teacher evaluation in the Uruguayan educational system (Grünberg, 1991). Thus, understandably, teachers may perceive high professional risks in using a written medium (where the record may be forwarded to others without authorisation) for discussing such content. A second reason explaining teachers' reluctance to use e-mail to share detailed accounts of their personal

practice is that they may be uncertain about the degree of interest that others might have in such content. According to this view, teaching resources are of *collective* interest (since all teachers may make use of them) and thus it is 'legitimate' to use e-mail (including public communication) to exchange them. Conversely, specific issues and incidents within teachers' classrooms are primarily *personal* concerns, whose relevance to colleagues is not obvious. Thus, many teachers may have refrained from using e-mail to discuss the inner workings of their classrooms because they feared that their colleagues would not find such communication of interest. As discussed before, receiving messages perceived as irrelevant was one of the main sources of 'resentment' and negative feedback. According to the interview data, a third reason for teachers to avoid sharing detailed accounts of personal practice, especially self-perceived teaching successes or achievements, was that they were afraid of being perceived as 'arrogant' and 'boasting'. In their views, such communication ran counter to the 'egalitarian' tradition and norm of Uruguayan schools.

The teachers were also reluctant to engage in discussions about pedagogy and learning. According to the evidence, they perceived higher threats to reputation and higher risks of generating negative feedback when expressing personal opinions (especially on controversial issues such as evaluation of educational reform) than when exchanging teaching resources. For example, as discussed in Chapter 9, some teachers felt that expressing opinions that diverged from the 'consensus' would be 'inappropriate'. Clearly such feelings are much more likely to restrict the exchange of 'expertise' than 'products'.

According to the interview data, **the content of the communication transmitted was restricted by technical limitations of the medium**. Some teachers were fearful that the content of their messages could be compromised by unauthorised access by students. Consequently, few teachers used the system to jointly prepare student evaluations or exams for example, in spite of its obvious logistical advantages. This finding confirms prior research (Kerr and Hiltz, 1982). Steinfield (1983, p. 97) found that '... people ... avoided using the system for confidential matters, reflecting a concern for the adequacy of electronic mail security'. Bruning (1994) concluded from his study of e-mail use by graduate students: 'Individuals who use electronic mail ... need to not be concerned about security issues when using a computer for communication (p. 17)'. Other teachers felt that the lack of graphics reduced the usefulness of Teachnet. As the Teachnet community was composed of Maths and Science teachers, this may have been a particularly strong limitation. Different results could be found, as discussed in Chapter 11, with teachers of other subjects which may rely less on graphics. This result is consistent with previous CMC research. As Eskridge (1989, p. 123) found: '...(teachers) indicated that the technical difficulty of sending documents was such that it discouraged exchange of instructional materials'. According to Merseth (1991, p. 145), 'the limited ability of the network to provide lesson and curricular assistance ... may be the result of technical limitations' since BTCN did not offer graphical capabilities.

This research found that **electronic mail supported the creation of multiplex relations** (almost two thirds of the links were multiplex). This result contradicts the claims of communication researchers who have maintained that CMC, as a low bandwidth medium, may be unable to support multiplex relations (Wellman et al, 1996, Kling, 1996, Kollock and Smith, 1996), hence leading mainly to 'one-issue', specialised relations. Again, this finding supports the view that communication behaviour might not be determined solely or primarily by the 'bandwidth' of the media used for communication. The overall evidence suggests that communication behaviour is a function of a complex set of individual, contextual and technological factors and that some people may use 'low bandwidth' media such as e-mail not only for 'task-oriented' communication but for a wide range of purposes including the Social Personal and Professional Life realms.

Stable relations contained significantly more teaching content than unstable relations.

This finding suggests that although non-teaching content may be appreciated, *professional content may be the key factor in deciding which e-mail relations to continue*. Again, this may derive from the nature of the Teachnet community, where all users share a common professional identity and therefore their motivations to join the community (and hence their expected rewards) might be of a professional nature. Indeed, the interview data provided strong indications that, for most teachers, the professional relevance and usefulness of communication content were crucial factors in maintaining their motivation to use the medium. In some communities, especially designated ‘co-ordinators’ are charged with the task of promoting use of the system. Strategies to accomplish this might be of a *social* nature such as introducing ‘newcomers’ to the community, greeting people publicly on their birthdays or helping users ‘meet’ strangers on-line who may share their same personal interests. Strategies for promoting communication may also be of a *professional* nature such as regularly disseminating information about professional events, providing professional information or advice on demand or encouraging public discussions of pedagogic issues. The results of this research suggest that, in the long run, those strategies centred on *professional* communication might be more effective for promoting sustained e-mail collegial communication. It should be noted that different results might be found in communities where people’s motivations might be, for example, to obtain emotional support or develop interpersonal social relations. In those cases, strategies for promoting system use should have to be centred on social and personal communication. This recommendation is discussed in Chapter 11.

There were few differences at the family level between the content of private and public communication. At the *category* level however, some significant differences were found. As discussed below, these differences were consistent with social exchange’s theoretical expectations that the perceived costs and rewards of interactions determine communication behaviour (O’Reilly, 1982, Miller and Jablin, 1991), Course Planning (T20) was *only* discussed in private. As discussed above, teachers may have little motivation to communicate about their courses *at all*, let alone discuss them in *public*. Job and Career (T5), Colleagues (T7) and Teacher Production (T9) were also discussed almost exclusively in private. Job and Career (T5) was used to trade information about job openings that were intended to benefit friends and acquaintances. Colleagues (T7) comprised a large share of ‘gossiping’ (informal, usually critical, sometimes intimate information about colleagues). Teacher Production (T9) involved mostly requests for support from trusted colleagues for the production of some teaching material or book. This may explain why teachers were reluctant to use public messages to address these topics. Conversely, Teacher Development Events (T11) was more discussed in public than in private. As this topic was usually not controversial and time-sensitive (this category was mainly used to code courses and lecture announcements), this may explain why it was mainly addressed in public. In sum, teachers may be reluctant to discuss sensitive matters in public (if at all) because the costs of such communication may exceed the potential rewards (an example of this is communication about course planning). Conversely, when teachers seek to communicate with a large number of colleagues about a time sensitive issue (for example, for announcing a coming conference), the logistical advantages of public communication may make it the type of communication of choice.

10.5. Explaining the exchange of professional resources.

The main patterns of exchange of professional resources by the stable participants were discussed in Chapter 8. Two facets of exchange behaviour were analysed: a) the initiation of exchange processes to obtain or spontaneously share professional resources (or ‘active’ behaviour) and b) teachers’ responses to requests received from colleagues (or ‘reactive’ behaviour).

‘Active’ behaviour (i.e. requests and spontaneous contributions) implies certain communication decisions, namely: a) the type of communication (i.e. public or private) to be used and b) for private requests or spontaneous contributions, the exchange partner (e.g. to whom the request or spontaneous contribution will be addressed). ‘Reactive’ behaviour involves two main decisions with regard to each request received: a) whether to reply to it or ignore it and b) when a reply is sent, the type of communication to be used for sending the reply (i.e. public or private).

To explain the observed patterns of exchange behaviour, the degree of association between these communication decisions and a number of variables that have been found to affect collegial behaviour in previous research was established using statistical techniques. Statistical data are given in Annex 8. The results, jointly with findings from the interview data, are used in this section to explain the exchange of professional resources by the stable participants.

10.5.1. ‘Active’ exchange behaviour.

10.5.1.1. Purposes of e-mail use.

This research found that **the stable participants used electronic mail significantly more for contributing than for requesting resources**. These results show that the exchange behaviour of the teachers might not be explained by an impulse for unilateral benefit. This pattern of behaviour may be a function of several factors.

First, in accord with collegiality research, it was found that many teachers felt that requesting assistance implied a public acceptance of low resourcefulness, which threatened their professional reputations (as discussed elsewhere, a consequence of this is that many teachers prefer to obtain resources by ‘monitoring’ other people’s communications instead of direct inquiries). In other words, for many teachers, *requesting* professional resources may be more ‘costly’ in professional terms than *sharing* resources of their own. This is not to say that sharing may be perceived as cost-free. According to the interview data, teachers perceived that contributions entailed risks of negative feedback (such as criticism or derision) and this influenced, as discussed later in this chapter, their exchange behaviour. The point is that the perceived social costs of sharing may be lower than those of requesting.

To understand the exchange behaviour of teachers it is also important to look at the rewards people seek when initiating exchange processes. When people *request* resources, their aim is straightforward: they seek to fulfil some need. Thus, their perceived rewards are dependent on receiving useful replies (no useful replies meaning no rewards and low quality replies meaning low rewards). The rewards people seek when *sharing* resources spontaneously are more complex. According to the data presented in Chapter 9 and Annex 8, the teachers shared their resources for two main reasons: a) to ‘balance’ their interpersonal relations (i.e. the more resources teachers *received* from their colleagues, the more they shared with them) and b) to obtain ‘intrinsic’ rewards. The nature of such ‘intrinsic’ rewards is discussed below.

For some teachers, spontaneous contributions supported their own self-images as ‘sociable’ individuals. For others, sharing their professional resources was a fulfilment of their self-imposed collegial ‘duties’. These teachers perceived their contributions as important for enriching common pools of knowledge that, they believe, in the end should benefit all teachers. Contributions (especially *public* contributions) were important for some respondents because they enabled them to argue their views on educational or policy issues. These results are compatible with previous social exchange research (Hoffman, 1981, Orr, 1989, Kollock, 1999). These ‘intrinsic’ benefits of sharing are in no way inherent to CMC. However, people who feel, for example a ‘collegial duty’ to share their professional knowledge may fail to engage in collegial sharing because of the logistical costs involved. As e-mail reduces the logistical costs of collegial sharing (for example, it facilitates duplication and distribution of some types of materials to large numbers of people or discussions involving geographically dispersed people), they may start doing so. Indeed, abundant evidence was found in the interview data showing that teachers perceived important logistical advantages in using e-mail to communicate with colleagues. Thus, e-mail seems to have the potential to unleash collegial contributions from those individuals who value such ‘intrinsic’ benefits and who refrain from sharing FTF because of the logistical costs involved. This conclusion is highly compatible with previous research carried out by Thorn and Connolly (1990) who studied CMC-based exchanges and argued that the capability of CMC to reduce the logistical costs of sharing resources may explain the contributing behaviour of users.

The rewards obtained when requesting resources are dependent on the receivers’ behaviour. If their requests are ignored, teachers obtain nothing (this was the case for more than half of public requests and a quarter of the private ones). Conversely, the rewards (both those oriented towards achieving ‘equity’ and those of an ‘intrinsic’ nature) of *sharing* are obtained by the very act of giving (for example, if sharing enables me to fulfil my ‘collegial duty’, I do not depend on receiving an acknowledgement to feel rewarded by my contribution).

In sum, *requesting* implies higher social costs and less certain rewards than *sharing*, which may explain why teachers used the system more for sharing than for requesting professional resources. This result is compatible with social exchange research that found that the perceived costs of sharing may be lower than those of requesting (Kram and Isabella, 1985, Pallas et al, 1991, Morrison, 1993).

It should be noted that these results refer to the overall exchange behaviour of the stable participants. More complex patterns of behaviour requiring deeper layers of explanation appeared when looking in more detail at the types of communication used, the types of resources sought or shared and the types of partners chosen for exchanging the resources. For example, although, on the aggregate, teachers may perceive requesting as more costly than sharing, this may not be the case when they have an urgent and critical need to meet. This is discussed later in this chapter.

10.5.1.2. Volume of exchange.

According to the data, **the volume of exchange (number of requests and spontaneous contributions performed) was strongly associated with the level and nature of the feedback they received.**

As shown in Annex 8, Section 6, the number of requests sent was strongly associated with the level of feedback received. The more teachers’ requests were ignored, the less they subsequently used the medium for seeking professional resources. These results

were strongly corroborated by evidence found in the interview data, which showed that requesting behaviour was constrained by lack of feedback. This pattern of behaviour may be explained from the social exchange theoretical perspective. Requesting professional resources is 'costly' for teachers because it implies admitting needs. To the extent that requests are unanswered and these costs are not offset, teachers may discontinue their use of the system.

It was also found that the number of spontaneous contributions *sent* by the stable participants was very strongly correlated with the number of private contributions they *received* during the period of study. In other words, the more resources teachers received privately, the more they shared with their colleagues.

An implication of these results is that people may keep using the system as long as they obtain resources that compensate for their time and efforts. If their ratio of sharing to receiving is too high, they may discontinue their use of the system unless they have a formal obligation or especially strong feelings of 'collegial duty'. These results suggest that educational planners seeking to foster collegial use of e-mail should look for strategies capable of ensuring that teachers receive regular feedback, especially to their requests. This is discussed along with a number of recommendations in Chapter 11.

10.5.1.3. Type of communication used.

As discussed in Chapter 8, **the teachers initiated in private a majority of the exchange processes** (74.8% of the 635 'active' acts were private). This was true for both *requests* (81.9%) and *spontaneous contributions* (70.5%). These results may be surprising since public messaging appears as an 'efficient' mechanism both for requesting and sharing resources. This section discusses why teachers may have selected private communication for conducting their exchanges in spite of the logistical advantages offered by e-mail.

Public communication appears as a more 'efficient' mechanism for requesting than *private* communication since it enables reaching large numbers of potential 'helpers' at a 'fixed' communication cost (a request sent to the ALL group reached 74 colleagues). Two reasons may explain teachers' inclination to ask for professional resources privately rather than publicly in spite of those logistical advantages. First, as discussed before, many teachers perceived requesting professional resources as a 'threat' to their professional reputations since it implies an admission of need. These social costs are proportional to the number of receivers. It is not the same to 'admit need' and request help from somebody with whom one has a relation as it is to 'broadcast' a need to a group of colleagues, many of them unknown. Thus, teachers may have preferred to use private communication for requesting resources to minimise the 'threat' to their professional reputations. A second reason, supported by strong quantitative evidence, may be that *public requests were much less replied to than private requests* (while 72% of the private requests received at least one reply only 44% of the *public* ones did). In other words, although public messages reached a large number of colleagues, most of those receivers ignored them (93% of the public requests *received* were ignored while only 27% of the private ones were ignored). Thus, over time teachers may have perceived public communication to be a less 'efficient' mechanism than private communication for effectively obtaining professional resources. In sum, public requests implied higher professional costs than private requests (since they involved exposing needs to many people) and lower rewards (since public requests were significantly less likely to be replied to). This may explain the teachers' preference to send most of their requests privately in spite of the logistical advantages of public messaging.

Public communication also appears as a more 'efficient' mechanism for sharing resources spontaneously than private communication. However, teachers opted for sending *privately* a large majority of their contributions (70.5%). Previous CMC research and the interview data discussed in Chapter 9 point to several reasons that might explain this pattern of behaviour. First, in some cases, teachers may seek to benefit *some specific colleagues* and exclude others from such benefits. This may account for a share of the spontaneous contributions sent privately. Second, the resource being shared may be of a *reserved or confidential nature* (Castle et al, 1991). Third, teachers may prefer private sharing to *avoid negative feedback*. Teachers may be able to assess the potential reactions to their spontaneous contributions from colleagues with whom they have regular exchanges but this is more difficult with public messages that reach a relatively large and diverse group of people, many of whom may be unknown to the message sender. This conclusion is consistent with previous CMC research carried out by Muscella and others who found that a group of teachers using CMC valued private mail because they did not have to worry about the extent to which their messages were of public interest (Muscella and DiMauro, 1995). In sum, people may chose to contribute in private because they want to benefit exclusively a specific colleague, because the contribution is of a confidential nature or because the risks of generating negative feedback exceed the logistical 'savings' achieved when using public messaging. As discussed in Chapter 8, this pattern of behaviour may diminish e-mail's potential to support professional development because instead of enriching 'public pools', knowledge remains in the private teacher-to-teacher realm.

Teachers' preference to share in private was especially true for contributions of 'expertise'. According to the evidence, **teachers were highly reluctant to share 'expertise' publicly** (83.6% of the unsolicited contributions of 'expertise' were private). These results, which suggest that teachers may perceive 'expertise' exchanges as entailing higher 'costs' (i.e. higher likelihood of generating negative feedback) than 'product' exchanges, are consistent with previous research. (Muscella and DiMauro, 1995).

It should be noted that the perceived social costs of requesting professional or sharing professional resources are not similar for all individuals. As discussed in Chapter 9, although the prevailing professional norms created an environment where most teachers felt such risks to their professional reputations, people's personality traits also influenced communication behaviour, in some cases deepening such fears (e.g. for timid people) and in others overcoming them (e.g. for people with a strong sense of 'collegial duty').

As discussed in Chapter 8, **teachers performed privately most of the coordination acts** (95.8%). This may be related to the composition of the e-mail groups in Teachnet during the period of study. E-mail groups (e.g. ALL, PHYSICS, HERZL) had been defined to include all teachers working in a given school or all teachers of a given subject (and combinations of those criteria) rather than on the basis of team membership for specific tasks or projects. Hence, public mail was surely perceived as inefficient for coordinating meetings related to specific tasks and projects since such messages would have reached many uninterested people. Thus, performing coordination acts publicly would not only compromise privacy but also possibly annoy the unwilling and unconcerned receivers. Under different circumstances, where e-mail groups might be created to reflect on-going collective tasks and projects, a higher use of public communication for coordination purposes could be expected.

10.5.1.4. Partner selection.

Within their established e-mail relations, teachers selected with whom to perform their private exchanges of professional resources (i.e. to whom they addressed their requests for, and contributions of, professional resources). This section discusses teachers' choices of exchange partners. For the reasons discussed in Chapter 8, three variables were analysed: previous acquaintanceship, professional homophily and contribution behaviour of potential exchange partners.

Previous acquaintanceship.

As discussed before, teachers were reluctant to send messages to strangers and hence created significantly more links with acquaintances than with previously unknown colleagues. However, it was found that within the established e-mail relations, **the stable participants did not limit their professional exchanges to those colleagues with whom they were acquainted before starting to use e-mail.**

According to the evidence, the stable participants were as likely to address their private requests for professional resources to acquaintances as to previously unknown colleagues. In other words, the evidence suggests that once a 'new' e-mail relation is created, teachers' reluctance to contact strangers for professional purposes may 'fade away' (as discussed in Chapter 8, this may not be the case for non-professional communication). These results give some support to 'reduced cues' theorists who argue that as CMC 'filters out' most social and paralinguistic cues, communication becomes less 'regulated' by social factors such as previous acquaintanceship (Sproull and Kiesler, 1986).

It is interesting to note that significantly more private contributions were sent spontaneously to *previously unknown teachers* than to acquaintances. In other words, the stable participants not only did *not* favour their acquaintances when sharing their professional resources but in fact the reverse was true. This result may reflect the fact that the 16 'new' relations between stable participants involved teachers working in *distant buildings* (i.e. at different schools)³⁰. As those 16 couples had fewer opportunities to share resources FTF than the 34 couples who worked in the same building, they may have relied more on e-mail than the others for their professional exchanges. Teachers may find it relatively easy to share their professional resources FTF with colleagues working in the same building since they may meet in the staffrooms, or leave materials or notes for them in their physical mailboxes. Hence, they may use e-mail only in special circumstances, for example when timetables do not coincide, privacy is required or a message has to be sent to many people at once. An implication of this finding is that in circumstances comparable to Teachnet's, the use of e-mail for collegial purposes may be inversely related to the opportunities teachers have for FTF interactions. This interpretation is consistent with CMC research carried out by Riel and Levin (1990).

The question remains of why this variable ('opportunities for FTF interaction') did not affect requesting behaviour in the same way as sharing behaviour. In other words, if couples working in the same building rely less on e-mail for their spontaneous *contributions* because they have more opportunities to communicate FTF, why would this not also be true for their *requests*? A reason for this may be that many contributions involve physical objects (e.g. books, photocopies). While same-building couples may find it relatively easy to hand such

³⁰ In the Teachnet community, most teachers working at the *same* school knew each other and most couples working at *different* schools reported *not* knowing each other. In other words, being acquainted and teaching at the same school were statistically indistinguishable (detailed sociometric data is given in Annex 8, Section 11).

resources to each other, *distant* couples may need to use e-mail to coordinate a meeting or in some cases to transfer electronically a transcription, synthesis or digitised version of the resource when this is feasible. Conversely, requests rarely involve physical objects. Additionally, requests create pressure on receivers to respond. Hence teachers, unless their need is crucial and urgent, might find that e-mail, as an asynchronous medium, creates less pressure on receivers to provide immediate feedback. Interview evidence discussed in Chapter 9 supports this interpretation. As Mr Pleh argued: '(With CMC) I can reflect more on my reply without the pressure you feel if somebody is waiting on the line ... (13:34)'.

Professional homophily.

Professional homophily (i.e. teaching the same subject) significantly constrained the exchange of professional resources. **Teachers sent significantly more of their requests and spontaneous contributions to subject colleagues than to teachers of other subjects.** Building on the results reported in Chapter 6, it may be concluded not only that the teachers created significantly less cross-subject relations but that those which were created were significantly less used for professional exchange.

The effect of professional homophily on partner selection may be explained from the social exchange theoretical perspective. The effects on *source selection* (i.e. to whom requests are addressed) and *recipient selection* are discussed below.

According to Foa and Foa (1974, p. 240), people select their exchange partners based on their perceptions of the capability and willingness of the others to satisfy their requests. Thus, the overriding criterion for *source selection* may be the potential partners' capabilities to deliver the desired resources. As most of the resources requested were highly subject-specific, the teachers may have addressed more of their requests to subject colleagues because they may have perceived that these teachers would be more likely to possess the desired resources.

This research found that the likelihood of receiving negative feedback was one of the key factors affecting teachers' use of e-mail for sharing resources with their colleagues. The interview evidence suggested that one of the main sources of negative feedback was receiving irrelevant unsolicited messages. In other words, teachers who sent messages found irrelevant by receivers were 'censored' or criticised by them. For some teachers, this 'peer criticism' was strong enough to strongly constrain their use of e-mail to communicate with anyone but their most trusted friends. As discussed in Chapter 9, teachers' assessments of the level of interest that a message might have for potential recipients strongly affected their decisions of whether to send the message. In sum, the evidence suggests that teachers may have contributed spontaneously more to subject colleagues because they may have felt that these colleagues would be the ones more likely to need or appreciate the professional resources being shared (hence the least likely to generate negative feedback). This explanation is consistent with the fact that a large majority of the exchanges involved resources that were highly subject-specific, while more general discussions of pedagogy (which were more likely to be of interest to teachers of different subjects) involved a small minority of all exchanges (11.1%).

As discussed in Chapter 8, this powerful constraining effect of professional homophily on partner selection may be a function of the organisation of teaching in Uruguayan secondary schools, where teachers have little incentive or need to interact with colleagues of other subjects. Different patterns of exchange could emerge if a curriculum reform currently under way creates a situation where teachers find it more rewarding and important to exchange cross-subject resources. This highlights the importance of the context in which a community is embedded in shaping communication behaviour and is further discussed in Chapter 11.

Previous contribution behaviour of potential recipient.

As the data presented in Annex 8, Section 7, suggests, recipient selection was affected by the previous contribution behaviour of potential recipients. **The more a teacher contributed to another, the more likely that he or she would be selected as recipient.**

This result is consistent with previous research which found that in social contexts where no rules or norms support sharing, people provide significantly more help to the people who provide more help to them (Kelley and Thibaut, 1978, Rheingold, 1993, Constant et al, 1996). It also gives support to social exchange theorists who argue that most people are driven by a search for ‘balance’ in their interpersonal relationships (Meeker, 1971, Walster et al, 1976, Roloff, 1981). As Roloff (1981, p. 20) put it, ‘We do not like to be obligated to others, nor do we like to have others not repay their obligations to us’.

10.5.2. ‘Reactive’ exchange behaviour.

10.5.2.1. Type of communication used for responding to requests.

This research found that although more than two-thirds (68.9%) of the requests received by the teachers during the period of study were *public*, **virtually all their replies (97%) were private.**

This may be a strategy to avoid negative feedback. As found in the interviews, one of the main sources of negative feedback is the irritation that receiving irrelevant unsolicited messages may create in unwilling receivers. As teachers may not be sure that solicited contributions will be of collective interest (i.e. of interest to people other than the ‘requester’), they may find it ‘safer’ to respond in private.

As discussed in Chapter 8, this pattern of behaviour may diminish e-mail’s potential to support professional development because instead of enriching ‘public pools’, knowledge remains in the private teacher-to-teacher realm.

10.5.2.2. Answering or ignoring colleagues’ requests.

Teachers may reply to or ignore the requests they receive from colleagues. To explain teachers’ response behaviour, the degrees of association between a number of variables and teachers’ response rates were analysed. These variables were: the type of communication used to send the request (i.e. public or private), the type of ‘requester’ (i.e. stranger or acquaintance, subject colleague or teacher of a different subject) and the previous contribution behaviour of the ‘requester’. The results are discussed below.

Type of communication used for requesting.

As discussed before, a majority of the requests were answered (70%). Thus, one may agree with previous research that, *on aggregate*, CMC may be an environment supportive of professional exchange (Finholt, 1992, Rheingold, 1993, Kollock, 1999).

However, relatively little effort has been made to put these results into perspective. Evidence from these investigations was, in most cases, reported in absolute terms, citing the average *number of replies* received per request (Feldman, 1987, Constant et al, 1996) as opposed to the *rates of response* (the relation between the number of replies and the number of people receiving the request). Additionally, most prior CMC research focused on one type of communication (i.e. public or private), thus overlooking the potential differences between response rates based on the type of communication used to send the request. This investigation into the use of Teachnet is one of the first to compare response rates to *public* and *private* requests.

It was found that **the response rate to private requests was ten times higher than the response rate to public requests** (72.8% and 7.2% respectively). Thus, although *on aggregate* a majority of the requests obtained feedback (70%), there were very important differences in response rates to public and private requests for professional resources. In fact, response behaviour was more typically one of *ignoring* the public requests they received (almost 93% of the public requests received were ignored). An implication of these findings is that *public* messaging may be effective for ‘broadcasting’ resources (i.e. unilateral dissemination from a source to many receivers) but less effective for engaging others in reciprocal exchanges.

These results are consistent with previous CMC research carried out in schools. West et al (1989, p. 21) found that teachers perceived that ‘private e-mail inquiries were almost guaranteed a response, in contrast with inquiries made in the public forums’. Castle et al (1991) found in their research on the use of the SRN computer network that teachers preferred private rather than public communication for certain communication purposes because they believed private messages would be noticed and replied to more quickly than public ones.

These results are also consistent with the assertion of ‘richness’ theorists that the level of ‘personalisation’ of the media used to address people may affect their communication behaviour. For example, people have been found to feel more compelled to answer a private letter than a leaflet sent to thousands of people (Steinfeld, 1986).

The difference between response behaviour to public and private requests may be explained from the social exchange theoretical perspective. Receivers of private requests know that if they fail to respond, they will be ‘liable’ for the full social and professional costs of ignoring the demand (these costs may be high in certain social contexts, especially when ‘requesters’ are close friends or have some institutional authority over the receiver). Conversely, as *public* requests are sent to groups of people, with none of them singled out as especially responsible for answering, receivers may not feel individually ‘liable’ for the full costs of not responding. In sum, public requests may be significantly less replied to (than private requests) because the perceived costs of not responding, or ‘response obligations’³¹ (Philips, 1972), may be perceived as lower since they are ‘diluted’ among all receivers. This explanation is consistent with Crook’s (1985) theoretical speculation that

³¹ As discussed in the review of the literature, research suggests that ‘response obligations’ are determined by two sets of factors, one general to the community and the other specific to the pair (‘requester’ - receiver of the request). The first includes formal rules (mandating response) or strong social or professional traditions (‘punishing’ lack of response). The second refers to the capability of ‘requesters’ to ‘punish’ some specific people who ignore their requests (through, for example, formal authority, threat of non-cooperation or withdrawal of support).

public requests for help should be less effective than private ones since recipients of public messages ‘... may feel no strong obligation to respond. That ... is what social psychologists have documented as the “bystander effect” in other social situations’.

Previous acquaintanceship.

Response behaviour was constrained by previous acquaintanceship. **Teachers answered significantly more of the requests received from acquaintances than of those received from previously unknown colleagues.** In the absence of formal rules or incentives, the stable participants may have replied more to acquaintances than to previously unknown colleagues for a number of reasons.

First, teachers may have a clearer idea of the exact nature of the requested resource when they have known the ‘requester’ for some time and hence feel more confident that the answer will be useful and relevant, thus reducing the risks of generating negative feedback. Prior research supports this interpretation. Constant et al (1996) has argued that when request receivers have little information about the ‘requesters’ they fear they might misunderstand the request and are more reluctant to reply, thus increasing the costs of exchanging help with strangers in computer networks.

Second, teachers are more likely to be ‘in debt’ with acquaintances than with colleagues previously unknown. This is important because communication research has consistently found that one of the driving forces of contributing behaviour is the search for balance in interpersonal relations (Roloff, 1981, p. 20). It should be noted that the reference is not to ‘debts’ derived from e-mail exchanges (the effect of the level of *e-mail* ‘indebtedness’ with the ‘requester’ on response behaviour is discussed separately). Some of the couples who created e-mail relations knew each other for a long time before starting to use e-mail. For example, some of the teachers had taught others at the National Teacher College and the younger ones may have understandably behaved more deferentially toward them than toward colleagues they had never met before. Other teachers had been close friends for years before starting to use e-mail. Although not all previously acquainted couples held such established or close relationships, which might lead to higher perceived ‘response obligations’, the situation was certainly more likely to occur than with complete strangers.

A third reason why teachers may have responded more to previously known colleagues is that those ‘requesters’ were able to exert more ‘pressure’ on them to respond since they worked in the same building (and hence were more likely to meet FTF). Conversely, most previously *unknown* ‘requesters’ taught at different schools and therefore had fewer opportunities to exert FTF ‘pressure’ (the term ‘pressure’ does not necessarily refer to explicit demands; it may also include those explicit or implicit messages which are used to remind another person that he or she is ‘in debt’ with someone). This interpretation is consistent with the claim of ‘reduced cues’ theorists that ‘social presence’ is lower in CMC because most social and paralinguistic cues are ‘filtered out’. From this theoretical perspective, requests sent by distant teachers (which in this research coincided with previously unknown teachers) may be less replied to because, as ‘social presence’ is lower in CMC, receivers may feel lower levels of ‘social pressure’ to comply.

Professional homophily.

Response rates to requests received from subject colleagues were significantly higher than response rates to requests from teachers of other subjects. In other words, **teachers were more likely to respond to requests from subject colleagues than to those sent by teachers of other subjects.** Two reasons may explain this pattern of response behaviour.

First, teachers are more likely to ‘possess’ a resource (e.g. the name of a book, the date of a conference, an opinion on a teaching approach) related to their own subject, and hence be in a position to send a useful reply, than a resource related to a *different* subject. As discussed before, this was important for teachers to help them avoid the negative feedback and threat to their professional reputations that incorrect or incomplete replies may generate. This interpretation is consistent with the fact that most exchanges involved *subject-specific* resources (as opposed to resources related to more general and cross-topic interest).

However, non-possession of the requested resource did not necessarily have to lead to non-response. According to the data, many teachers who lacked the requested resource replied with comments on the request itself, with recommendations for an alternative source to whom the request could be addressed or requesting clarifications about the request itself (these were also counted as ‘replies’ as discussed before). Thus, non-possession of the requested resource should not be accepted as sole explanation for ignoring requests.

A second reason why teachers may reply more to subject colleagues is that they may perceive the costs of non-response to subject colleagues as higher than the costs of non-response to teachers of other subjects. As teachers used e-mail mainly to exchange subject-specific resources, they may have felt that subject colleagues would be the ones more likely to ‘possess’ the resources they themselves might need in the future. Hence, creating ‘feelings of indebtedness’ in subject colleagues may be more valuable than creating them in teachers of other subjects. In other words, the evidence suggests that teachers may prefer to ignore requests from teachers of other subjects, when they feel they are unable to satisfy them adequately, rather than to contribute a partial or tentative answer, because the costs of risking negative feedback may exceed the costs of non-response. However, the reverse may be true for requests received from subject colleagues since the costs of non-response may be higher.

Previous contribution behaviour of ‘requester’.

The number of *contributions* received from a ‘requester’ before a request was received, was associated with the response rate (statistical data are given in Annex 8, Section 8). **The more a teacher contributed to another before sending a request to him or her, the more likely that he or she would reply to the request.**

This result is consistent with previous research which found that in social contexts where no rules or norms support sharing, people provide significantly more help to the people who provide more help to them (Kelley and Thibaut, 1978, Rheingold, 1993, Constant et al, 1996) or in other words, that most people are driven by a search for ‘balance’ in their interpersonal relationships (Meeker, 1971, Walster et al, 1976, Roloff, 1981).

10.6. Summary: research question V.

This chapter has addressed the fifth research question:

“How can the collegial communication behaviour of teachers using electronic mail be explained?”.

Explanations for each of the four dimensions of communication behaviour investigated in this research (i.e. system use, development of e-mail relations, topics addressed and exchange of professional resources) were discussed in sections 2 to 5. This section summarises the main overall conclusions.

One of the key conclusions is that the main patterns of communication behaviour of the teachers using e-mail were highly consistent with the theoretical expectations and assumptions of social exchange theory. The overall evidence suggests that the development of collegiality among teachers using e-mail is a process driven by two forces: a) maximising the perceived professional 'benefits' (i.e. rewards minus costs) obtained in electronic exchanges, and b) achieving 'balance' in interpersonal relationships. Rewards consist of 'resources' obtained from communication partners and may be 'extrinsic' (e.g. teaching materials) or 'intrinsic' (e.g. fulfilment of self-imposed 'collegial duties'). Costs may be *psychological* (e.g. timid people may find it difficult to communicate with strangers), *logistical* (e.g. time for typing messages) or *social* (e.g. threats to professional reputation). 'Balance' refers to the mutual 'benefits' obtained by the participants in a relation.

As related to the first force, teachers' communication behaviour reflected their perceptions of the 'efficiency' of e-mail for fulfilling their communication needs (i.e. the extent to which e-mail enabled them to obtain valued professional rewards at relatively low costs). The higher the perceived 'efficiency' of e-mail, the more likely that teachers would use it for collegial purposes. An important conclusion was that in circumstances comparable to those of Teachnet, it is the *professional* rewards obtained in e-mail exchanges that may shape the communication behaviour of teachers. According to the evidence, the degree of affinity between the content of the communication received and teachers' *professional* interests is one of the key factors influencing sustained use of the system. The more e-mail content diverges from teachers' professional interests, the less likely that they will use the system in the long run.

Concerning the second force, the overall evidence suggests that the less 'balanced' a relation is perceived to be by the participants, the less likely that it will be continued over time. It should be noted that for an e-mail relation to be continued over time, *mutual* satisfaction is required (while it is enough for one party to withdraw to *interrupt* a relationship, both parties must be satisfied for the relation to *continue*). An important implication of these results is that unilateral relations between peers may not be sustainable in the absence of special rules or incentives. They also imply that for the study of collegial relations, analysing the communication behaviour of *both* parties involved is necessary. This is important since, as discussed in Chapter 3, many investigations of CMC and collegiality have focused on the (usually self-reported) communication behaviour of isolated individuals.

The overall evidence suggests that, by reducing the *logistical* costs of communication, e-mail may rapidly unleash a relatively large number of collegial interactions between teachers with access to the system. This may be especially true for teachers whose personality traits provide them with 'intrinsic' benefits for sharing, or for teachers who are in urgent and critical need of professional resources and due to geographical isolation or other reasons find it very costly to interact FTF with colleagues.

However, a combination of high social costs of collegial exchange (especially those deriving from the professional norms of the teaching community), technical limitations in the type of content that may be transmitted (e.g. lack of graphics), contextual constraints (such as inadequate technical support or lack of time) and relatively low incentives for collegial exchange (especially when system use has no specific goals and no forms of teacher collaboration are mandated) may lead to only a small fraction of teachers using the system in the long run.

The professional norms prevailing in the Teachnet community (i.e. self-reliance, non-intervention, and egalitarianism) had already been highlighted in previous research as powerful factors inhibiting collegial exchange (West et al, 1989). However, little was known

about the nature of such constraints and how they may actually influence collegial behaviour. The results of this research suggest that not all collegial interactions may be equally constrained by such norms. For each communication choice, teachers were significantly more inclined towards the option implying lesser challenges to professional norms. Firstly, a majority of the e-mail exchanges involved 'products' rather than 'expertise'. Secondly, teachers used the system for *requesting* much less than for *contributing*. Thirdly, most exchanges were carried out in private. Finally, teachers were less likely to create relations with *strangers* than with acquaintances. It is important to note that community norms may *foster* as much as *constrain* exchange behaviour. This is important for educational planners aiming at encouraging collegiality and is discussed in the next chapter.

In sum, the results discussed in this chapter suggest that understanding (and planning for) the collegial use of CMC requires a thorough understanding of the types of resources that teachers need and value and the costs they may perceive in using e-mail to seek or share such resources. For this, researchers need a holistic and dynamic view of teachers' personalities and professional interests, of the strengths and limitations of the communication technology and of the professional and cultural norms prevailing in the community where the e-mail system is deployed.

CHAPTER 11

Conclusions

11.1. Introduction.

The aim of this research was to further our understanding of how collegiality might develop among secondary school teachers using electronic mail. As such, the study should be seen as a development of the corpus of educational research on collegiality, professional development and teacher use of computer-based media.

This final chapter summarises the main conclusions and contributions of this research. It also outlines some limitations of the study and proposes some areas for further research. Finally, some of the key characteristics of the Teachnet community are discussed to help the reader assess the applicability of the results in other contexts.

11.2. Theoretical contributions of this research.

To achieve its aim, this research project investigated the use of electronic mail by 75 teachers of four Uruguayan secondary schools over a period of 37 weeks.

Collegial interactions between teachers can be seen as part of the broader field of human communication, and electronic mail as a medium within the array of media that teachers may use for communicating with colleagues. Within this framework, the communication literature provided the theoretical background for this investigation, guiding the definition of research questions and the interpretation of results. This was important because, as discussed in Chapter 3, most prior research into CMC-based teacher collegiality has lacked a relevant theoretical background and in particular seemed unaware of the century-long line of communication scholarship. Grounding studies of CMC in recognised theoretical approaches is important for several reasons. First, it helps researchers avoid focusing on the technology rather than on the more fundamental educational issues involved. Second, it helps comparisons with findings and conclusions of prior research. Third, and particularly important for a new and emerging field, it provides a mechanism for ‘importing’ theoretical premises and principles from more developed fields (Fulk and Steinfield, 1990, p. 15).

This research project was one of the first to use theoretical frameworks and research techniques drawn from the communication literature to investigate the use of e-mail by secondary school teachers. The network theoretical approach was one of the research frameworks guiding this investigation. A key concept in this approach is that communication research should focus on *relations* rather than on *individuals*. This was important to help conceptualise message exchanges as a network of relations between teachers. Based on this paradigm, it was decided to analyse collegial behaviour in terms of *couple* properties (e.g. previous acquaintanceship, professional homophily) and *link* properties (e.g. intensity, stability, multiplexity). These conceptual definitions, grounded in network theory, guided the collection and analysis of the dense ‘traffic’ data generated by 75 people sending messages to each other over 37 weeks.

Social exchange theory was the key theoretical framework assisting the interpretation of results. This theoretical perspective posits that individuals initiate, maintain and terminate relationships on the basis of their perceptions of the costs and rewards associated with those relationships. Rewards consist of 'resources' obtained from communication partners. According to this approach to communication research, people's exchanges consist of dynamic *processes* (by which people exchange 'resources') rather than discrete *acts*. This was helpful for understanding the importance of analysing the *outcomes* of people's communication, and, more generally, the importance of analysing the content of entire 'relations' between pairs of teachers, as opposed to isolated messages. This was important because most prior research has focused on individual electronic messages for understanding the purpose and meaning of communication.

Finally, the 'richness' approach to the study of media use was helpful for understanding how the technical properties of e-mail affected teachers' communication behaviour. Although this theoretical perspective has been widely used to research the use of different media in a variety of contexts, few studies involved teachers and schools.

This project contributes to social exchange theory development since little research has been carried out within this paradigm to account for technology-mediated communication, particularly in educational contexts. The results of this research help extend the principles and assumptions of this theoretical approach to *computer-mediated* communication, shedding light on complex processes such as partner selection, response behaviour and the use of public or private communication. These contributions help pave the way for new developments in collegiality research, emphasising greater sensitivity to the effects of different media in the development of collegial relations between schoolteachers. The results also highlight the importance of understanding the social norms and values prevailing in the social system in which communicants are immersed. The patterns of exchange of professional resources uncovered in this investigation extend existing knowledge of the types of resources that teachers are willing or able to exchange using electronic communication. This is important because the concept of 'resource' is at the core of the social exchange paradigm.

This project also contributes to the network theoretical perspective for studying communication. By jointly analysing the *content* and *structure* of communication flows, and by taking a longitudinal view of communication, the project advances undeveloped areas of research within the network literature, especially the stability and multiplexity of links. This research shed light on the effects of two key couple properties, *previous acquaintanceship* and *professional homophily*, on the creation and development of links, a contribution that may help contrast the main factors shaping CMC and FTF communication behaviours and draw meaningful theoretical conclusions on the effect of media on the development of communication networks.

Theories of media use are also enhanced by this study. Until recently, most studies of CMC focused on the 'richness' of the medium to theorise about communication behaviour. The Teachnet research project has shown that, although e-mail's properties influence communication behaviour, there are personal and contextual factors that shape the communication behaviour of teachers and ultimately how and why collegiality might develop among teachers using e-mail. These results, which show that people may use 'low bandwidth' media such as e-mail for a wide range of purposes including a sizeable amount of social communication, give support to critics of 'richness' theories who argue that use of media may not be a function of invariant technical properties but the result of the interplay of a number of personal and contextual factors.

To establish the nature of teachers' exchanges, an extensive analysis of the content of messages was carried out and a taxonomy developed for categorising 'topic'. This research-based typology constitutes *by itself* a methodological contribution to research on educational communication. There have been persistent calls in the literature for the development of research-based taxonomies and categorisation systems for teacher CMC exchanges such as those which have existed for many years in FTF communication research (Bales, 1950). This should facilitate comparison between studies and increase the overall validity and usefulness of results (Stohl and Redding, 1987, p. 454, Cole, 1996). As Broholm (1991, p. 179) recommended: '... a clear and reliable taxonomy of the types of teacher communication would be extremely useful for research on educational communication'.

11.3. The research methods used in this study.

To achieve the aims of this study, the communication behaviour of teachers using e-mail had to be investigated. The review of the literature suggested that a multidimensional view of communication behaviour was needed since not all forms of collegiality have the same impact on educational change. Four main dimensions of communication behaviour were investigated: system use, relationship development, communication content and professional exchange. As discussed in Chapter 4, different sources and methods were used to collect and analyse the data pertaining to each of these dimensions of collegiality.

The research design proved effective in light of the aim of the study. A 'rich', comprehensive account of the development of collegiality among teachers using e-mail was obtained which enabled analysis and comparisons with the literature. The main methodological conclusion from this study is that the joint analysis of 'traffic', content and interview data strongly enhances the validity of communication research. In fact, the researcher did not achieve comprehension of some of the patterns of behaviour until the last stage of the research, when data from *all* sources had been analysed. Indeed, some preliminary impressions derived from the 'traffic' data proved to be, in light of the content analysis or of the interview data, highly misleading.

It is of interest to researchers to note that the nature of most communication data collected in this research was such that normality could not be assumed. This is important when selecting statistical procedures for the analysis of communication data. As discussed in Chapter 4, the CMC literature shows cases where tests are used (e.g. the t-test) which assume the normality of underlying distributions with no clear evidence reported to support this assumption (Sandlin, 1986, Grandgenett and Harris, 1994).

Another conclusion of this study is that CMC research designs should include public and private communication. Significant differences between private and public communication behaviour were found, which suggest that investigations excluding one of them might produce highly distorted results.

This research found significant changes in communication behaviour over time, which suggest that research designs should avoid 'static' pictures of communication exchanges.

The results of this research support the view that a *relational* approach (such as the one used here) may be better suited for investigating the development of e-mail collegiality than approaches focusing on *individual* behaviour. According to the evidence, teachers' behaviour towards their colleagues strongly conditioned those colleagues' behaviour towards them in relation to important processes such as deciding whether to continue or to interrupt a relation, selecting a source or deciding whether to reply to or ignore a request for professional resources.

In retrospect, the amount of effort required for analysing the content of communication was vastly underestimated and at some stages caused significant slippage in the project's schedule. It is recommended to researchers that special attention be given to sampling criteria for content analysis to ensure not only that the sample leads to valid results but also that the amount of data to be analysed is manageable with the resources available. Another recommendation to researchers of CMC-based teacher communication is to plan carefully for the IT resources that may be needed and make full use of them. In this line of research, IT is usually needed across the research process, starting from the collection of 'traffic' data from network servers to their analysis using database and statistics programs. Standard programs are not always fully adequate for some of these tasks. Consequently technical advice should be available to help 'tailor' programs for the specific needs of communication research including data management, analysis and storage. In this project, the researcher himself developed some small computer programs to overcome unexpected technical difficulties. The experience of this research, as documented in this thesis, may be of help when planning a project seeking to automatically collect communication data and analyse it using computer-assisted techniques.

11.4. Limitations of this study.

The Teachnet community and the research design had several characteristics, which are discussed below, that limit the scope of this study.

A possible limitation lies in the composition of the user community. The 75 teachers taught 'scientific' subjects (i.e. Maths or Science). CMC use may show significant differences for teachers of 'humanistic' subjects. The two groups have been found by Grünberg (1991) to differ in their attitudes towards IT and other potentially important variables. Thus, it is possible that different results may be found in communities with a more diverse mix of teachers. The four schools are urban, affluent and non-governmental. Although no research data is available, it is likely that teachers in such schools are on average more educated and technologically sophisticated than teachers of Uruguayan rural and public schools. On the other hand, teachers of rural schools might be more eager than their urban colleagues to use electronic mail because, being geographically isolated from colleagues, they may lack any other way for obtaining professional resources. This research was unable to shed light on such issues.

Another relevant characteristic of the user community covered in this research is that it was a 'closed group'. This means that no 'newcomers' joined the user community after the initial period. This excluded the possibility of comparing the patterns of communication between individuals with different tenure within the group. It would be important to know, for example, if newcomers would find it difficult to join 'ongoing' e-mail dialogues, or if conversely a person joining a community that has already adopted this medium would feel more compelled to use it. This is further discussed below under the heading 'Suggestions for further research'.

The duration of the study and the number of measurement points also limit the scope of the Teachnet research. Overall, this study covered 37 weeks of e-mail use from August 1996 to May 1997. Thus, yearly regularities in the patterns of use could not be identified (the Uruguayan school year goes from March to December). Relatively little is known about cyclical regularities of the use of CMC by teachers. However, pioneering work carried out by Levin et al (1988) and Chung (1991) suggests that some yearly cyclic patterns might exist in the usage of computer networks by teachers. Only two measurement points were used in this study to obtain 'traffic' data. This allowed the investigation of the stability of

links created in the first 20 weeks. Additional points of measurement would be necessary to determine the stability of links created after that period or to establish whether discontinued links are resumed at later stages. Additional points of measurement would also be required to analyse long-term changes in intensity and multiplexity.

This study focused on *e-mail* collegiality, hence excluding FTF teacher exchanges and those based on other media such as the telephone. Strictly speaking, this should not be considered a limitation in view of the aim of the research, which was concerned with the development of *e-mail* relations. However, from a broader point of view, a multimedia approach, covering exchanges using a variety of media, could help achieve a more complete understanding of the dynamics of collegial interactions among teachers with access to a variety of media. For example, it could shed light on the extent to which those teachers who discontinue their *e-mail* relations keep communicating FTF. A multimedia approach would also allow for a better understanding of ‘dialogues’ taking place across different media. This is further discussed below under the heading ‘Suggestions for further research’.

Samples were ‘purposively’ chosen and this limits statistical generalisability of findings. However, the in-depth analysis provided for each research question and the detailed discussion of the specific characteristics of the Teachnet community included in this chapter may help the reader assess the applicability of its findings in other contexts. Again, this should not be considered a limitation since the study aimed at understanding and explaining communication behaviour rather than confirming hypotheses and generalising results.

The design of the sociometric instrument used to establish which pairs of teachers knew each other at the time the study began limited this study in some respects. Respondents were offered only a binary choice (i.e. know/ don’t know) for each of the 74 other teachers. This is a widely used design in survey sociometry (see for example Bikson and Eveland, 1990, p. 259). However, as most teachers working in the same building knew each other at least superficially, this might have led to the strong overlapping between data on *previous acquaintanceship* and *school*. In other words, ‘teaching at the same school’ became in practice the equivalent of ‘knowing each other’. With a sociometric instrument offering a larger number of categories to describe acquaintanceship, teachers may use the ‘stronger’ categories of acquaintanceship for those colleagues with whom they have closer bonds than just seeing each other in the staffrooms (see Sproull and Kiesler, 1986, Feldman, 1987 or Constant et al, 1996 for examples of sociometric checklists using more categories).

11.5. The main conclusions of this research.

Chapters 5 to 10 presented the research findings and discussed the evidence for the main conclusions of this research, which are summarised below.

This investigation has found that the development of collegiality among teachers using e-mail is a complex process, influenced by many interacting factors at the personal, community and social system levels. These results suggest that the development of collegiality may not be a function of individual factors but the result of the dynamic interplay of various forces. For example, while access to the system may be essential, it should not be expected that providing teachers with more computers or faster modems might, *per se*, lead to the development of collegial relations in the presence of powerful personal or contextual factors inhibiting use. These conclusions are in accord with sociocultural approaches to the study of innovation and change which postulate –contrary to technological determinism approaches - that use of new technology is not ensured by its mere availability (Blumenfeld et al, 1979). The implicit assumption of technological determinism (Ellul, 1964), which

was for many years one of the leading theoretical approaches for explaining the adoption of technological innovations, is that as long as a technology is available, adoption is inevitable. An implication of these results is that to understand how collegiality develops among teachers using CMC, a holistic view of the technology, the views and personalities of the users involved and the social structure and norms of the community is required.

As discussed in Chapter 10, the overall evidence led to the conclusion that the communication behaviour of teachers with access to e-mail reflects their perceptions of the 'efficiency' of the system for fulfilling their communication needs (i.e. the extent to which e-mail enables them to obtain valued professional resources at relatively low costs). The higher the perceived 'efficiency' of e-mail, the more likely that teachers will use it for collegial purposes. As mentioned above, a complex set of interacting factors at the personal, community and social system levels shape teachers' perceptions of the 'efficiency' of e-mail to achieve their communication purposes. Chapters 9 and 10 discussed in detail the nature of those factors, how they interact with each other and how and why they influence the development of collegiality.

Contrary to the expectations of 'richness' theorists, perceived 'efficiency' was *not* primarily determined by the technical properties of e-mail. 'Richness' theorists argue that people select media on the basis of the 'bandwidth' requirements of their communication needs, with people using 'richer' media such as FTF for 'high equivocality' purposes (e.g. negotiating an agreement) and less 'rich' media such as e-mail for 'low equivocality' purposes (e.g. borrowing a book). The evidence obtained in this research suggests that, in circumstances comparable to those of the Teachnet community, people might prefer FTF communication for *all* purposes, with teachers resorting to e-mail only when their counterpart is inaccessible FTF or when they need to 'broadcast' information to a large number of colleagues. These results give support to critics of 'richness' theory, until recently the dominant paradigm in media use research, who have argued that media use may depend not only on 'richness' but also on other factors such as group norms and other individuals' communication behaviour (Fulk and Ryu, 1990).

The results of this research suggest that teachers' uses of e-mail are *interdependent* behaviours (meaning that one person's choices affect the communication behaviour of others). For example, if a teacher's requests are systematically ignored by his or her colleagues this may lead to him or her interrupting system use. More generally, when a teacher starts 'participating' in electronic communication (i.e. to read and write messages regularly), there may be an increase in the perceived 'efficiency' of e-mail by *other* teachers (those who consider him or her a valuable professional partner). Conversely, when a teacher discontinues his or her participation, those teachers who need or want to communicate with him or her may decrease their own use of the system. This effect may be particularly powerful when the person who discontinues participation is highly 'popular' or 'generous' and has contributed a disproportionate share of the professional resources exchanged in the community. The overall conclusion is that the larger the share of teachers' 'preferred partners' that are 'reachable' using e-mail, the more likely that they will use the system for collegial purposes. This may be especially true when the 'preferred partners' are not easily accessible through other means due to geographical, scheduling or other reasons. This is an important design issue that educational planners should ponder when implementing a CMC system for teachers and is discussed in the next section. It should be noted that it is not enough for people to have an e-mail address to be perceived as 'reachable' through the system. They have to regularly read their messages and give some feedback to those who send messages to them. This is the reason why the rules of 'communication discipline' (i.e. those rules that may explicitly or implicitly set, for example, how often users are expected to access the system) may strongly shape the use of e-mail for collegial purposes.

The main conclusions of this research regarding the extent and nature of collegiality among teachers using e-mail in circumstances comparable to those of the Teachnet community are as follows:

- a) a large proportion of teachers with access to e-mail may initially use it to communicate with colleagues. However, the volume of use may show large differences, with most teachers using it only very sporadically and a few generating a large share of total communication. After some time, most relations initially created may be dropped and creation of new links slow down significantly. In the long run, only a relatively reduced 'kernel' of highly committed users may use the system regularly to communicate with each other. These teachers are likely to include those who perceive high 'intrinsic' rewards from collegial sharing (e.g. those who feel a 'duty' to help colleagues or whose views on teaching put a high value on collegial exchange) and those who are in need of professional resources and whose 'preferred' partners are relatively inaccessible by other means.
- b) electronic mail may support relatively little expansion and (subject) diversification of teachers' collegial networks. E-mail relations are more likely to be created between acquaintances than between strangers and between subject colleagues than between teachers of different subjects. These results are important because they suggest that the potential of e-mail to support the creation of 'new' and 'weak' ties and thus facilitate the circulation of fresh concepts and ideas may be limited. However, the relatively few 'new' and cross-subject relations that are established may be as likely as the rest to remain active in the long run.
- c) among those teachers who use the system regularly, a majority of communication may be 'task oriented'. This is important because collegiality research has consistently found that educational change is supported by collegial interactions that focus on teaching (as opposed to social or non-task professional issues).
- d) those committed users may actively use the system for the exchange of professional resources. However, most exchanges may consist of 'teaching resources', with few focusing on teachers' classrooms or on more abstract discussions of pedagogy and educational theories. Although this may help teachers enrich their professional 'repertoire', it may provide only limited support for 'higher' levels of professional development (involving changes in deep-rooted beliefs and 'opening' teachers' classrooms to mutual critique as an accepted collegial norm).
- e) teachers may use the system more for sharing than for requesting professional resources. In other words, teachers may not use e-mail as a database for unilateral benefit but for sharing their resources *with each other*, thus supporting the development of collegiality. However, most of the sharing may be private, thus leaving relatively few useful resources in the public realm. This may lead to many teachers dismissing e-mail as a mechanism for obtaining professional resources (this is especially true for those teachers who prefer to obtain their resources by 'monitoring' other people's exchanges because they perceive direct inquiries as too costly). Within established relations, e-mail may function as an effective medium for obtaining professional resources *on-demand*, with most private requests obtaining relatively prompt answers (public requests may be ignored by most receivers but, *on aggregate*, a sizeable share may obtain replies).

The relatively few 'new' relations that may be created may be used as much as 'old' relations for exchanging professional resources. In other words, although teachers using e-mail may incorporate relatively few new colleagues into their 'collegial networks', those few that are incorporated may become new sources (and recipients) of professional resources. This may not be true for 'cross-subject' relations, which may not only be less likely to be established but also, when established, significantly less used for exchanging professional resources than professionally homophilous relations.

In sum, the overall evidence suggests that groups of committed e-mail users may form communities where seeking and sharing professional resources are accepted behaviours and this may support educational change and professional development. However, the impact of collegiality in such e-mail-linked communities (they might be called 'e-communities') may be limited for several reasons: a) few sources might be 'new', b) most exchanges might take place between teachers of the same subject, and c) a majority of collegial interactions may focus on teaching resources at the expense of more sensitive and abstract concerns related to teachers' practice and educational views.

11.6. Recommendations for the design of CMC systems for teachers.

The investigation provides a comprehensive framework for understanding how collegiality might develop among a group of secondary school teachers using e-mail. This research-based knowledge might help educational planners design and implement effective CMC systems for supporting collegiality between teachers. Designing a CMC system implies decisions concerning the technology (e.g. speed, network topology, message management tools), project implementation (e.g. access, technical support, training), the organisation of system use (e.g. 'free' or 'structured' with specific tasks to be performed) and the selection of those teachers who may form the user community. This research helps understand the likely outcomes of such choices. The following paragraphs discuss a number of recommendations.

Designing the system.

The results of this investigation may help educational planners understand the trade-offs involved in different technological options. For example, the results suggest that systems capable of supporting interactive communication when needed (e.g. instant messaging), ensuring privacy and confidentiality from student intrusion (e.g. data encryption), transmitting graphics and facilitating message management (e.g. automatic message filtering) may be more effective in supporting collegiality than systems lacking those features.

The evidence suggests that adequate levels of access to the system, training and technical support may be essential for system use. System planners should therefore provide users with enough computers and phone lines, training and technical support for ensuring that teachers can effectively use the system knowledgeably and that minor malfunctions do not disrupt system use for long periods of time.

As discussed in Chapter 9, some teachers did not use Teachnet because their 'preferred partners' were not reachable through the system. This suggests that educational planners should attempt to include 'entire collegial networks' within the user community (i.e. for each teacher, those who are his or her 'preferred partners'). This may require some previous research on teachers' 'preferred partners' but the effort is likely to be worthwhile since it

may significantly improve the perceived usefulness of e-mail for obtaining professional resources. It should also be important to provide users with easy-to-find, possibly on-line, information about who is a member of the user community with some key professionally relevant data such as subject taught, teaching experience or school of employment. This may help teachers identify potentially rewarding communication partners and hence promote system use.

As discussed in Chapter 10, some of the most committed users of e-mail may be those who perceive high 'intrinsic' rewards from collegial exchanges. E-mail seems to have the potential to unleash relatively large numbers of professional contributions from those individuals who value such 'intrinsic' benefits. These results suggest that inclusion in the user community of at least a few highly experienced teachers with a reputation for 'collegial duty' may be important to ensure that a certain volume of professional sharing takes place. This recommendation is consistent with previous CMC research, which has found that a few highly interested and resourceful individuals may be able to provide enough communication 'momentum' for a large share of the community to find e-mail use enticing (Oliver et al, 1985, Eskridge, 1989).

The evidence strongly emphasises the importance of the 'launching' period of a computer network in the development of collegial relations. This implies that network planning should ensure that factors deemed important by the teachers such as technical support are in place *from the start*, since it might not be easy in 'free use' systems to lure users back to the community after they withdraw because of poor technical service.

The results of opting for 'free use' or 'structured' approaches to system use appear as more understandable in light of the results of this investigation. The evidence suggests that in social contexts where collegial interactions bring relatively low rewards and high social 'risks', the development of collegiality may be strongly constrained. The development of e-mail collegial relations may be fostered by 'structuring' system use in different ways. First, communication 'obligations' should be known, agreed and enforced (for example incentives or rules should ensure that teachers read their messages regularly). Second, special collaborative tasks could be organised, especially involving teachers of different subjects and different schools with specific schedules to meet (i.e. thus increasing 'task interdependency').

Facilitating system use.

Many CMC projects for teachers provide for 'co-ordinators' (also called 'facilitators' or 'moderators') whose task is to stimulate system use, mainly through public discussions. Some of the following recommendations concern the strategies that such 'co-ordinators' might use.

In some projects, 'co-ordinators' are hired only for the initial period to 'jumpstart' communication, with the expectation that after some time communication will be self-sustaining. However, as discussed before, it was found that when a highly connected and prolific individual leaves the community, the result may be a 'chain effect' leading to other individuals reducing their use of the system. Thus, the evidence suggests that the 'jumpstart' strategy may not be effective as such and that measures may be needed to make up for the absence of the 'co-ordinator'.

Due to its logistical advantages, 'co-ordinators' tend to resort to public communication for their communications. However, according to the results of this research, while receiving

private messages was significantly associated with sustained system use, this was not the case for *public* messages. These results suggest that ‘co-ordinators’ should look for strategies capable of ensuring that teachers regularly receive *private* messages.

According to the evidence, the degree of affinity between public communication and teachers’ professional interests strongly affected their disposition to use the system. These results suggest that ‘co-ordinators’ should make an effort to identify some of the main professional interests of the users, especially those that may be of interest to all or most of them. Based on this information they should attempt to steer public communication in such a way that the largest possible number of teachers find its content professionally relevant and useful (the system itself may be used for obtaining such data with relatively little collection effort). Thus, strategies for promoting system use should give pre-eminence to *professional* communication (e.g. disseminating information about professional events or encouraging the exchange of teaching materials). This is not to say that *social* communication plays no role in the development of collegiality. At the initial stages of the creation of a community, social communication may help ‘break the ice’ between strangers, and create a more ‘informal’ environment. However, according to the evidence, in the long run it is the *professional* content of the messages received that tends to shape communication behaviour. This is important since there have been a number of CMC research reports stressing the importance of social strategies for promoting the use of CMC (see for example, Kaye, 1988).

This research found that teachers might be highly reluctant to create e-mail relations with strangers. A strategy to address this limitation of e-mail may be to circulate short biographical notes of all users at the initial stages of system use to allow people to recognise similarities in experience or professional interests with each other. Another, costlier, strategy may be to organise regular FTF meetings for people to get to know each other and recognise mutual similarities.

Among all users, it is recommended that ‘co-ordinators’ pay special attention to ‘peripherals’ (i.e. teachers with only one e-mail relation). The reason for this is that, according to the evidence, ‘peripherals’ are more likely to be excluded from the network of collegial relations over time rather than to strengthen their connection with the community. It should be noted that in most communities, other than very small ones, special software might be required for ‘co-ordinators’ to keep track of changes in teacher ‘connectedness’.

Many teachers are reluctant to explicitly *ask* for help from colleagues because of the professional costs involved. Those teachers usually rely on receiving spontaneous contributions, especially public contributions, to obtain professional resources (this strategy is called ‘monitoring’ in the exchange literature). The larger the number of resources spontaneously contributed, the more that those ‘inquiry-averse’ teachers will find e-mail an effective mechanism to obtain professional resources. Thus, spontaneous contributions, especially public contributions, may play a key role in the development of collegiality among teachers using e-mail. This suggests that it should be important to introduce incentives for teachers to share their resources publicly. It should be noted, however, that the introduction of incentives for public sharing may generate an oversupply of potentially irrelevant resources leading to ‘information overload’ (Thorn and Connolly, 1990). As discussed in Chapter 9, this was perceived as a factor affecting the perceived ‘efficiency’ of e-mail for obtaining professional resources by some of the teachers using Teachnet. In other words, a balance must be found between the benefits and costs of public sharing.

11.7. Suggestions for further research.

This section briefly outlines some areas for further research that could add to our understanding of the development of collegiality among schoolteachers with access to e-mail. Some of these suggestions derive from the limitations of the Teachnet study discussed in a previous section.

Multimedia research is an important area of development in this field that could vastly enrich our understanding of the communication patterns of schoolteachers. Research encompassing teacher exchanges over different media could provide a better understanding of the role of e-mail in the array of media that teachers may use to communicate with colleagues. Such research could help establish the communication purposes for which teachers may select e-mail rather than FTF communication or other media, or the conditions in which teachers may choose to interrupt an e-mail 'dialogue' and continue it FTF, among other issues. It should be noted that such research poses daunting requirements in terms of data collection and analysis, and that delicate methodological problems have to be addressed to ensure adequate comparability between communication data exchanged through different media and collected using disparate sources and methods.

This study developed typologies for the types of resources and topics found in teachers' messages. As discussed before, there are no agreed typologies in the literature. This impairs building on, and comparison with, previous research. Hence, it would be important to carry out more research to assess the applicability of the typologies developed in this study to other contexts and help refine them for more general use. The availability of research-based, widely accepted typologies of communication content could prove an invaluable tool to help research in the future where presumably all citizens, and teachers in particular, may gain access to computer-based media. Without such typologies, content analysis of the vast amounts of communication exchanged between people using a changing array of established and 'new' media will become increasingly more complex.

Research of teacher use of CMC technologies other than e-mail, with different technical properties such as instant messaging or two-way video, which are increasingly available in schools, would help achieve a better understanding of how and why teachers use technology-based media for different communication and collaboration requirements. The Teachnet research has provided a sound basis for such research by highlighting those technical properties of media that are theoretically meaningful from a collegiality point of view (e.g. asynchronicity). This is important to help avoid technology-led research (as opposed to educationally motivated research).

More diverse teaching communities should be studied to have a better understanding of the effect of variables such as geographical distance or subject taught on communication patterns. Including rural schools, where teachers are isolated from knowledge centres (e.g. libraries) and from other schools, could be of special interest for understanding how e-mail is used by teachers for whom this may be the *only* viable way of obtaining professional resources.

As discussed in the previous section, it would be important to investigate how 'newcomers' integrate into existing e-mail communities. For this, research designs should allow for the regular incorporation of new teachers into the community. Research into these socialisation processes might provide important insights for principals or heads of department on how to assist the social and professional integration of 'newcomers' into the community.

11.8. The social and cultural context of the Teachnet project.

Explanations, according to Kaplan (1964, p. 351), are always open, depend on certain conditions and are limited to specific contexts. The findings of this research cannot be generalised beyond the context of the Teachnet project. However, the in-depth analysis and tentative explanations provided in previous chapters of this report may help readers assess the likely usefulness and applicability of this study for understanding other situations. It is also important to highlight some of the key characteristics that distinguish the context in which the analysed behaviour took place and discuss how communication behaviour might change with changes in those conditions (Feenberg and Bellman, 1990, Schmitz and Fulk, 1991, Zack, 1993). This is the purpose of this section.

One of the main defining characteristics of the Teachnet user community is that it shared a common professional identity. Different results may be found in communities composed of people whose motivation is, for example, to create social ties. In contrast with the results of the research into the use of Teachnet, in socially-oriented communities people have been found to develop numerous relations with strangers and to discuss matters of a highly intimate nature with them (Wellman et al, 1996, Garton, Haythornwaite and Wellman, 1997, Wellman and Gulia, 1997). Another interesting difference between the use of Teachnet and the use of CMC in socially-oriented communities is that while general interest issues (e.g. politics, sports) were scarcely discussed in Teachnet (they accounted for less than three percent of communication), such topics have been found to be prevalent in large communities where people do not share a professional identity nor common tasks (Quarterman, 1994, Wellman and Gulia, 1997).

Another important characteristic of the Teachnet community is that it was composed of schoolteachers. Important differences have been found in studies of CMC among other professional communities, for example, managers or scientists (Allen, 1978, Rice, 1982). E-mail use in school contexts has usually been found to be lower than in industrial contexts. A full analysis of the differences between organisational variables in schools and industry that may explain the higher levels of e-mail use in industry falls beyond the aims of this study (Steinfeld, 1983 and Kaye, 1992 among other authors, provide useful reviews). Some tentative explanations are offered below.

Differences in 'task interdependency' (i.e. the extent to which individuals need each other to achieve their work goals) may be particularly influential. As discussed in Chapter 3, this task feature has been reported as influencing communication behaviour because it creates a situation where people have an interest in ensuring that *all* individuals obtain the resources they need to perform their job. Educational researchers have found that teaching is a 'low interdependence task' (Pellegrin, 1976, p. 368). Conversely, in industry, collegial exchange is in many cases essential for task completion and supported by formal and informal rules and by the organisation of work (Greenberg, 1980). It is possible that the relatively high levels of 'task interdependency' that characterise some industrial organisations drive people to communicate and collaborate with colleagues. In schools, however, a combination of higher costs for conducting collegial exchanges (derived partly from professional norms that 'punish' asking for and giving professional resources) and lower costs for *not* collaborating lead to highly stable 'collegial networks' where many teachers rarely transcend their existing professional ties. Another relevant difference between schools and industry which has been highlighted by the literature is that the *level of access to computer and telecommunications equipment and the technical support available* is, on average, much higher in industry. Since many industrial or governmental organisations perceive of information exchange and collaboration as essential for task fulfilment, they provide the support needed to ensure that people do not remain unconnected for long periods of time.

More generally, the differential views on the importance of collegiality between schools and industry is reflected in the existence of professional norms and rules supporting or mandating cooperation, in the physical layouts of buildings and in people's schedules which are usually designed to ensure that people needing to work together are physically close and their time tables are compatible (Greenberg, 1980). As Johnson (1990) put it: 'Business and industry put discussion ... at the centre of their enterprises and allocate vast resources to ensure that work is coordinated, but the educational workplace requires that teachers continuously deliver services ... pushing collegial interactions to the margins of the workday' (p. 172).

Another relevant characteristic of teaching communities in Uruguay is their *low level of differentiation*. There are few formal hierarchies among classroom teachers. In the absence of formal status differentiation, *informal* hierarchies develop, mainly based on teachers' reputations. Hence, professional reputation, although important in all professions, becomes one of the sole status indicators among teachers. As reputations are slow to build and vulnerable, this may lead to overly cautious collegial behaviour, highly protective of professional reputations.

There were no formal or informal incentives for collaboration within the Teachnet community. Different results may be found in communities where formal or implicit rules or incentives support collegial communication. Examples of such incentives or rules may be found in schools where teachers are entitled to paid time earmarked for collaboration, in schools organised around a teaching philosophy which puts a strong value on collegiality or in systems where syllabi mandate cross-subject work. In such contexts, where collaboration is mandated or strongly encouraged, e-mail may support the development of more 'new' and cross-subject relations because those rules and incentives might offset the perceived risks associated with communicating with strangers and the low expected rewards from communicating with teachers of other subjects. It is also possible that in such communities the overall amount of use might be higher and that usage may vary less widely among users.

It is also important to note that the use of Teachnet was 'unstructured' and voluntary. The Teachnet project provided a group of secondary school teachers with unrestricted access to electronic mail for free and voluntary use. There were no incentives to use e-mail, no specified purposes or tasks to be undertaken and no formal or tacit rules defining communication 'obligations'. In the absence of formal or tacit rules, uncertainty about other people's communication behaviour led to some people dismissing the system for some purposes. For example, as there were no rules defining 'reading obligations' (i.e. how often users were expected to read their messages) people were uncertain about when their messages would be read by the receivers. Consequently, many teachers refrained from using e-mail for time-sensitive purposes. This suggests that a more structured use of the system could foster higher levels of sustained collegial communication. As one of the stable participants put it: 'Availability of the communication medium is not enough ... Knowledge will not circulate spontaneously ... it has to be organised in some way (Ms. Jcab, 9:33)'. This result is compatible with the findings of prior research (Riel and Harasim, 1994, p. 9). According to Riel and Levin (1990, p. 157): 'To expect that teachers will simply share their knowledge ... on a network ignores the need for ... structure that is taken for granted in other forms of social interaction'.

The size of the Teachnet community should also be borne in mind when interpreting the results of this research. The Teachnet community was a medium-size group of 75 users. This was a much larger community than those studied in the stream of CMC research using 'laboratory-type' techniques, where small groups of people 'play out' pre-designed

communication roles for short periods of time (Walther and Burgoon, 1992, Constant et al, 1994). On the other hand, the Teachnet community was much smaller than the ones investigated by social psychologists and others interested in large scale phenomena involving thousands of people, mostly unknown to each other and dispersed among large geographical distances (Finholt, 1992, Garton, Haythornwaite and Wellman, 1997). Some results of the Teachnet research may not be applicable to either very small or very large groups. Research has shown that in very small groups communication behaviour may be strongly affected by a number of factors that 'fade away' in larger communities. Among these are the leadership exerted by strong personalities, the inclination towards 'group think' and reluctance to challenge apparent consensus. Other factors may be specific to large communities. For example, a sense of 'anonymity' may help people express themselves more freely than in medium-size communities where people frequent the same professional circles and hence may meet with one another at any time.

The social structure of the Teachnet community was found to be very influential in the development of collegiality among the teachers using e-mail. Within this community, a majority of the teachers were unknown to each other (on average, each teacher knew only a quarter of the other 74 before starting to use Teachnet). As previous acquaintanceship was found to be a strong constraint to the creation of collegial relations, it is possible that in professional communities where most people know each other before system deployment, e-mail use may reach higher levels than in the Teachnet community. Similar arguments may be made in relation to professional homophily and professional partnership. It is possible that in a community where all users teach the same subject connectedness may reach higher levels.

Finally, some comments on cultural aspects of communication behaviour are warranted. This research was not cross-cultural. Cross-cultural research on CMC-based teacher collegiality is too scarce and fragmented to provide a basis for discussion (Straub, 1994). However, some tentative reflections may help situate the reader and guide future research. Two differences between cultures have been highlighted by researchers for their potential impact on media use: individualism, and uncertainty avoidance.

According to Singelis and Brown (1995), collectivism and individualism are basic cultural distinctions between countries. They argue that individualistic cultures emphasise 'being direct in communication' and under-emphasise the feelings and opinions of others. In contrast, collectivism leads to an emphasis on status, subtlety and personal relations when communicating. These cultural distinctions have been found to influence people's communication preferences, with people from collectivist cultures finding e-mail less useful (since it conveys very few contextual cues) than people from individualistic cultures (Rice et al, 1995).

Uncertainty avoidance is defined as 'the degree to which members of a society feel uncomfortable with uncertainty and ambiguity' (Hofstede, 1984, p. 83). Some limited evidence (Straub, 1994, Bento, 1995) has been found suggesting that people from countries with higher uncertainty avoidance may be less inclined to use e-mail since it is a medium with low 'social presence'. Given that Latin American countries have been found to be some of the ones with highest uncertainty avoidance in the world (Hofstede, 1984), it is possible that research carried out in countries with lower uncertainty avoidance could find different results. For example, the objections of some of the Teachnet teachers to the 'lack of structure' of system use could be partly related to a need to avoid ambiguity.

This section has reviewed some of the key characteristics of the Teachnet community and discussed how results might be affected by changes in those conditions. This discussion might help readers assess the applicability of this research to their own situation. It also provides important background for the design of future research.

11.9. Concluding remarks.

One of the defining characteristics of the beginning of the twenty-first century may be the dramatic expansion in the communication media available to citizens from all walks of life. This has brought along high expectations regarding the possible positive impact of such technological developments on important social issues such as the democratisation of access to information, technology-based economic growth and intercultural communication.

Although schools have hitherto been relatively slow in the large-scale integration of new communication technologies, this has changed in recent years since technological developments have reduced the costs and complexity of new computer-based media. Electronic mail and access to the Internet are increasingly available to teachers and schools in many countries, including Uruguay. Research, carried out mainly in non-educational contexts, has led to expectations that new communication technologies may support the creation of more collegial educational environments where schoolteachers from different backgrounds and disciplines might communicate and collaborate with each other, freed from the constraints that hamper FTF communication.

This is important because certain forms of collegiality have been consistently found to be associated with educational change and the professional development of teachers. Furthermore, creating educational environments more supportive of collegiality may be essential to cope with the increasingly complex demands brought on by the social, economic and technological changes of our era.

The results of this research give some limited support to these expectations. The evidence suggests that e-mail may indeed support the exchange of professional resources among some of the teachers with access to the system. However, the potential of e-mail to support educational change and professional development may be limited because relatively few 'new' or 'weak' ties may be created and because teachers may avoid exchanging those types of resources which lead to exposure and debate concerning the inner workings of their classrooms and long-held views and assumptions about teaching and learning.

An overall conclusion of the study is that CMC should not be expected to *induce* collegiality: it can only facilitate it when people's views, professional norms and the organisation of work support it. If such factors are supportive of collegiality, e-mail may amplify it. Otherwise, it may make relatively little long-term impact. In other words, deployment of an e-mail system as an isolated measure, within a community where the perceived rewards for collaboration are low and the perceived costs of seeking and sharing are high, is unlikely to lead to the development of collegial relations. However, an e-mail system may be a highly effective instrument as part of an overall strategy, which addresses the array of social and contextual factors which shape teacher collegiality.

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Montevideo, Date

Mr./Mrs. XXXXXX
Principal
YYYYY school

Dear Mr./Mrs. XXXXX

Following our conversation with regard to the Teachnet project, I hereby wish to invite your school to participate in said project.

Toward this end I would like to inform you what resources your institution would be expected to contribute to allow for its participation:

- 1) one telephone line for the exclusive use of the project;
- 2) one networked computer in the teacher room; and
- 3) access to the teachers of your school in order to hold training courses on network use, collect questionnaire data and carry out interviews.

Sincerely yours,

Ing. Jorge Grünberg

This is an English translation of the original Spanish language letter.

TEACHNET PROJECT PARTICIPATION REQUEST

The applicant below requests inclusion in the Teachnet project.

Some messages may be collected and analysed for research purposes. All data will be collected, analysed and stored guaranteeing absolute confidentiality of content and source anonymity. You may withdraw from the project at any time and ask for your data to be removed from files. Please note that the password for access to the network is personal, confidential and non-transferable.

Name:

School:

Subject:

Signature:

Date:

This is an English translation of the original Spanish language form.

TEACHNET PROJECT

Dear teacher:

The following form will allow us to know more about the teachers who will participate in the Teachnet project. Whatever information is obtained will be treated according to strict rules of confidentiality.

I – Teacher information

L.1 – NAME
L.2 – AGE
L.3 – ADDRESS
L.4 – TELEPHONE
L.5 – SCHOOL
L.6 – SUBJECT TAUGHT
L.7 – TEACHING EXPERIENCE (numbers of years)

II – Home computer availability

II.1 – Do you have a computer at home?	Yes No
If you answered <u>affirmatively</u> please answer the following questions:	
II.2 – What model is the computer you own? A – PC (without a hard drive)
 B – PC/XT
 C – PC/AT (or 286)
 D – PC/386
 E – PC/486
 F – PC/586 (or Pentium)
 G – Other specify
II.3 – Does your computer have a modem?	Yes
	No
II.4 – How much disk storage capacity does your hard drive have?	
II.5 – How much memory does your system have?	
II.6 – Do you have a printer?	Yes
	No

III – **If you do not have a computer at home.**

Are you interested in having a computer so as to be able to communicate through electronic mail?	Yes
	No

IV – **Do you have any experience using computer networks?**

Yes	Specify

No	

V – **Other comments.**

.....

.....

.....

.....

.....

This is an English translation of the original Spanish language form.

TEACHNET PROJECT

Dear teacher:

In the context of the Teachnet Project we request your cooperation regarding which of the other 74 teachers who registered for using the network are known to you.

For this reason we request that you fill out the following form.

All data provided will be treated according to strict rules of confidentiality.

Please write the appropriate choice for each of the 75 teachers listed below (please leave your own name unchecked).

- 0 Don't know him/her.
- 1 I know him/her

Biology

- Bbes **Roosevelt** ___
- Dcar **Churchill** ___
- Rcas **Churchill** ___
- Mcut **Roosevelt** ___
- Odia **Churchill** ___
- Sesp **De Gaulle** ___
- Niro **Herzl** ___

- Smac **Churchill** ___
- Spaz **Churchill** ___
- Jrod **Herzl** ___
- Asen **Roosevelt** ___
- Ssic **Roosevelt** ___

Physics

- Abar **De Gaulle** ___
- Hben **Herzl** ___
- Rcam **Churchill** ___
- Eega **Herzl** ___
- Bfer **Roosevelt** ___
- Plin **Churchill** ___
- Mlor **De Gaulle** ___
- Gmar **De Gaulle** ___
- Joli **Herzl** ___
- Rpit **De Gaulle** ___
- Arod **Roosevelt** ___
- Pszt **Herzl** ___
- Avil **Herzl** ___

Maths

- Vacq **Churchill** ___
- Lbel **De Gaulle** ___
- Abra **Roosevelt** ___
- Mbru **Roosevelt** ___
- Jcab **Roosevelt** ___
- Ecar **Roosevelt** ___
- Lcas **Herzl** ___
- Scas **Herzl** ___
- Dcro **De Gaulle** ___
- Sdde **Herzl** ___
- Hdea **Churchill** ___
- Mdef **De Gaulle** ___
- Mdub **De Gaulle** ___
- Egan **Roosevelt** ___
- Cgat **De Gaulle** ___
- Gjoh **Churchill** ___

- Ajue **Herzl** ___
- Mkac **Roosevelt** ___
- Skri **De Gaulle** ___
- Plhe **De Gaulle** ___
- Jlei **Roosevelt** ___
- Eluz **De Gaulle** ___
- Amar **Roosevelt** ___
- Fmet **De Gaulle** ___
- Toch **Roosevelt** ___
- Gpap **De Gaulle** ___
- Gpen **De Gaulle** ___
- Sper **Roosevelt** ___
- Erod **Roosevelt** ___
- Msan **Churchill** ___
- Asan **Herzl** ___
- Jsil **Herzl** ___
- Dsto **De Gaulle** ___
- Sten **Herzl** ___
- Avia **Churchill** ___
- Dwil **Churchill** ___
- Mzam **De Gaulle** ___

Chemistry

- Gbar **Herzl** ___
- Afer **De Gaulle** ___
- Sfer **Churchill** ___
- Efig **De Gaulle** ___
- Mgar **Herzl** ___
- Wmar **Churchill** ___
- Emaz **De Gaulle** ___
- Mmes **Churchill** ___
- Alro **Roosevelt** ___
- Mrod **Herzl** ___
- Atoj **De Gaulle** ___
- Mvil **Churchill** ___
- Mzil **Herzl** ___

Name:.....

School:.....

Subject:.....

Signature:.....

Date:.....

Note: the names of the teachers have been changed to preserve anonymity.

This is an English translation of the original Spanish language questionnaire.

1. Description of the 75 teachers of the sample.

School.

Eighteen teachers taught at the Herzl school, 17 at Churchill, 18 at Roosevelt and 22 at De Gaulle. None of the teachers taught at more than one of the four schools.

Subject taught.

Thirteen teachers taught Physics, 37 Mathematics, 12 Biology, and 13 Chemistry.

Gender.

Participants were 54.7% female (n=41) and 45.3% male (n = 34).

Age.

The ages of the 75 teachers were distributed as follows: 4 teachers were less than 30 years old, 25 between 30 and 39 years, 28 between 40 and 49, 14 between 50 and 59, and 4 were 60 or more. The average age was 43.3 years.

Teaching experience.

The number of years of teaching experience of the 75 teachers was distributed as follows: 14 teachers had less than 9 years of experience, 25 had between 10 and 19 years, 24 between 20 and 29, 7 between 30 and 39, and 4 teachers had 40 or more years of experience (one teacher did not answer this question). The average teaching experience was 19.1 years.

Previous experience with electronic mail.

A large majority of the teachers (78.6%) answered that they had not used electronic communication before starting to use Teachnet.

Availability of home computer.

Most teachers (86.7%) had a computer available at home to access the computer network.

Proximity of school computer.

Sixty-two teachers (82.6%) had access to a networked computer in their staff room at school or alternatively in their laboratory.

Previous acquaintanceship.

At the beginning of the project, each teacher was asked to identify which, if any, of the other 74 teachers he or she already knew. Of the 2775 possible pairs of teachers, 2071 (74.6%) were 'unacquainted' and the other 704 (25.4%) were 'acquainted'. In other words, each teacher knew on average 18.8 of the other 74 teachers using Teachnet.

It should be noted that the purpose of collecting these data was mainly to distinguish between the communication behaviour of strangers (i.e. 'not acquainted') and teachers who knew each other (i.e. 'acquainted'). The 'acquainted' category may include a wide range of different types of relations, from close friends communicating everyday to individuals who know each other but seldom meet or communicate.

Summary of demographic data.

The 75 teachers taught four different subjects in four different schools. The largest group taught Maths (n=37), followed by Physics and Chemistry (n=26) and the rest (n=12) taught Biology. A slight majority (54.7%) of the teachers was female.

The group was middle aged (average age was 43.3) and experienced (average number of years of teaching experience was 19.1). A large majority of the teachers had no previous experience in the use of electronic mail (78.6%) although most of them owned a home computer (86.7%) or had access to a computer at school (82.6%). Teachers knew on average 18.8 teachers of the other 74 teachers using Teachnet.

2. Determining which couples created links.

The flow of private messages between each pair of teachers was analysed with the purpose of deriving the links established between them in a number of successive steps.

Messages sent generated messages received.

The first step in analysing the traffic data was to obtain a list of all messages *received*. First, a file containing all messages *sent* in the period of investigation was extracted from the computer. Secondly, this file was processed using a computer program following the criteria detailed below:

- Each message sent generated as many messages *received* as receivers specified by the sender (each receiver receives a copy of the message).
- Each message sent to a group ('public' message) generated as many messages received as persons belonging to the receiving group.
- Self-messages were discarded (i.e. messages sent by the sender to himself or herself).
- Messages sent after the last log-on of the receiver were discarded since they were not read.
- Messages sent to receivers who were not part of the 75 science teachers included in the investigation were discarded.
- Messages received from senders who were not part of the 75 science teachers included in the investigation were discarded.

The computer program created a file of messages received. Each message received had the following data recorded: receiver, sender, date and time of sending, date and time of reception (i.e. first log-on of receiver after sending) and mode of reception (i.e. received as an individual or as a member of a group).

Messages received generated links.

The file of messages received was analysed by another computer program to generate another file containing the links established in the period of investigation. This program checked all 2775 possible pairs of teachers to check whether each member of the pair had received a private message from the other.

3. Agreement rates in topic analysis.

Message text analysis consisted of three processes:

- Unitizing (i.e. identifying the ‘thematic units’ or ‘quotations’ in each message).
- Coding (i.e. assigning each ‘quotation’ to one and only one of the 20 categories).
- Weighting (i.e. counting the number words included in each quotation).

Unitizing.

Unitizing consisted of decomposing each message in contiguous segments addressing a single topic. Each of these thematic units was coded as an ATLAS ‘quotation’. The main issue in unitizing is finding the boundary where the sender changes topics within the text of a message. Writers may change topic independently of grammatical units; that is, they may change topics within a sentence or paragraph. In some cases, writers use explicit linguistic ‘markers’ in their text for ‘announcing’ a change of topic. Markers may be semantic (e.g. ‘as to the other remaining issue’) or graphical (e.g. bullets or numbers or special symbols). However in other cases topic changes are left for the receiver of the message to infer.

Unitizing was carried out for the 1356 messages included in Sample 1 by the researcher. An independent trained coder ‘unitized’ a random sample of 105 messages. The metric applied to measure intercoder reliability was the percentage of messages in which the two coders agreed on the quotations found. The two coders agreed on 93 of the 105 messages (88.6%). Using the formula for the binomial variance found for example in Nelson (1982)¹ and using the normal approximation, a 95% confidence interval covered (0.825, 0.947). In other words, we can be 95% confident that the percentage of messages in which there is agreement is at least 82.5%. This level of agreement was considered acceptable given Krippendorff’s (1990) recommendation of a minimum reliability of 80%.

Coding.

Once message texts were decomposed into quotations, each of these quotations was assigned to one of the 20 categories (ATLAS was used to ‘assign’ the quotation to one of 20 codes representing the 20 categories). Category reliability requires that ‘competent judges will agree to a sufficiently high degree on which items of a certain population belong in the category and which do not’ (Schutz, 1958, p. 512). To corroborate the reliability of the category system, a large sample of 1559 quotations (out of the 1858 total number of quotations) was categorised by an independent coder and agreement rates were computed. Agreement was found in 1438 cases (92.2% of the decisions). As recommended in the literature, agreement was *not* computed by comparing totals per category but quotation by quotation. This agreement level was deemed acceptable in accordance with the literature (Constant et al, 1996, Krippendorff, 1990, Hernandez, Fernandez and Baptista, 1998)².

¹ $p\text{-hat} \times (1 - p\text{-hat})$, divided by $n=105$, where in our case $p\text{-hat}=0.886$.

² To decide whether this reliability was acceptable, Scott’s pi was calculated (Scott, 1955). Pi is an index of reliability that corrects for the number of categories and for the frequency with which each is used. It can be roughly interpreted as the extent to which the coding reliability exceeds chance. The expected chance agreement (the sum of the squares of the distribution percentages of the categories of the master distribution) was 12.8%. Thus $\pi = 0.911 = ((0.922 - 0.128) / (1 - 0.128))$. Using the formula for the variance of pi found in the same paper, and using the fact that coder reliability is a binomial random variable with $n=1559$ and hence effectively normal (Nelson, 1982), a 95% confidence interval covered (0.896, 0.926). In other words, we can be 95% confident that Scott’s pi is at least 89.6%. As the level of acceptance for Scott’s pi varies in the literature from 0.8 (Constant et al, 1996, Krippendorff, 1990) to 0.89 (Hernandez, Fernandez and Baptista, 1998) the coding process was found acceptable (using 0.05 as our alpha or probability of type I error).

Counting.

Counting posed no threats to reliability since the number of words included in each category was counted automatically and registered in a computer file.

A different approach was used by Finholt et al (1990) in their research of e-mail use by ad hoc task groups. Acknowledging that messages could contain several categories of content, each category was assigned a fractional weight. For example, if two topics were discussed in a single message, 0.5 was counted for each. It was decided that such an approach was not convenient for the Teachnet research project because the relative weight of each category within a message is not taken into account. In other words, a 500-word message where 490 words correspond to category A and 10 to category B and another 500-word message where half the content corresponds to each of the two categories, would both be coded as 0.5 for A and 0.5 for B.

4. Agreement rates in exchange analysis.

First, the second coder read through the 1356 messages, identified the exchange acts in each message and assigned each of the exchange acts to one of the three initial intent categories. Of the 1356 messages, the two coders fully agreed in 1280 or 94.4%. The two coders were in 'full' agreement for a message when both independently identified the same 'exchange acts' and assigned each exchange act to the same category among the three.

Secondly, he independently analysed the 627 requests received, assigned each of them to the 'answered' or 'ignored' categories and coded each 'contribution' as 'unsolicited' or 'solicited'. The two coders fully agreed in 96.1% of the requests. A full agreement meant that both coders identified exactly the same contributions as answers. In other words, if a teacher T_2 received a request R from a teacher T_1 and sent three different contributions intending to fulfil the request, both coders were in full agreement only if they identified all three of them, and only those, as 'solicited contributions' related to R.

Finally, he independently assigned each of the 912 exchange acts found in the first stage to one of the 23 resource categories. There were 73 disagreements, so the two coders were in agreement in 92% of the coding decisions.

These agreement levels were judged as acceptable by the researcher in accordance with the literature (Constant et al, 1996, Krippendorff, 1990, Hernandez, Fernandez and Baptista, 1998).

1. Access rates.

1.1. Point of access.

The access rate from *school* was 0.78 logins per teacher per week and the access rate from *home* was 1.99 per teacher per week. The difference between the two login rates is statistically significant, something that can be asserted with at least 99.9% confidence. This can be inferred from the strong rejection obtained from applying the Wilcoxon Matched-Pairs Signed Ranks test, which yielded an observed significance value of $p < 0.001$.

This nonparametric test seemed the most appropriate procedure to test the hypothesis of equal distributions given the non-negative, roughly continuous nature of the data and given that the data did not follow any of the better known distributions such as the normal or the Poisson¹. Most histograms in this study appeared heavily stacked on the left, but with enough data points far out on the right tail to negate use of the Poisson distribution. That is why tests and other statistical procedures based on the assumption of normality, and sensitive to its violation—such as the t-test—were seldom used in this research (see for example Lehmann, 1975 for discussion of the Wilcoxon Matched-Pairs Signed Ranks and other nonparametric tests).

1.2. Days of access.

The login rates per teacher per day were 0.380 between Monday and Friday and 0.265 during the weekend. The difference between these two login rates is statistically significant, something that can be asserted with 99.9% confidence. This can again be inferred from the results of applying the Wilcoxon Matched-Pairs Signed Ranks test, which yielded $p < 0.001$, hence strongly rejecting the hypothesis of equal distributions.

Among the 5509 logins from teachers' homes, 1468 were carried out during the weekend (i.e. Saturday or Sunday) while 4041 took place between Monday and Friday. The respective login rates per teacher per day were therefore 0.265 during the weekend and 0.291 during weekdays. This difference is *not* statistically significant ($p = 0.14$).

1.3. Access rates and personal variables.

1.3.1. School.

School.	Teachers.	Logins.	Average / Teacher.	Standard deviation.
Herzl	18	1452	80.7	87.0
Churchill	17	2197	129.2	174.3
Roosevelt	18	1442	80.1	105.9
De Gaulle	22	1653	75.1	69.7
Total	75	6744	89.9	112.8

Churchill teachers accessed the system with the highest average login rate, about 50% higher than the rate around which the other three schools clustered. Despite this difference, no evidence was found using the Kruskal-Wallis test to reject the hypothesis that the four distributions are the same. The Chi-square statistic totals 0.34, with 3 degrees of freedom, with an observed significance value of $p = 0.95$.

¹ The observed distribution of logins did not pass the Kolmogorov-Smirnov test of normality ($p = 0.002$) or the test of Poisson distribution ($p = 0$). Even a natural log transformation yielded a Kolmogorov-Smirnov normality test rejection, with $p = 0.045$.

The Kruskal-Wallis nonparametric test (Lehmann, 1975, p. 204) applies to a situation such as the current one in which we wish to compare more than two conditions, where each condition has been applied to different, non-overlapping subpopulations (in this case this refers to the four schools where each of the 75 users may teach²). This differs from the situation earlier, in which there were two measurements for each member of the population and where the Wilcoxon Matched-Pairs Signed Ranks test applied.

1.3.2. Subject taught.

Subject.	Teachers.	Logins.	Average / Teacher.	Standard deviation.
Physics	13	1845	141.9	120.8
Math	37	3356	90.7	130.7
Biology	12	996	83.0	80.1
Chemistry	13	547	42.1	36.5
Total	75	6744	89.9	112.8

Again, despite some noteworthy differences among the subject totals, the evidence found using the Kruskal-Wallis test was too weak to reject the hypothesis that the four distributions are the same at the 0.01 level. The Chi-square statistic totals 8.33, with 3 degrees of freedom and a significance value of $p=0.040$. Even though this result does allow us to conclude that there is a significant difference between the four distributions, we can assert this only with 96% confidence, which is too low a confidence level given the myriad statistical tests that were conducted with the traffic data. Rejecting only at low p-values protects us from committing Type I errors, that is, rejecting hypotheses that are in fact true. Setting the significance levels at 0.01 means that only one percent of rejections will be invalid.

1.3.3. Gender.

Gender.	Teachers.	Logins.	Average / Teacher.	Standard deviation.
Men	34	3233	95.1	128.8
Women	41	3511	85.6	99.1
Total	75	6744	89.9	112.8

The Mann-Whitney test, which tests the same hypothesis of equal distributions but for the case of two populations, showed that the evidence was *not* sufficient to reject the hypothesis, with a z-value of -0.12 and $p=0.91$.

1.3.4. Age.

The Pearson correlation coefficient between age and number of logins over the period of study was 0.055, with a p-value of 0.64, meaning the correlation was effectively zero, and reflected no linear association between the two variables.

² None of the 75 teachers taught at more than one of the four schools.

1.3.5. Teaching experience.

The Pearson correlation coefficient between years of teaching experience and number of logins over the period of study was 0.095, with a p-value of 0.42, reflecting no linear association. This was to be expected since age and teaching experience had a correlation of 0.83, meaning they effectively measured the same thing.

1.3.6. Previous experience with electronic mail.

Previous experience .	Teachers.	Logins.	Average / Teacher.	Standard deviation.
Yes	16	1349	84.3	73.6
No	59	5395	91.4	121.8
Total	75	6744	89.9	112.8

The Mann-Whitney test yields a z-value of -0.66 , with $p=0.51$ and therefore the hypothesis of equal distributions was *not* rejected.

1.4. Access rates and logistic variables.

1.4.1. Availability of home computer.

Home computer.	Teachers.	Logins.	Average/ Teacher.	Standard deviation.
Yes	67	6508	97.1	117.0
No	8	236	29.5	29.8
Total	75	6744	89.9	112.8

The Mann-Whitney test yields a z-value of -2.2 , with $p=0.027$. The hypothesis of equal distributions was therefore *not* rejected at level 0.01, although as can be seen from the table, the advantage of having a computer at home resulted in those teachers logging into the system three times more often than those who lacked it. The fact that this result is not significant at the 0.01 level may be a function of the very small number of teachers ($n=8$) who lacked home computers.

1.4.2. Proximity of school computer.

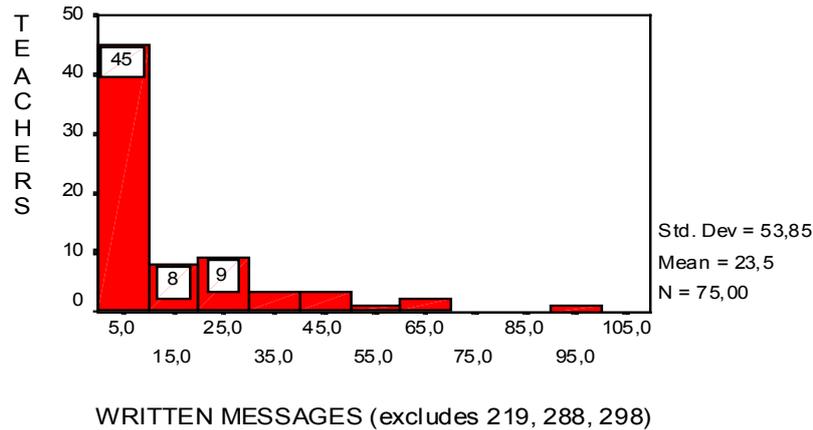
Proximity of school computer.	Teachers.	School logins.	Average/ Teacher.	Standard deviation.
Yes	62	1110	17.9	19.3
No	13	125	9.6	18.9
Total	75	1235	16.5	19.4

Considering logins from school, there was almost a two-to-one difference in the average login rates in favour of those who had close access to a networked computer at school. The Mann-Whitney test yielded a z-value of -2.42 , with $p=0.016$. The hypothesis of equal distributions was therefore *not* rejected at level 0.01, although it was very close.

2. Message writing.

The histogram below shows the number of messages written per teacher in the period of study, excluding the three largest data points so as to better depict the observed distribution.

Histogram of written messages by the 75 teachers from 8/96 to 5/97.



2.1. Written messages and personal variables.

2.1.1. School.

School.	Teachers.	Messages written.	Average/ Teacher.	Standard deviation.
Churchill	17	519	30.5	70.6
Roosevelt	18	725	40.3	81.9
De Gaulle	22	239	10.9	11.7
Herzl	18	282	15.7	20.8
Total	75	1765	23.5	53.9

Despite the obvious differences between school averages, the Kruskal-Wallis test results did *not* provide evidence to reject the hypothesis that the underlying distributions are one and the same. The Chi-square statistic totals 0.61, with 3 degrees of freedom, with a significance value of $p=0.89$.

2.1.2. Subject.

Subject.	Teachers.	Messages written.	Average/ Teacher.	Standard deviation.
Physics	13	321	24.7	27.6
Math	37	1180	31.9	73.3
Biology	12	146	12.2	15.9
Chemistry	13	118	9.1	13.3
Total	75	1765	23.5	53.9

Again, despite some noteworthy differences among averages per subject the Kruskal-Wallis test results did *not* provide evidence to reject the hypothesis that the underlying distributions are one and the same. The Chi-square statistic totals 5.29, with 3 degrees of freedom, with a significance value of $p=0.15$.

2.1.3. Gender.

Gender.	Teachers.	Messages written.	Average/ Teacher.	Standard deviation.
Male	34	653	19.2	49.5
Female	41	1112	27.1	57.6
Total	75	1765	23.5	53.9

The Mann-Whitney, which tests the same hypothesis of equal distributions but for the case of two populations, showed that the evidence was *not* sufficient to reject the hypothesis ($z=-0.42$, $p=0.68$).

2.1.4. Age.

The Pearson correlation coefficient between age and number of messages written over the period of study was 0.0009, with a p-value of 0.99, probably a candidate for the classical formless cloud-type scatter diagram, reflecting absolutely no linear association.

2.1.5. Teaching experience.

The Pearson correlation coefficient between years of teaching experience and number of messages written over the period of study was 0.055, with a p-value of 0.64, reflecting no linear association. This was to be expected, since as we mentioned previously, age and teaching experience had a correlation of 0.83, meaning they effectively measured the same thing.

2.1.6. Previous experience with electronic mail.

Previous experience.	Teachers.	Messages written.	Average/ Teacher.	Standard deviation.
Yes	16	256	16.0	16.4
No	59	1509	25.6	60.1
Total	75	1765	23.5	53.9

The Mann-Whitney test yields a z-value of -1.13 , with $p=0.26$. The hypothesis of equal distributions was therefore *not* rejected.

2.2. Written messages and logistical variables.

2.2.1. Availability of home computer.

Home computer.	Teachers.	Messages written.	Average/ Teacher.	Standard deviation.
Yes	67	1755	26.2	56.4
No	8	10	1.3	1.3
Total	75	1765	23.5	53.9

The Mann-Whitney test yields a z-value of -2.86 , with $p=0.0042$. The hypothesis of equal distributions *was* therefore rejected. As can be seen from the table, the advantage of having a computer at home resulted in those teachers writing 21 times more messages on average than those who lacked it.

2.2.2. Proximity of school computer.

Computer close.	Teachers.	Messages written.	Average/ Teacher.	Standard deviation.
Yes	62	1662	26.8	58.6
No	13	103	7.9	9.5
Total	75	1765	23.5	53.9

The Mann-Whitney test yields a z-value of -1.22 , with $p=0.22$. The hypothesis of equal distributions was therefore *not* rejected at level 0.01.

2.3. Written messages and system variables.

2.3.1. Messages written and number of logins.

The correlation coefficient between the number of written messages and the number of logins was 0.81, with $p=0$, a fairly strong linear association. In other words, the more frequently teachers logged in, the more messages they wrote.

Only two teachers were found that could qualify as relatively high on logins and relatively low on written messages. One logged in 112 times (77th percentile for logins) but wrote only two messages (30th percentile for written messages); another had 235 logins (92nd percentile) and three written messages (36th percentile).

2.3.2. Written messages and messages received.

The number of messages *written* by each teacher was compared with the number of total, private and public messages *received* by each of them.

The correlation coefficient between the number of messages *written* and the total number of messages *received* was 0.63 with $p=0$, meaning that this correlation *is* significantly different from zero. The average number of messages written per message received was 0.069 and the standard deviation 0.12

The correlation coefficient between messages *written* and public messages *received* was 0.18 with $p= 0.12$, meaning that this correlation is *not* different from zero. The average number of messages written per *public* message received was 0.093 and the standard deviation 0.20.

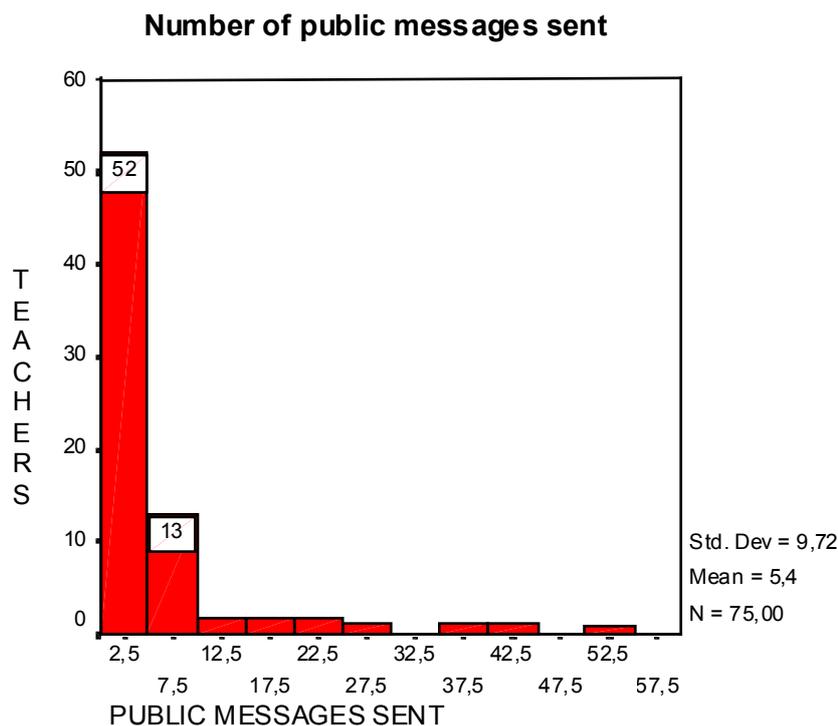
The correlation coefficient between messages *written* and private messages *received* was 0.95 with $p= 0$ again meaning that this correlation *is* significantly different from zero. The average number of messages written per *private* message received was 0.95 and the standard deviation 0.79.

These results point to a strong relation between the number of private messages received by teachers and the number of messages they write. The opposite is true of public messages, where there is effectively no association with written messages.

3. Message sending.

3.1. Public messages.

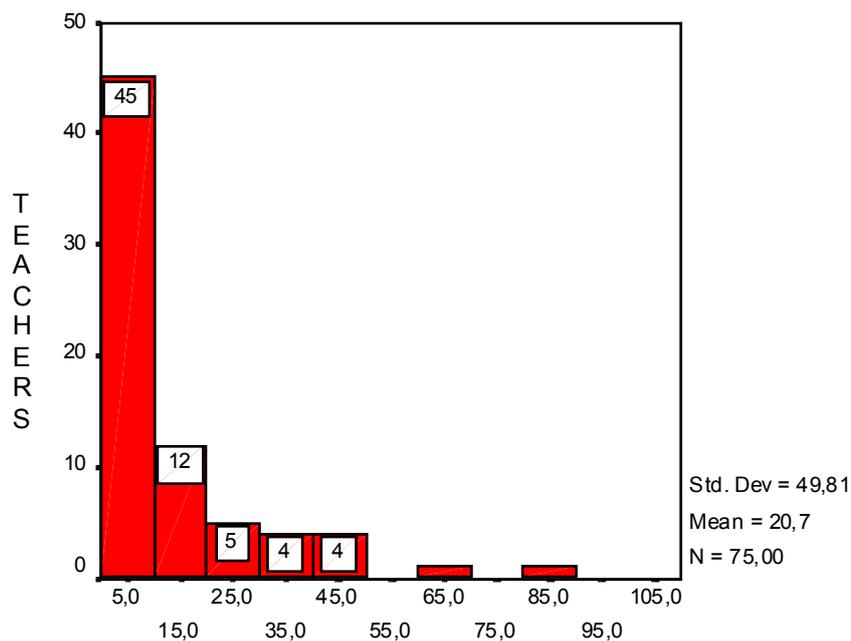
The histogram below shows the number of public messages sent per teacher in the period of study.



3.2. Private messages.

A quarter of the teachers (25.3%, $n= 19$) did not send any private messages and close to two thirds (60%) sent less than 10 messages. At the other extreme, three teachers sent more than 200 private messages each. Hence the histogram reflects a very skewed, non-normal distribution. The histogram below excludes the three largest observations so as to better depict the shape of the observed distribution.

Histogram of private messages sent



PRIVATE MESSAGES SENT (EXCLUDES 206, 260 and 279)

3.3. Receivers of private messages.

The 75 teachers sent 1556 private messages in the period of study.

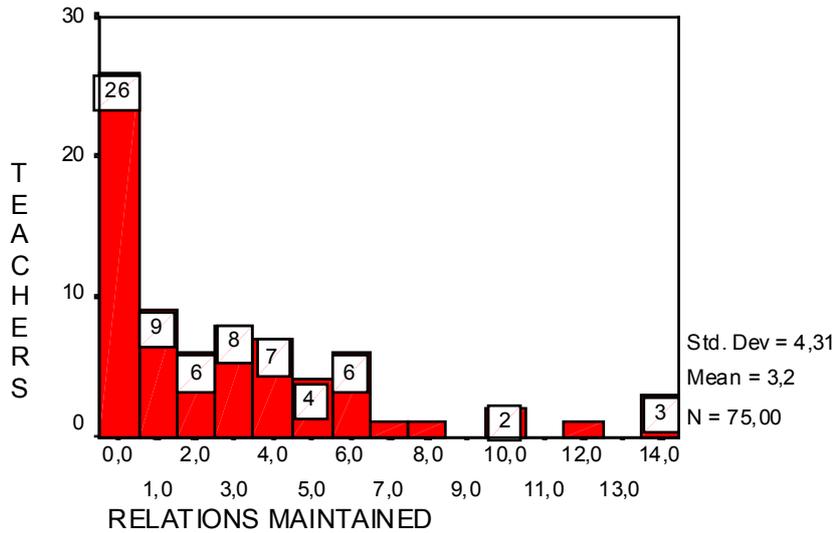
A large majority (69.7%, $n = 1085$) of the 1556 messages were sent to previously known colleagues. According to the sociometric data collected in the first stage of the research, teachers reported knowing before the start of the project an average of 18.8 of the other 74 teachers (25.4%). Binomial formulas were applied (Nelson, 1982) to determine whether the percentage of messages sent to previously known colleagues (69.7%) was significantly different than could have been expected by chance. These formulas are used to establish whether an observed percentage of sample occurrences differ significantly from some specified probability of occurrence. A 99.9% confidence interval (CI) for the percentage of messages sent to previously known colleagues was computed using those binomial formulas. The CI was [65.9%, 73.5%] and since it does *not* cover 25.4% it was concluded, with 99.9% confidence, that the number of private messages sent to previously known colleagues was significantly greater than could have been expected by chance.

Among these same 1556 private messages, 1098 or 70.6% were sent to subject colleagues (i.e. teachers who taught the same subject as the sender). Applying binomial formulas again, a 99.9% CI for the percentage of messages sent to subject colleagues runs from 66.8% to 74.4%. On average, each teacher had 23.7 subject colleagues participating in the study, which out of 74 means 32%. Since the confidence interval above does *not* cover 32% it was concluded, with 99.9% confidence, that the number of private messages sent to subject colleagues was significantly greater than could have been expected by chance.

1. Teacher connectedness.

An histogram of the number of relations maintained per teacher is shown below.

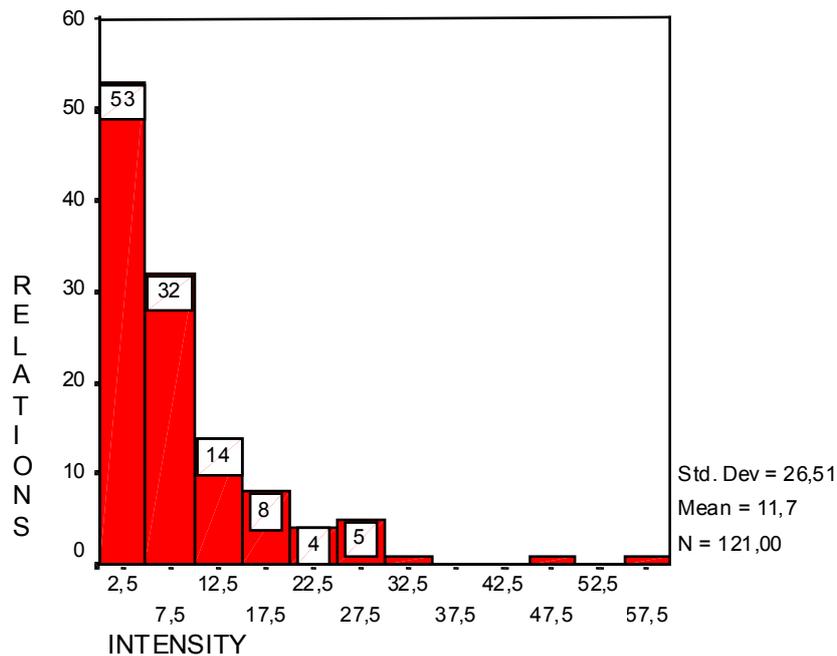
Histogram of the number of relations maintained per teacher.



2. Intensity of links.

The histogram of the intensities of links appears below. The two largest observations (222 and 183) are excluded so as to better depict the shape of the observed distribution.

Histogram of intensities



3. Couple properties and link creation.

3.1. Link creation and previous acquaintanceship.

Among the 2775 couples, 704 were previously acquainted and 2071 were not. Of the 704 previously acquainted pairs, 80 created a link (11.4%) while of the 2071, 41 did (2%). These two percentages (11.4% and 2%) were compared using a Chi-square test on the table below.

Couples.		Relation.	
		Formed.	Not formed.
PREEXISTENT	704	80 (31)	624 (673)
NEW	2071	41 (90)	2030 (1981)
Total	2775	121	2654

The Chi-square statistic yielded 108.9 with one degree of freedom, an extremely large number that corresponds to a p-value effectively 0. It was concluded that a significantly much larger percentage of potential relations was realised among couples that previously knew each other than among strangers.

The effect of *previous acquaintanceship* on the formation of relations when corrected for the effect of professional homophily was tested. As shown in the table below, 21 relations between strangers were created among the 541 previously unacquainted couples teaching the same subject.

Same subject couples.		Relation.	
		Formed.	Not formed.
PREEXISTENT	347	53(29)	294 (318)
NEW	541	21(45)	520 (496)
Total	888	74	814

The Chi-square statistic came to 34.2, so that the p-value is 5.0×10^{-9} . The conclusion was that among couples that taught the same subject, a significantly larger percentage of potential relations was realised among couples that previously knew each other.

Twenty links were established by the 1530 unacquainted couples that taught different subjects.

Different subject couples.		Relation.	
		Formed.	Not formed.
PREEXISTENT	357	27(9)	330 (348)
NEW	1530	20(38)	1510 (1492)
Total	1887	47	1840

This time the Chi-square test yielded 43.2, so that the p-value is effectively 0. The conclusion again was that among couples that taught different subjects, a significantly larger percentage of potential relations was realised among couples that previously knew each other.

3.2. Link creation and professional homophily.

The effect of professional homophily (i.e. teaching the same subject) on link creation was tested by comparing the percentage of relations created among the 888 couples teaching the *same* subject ($74/888 = 8.3\%$) with the percentage of relations created among the 1887 couples teaching *different* subjects ($47/1887 = 2.5\%$).

Subject.		Relation.	
		Formed.	Not formed.
SAME	888	74 (39)	814 (849)
DIFFERENT	1887	47 (82)	1840 (1805)
Total	2775	121	2654

For this comparison, Chi-square= 48.5, so that the p-value (or observed significance level) is effectively 0. The conclusion was that a significantly *much* larger percentage of potential relations was realised among couples that taught the same subject.

The effect of professional homophily among the 704 couples that previously knew each other was similarly tested.

Subject.		Relation.	
		Formed.	Not formed.
SAME	347	53(39.4)	294 (307.6)
DIFFERENT	357	27(40.6)	330 (316.4)
Total	704	80	624

This time Chi-square= 9.68, which corresponds to a p-value of 0.0019. The conclusion was that among teachers who previously knew each other, a significantly larger percentage of potential relations among couples teaching the same subject was realised.

To complement this comparison, the effect of professional homophily among the 2071 couples that were previously *unacquainted* was tested.

Subject.		Relation.	
		Formed.	Not formed.
SAME	541	21(10.1)	520 (520.3)
DIFFERENT	1530	20(30.3)	1510 (1499.7)
Total	2071	41	2030

For this case Chi-square= 11.1, equivalent to a p-value of 0.0009. The hypothesis of independence was again *rejected*.

4. Couple properties and link stability.

4.1. Link stability and previous acquaintanceship.

The effect of previous acquaintanceship on link stability was tested by comparing the percentage of stable relations created among the 72 couples that previously knew each other ($26.4\% = 19/72$) with the percentage of stable relations created among the 29 couples that did *not* previously know each other ($17.2\% = 5/29$) among the 101 links created in P1.

Couples.		P1 Relation.	
		Stable.	Unstable.
PREEXISTENT	72	19(17.1)	53 (54.9)
NEW	29	5(6.9)	24 (22.1)
Total	101	24	77

The Chi-square statistic added up to 0.52, equivalent to a p-value of 0.47. Thus there was *not* enough evidence to reject the hypothesis of independence: the percentage of stable relations created among previously acquainted couples was not significantly different than the percentage of stable relations among previously *unacquainted* couples.

4.2. Link stability and professional homophily.

The effect of professional homophily on link stability was tested by comparing the percentage of stable relations created among the 63 couples teaching the same subject (22.2%= 14/63) with the comparable figure for pairs where subject taught was different (26.3%= 10/38).

Subject.		P1 Relation.	
		Stable.	Unstable.
SAME	63	14(15.0)	49 (48.0)
DIFFERENT	38	10(9.0)	28 (29.0)
Total	101	24	77

From this table, Chi-square= 0.06, equivalent to a p-value of 0.81. Again there is *not* enough evidence to reject the hypothesis of independence: the difference in the percentages of stable relations created among *same subject* couples and among *different subject* couples was not statistically significant.

5. Network dynamics.

5.1. Changes in link creation.

Of the 121 relations created during the period of study, 101 (83.5%) were created in the first period involving 47 teachers and 20 (16.5%) in the second one involving 28 teachers. Thus, 3.6% (101/2775) of the possible pairs of teachers established relations in P1 and 0.75% (20/2674) of the pairs of teachers who did not establish relations in P1 (2775-101) created a link in P2. A Chi-square test was used to compare these two percentages (3.6% and 0.75%) and yielded a statistic equal to 51.2 with one degree of freedom, a very large number that corresponds to an extremely small p-value, effectively 0. It was concluded that a significantly larger proportion of the possible pairs of teachers established relations during P1 than during P2.

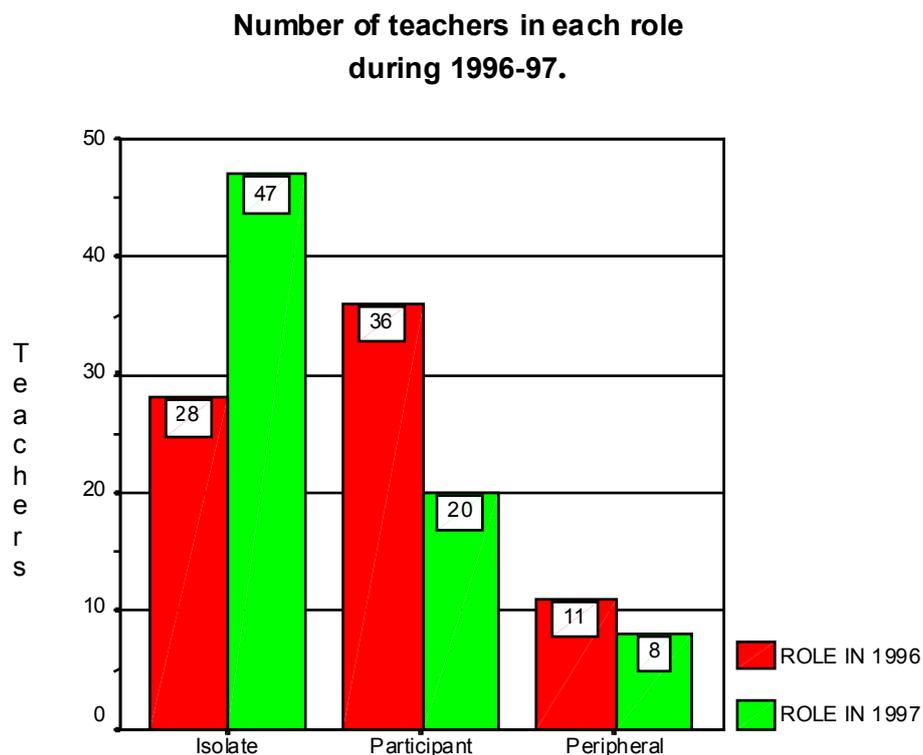
The same was true when only pairs teaching the same subject were analysed. The proportion of same subject couples which established relations in each period (6.9% and 1.3%) were similarly tested using a contingency table. The Chi-square statistic totalled 33.1, which means a p-value of 8.8×10^{-9} . The conclusion was that a significantly larger percentage of potential relations between professionally homophilous couples was realised during P1 than P2.

No such comparison could be made between the number of links created between strangers in P1 and P2 because it could not be assured that those teachers who had declared in the sociometric survey that they did not know each other in August 1996, were still strangers in February 1997.

5.2. Changes in communication roles.

Communication roles may change over time as some links become null (i.e. no more private messages are exchanged between the transceivers) and others are created.

The bar graph below shows the distribution of the roles among the population of 75 teachers: the bar to the left for P1 and the bar to the right for P2.



As can be appreciated from the bar graph, there were a number of role changes from one period to the next. The changes are summarised in the following table, with totals for each role for the year shown in parentheses, and the total changes by role in the last column and row.

Role changes from P1 to P2

1997 Ý † 1996	I (47)	PER (8)	PAR (20)	Changed from 1996 Role.
I (28)	26	2	0	2
PER (11)	7	1	3	10
PAR (36)	14	5	17	19
Changed into 1997 Role	21	7	3	31

Thirty-one of the 75 teachers (41.3%) changed roles from P1 to P2. Most changes (84%, n=26) consisted of movements towards lower connectedness. Nineteen of the 36 teachers who were participants in P1 (52.8%) were isolates or peripherics in P2 and seven of the 11 teachers (63.6%) who were peripherics in P1 were isolates in P2. In sum, 26 of the 47 participants or peripherics (55.3%) reduced their level of connectedness from one period to the other. This compared to just 5 movements toward *higher* connectedness. Two of the 28 isolates changed in P2 into peripherics and 3 of the 11 peripherics changed in P2 into participants.

A 2x2 contingency table shows that the movements towards lower connectedness among P1 participants and peripherics (21 of 47) were significantly more than movements towards higher connectedness among P1 isolates (2 out of 28). The Chi-square statistic came to 9.97, equivalent to $p=0.0016$.

5.3. Changes in link properties.

5.3.1. Intensity.

The distribution of intensities during the *first* period for the 101 relations formed during P1 and the distribution of intensities during the *second* period for the 20 relations formed during P2 were compared. On average, the 101 P1 relations exchanged 10.2 messages and a median of 5 messages. The 20 P2 relations exchanged on average 3.8 messages and a median of 4 messages.

The Mann-Whitney test yielded a z-value of -2.47 , with $p=0.013$. The hypothesis of equal distributions was technically *not* rejected at level 0.01, although it was extremely close to significance. In sum, there was no significant difference (at the 0.01 level) between the intensity of the relations created in P1 during the first period and the intensity of the relations created in P2 during the second period.

The intensity of the 24 stable relations during P1 were also compared with their intensity during P2.

Stable relations.	Total Intensity.	Average intensity.	Standard deviation.	Median.
Period 1	595	24.8	39.2	11
Period 2	270	11.3	15.4	6
Total	865	36.0	53.0	19.5

In addition to the obvious differences shown in the table, P1 intensities of stable relations ranged from 3 to 153, while P2 intensities ranged from 2 to 69. Not surprisingly, then, the Wilcoxon Matched-Pairs Signed-Ranks Test rejected the hypothesis of equal distributions, with $p=0.0093$. A log transformation yielded marginal results in terms of fits to normal distributions; nonetheless, the Paired Differences t-test rejected at the 0.01 level, hence confirming that the intensities of the 24 stable relations were significantly lower in P2.

5.4. Changes in the determinants of link creation.

This section looks separately at the effect of previous acquaintanceship and professional and personal homophily on link creation in the two periods of study. Two by two contingency tables are used to perform Chi-square tests on the percentages of relations created according to each variable.

5.4.1. Previous acquaintanceship.

Comparing the percentage of P2 relations created among couples that previously knew each other ($8/704 = 1.1\%$) with the percentage of P2 relations created among couples that did *not* previously know each other was not possible because it could not be ensured that those people that were not acquainted in August 1996 had not met in February 1997.

5.4.2. Professional homophily.

The percentage of relations created during P1 among the 888 couples that taught the same subject was 7.1% (63/888) while the percentage created among the 1887 couples that taught *different* subjects was 2% (38/1887).

Subject.		P1 Relation.	
		Formed.	Not formed.
SAME	888	63 (32.3)	825 (855.7)
DIFFERENT	1887	38 (68.7)	1849 (1818.3)
Total	2775	101	2674

For this comparison, Chi-square= 43.1, corresponding to a tiny p-value of 5.2×10^{-11} , meaning that a significantly *much* larger percentage of potential relations was realised in the first period among couples that taught the same subject.

The same comparison was carried out for the 20 relations created in P2 using the table below (the percentages were 1.2% and 0.5%) .

Subject.		P2 Relation.	
		Formed.	Not formed.
SAME	888	11 (6.4)	877 (881.6)
DIFFERENT	1887	9 (13.6)	1878 (1873.4)
Total	2775	20	2755

For this comparison, Chi-square= 3.89, with $p = 0.049$, a total that did not allow rejection of the hypothesis of independence. It was concluded (at the 0.01 level of significance) that the percentage of potential P2 relations realised among couples that taught the same subject was *not* significantly different from the percentage of potential P2 relations realised among couples that taught different subjects.

1. Examples illustrating all 20 categories for coding topics.

(T1 Social Personal) “How did Bobby spend his birthday? Eddie had his birthday yesterday too.”

(T1 Social Personal) “So Jackie. Are we going out to celebrate New Year’s eve this year? I don’t think it’s worth it, do you? Things aren’t going so fantastic that we can pretend nothing’s wrong and go out, right?”

(T2 General Interest) “The first of January of 2000 is the first day of the 21st century; just like your little grandson, this first year of the 21st century will begin on the first of January of 2000. When a year has passed then we will be living in the second year of the 21st century and so on..”

(T3 CMC and Teachnet Project) “How did you manage to have your complete name appear in the ‘from’ field instead of your username?”.

(T5 Job and Career) “Jackie, at Charlemagne school there will be two first year classes, two second years and one third year. I am going to have one first year and two second years and Joy Stevens, who’s the other one there, the other first year. Neither of us is taking the third year class so another teacher will be hired.”

(T6 Students) “Regarding your students of the Charlemagne school, I will later give you more detailed impressions of each one if you want. It’s a very heterogeneous group, which this year added 2 or 3 new students ... You have very good kids and others that are troublesome. But very good things can be accomplished with them. I would like to talk it over with you.”

(T7 Colleagues) “Farnsworth sent me a message where the subject of Dana popped up and it seems she does not answer because ‘her conscience is clean’. Don’t tell anybody but it seems that the direct appointment was ‘clean clean’.”

(T8 Educational System) “Hello. I wanted to ask you what ought to be in your view the immediate strategies to be implemented in our country to bring us to the same level as other countries with respect to education in Mathematics.”

(T9 Teacher Production) “I wanted to let you know that the collection of problems for the first three years of secondary school that me and my colleagues have produced is now ready. It consists of 171 problems with their corresponding comments and a separate set of solutions. It is available to you in case you want to ‘check it out’.”

(T10 Professional Plans) “I found out yesterday through Nancy, the psychologist, chatting in the staff room that you are travelling to Brazil for a Maths workshop. What is it? Where are you going? what will you be doing? Why didn’t you say anything? I’m always in limbo. When do you leave? Who else is going? Greetings. See you later. Patricia the uninformed.”

(T11 Teacher Development Events) “On Nov 5 and 8 an Argentinean lecturer is coming to give two conferences on Mathematics teaching at 8:30 AM.”

(T12 Teacher Education) “Why is it that my beloved Teachers’ College (and I mean it) doesn’t really provide us with substantial content that can be applied in the classroom?”

(T13 Educational Theory) “What you assert is correct regarding mediations, from a cognitive point of view, I think the explanation can be understood from several points of view: as you know for Piaget one of the basic cognitive functions is classification, the children classify first within identical categories, which is later applied in arithmetic operations, first they calculate $4 + 4$ or $3 + 3$ then $3 + 5$.”

(T14 Teaching Philosophy and Teacher Attitudes) “Regarding ‘silence’, or beyond that, speaking or not speaking in class (only questions that barely lead to ‘hints’), each day I become more convinced that whoever among us is capable of putting together a course in which he does not have to open his mouth, and overcome the temptation to open it, if there is anyone who can reach a 100% achievement rate, he must be the one..”

(T15 Evaluation) “Now that step by step I am approaching diagnosis and treatment work, I realise that I have been very wrong in attempting to evaluate thinking processes with tests for my poor students. A process is longitudinal and cannot be evaluated from a cross section. That’s why I always remember your words or misgivings about how we manage to evaluate aptitudes and attitudes.”

(T16 Syllabus) “...I would like to ask you who included in the syllabus for the first three years of secondary school several years ago the famous D (decimals), I cannot remember the exact date.”

(T17 Teaching Materials, Scientific Info and Bibliography) “In the first year textbook we included this exercise: ‘A person says: I have as many brothers as sisters. This person’s sister states: I have twice as many brothers as sisters. How many siblings are there in all?’”

(T17 Teaching Materials, Scientific Info and Bibliography) “There is a specific book on what you need, the author is Matila Gica (I don’t know how to spell it). I don’t have it, I know M. Williams has it, at least you can ask her details about the author etc ... Hope this helps.
Pat”

(T18 Teaching Approach) “We start with movement, for example we tell them to draw the letter L (double) and later repeat it somewhere else on the page. From there we deduce the movement, properties, vector, etc. We also define parallelograms and demonstrate their properties through movement. We try to stress constructions with ruler and compass. We review triangles again since that’s presented earlier, and we also ask that they move the triangle notable points. Sometimes we have done free movement projects on figures and have exhibited them. I hope this short scheme is useful to you”.

(T19 Teaching activity) “I was told that you have already presented the potato problem in the first year class; I am sorry because until now our students don’t know the pair of coordinated axes. So, what will happen? You will have to explain to them a topic that is not in *your* subject. Or what will happen, is that they will consult *me*. I thought that we were going to *coordinate* an activity that would take place during our modules, for that reason, I expressed enthusiasm; this way, I don’t think it will be as useful, from the mathematical point of view, of course.”

(T20 Course Planning) “I already finished spatial geometry. I even assigned the construction of the 5 regular polyhedrons to a group of students, find out who Euler was and research Euler’s relation to polyhedrons. I already started with the equation for a straight line and I am on the parallelism condition. I had honestly forgotten about financial maths. But I will leave it for the end, for the last few weeks when they don’t want to see anything else.”

2. Criteria for determining the value of multiplexity.

Given a link L between teachers T_1 and T_2 and a family of categories F , which includes categories C_1, C_2, \dots, C_n , then the family F is addressed in link L if there is at least one pair of messages of link L such that:

- a) one of the messages is sent by T_1 and the other by T_2 ,
- b) each of the two messages includes at least one quotation assigned to a category C_i which is included in family F .

It should be noted that reciprocity was required as shown above. In other words, if one of the two teachers *sent* a message about student behaviour to the other but never *received* a message addressing that topic from the other, then Students (T6) was *not* counted as a category addressed in that link.

3. Number of words per category in private communication.

	Words.	%
T17 Teaching Materials	32 335	27.7%
T1 Social Personal	13 496	11.6%
T19 Teaching Activity	12 314	10.6%
T18 Teaching Approach	7557	6.5%
T3 CMC	7325	6.3%
T9 Teacher Production	6591	5.6%
T5 Job and Career	6476	5.5%
T7 Colleagues	6245	5.4%
T14 Teaching Philosophy	4187	3.6%
T8 Educational System	4181	3.6%
T16 Syllabus	3310	2.8%
T11 Teacher Development Events	2483	2.1%
T13 Educational Theory	2363	2%
T6 Students	2188	1.9%
T20 Course Planning and Development	1696	1.5%
T10 Plans and Projects	1347	1.2%
T2 General Interest	1030	0.9%
T15 Evaluation	752	0.6%
T12 Teacher Education	636	0.5%
T4 Miscellaneous	176	0.2%
Total	116 688	100 %

4. Private content and couple properties.

4.1. Topics and couple properties.

The tables below include the percentage of the row total and the expected value ((column total x row total) / overall total). Because word totals are relatively large numbers, the Chi-square tests may tend to reject the hypothesis of independence given even minimal differences in the distribution percentages. To address this potential threat to external validity, additional tests were carried out using the number of *quotations* per topic rather than the number of *words* per topic, whenever percentages were very close.

4.1.1. Previous acquaintanceship.

	Non-professional.	Professional Life.	Teaching.	Total.
Previously Acquainted. (34)	17063, 23% (13931)	20721, 28% (19066)	36015, 49% (40802)	73799
Previously Unacquainted. (16)	4964, 12% (8096)	9426, 22% (11081)	28499, 66% (23712)	42889

The Chi-square test statistic performed on the table above came to 3835 with two degrees of freedom, an extremely large value that corresponds to a p-value effectively zero. Thus, based on word totals, there was an important difference between the family distributions of previously acquainted and previously unacquainted couples. As shown in the table, the percentage of non-professional content among strangers (12%) was close to half the comparable number for previously acquainted couples (23%).

Separating Social Personal (T1) from all other topics as in the table below yields another significant result, the Chi-square statistic totalling 1802 with one degree of freedom, so $p=0$. As the table below shows, links between strangers were used for social personal purposes significantly less than links between previously acquainted individuals (6% vs. 15%).

	Social Personal. (T1)	All other topics.	Total.
Previously Acquainted. (34)	10 772, 15% (8536)	63 027, 85% (65 263)	73799
Previously Unacquainted. (16)	2724, 6% (4960)	40 165, 94% (37 929)	42889

4.1.2. Professional homophily.

	Non-professional.	Professional Life.	Teaching.	Total.
Same subject. (30)	15211, 16% (18314)	28356, 29% (25066)	53453, 55% (53640)	97020
Different subject. (20)	6816, 35% (3713)	1791, 9% (5081)	11061, 56% (10874)	19668

Couples teaching the same subject discussed topics related to teaching about as often, measured in words, as different subject couples (55% vs. 56%). However professionally homophilous couples (i.e. couples teaching the same subject) devoted a much larger proportion of communication to Professional Life topics (29% vs. 9%). Differences were strongly significant (the Chi-square statistic was 5685 and $p=0$). Thus, the distribution of words among the three families was significantly different between same subject and different subject couples.

4.2. Multiplexity and couple properties.

4.2.1 Previous acquaintanceship.

A Chi-square test was carried out to compare the multiplexity distribution among couples that were acquainted with each other before the period of study began and the multiplexity distribution of links between strangers. The table below reports the number of links per multiplexity value in each category. The 'zero' multiplexity value was combined with the 'one' value in order to perform the Chi-square tests without running into cell sample size problems, although all the numbers are reported in the tables.

Multiplexity.	0	1	2	3	Average.
Previously acquainted (34).	0	10	12	12	2.06
Previously unacquainted (16).	1	7	3	5	1.75

The Chi-square test statistic came to 2.33 with two degrees of freedom, with $p=0.31$, meaning there was effectively no discernible difference between the multiplexity distributions of previously acquainted and previously unacquainted couples.

4.2.2. Professional homophily.

The multiplexity distribution of the 30 couples that were professionally homophilous (i.e. that taught the same subject) was compared using the same test with the distribution of multiplexity values among the 20 couples who taught different subjects.

Multiplexity.	0	1	2	3	Average.
Same subject (30).	1	10	7	12	2.0
Different subject (20).	0	7	8	5	1.9

The Chi-square test statistic totalled 1.91 with two degrees of freedom, with $p= 0.38$, meaning the differences between the multiplexity distributions of same subject and different subject couples were *not* statistically significant.

5. Number of words per category in public communication.

	Words.	%
T17 Teaching Materials	16 078	37.4 %
T14 Teaching Philosophy	4403	10.2 %
T1 Social Personal	2987	6.9 %
T11 Teacher Development Events	2822	6.6 %
T3 CMC	2669	6.2 %
T2 General Interest	2263	5.3 %
T16 Syllabus	2115	4.9 %
T8 Educational System	2054	4.8 %
T18 Teaching Approach	2054	4.8 %
T15 Evaluation	1684	3.9 %
T19 Teaching Activity	1401	3.3 %
T13 Educational Theory	773	1.8 %
T9 Teacher Production	490	1.1 %
T5 Job and Career	305	0.7 %
T7 Colleagues	303	0.7 %
T4 Miscellaneous	218	0.5 %
T12 Teacher Education	189	0.4 %
T6 Students	91	0.2 %
T10 Professional Plans	80	0.2 %
T20 Course Planning	0	0
Total	42 979	100 %

6. Comparing the content of public and private communication.

The distribution of words per family among the public messages sent by the 20 stable participants and the distribution of words per family in the 1063 messages contained in the 50 relations were compared to determine the existence of significant differences between the content of public and private communication.

	Non-professional.	Professional Life.	Teaching.	Total.
Private messages (1063).	22 027, 19% (22 044)	30 147, 26% (26 661)	64 514, 55% (67 982)	116 688
Public messages (293).	8 137, 19% (8120)	6 334, 15% (9820)	28 508, 66% (25 040)	42 979

As the table above shows, there was no difference in the proportion of words devoted to non-professional content between public and private messages. However public messages contained more teaching topics (66% vs. 55%), while private messages delved more into professional life topics (26% vs. 15%). This difference was significant (the Chi-square test statistic total was 2351 with two degrees of freedom, and $p=0$).

Looking at the six subfamilies some large significant differences between private and public communication were found (the Chi-square statistic total was 7331 with five degrees of freedom and $p=0$). First, the evidence showed that public communication was significantly less used for social and personal purposes than private communication (6.9% vs. 11.6%). Job and Context was also significantly less discussed in public (6.4% vs. 16.4%) while Pedagogy was addressed publicly significantly more than privately (20.9% vs. 9.1%). The percentage of Teaching Practice content was similar in public and private communication.

	Social Personal. (T1)	Other. (T2-T4)	Job & Context. (T5-T8)	Teacher Production. (T9-T12)	Pedagogy. (T13-T16)	Teaching Practice. (T17-T20)
Private Messages. (1063)	13 496 11.6 % (12 046)	8531 7.3 % (9998)	19 090 16.4 % (15 963)	11 057 9.5 % (10 698)	10 612 9.1 % (14 315)	53 902 46.2 % (53 668)
Public Messages. (293)	2987 6.9 % (4437)	5150 12.0 % (3683)	2753 6.4 % (5880)	3581 8.3 % (3940)	8975 20.9 % (5272)	19 533 45.4 % (19 767)

1. Categories for coding the type of resource.

All superscripted numbers refer to the endnotes at the end of this Annex.

Information.	Materials.	Opinions.
Info on Bibliography ¹ and Teaching Materials ² .	Bibliography ³ and Teaching Materials ⁴ .	Opinion on Bibliography ⁵ and Teaching Materials ⁶ .
Info on Teaching Approach or Use of Teaching Materials.	Teaching Approach ⁷ .	Opinion on Teaching Approach or Use of Teaching Materials ⁸ .
	Scientific Data.	
Info on Teaching Project.	Material for Teaching Project.	Opinion on Teaching Project ⁹ .
Info on Course Development ¹⁰ .		Opinion on Course Development.
Info on Students.		Opinion on Students.
		Opinion on Pedagogy and Teacher Attitudes.
		Opinion on Educational System ¹¹ .
Info on Syllabus.		Opinion on Syllabus.
Info on Teacher Development Event.		Opinion on Teacher Development Event.
Info on Teacher Production.	Teacher Production ¹² .	Opinion on Teacher Production ¹³ .

2. Definitions of categories and coding criteria.

2.1 Exchange acts.

The following coding rules were followed for identifying and counting exchange acts:

- Only exchange acts in which the resource sought or provided was of direct and concrete relevance and usefulness to teaching practice or professional development were counted. Exchanges of a social and personal nature were excluded along with exchanges related to teachers' working lives but with no direct bearing on teaching practice or teacher development. The following examples illustrate the difference between professional resources and the others.
- Each exchange act was counted as many times as different resources it involved. For example, an exchange act used to request information on a book and an opinion on an exercise is counted as *two* exchange acts.
- No act may span more than one message. For example if the transcription of a conference was sent in two different messages, it was counted as *two* 'contributions'.
- Repetitions either for technical or other reasons were *not* counted as new acts (it was not uncommon for teachers in the first few weeks of using Teachnet to send inadvertently a message more than once).

- Clarifications (i.e. messages clarifying the meaning of previous messages) were *not* counted as new acts.

“I ra-(or rec)-tify the Bulletin number that contains the article by A. Bodin: number 368/1989 pp. 195-219.- (My concern is because in the e-mail at school you put 386).-“

“Reading your answer I realised I had been unclear. What I want to go see at Mosca Bookstore is teaching material, not textbooks. Of course it’s good to consider textbooks and ask for some of those really good ones. That’s fine too. But I really meant teaching material. So I reiterate my concern and in this sense, do you think Mosca Bookstore is adequate?”

2.2. Intent of the exchange act.

(Request) “Do you think you might have some practical exercise on rational functions for the fourth grade that is unrelated to the area of a rectangle or to the Boyle-Marriott law? I need it for the trainee and in the books there are practically no practical exercises.”

(Request) “Here goes my request. Which is ours, not mine. Let me tell you. Among all the topics in the second grade book is linear functions. We are right now preparing that topic for the book. As you probably know, the topic is linear functions but there is nothing linear about it and we can’t be objective enough to evaluate it. We thought of you, if it’s not a big commitment or too much bother, to give it to you and have you evaluate it! Why you? For several reasons. One because you have all our trust and another because you are going to give us your honest opinion. What do you think? Give me an answer.”

(Unsolicited contribution) “The free radicals (oxygenated water, etc.) participate in the aging of tissue, in metabolic sicknesses and in inflammations. Cells protect themselves from free radicals by synthesising glutation (molecule formed by three amino acids). It has been shown that if a type of cell reduces its glutation production, the increase in the concentration of glucose contained in the cultivation medium causes the death of the cells. On the other hand we know that glucose self-oxidises easily and produces free radicals. Therefore in the absence of glutation, glucose is responsible (through these radicals) for damages that derive in the death of the cell. This potential toxicity of glucose becomes relevant if one keeps in mind that in diabetes MELLITUS the rates of intracellular glutation are diminished. Scientific World 8/96.”

(Unsolicited contribution) “In case you like these kinds of problems, should a solution be found, if necessary with assistance, they often passionately search for a way to find them all in

THREE
+ TWO
=====
FIVE

(Especially if it involves the decoding of a message our spies intercepted from the enemy.)”

(Private request; December 12, 1996) “I need to know the date of publication of the book you lent me on scientific education.”

(Private solicited contribution; one day later). “I confirm from home, as the computer has been repaired. Proceedings from the colloquium “The objectives of a Scientific Education,” 28 and 29 April 1990, Palaiseau (with one “s”), (Ecole Polytechnique), organised by the Scientific Education Interest Group. (February 1991, edition).”

(Private request; August 30, 1996) “What I did think about and liked very much is your brochure production idea. In order to encourage group mingling, I think we could suggest to both groups that whoever wants to work in the production of the brochure should come forward. We could form a group of, say, 6 students, three from my 3rd year group and three from yours, who could work on the brochure.

What do you think? If you agree, let me know, so that we get the brochure Production guidelines out and give them to the kids. OK? “

(Private solicited contribution; later the same day). “I agree with the team proposal to make the brochure. I have some history of the origins of Rubik’s cube (in English) and I could also include all the shapes that can be built (some of them actually) and I also have one that cannot be built (a skyscraper).”

(Coordination) “Let us communicate as soon as you finish with the material so we can return it.”

The following coding rules were followed for coding the intention of exchange acts:

- For an exchange act to be assigned to the ‘request’ category, the text of the communication must convey a clear intention to actually obtain a resource independently of the grammatical form. This means for example that neither every question is coded as a ‘request’ nor a ‘request’ is necessarily expressed in interrogative form. For example:
- Rhetorical questions were coded as ‘contributions’ rather than ‘requests for opinion’.

“I do not share the same concept regarding the problem that applies the second degree equation, perhaps because I have always rejected that kind of complicated working that is not easy to apply, I think it’s important to use problems in our day to day, but I wonder if the student fails to see the application, and is not inspired by poetry, ancient times, etc.”

- Proposals were coded as ‘requests for opinion on proposal’.

“One other thing, I would like to borrow your idea of what you did last year with the puff pastries I think it was, to do a statistical exercise. We could coordinate this too, right? I await response.”

“With regard to the linear function besides reading it and giving an opinion, I would still have time to test it on the second graders of School 29 that is if you authorise it.”

- Requests for clarifications of requests received previously were not counted as ‘requests’ (they were counted as ‘solicited contributions’ associated with no specific resource as discussed in a later section).

(Private request; 10/26/96) “I have another question for you (if I ever become a bit of a pain let me know I won’t get offended) Do you have exercises that apply homographic functions (I hate that name, I think it’s stupid) unrelated to the area of a rectangle or the Boyle-Mariot law? I need it for the trainee and they are rare in the bibliography.”

(Private solicited contribution; one day later) “If you tell me what is termed homographic functions nowadays, I may be able to help you. (Almost every dog has had its collar changed, and some people feel “up to date” with that).”

(Private request; 11/27/96) “We have to talk about what we are going to request for 1997. I am referring to books but maybe also some material or device we consider important. It’s the first time the Secondary School grants us a budget, differentiated into Physics and Chemistry. If you agree we can already make the evaluation for 1996. Take care.”

(Private clarification; two days later) “Ann, I would like to know when is the meeting you propose because I didn’t receive anything.”

- Private contributions were classified as ‘solicited’ only if the sender of the contribution had received the request from the receiver. Otherwise, the contribution was considered ‘unsolicited’ (literally ‘unsolicited’ *by the receiver*). In other words, the same contribution may be coded as ‘solicited’ when sent to one receiver and ‘unsolicited’ when sent to another one. For example if a teacher A requests from teacher B the date of a seminar, and B responds to A with a copy to a third teacher C; the B to A communication was coded as a ‘solicited contribution’ while the communication from B to C was coded as an ‘unsolicited contribution’.
- Some exchanges were initiated by FTF requests but answered using electronic mail. This was established because teachers made reference to the non-CMC requests in their messages. Those contributions were coded as ‘solicited contributions’.

(Private solicited contribution). “Hello teachers. They are requesting a panel report, hence I started writing this, which I may later publish somewhere. But before sending it to “all” I would really appreciate it if you could review it and make additions you consider appropriate. There is some work yet to be done towards the end, the question session, for example”

- Messages whose intent was to reply to a request but that did not transfer a resource (for example a request for clarification sent to obtain more data on the resource being sought) were coded as ‘solicited contributions’ because they were considered part of the process of fulfilling the request but no resource was assigned to this exchange.

(Private solicited contribution). “I am searching for the APMEP bulletin.”

(Private solicited contribution). “I have not forgotten about the bulletin.”

2.3. Resources exchanged using electronic mail.

Info on Bibliography and Teaching materials.

(Public contribution) “Beginning 7 or 8 years ago, in France, the Public School Math Teachers Association (APMEP), proposes national tests to evaluate the effectiveness of different programs in the subject, leaving the decision of a group’s participation up to each teacher. Nowadays the population affected is in the order of 120 thousand students per course. APMEP, under the name EVAPM, later publishes the tests, for each exercise or problem the percentage of correct solutions, and pertinent comments. Thanks to the kindness of professors MS and NR, the publications on Seconde, Quatrieme and Sixieme-Cinquieme, fairly equivalent to our 4th, 2nd and 1st year of high school respectively, are now in Montevideo.

It is hoped that soon we will also have those corresponding to Troisieme and Premier (our 3rd and 5th), as well as two Macintosh (HyperCard) diskettes containing the EVAPMIB file, with all the APMEP tests, those belonging to the Official French Evaluations, and those belonging to the international Evaluations, commented and classified by objectives and topics.”

(Private request) “I need to know the date of publication of the book you lent me on scientific education.”

Info on Teaching Approach or use of Teaching Materials.

(Private unsolicited contribution). “I was reading the fourth grade material and I liked it. Especially the first few pages that contain lots of mental exercise problems besides sequences, equations, etc.”

(Private solicited contribution). “I show the Cabri to my fifth grade classes. Whoever wishes to, uses it, but I do not develop a course based on the Cabri, because it would have to be organised very differently from how I approach it, and I have not dedicated myself to that.”

Info on Teaching Project.

(Public request) “Does anybody have any information on when will the first try-outs for the Olympiad take place?”

(Private request) “I found out yesterday through Esther, the psychologist, chatting in the teachers’ meeting room that you are travelling to Brazil for a Math workshop. What is it? Where are you going? what will you be doing? Why didn’t you say anything? I’m always in limbo. When do you leave? Who else is going?”

Info on Course Development.

(Private unsolicited contribution). “Hi Rose: Checking my mail I have decided to answer you. Are you just now teaching cinematics? How or when do you plan to use sum of forces in cinematics? I started with Force, resilience, then displacement, velocity, acceleration. Before the holidays we worked some on the life and works of Galileo and Newton. July and August, Newton’s principles. By the way today a student pointed out to me that in the newspaper there had been a headline on Newton’s principles and it was an advertisement for the DIDAVISION video, which they say are good. Maybe we’ll see it in class. We also saw parts of the Apollo 13 video, very helpful for inertia, action and reaction and for gravitation. Now I started work and I think I am behind!! But I see that in general everybody is more or less there or farther behind. Well, it’s late.”

(Private request) “I would like to know what topics you have already covered in second year; I am a bit flustered with the time, as usual. I have been teaching second year for 10 years and I think I have never been able to finish the curriculum.”

Info on Students.

(Private unsolicited contribution) “Regarding your Piaget secondary school students, I will later give you more detailed impressions of each one if you want. It’s a very heterogeneous group which this year added 2 or 3 new students, luckily. They are the Piaget secondary school pioneers and they all come from different places. None from J. Piaget school since the secondary school started a year before the first elementary school graduation. You have very rich kids and others that are troublesome. But very good things can be accomplished with them. I would like to talk it over with you.”

(Private solicited contribution) “Mike is a very troublesome kid. He has had during all of last year terrible relations with the class to the point that he lived completely isolated without anybody even saying a word to him. He is always alone, sad, downcast. He is not a bad student, on the contrary, he is studious and makes an effort. Who knows how he is doing right now in terms of spirits; Missy if she wants to, is brilliant. She’s just a bit apathetic, she needs to be shaken up since she has that sort of thing, she pulls better grades than anybody, but studies little or nothing and easily flies off into the sunset. Charlene has terrible problems and especially at the emotional level. A long story. She came from Sweden during first year with her mother, parents are separated, with big problems making friends with her classmates because of the enormous difference between the two societies, with big emotional lows over the father, anyway, very troublesome. She needs to establish an emotional link to the teacher. She’s sometimes aggressive towards her classmates, she shuts in, she gets upset, anyway. Complicated.”

Info on Syllabus.

(Private solicited contribution) “Hello again. Regarding the topic angles and circumferences it is not in the new curriculum. We will continue to teach it in a hurry in fourth year before arcs maybe. Now since programs are being rewritten, completed and ordered who knows, maybe it’ll show up.”

(Private request) “Changing the subject I would like to ask you who put in the curriculum for the first three years of secondary school the famous D (decimals) set several years ago, I cannot remember the exact date.”

Info on Teacher Development Event.

(Private unsolicited contribution) “‘MATHEMATICS EDUCATION AT THE OUTSET OF THE YEAR 2000 – SOME CONJECTURES’
CLAUDE GALIN
TUESDAY THE 17TH TIME 5 PM AT THE ENGINEERING BUILDING”

(Public unsolicited contribution) “Tomorrow Thursday December 5, at the National Teacher College, at 6 pm there will be a conference by Prof. John Smith (Educational Paradigms).”

Info on Teacher Production.

(Private unsolicited contribution) “About a month ago I won a contest among aspirants and I am part of a team with three other teachers. We are under Jackson’s leadership and the selection is becoming truly difficult because they cannot be simple exercises, or step-by-step problems they have to be real problems (see, they have to adhere to the latest fashion trends). It has become difficult. It goes like this: the student has to assimilate the concept he is supposed to learn through the problem. And anyway like you say, he who knows, knows and he who doesn’t, is boss. HAH! I hope this assignment does not overwhelm me.”

(Private request) “How do you three organise yourselves to assemble a unique piece of work? I guess you split up the topics, each one prepares a proposal and then you discuss it, is that it?”

Bibliography and Teaching Materials.

(Private solicited contribution) “Here are the problems:

An urn contains 10 balls numbered from 1 to 10. Three are drawn. What is the probability that the product of the numbers on the balls is a multiple of 8?
Using only a straight-edge ruler determine the midway point of a segment. Discuss according to whether the length of the segment is greater, smaller or equal to the length of the segment.”

(Private unsolicited contribution) “The enclosed file was made in WinWord. It deals with an update of the state of the human fascioliasis as an emerging zoonosis. Hope you find it original.
(This file must be converted with BinHex4.0)”

Teaching Approach.

(Private solicited contribution) “With regard to systems all I am saying is ‘let us consider a set of two equations in two unknowns

$$ax+by+c=0$$

$$a'x+b'y+c=0$$

The set of two equations in this form is called a system of two equations in two unknowns. I don't think that's a definition and I think it does not need to be defined, I think that what has to be emphasised is what it means to solve a system.

Otherwise I can say this: when I consider two equations in the above form and I bound them with braces it means that I am looking for the intersection of the solution sets of both equations.”

(Public unsolicited contribution) “I do not define at this level what a system of equations is, either. I simply state a problem that gives rise to two equations in two unknowns that are related and I say that when I have a set of two equations and I look for the intersection of the solutions, I have a system of equations. It turns out that a discussion erupted because a colleague thinks that I can't say I have a system of equations when I have two equations in which I am looking for the intersection because the system may be incompatible and said intersection may not exist. To me, and this is my opinion, since what I am doing is precisely not a definition, then I can say the previous, because the discussion over the existence or lack thereof of the intersection comes later.”

Scientific Data.

(Private unsolicited contribution) “The free radicals (oxygenated water, etc.) participate in the aging of tissue, in metabolic sicknesses and in inflammations. Cells protect themselves from free radicals by synthesising glutation (molecule formed by three amino acids). It has been shown that if a type of cell reduces its glutation production, the increase in the concentration of glucose contained in the cultivation medium causes the death of the cells. On the other hand we know that glucose self-oxidises easily and produces free radicals. Therefore in the absence of glutation, glucose is responsible (through these radicals) for damages that derive in the death of the cell. This potential toxicity of glucose becomes relevant if one keeps in mind that in diabetes MELLITUS the rates of intracellular glutation are diminished. Scientific World 8/96.

Like I told you I am surprised by the arrival of element 112. We gave our welcome to 110 in 1995 and it turns out it was discovered along with 111 in 1994. Do you know anything about suggested names?”

(Public request) “I heard yesterday that there is research being carried out on mosquitoes and their influence on the transmission of some diseases, as we know. The term ‘Vector’ appeared associated with this subject; apparently meaning transmitter. I would like to know if ‘our’ vector has an equivalent or similar meaning, or different. Do you know?”

Material for Teaching Project.

(Private unsolicited contribution) “Brooke, I send you along the objectives in case you want to start putting together a draft (I’m going to do it).

The objectives of teaching Mathematics:

We teach Mathematics so that the student:

Develops and perfects his potential capacities related to the mental faculties tied to mathematical activities.

Knows, understands and uses the leading ideas of Mathematics of his era, appreciates its instrumental value with regards to its aid in the knowledge of reality by its contributions to the factual sciences, and is able to adapt to the conditions of modern society, which demands the possession of mathematical concepts, not just by the technical person or the man of science but also by the common man.

Realises the relation of Mathematics to the other objects of the world of culture.

Recognises that Mathematics is the work of creative spirits, and that he himself may obtain intellectual pleasure if he adopts creative or recreative attitudes when facing problems posed by this science.

Affirms himself through the knowledge of his potentialities and his limitations with regards to the mental operations pertaining to Mathematics.

Recognises the aesthetic values characteristic of mathematical activity.

‘Be willing to reexamine any of his beliefs (intellectual courage), change it when a reason to do it exists (intellectual honesty) and not frivolously modify a belief without a good reason (wise restraint)’.

This last one is from Polya and I consider it one of the most marvellous things I have read in my life.

Well these are the 7.

Regarding the forms of evaluation at this time I can think of: class participation, doing the homework assignments, tests, attitude towards the subject and his classmates, participation in course projects, I don’t know what else.

Let me know what you think of all this.”

Teacher Production.

(Public unsolicited contribution) “I wanted to let you know that the collection of problems for the first three years of secondary school is now ready. It consists of 171 problems with their corresponding comments and a separate set of solutions.

It is available to you in case you want to ‘check it out’.”

Opinion: Exchanges carrying personal views of the sender such as opinions, recommendations or advice were assigned to one of the Opinion categories. These included recommendations of bibliography, evaluative comments on the usefulness of a computer programme for the Uruguayan syllabus or advice on how to use an exercise with students to help explain a certain topic.

Opinion on Bibliography and Teaching Materials.

(Private unsolicited contribution) “About the ‘cross’ problem, (I speak hypothetically because I didn’t know about it and I lack the ‘space’ now to propose it), I find it interesting because: a) very unlikely that they don’t finish successfully; b) it demands they search for strategies to attack it (discover what characteristics the number ‘intersection’ must have) c) it has more than one solution, which contributes to the destruction of the concept we often teach them that the solution must be unique; d) it ‘softens’ them as much in mental calculations (in the end, the tables), as in decomposition in sums. I realise that if presented, (fairly early so they become confident with research), I would have them spend a little while working individually, and when practically everybody had at least one solution, I would have them work in pairs, so as to exchange what had been found up to that point, and continue looking for other solutions together.

At this point in my course, where they’re used to looking for the totality of solutions, the problem would become almost impossible. I would like it as a fifth year problem, especially if presented after giving combinatorics. (although to calculate the permutations of 4 you don’t need more than being able to think without fear.)”

(Private unsolicited contribution) “I really liked the Ton Ton book. Some activities I knew about but not all of them. So it will be very useful. I understood everything regarding the geometric figure going by the coordinates and I was able to (I think) make myself a rough sketch, I still cannot picture it.”

Opinion on Teaching Approach or use of Teaching Materials.

(Private solicited contribution) “I show the Cabri to my fifth year classes. Whoever wishes to, uses it, but I do not develop a course based on the Cabri, because it would have to be organised very differently from how I approach it, and I have not dedicated myself to that.”

(Private unsolicited contribution) “I think you misinterpreted. I am talking about the intersection of solution sets. Beyond the intersection of straight lines. Although I think any time I have a system of equations, I can associate each of the equations with a function of \mathbb{R} in \mathbb{R} and graph the solution set. Then I really can talk about whether there is an intersection of straight lines which are the graphical representation of said functions.

But independently of the straight lines, I stress, I can say whether or not the solution sets have an intersection.”

Opinion on Teaching Project.

“I went to the fair and was very pleased. There were several students in charge of the stand (they felt it was theirs) but there were none at Susan's, just herself keeping an eye on it. There were heaps of people putting the cube together and requesting their certificates (that was a good idea). Maybe it wasn't as noticeable as Susan's but I thought it was adequate, I don't believe it was of poorer quality. Susan's stand was an unbelievably huge mess. Despite showing interesting things like the air-navigation project, I think the panels were overloaded with information.

To sum up, we achieved:

Student participation

Maths research

Student ideas for the implementation of the stand

Active participation of those who attended the fair

A meaningful brochure to spread the word among teachers and those who wish to own a didactic game.

I think we should be pleased, shouldn't we? “ .

(Private unsolicited contribution) “We will not be able to do the annual project jointly since it is carried out based on the specific analysis of the class and the difficulties to be resolved in each class. We can still get together to assemble them for each class and if there were common obstacles we could devise the same strategies. There is enough to talk about. I used to think that annual planning is what they taught us at the National Teaching College with the course objectives, what you will teach and how, etc., but it turns out that's not planning, planning is putting together this blessed project they want us to do.”

Opinion on Course Development.

(Public unsolicited contribution) “The curriculum in each course NEVER ends: if the class is slow, because the most elemental and indispensable things have to be repeated class after class, and time is wasted; if the group is smart and anxious, because we get wrapped up in some topics and we go further and further, glad that the kids follow the action and even better, get involved in it.”

(Private request) “One other thing, tomorrow I am going to order the handout on factoring for all the third years, is that okay?”

Opinion on Students.

(Private unsolicited contribution) “About the second year class let me tell you two or three things I have thought about this subject: a) they are extremely noisy and disorderly, b) there is a good number of students with good potential and an enormous desire for very good grades, c) they are very anxious and they require the teacher’s personal attention, it doesn’t matter if he is giving help or an explanation to a classmate, d) there is a group of several chatty girls, spread out who generally interrupt the healthy development of the class and who if one singles them out they act as victims of an injustice, and we could go on...”

(Private solicited contribution) “About the Piaget secondary school, I thought the kids were somewhat nasty, closed in unwilling to open up, they scarcely participated well I don’t want to be negative. We’ll see tomorrow. The classroom is too small for 25 big kids and the air is stagnant. I don’t know how I will manage the day of the test. I will have to make several versions so they don’t cheat.”

Opinion on Pedagogy and Teacher Attitudes.

(Private unsolicited contribution) “Don’t be so harsh, I think I am very tolerant of my students’ mistakes, low grades just mean that they have not accomplished anything, and they have to keep working. Sometimes it happens that in class when I run an oral discussion and some participate and they make a wrong comment, I don’t say anything, I just ask more questions, ‘Does anybody else have an idea, what do the rest of you think?’ and then I work based on what everybody said, explaining if I can where the not so correct ideas came from, but sometimes this doesn’t satisfy them, they ask me to tell them whether what they said was right or wrong. Neither right nor wrong it’s an incomplete phase of the idea, I tell them.”

(Private unsolicited contribution) “Regarding the ‘silence’, or beyond that, the saying or not saying in class (only questions that barely lead to ‘hints’), each day I become more convinced that whoever among us is capable of putting together a course in which he does not have to open his mouth, and overcome the temptation to open it, if there is anyone who can reach 100% yield, he must be the one. It is already 40 years ago that Williams used to say: ‘To me, the best Lab teacher is he who does not open his mouth’. I hope some day we get there.”

Opinion on Educational System.

(Private unsolicited contribution) “Regarding the notion that we are not so far behind I allow myself to disagree almost *‘in totum’*. In other places, the validity of hypotheses is verified through evaluations. Here we are still proposing tests without giving specifics completely ignoring motivations and activation methods of human memories. Its validity is not even analysed as a proper instrument for the evaluation. In particular, those anachronistic tests with which here they intend to evaluate the level of admission to the University, in Spain, after simultaneously proposing the highly advertised prerequisites test to the first-year students and those in third and fourth year of university who had already passed the courses whose prerequisites were being tested, stopped proposing them! The results are practically the same! (No worthy psychologist ‘invents’ a test!) (Very little is known about human memories.)”

Opinion on Syllabus.

(Private unsolicited contribution) “My question meant to be specifically about second degree EQUATIONS. Personally I think it’s a topic that makes no sense to address it in the curriculum for the first three years of secondary school with its current objectives. (When I was an Inspector, we ‘scratched it’ from the third year curriculum. We must not have been too far off, since in many countries they did the same thing.) As far as ‘Optics’, I know little about modern Physics, but I still believe, even if it’s just as humanity’s cultural tradition, that to hide in the last two years of secondary school, and even more in Teacher Education its link to Geometry constitutes a crime ‘against humanity’. (Apolonius and Euclid were no dummies.)”

(Private solicited contribution) “The experience of just decimals was done in Berkeley barely 20 years ago. Those who only found out that in Berkeley they were going to do it (and don’t know that those who really do research and know, are capable of learning by analysing a failure instead of denying it, don’t even know about the failure because they have not read anything in 20 years) suggest and push so that the same is done here, so as to be up-to-date... (And I continue to hold that we are light years behind the rest of the world, and we will continue to be as long as there are people who feel ‘modern’ and/or ‘up-to-date’ while living with the obsession of doing what fortunately was not done or was barely done during the sixties.)”

Opinion on Teacher Development Event.

(Private unsolicited contribution) “At the National Teacher College I spent 20 minutes and left. I was with a friend who was there the entire day and did not really get much out of it. I was afraid it was going to be like that! Why is it that my beloved National Teacher College teachers (and I mean that) don’t really provide us things with substantial content so that they can be applied in the classroom? How can it be that assistants are not given a copy of what Brousseau talked about at the ICME? I am a bit tired of those ideas they let fly which are like I say and I don’t say.”

(Private unsolicited contribution) “Today I went to Gimenez’ talk at the Polytechnic. It was excellent. He is brilliant. Later with more time I’ll tell you what he talked about. There are many things that can be implemented for next year.”

Opinion on Teacher Production.

(Private request) “Well, Jackie. Here goes my request. Which is ours, not mine. Let me tell you. Among all the topics in the second grade book is linear functions. We are right now preparing that topic for the book. As you probably know the topic is linear functions but there is nothing linear about it and we don’t have enough objectivity to evaluate it. We thought of you, if it’s not a big commitment or too much bother, to give it to you and have you critique it! Why you? For several reasons. One because you have all our trust and another because you are going to tell it like it is! What do you think? Give me an answer.”

(Private unsolicited contribution) “By the way I bought your book and I use it quite a bit however, if you allow me a criticism, I did not care much for the definition of fractions. Don’t you think it would be better to define it (at the first year level) as a representation of the result of the division of two integers, without specifically talking about ordered pairs?”

2.4. Outcomes of requests.

The outcome of requests was analysed using the following variables: number of replies received and delay in obtaining the first reply.

Given a request R sent by teacher T to teachers $T_1, T_2 \dots T_N$, the number of replies received was computed as the number of receivers who sent T at least one reply to request R. In the case of private requests the value of this variable was therefore ‘0’ or ‘1’ while for public requests the value could be any number from 0 to N where N is the number of stable participants within the recipients. For example the ALL public address includes 75 recipients but only the 20 stable participants in the sample are counted as potential ‘repliers’.

If a request R was sent on day D1 and the first reply was sent (not necessarily *received*) on day D2, the delay in obtaining the first reply was computed as the number of days between D1 and D2.

3. Messages used to perform exchange acts.

	Private.	Public.	Total.
Number of messages containing exchange acts.	524	132	656
Total number of messages	1063	293	1356
% of messages used to perform exchange acts.	49.3%	45.1%	48.4%

The hypothesis that the two percentages (i.e. 49.3% and 45.1%) were the same was tested in the following table. The Chi-square test statistic totalled 1.64 with one degree of freedom, and $p=0.2$.

Messages.	At least 1 exchange (expected).	No exchanges (expected).
Private. (1063)	524 (514.3)	539 (548.7)
Public. (293)	132 (141.7)	161 (151.3)
Total. (1356)	656	700

4. Resources exchanged and partners selected for exchanges.

	Information.	Materials.	Opinions.
Teaching Methods and Resources (580).	Info on Bibliography and Teaching Materials (138).	Bibliography and Teaching Materials (201).	Opinion on Bibliography and Teaching Materials (99).
	Info on Teaching Approach or Use of Teaching Materials (19).	Teaching Approach (29).	Opinion on Teaching Approach or Use of Teaching Materials (68).
		Scientific Data (26).	
Course and Project Management (93).	Info on Teaching Project (20).	Material for Teaching Project (7).	Opinion on Teaching Project (30).
	Info on Course Development (17).		Opinion on Course Development (2).
	Info on Students (9).		Opinion on Students (8).
Pedagogy and Educational System (93).			Opinion on Pedagogy and Teacher Attitudes (45).
			Opinion on Educational System (27).
	Info on Syllabus (7).		Opinion on Syllabus (14).
Others (69).	Info on Teacher Development Event (28).		Opinion on Teacher Development Event (10).
	Info on Teacher Production (10).	Teacher Production (3).	Opinion on Teacher Production (18).
(835)	(248)	(266)	(321)

Of the 635 'active' acts, 393 or 61.9% involved 'products'. To test whether 'active' acts involving 'products' were significantly more than half of the 'active' acts, a 99% confidence interval (CI) was formed for the percentage of 'active' acts involving products (61.9%). Using binomial formulas as before, the 99% CI for 393 of 635 covers [56.9%, 66.9%]. Since it does not cover 50%, it was concluded with 99% confidence that the percentage of active acts involving 'products' were significantly more than half.

Of the 635 'active' acts, 475 were private and thus involved an exchange partner. Of those 475 private 'active' acts, 275 or 57.9% were between teachers who were acquainted before starting to use e-mail. To test whether private 'active' acts involving acquaintances were significantly different from 68% (the percentage of the 50 links of Sample 1 that were established between acquaintances), a 99% confidence interval (CI) was formed for the percentage of private 'active' acts involving previously acquainted teachers (57.9%). Using binomial formulas, the 99% CI for 275 of 475 covers [51.1%, 64.7%]. Since it does not cover 68%, it was concluded with 99% confidence that the percentage of active acts involving previously acquainted teachers (57.9%) was significantly below 68%.

Of the 475 private 'active' acts, 405 or 85.3% were between teachers who taught the same subject. To test whether private 'active' acts involving subject colleagues were significantly more than 60% (the percentage of the 50 links of Sample 1 that were established between subject colleagues), a 99% confidence interval (CI) was formed for the percentage of private 'active' acts involving subject colleagues (85.3%). Using binomial formulas, the 99% CI for 405 of 475 covers [81.1%, 89.5%]. Since it does not cover 60%, it was concluded with 99% confidence that the percentage of active acts involving subject colleagues was significantly above 60%.

More than 60% (61.9%, n= 393) of the 635 'active' acts involved 'products' and 38.1% 'expertise' (n= 242). As the table below shows, 79.3% (n= 192) of the 242 'active' acts involving 'expertise' were private while of the 393 'active' acts involving 'products' 72% were private. A Chi-square test yielded a statistic of 5.12 with one degree of freedom and p=0.024. In sum, a larger share of exchanges of 'expertise' was carried out in private (79.3%) than of exchanges of 'products' (72%).

Active acts.	Products (expected).	Expertise (expected).
Private. (475)	283 (295.5)	192 (179.5)
Public. (160)	110 (99.5)	50 (60.5)
Total. (635)	393	242

5. Outcome of requests.

A Chi-square test carried out on the table below yielded a statistic of 12 with one degree of freedom, and p=0.00054. The association between type of communication in requests and outcome (i.e. answered or ignored) was thus highly significant.

Requests.	Answered (expected).	Unanswered (expected).
Private. (189)	142 (132.3)	47 (56.7)
Public. (41)	19 (28.7)	22 (12.3)
Total. (230)	161	69

6. Factors influencing resource seeking behaviour.

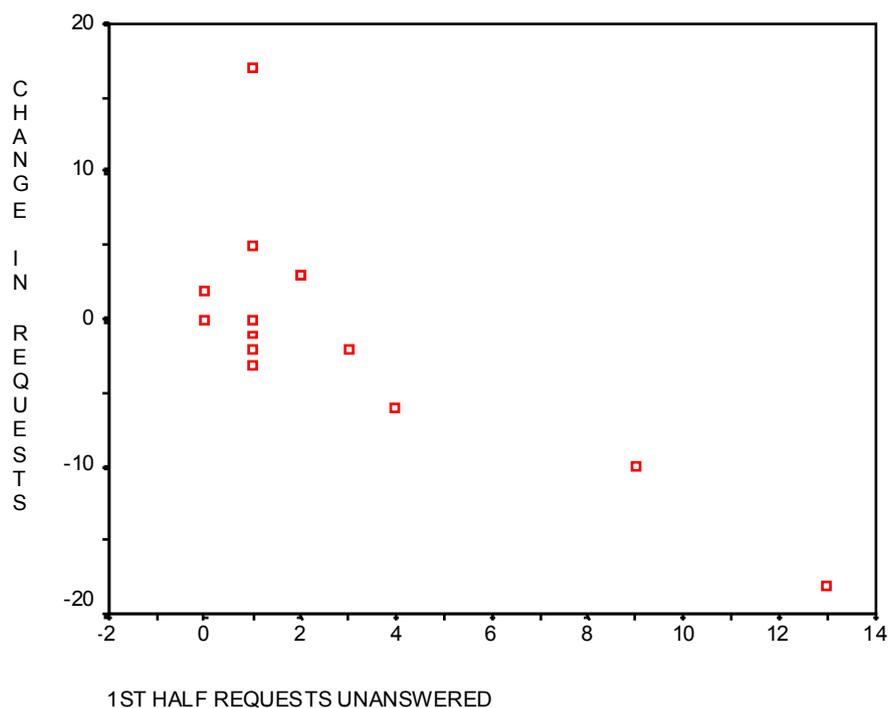
6.1. Number of requests sent.

Teachnet exchange data was analysed to determine whether the outcome of requests previously sent affected the resource seeking behaviour of the stable participants.

The first period of study (P1) was divided into two intervals: the first from August 8, 1996 to October 5, 1996 and the second from October 6, 1996 to December 27, 1996. These dates were selected such that the 178 requests sent out during P1 (out of 230 in P1 and P2) would be divided in exactly 89 requests sent during each interval. The aim was to establish whether the number of requests sent by the teachers during the *second* interval was related in any way to the number of requests they sent during the *first* interval that were ignored.

For the 14 teachers who sent out at least one request during the first interval, the change in the number of requests sent during the *second* interval (i.e. if a teacher sent five requests during the first half and three during the second half the change in requests would be minus two) was plotted versus the number of their requests that were ignored during the *first* interval. The graph below shows the results.

Plot of Change in Requests in 2nd half of P1 vs. Unanswered Requests 1st half of P1



The simple correlation coefficient was -0.77 with $p=0.001$, meaning a fairly strong negative linear association. The more teachers' requests were ignored, the fewer requests they sent in the future.

This result encouraged the fitting of a regression model, with the change in the number of requests sent out as the response or dependent variable. The resulting regression was in fact significant, with the observed significance level for the model being $p=0.001$. The adjusted R squared was 0.56. The regression equation was given by $\hat{y} = 3.662 - 1.662 \times \text{Unanswered Requests}^{14}$.

6.2. Types of resources sought.

More than half of the 238 requests (60.9%, n= 145) sought 'products' while 39.1% (n= 93) sought 'expertise'. The former percentage (60.9%) was significantly greater than the 'expected' one¹⁵ (50%). In other words, teachers used e-mail to ask for 'products' significantly more than could be 'expected'.

6.3. Type of communication used to seek resources.

The 20 stable participants sent 238 requests, of which 195 or 81.9% were *private*. This percentage (81.9%) was significantly greater than the 'expected' one¹⁶ (50%). This result suggests that teachers were more inclined to use *private* communication rather than *public* communication to ask for resources.

Private requests differed from public ones in the type of resource they sought. A majority of the 43 *public* requests (55.8%, n= 24) sought 'expertise' while of the 195 *private* requests 35.3% (n= 69) sought 'expertise'. This difference was *not* significant (although it was close at 0.021)¹⁷.

6.4. Source selection.

6.4.1. Influence of the type of partner.

More than two thirds of the 195 private requests (68.2%, n= 133) were directed at colleagues with whom the 'requesters' were previously acquainted, while 62 or 31.8% were directed at strangers. The first percentage (68.2%) is almost equal to the 'expected' one (68%). This result suggests that teachers were as likely to request resources from strangers as from previously known colleagues.

A large majority of the 195 private requests, (84.6%, n = 165) were directed at teachers who taught the same subject, while 30 or 15.4% were directed at teachers who taught a different subject. This percentage (84.6%) was significantly higher than the 'expected' one (60%)¹⁸.

6.4.2. Influence of type of resource sought.

The types of resources that teachers sought from strangers and from known colleagues were compared to establish whether the type of resource sought affected the selection of partner. Of the 133 requests directed at previously known colleagues, 61.7% asked for 'products' and of the 62 requests directed at *strangers*, 71% asked for 'products'. A Chi-square test found no significant difference between the type of resource that teachers sought from previously acquainted colleagues and the type of resource they sought from *strangers*¹⁹.

The types of resources that teachers sought from teachers of the same subject and from teachers of other subjects were compared for the same purpose. Within the 165 requests directed at subject colleagues, 65.5% sought 'products' while within the 30 requests directed at teachers who taught a *different* subject, 60% sought 'products'. A Chi-square test found no significant difference between the type of resource that teachers sought from subject colleagues and the type of resource they sought from colleagues teaching different subjects²⁰.

7. Factors influencing unsolicited sharing behaviour.

7.1. Number of unsolicited contributions performed.

To assess whether there was a significant association between the number of private contributions that teachers *received* and the number of unsolicited contributions they *sent*, during the entire period of study, the correlation coefficient was computed. The correlation coefficient is 0.66, with $p=0.002$, a positive association between the two variables that is statistically significant at level 0.01.

Looking at the scatter plot, however, it is clear that there is one point that is highly influential on this result. One teacher (HDEA) sent out 118 private unsolicited contributions, more than 40% of the total. When this data point is excluded from the calculation, the correlation between private unsolicited contributions sent and private contributions received jumps to 0.98, with $p=0$ ($n=19$), a very strong positive association.

7.2. Types of resources contributed spontaneously.

Of the 397 unsolicited contributions, 250 or 63% transferred ‘products’ while 147 or 37% transferred ‘expertise’. The actual percentage of contributions transferring ‘products’ (63%) was significantly higher than the ‘expected’ one²¹ (50%).

7.3. Type of communication used to contribute resources.

Teachers performed 397 unsolicited contributions, 280 or 70.5% of which were *private* while 117 or 29.5% were *public*. The actual percentage of private unsolicited contributions (70.5%) was significantly higher than the ‘expected’ one²² (50%).

The type of communication used for contributing ‘products’ differed significantly from the type of communication used to contribute ‘expertise’. Most of the 147 contributions of ‘expertise’, (83.7%, $n=123$) were *private* while of the 250 contributions of ‘products’ 62.8% ($n=157$) were private. A Chi-square test showed that there was a significant association between type of resource shared and types of communication used for sending the contribution²³. Teachers seemed highly reluctant to share ‘expertise’ *publicly*.

7.4. Recipient selection.

7.4.1. Influence of the type of partner.

Half of the 280 private contributions, (50.7%, $n=142$) were directed at colleagues with whom the contributors were previously acquainted, while 138 or 49.3% were directed at strangers. The first percentage (50.7%) was significantly *lower* than the ‘expected’ one²⁴ (68%).

Of the 280 private contributions, 240 or 85.7% were directed at colleagues who taught the same subject. This percentage (85.7%) was significantly *higher* than the ‘expected’ one²⁵ (60%).

7.4.2. Influence of the type of resource contributed.

Within the 142 contributions directed at previously known colleagues, 80 or 56.3% involved 'products' while 62 or 43.7% involved 'expertise'. Within the 138 unsolicited contributions directed at strangers, 77 or 55.8% involved 'products' while 61 or 44.2% involved 'expertise'. Since the two distributions were practically identical, it was concluded that there was no difference between the type of resource teachers contributed spontaneously to previously acquainted colleagues and the type of resource teachers contributed spontaneously to strangers.

Within the 240 contributions directed at subject colleagues, 57.1% involved 'products' while within the 40 contributions directed at teachers who taught a *different* subject, 50% involved 'products'. According to the results of a Chi-square test there was no significant difference between the type of resource contributed to colleagues teaching the same subject and to colleagues teaching different subjects²⁶.

7.4.3. Contribution behaviour of potential recipients.

To assess whether teachers were more likely to contribute more (i.e. select as recipients) to those colleagues who had previously contributed more to them, the correlation coefficient between the number of private contributions *received* during the first half of P1 (8/8/96 to 10/17/96) and the number of private unsolicited contributions *sent* during the second half of P1 (10/18/96 to 12/27/96) was computed for each of the 380 (20 x 19) possible couples that could be formed among the 20 stable participants.

The correlation coefficient between the two vectors is 0.39, with $p=0$, a relatively weak yet statistically significant linear association. Looking at the scatter plot, however, it is clear that there is one point that is highly influential on this result. One teacher sent another 46 private unsolicited contributions during the second half of P1 (HDEA to TOCH) while the sum of all other private unsolicited contributions during the second half of P1 was 58. So this one teacher accounted for almost half of the total. When this extreme data point is excluded from the calculation, the correlation coefficient jumps to 0.81, with $p=0$, representative of a fairly strong positive association between the two variables.

8. Factors influencing response behaviour.

Given a request 'R', received by teacher 'B' from teacher 'A', 'R' was counted as 'answered' if at least one reply was sent from 'B' to 'A' concerning 'R' and counted as 'ignored' if no replies were sent by 'B' to 'A' concerning 'R'.

The 20 stable participants received a total of 627 requests for professional resources from one of the other 19 stable participants, for an average of 31.35 each. As discussed in Chapter 4, requests received from oneself were excluded (this is the case for example of public requests sent to groups which include the sender) as were requests *sent* but not *received* (meaning that the receiver did not read his or her messages after the date the request was sent).

Of the 627 requests received, more than two thirds (68.9%, $n= 432$), were public (i.e. received as a member of a group) and slightly less than one third (31.1%, $n= 195$) were *private* (i.e. received as an individual). It should be noted that although most of the requests *sent* were private (81.9%), most of the requests *received* were public (68.9%). The difference

is obviously caused by the fact that each public request sent generates as many requests *received* as the number of stable participants in the receiving group. For example, a public request *sent* to the ALL group generated 19 requests *received*, while a private request *sent* generated only one request *received*.

A majority of the requests received (55.3%, n=347) sought 'products' and less than half sought 'expertise' (44.7%, n= 280).

Slightly more than half (53.9%, n=338) were received from strangers and the rest (46.1%, n= 289) from previously known colleagues.

More than two thirds were received from subject colleagues (69.9%, n= 438) while less than one third (30.1%, n= 189) were received from teachers of other subjects

Teachers ignored almost three-quarters (72.4%, n= 454) of the 627 requests they received. The response rate (i.e. number of requests received that were answered divided by the total number of requests received) was therefore 27.6% (173/627). The following section looks at the influence of a number of variables (i.e. type of communication used to send the request, type of resource requested, type of 'requester') on response rates.

8.1. Influence of the type of communication used to send the request.

Response rates differed by type of communication (i.e. public or private). Of the 195 *private* requests received, 72.8% were answered while of the 432 *public* requests received, 7.2% were answered. In other words, private requests were answered ten times more frequently than public requests. This difference was obviously significant²⁷.

8.2. Influence of the type of resource sought.

There were no significant differences in response rates based on the type of resource requested. Of the 347 requests received involving 'products' 29.1% were answered and of the 280 requests received involving 'expertise', 25.7% were answered. This difference was not found to be significant²⁸. In other words, requests for 'products' were answered about as frequently as requests for 'expertise'.

Similar results were found when looking separately at the 195 *private* requests received²⁹ and the 432 *public* requests received³⁰.

8.3. Influence of the type of 'requester'.

8.3.1. Previous acquaintanceship.

First, it was found that response rates differed significantly based on *previous acquaintanceship*. Of the 289 requests received from *previously known* colleagues, 34.6% were answered (n= 100), while of the 338 requests received from *strangers*, 21.6% were answered (n= 73). According to the results of a Chi-square test, this difference was highly significant³¹. Thus, according to the data, requests from *known colleagues* were answered significantly more than requests from *strangers*.

When looking separately at the 347 requests received for 'products' and the 280 for 'expertise' it was found that this difference was only significant in the case of the requests for 'expertise'³². Teachers answered more than twice as many requests for 'expertise' from known people (34.5%) than requests for 'expertise' from strangers (17%). Teachers also answered more requests for 'products' from *previously known* colleagues than from *strangers* (34.7% vs. 24.9%) but this difference was *not* significant at the 0.01 level³³ (although it was not far from significance at 0.061). In sum, requests for 'expertise' from known people were significantly more answered than from strangers. Requests for 'products' from known people were also more answered than requests for 'products' from strangers but the difference was not statistically significant (although it was close to significance).

Teachers answered significantly *more* of the 62 *private* requests received from *strangers* (88.7%, n= 55) than of the 133 *private* requests received from previously known colleagues (65.4%, n= 87)³⁴. Of the 432 *public* requests received, 156 were sent by previously known colleagues and 276 from strangers. The response rate for the former was 8.3% (n= 13) while the response rate for the latter was 6.5% (n= 18). This difference was *not* significant³⁵. In other words, teachers answered *public* requests from strangers as much as *public* requests from previously known colleagues.

8.3.2. Professional homophily.

More than a third (34.7%, n= 152) of the requests received from *subject colleagues* were answered while the response rate for requests received from teachers of *other subjects* was significantly lower (11.1%, n= 21)³⁶. Thus, requests from subject colleagues were answered significantly *more* than requests from teachers of other subjects.

The same analysis was carried out separately for the 347 requests received that sought 'products' and the 280 that sought 'expertise'. It was found that teachers answered requests for 'products' from subject colleagues significantly *more* than from teachers of other subjects³⁷. When 'expertise' was sought, more requests received from subject colleagues than from the others were answered (29.3% vs. 13.8%) but this difference was not significant although it was very close to significance at 0.019³⁸.

Of the *private* requests received from subject colleagues 76.4% were answered while of the *private* requests received from teachers of different subjects 53.3% were answered. This difference was *not* found to be significant, although it was close at 0.017³⁹. Of the 273 *public* requests received from subject colleagues, 9.5% were answered while of the 159 *public* requests received from teachers of other subjects 3.1% were answered. This difference was *not* significant although it was also close to significance at 0.022⁴⁰. In other words, teachers replied to more private and public requests received from subject colleagues than from teachers of other subjects. Although these differences were not significant at the 0.01 level they were very close to significance.

8.4. Influence of the exchange behaviour of 'requesters'.

For each *request* received by each teacher, the number of *contributions* previously received by the teacher from the 'requester' was computed. Two histograms were produced with this data, one for *answered* requests and the other for *unanswered* requests. Then the two histograms were compared using the Mann-Whitney nonparametric test of equal distributions. The basic statistics appear in the following table. As shown in that table,

the average number of contributions received from a teacher before answering his or her request was three times the number of contributions received from a teacher before ignoring his or her request (15.5 vs. 5.3).

	Requests received.	Average number of previous contributions.	Median.	At least 1 contribution.
Answered.	173	15.5	7	152 (88%)
Unanswered.	454	5.3	2	372 (82%)
Total.	627	8.1	3	524 (84%)

The Mann-Whitney test yielded a z-value of -6.64 and $p=0$, meaning the hypothesis of identical distributions was strongly *rejected*. The number of contributions previously received was significantly larger for *answered* requests than for requests *ignored*. In other words, the more a teacher contributed to another, the more likely the other was to answer his or her requests. The same result was found when looking only at the *private* contributions received from the requester⁴¹, with differences even more pronounced. However, when looking only at the number of *public* contributions received from the requester, no significant difference was found⁴².

This result is consistent with a finding obtained by comparing the ‘symmetry’ of the 24 stable links with the ‘symmetry’ of the 26 unstable ones.

Exchange theorists argue that people decide to continue or discontinue their relationships on the basis of the perceived ‘equity’ of exchanges (i.e. the relation between the amount of resources that each member of a couple receives from the other) and that unilateral relations may not be sustainable (Walster, et al., 1976, Nord, 1980, Miller and Jablin, 1991, p. 97, Hudson and Jablin, 1992). This research compared the ‘symmetry’ of stable and unstable links. Symmetry is a measure used by communication researchers (Thorn and Connolly, 1990) to analyse the relative benefits obtained by two people in a relationship.

For the 39 relations that exchanged at least one contribution, ‘symmetry’ was defined as $S = 1 - [\text{absolute value of (contributions of A to B - contributions of B to A)}] / (\text{contributions of A to B} + \text{contributions of B to A})$ for any pair of teachers A and B. Hence symmetry ranged from zero to one, with zero being a totally asymmetrical relation in which all the contributions flowed in one direction, and one being a perfectly symmetrical relation in which half of all contributions flowed in either direction. For example, a relation in which A sent 2 contributions to B and B sent 8 to A had a symmetry of 0.40.

The average symmetry was 0.60. There were seven relations with symmetry of one and 11 relations with symmetry zero. The 39 relations included 21 *stable* and 18 *unstable* relations. The stable relations had an average symmetry of 0.62, the unstable ones 0.44. The stable relations had a median symmetry of 0.60, the unstable ones 0.25. These differences resulted in a significant ANOVA at the 0.05 level. Taking *symmetry* as the dependent value and *stability* as the factor to be tested, an F statistic total of 4.43 was obtained with $p=0.042$.

In sum, although these results should be interpreted with caution due to the small numbers involved, it may be concluded that the evidence suggests that symmetry was in fact significantly associated with stability. This conclusion gives support to exchange theory’s claim that unilateral relations may not be sustainable in the long run.

9. Comparing requesting behaviour and unsolicited sharing behaviours.

9.1. Correlation between requests and contributions.

The number of requests sent and the number of unsolicited contributions performed per teacher were not significantly correlated (Pearson correlation coefficient was 0.51 with $p=0.023$).

9.2. Type of communication used in requests and contributions.

Although requests and unsolicited contributions were more likely to be sent privately than publicly, the tendency was stronger for requests than for unsolicited contributions. Within the 238 requests, 81.9% were private while within the 397 unsolicited contributions 70.5% were private. In other words a larger percentage of requests than of unsolicited contributions were sent *privately*. According to the results of a Chi-square test this difference was significant⁴³. Thus, a request was more likely to have been sent privately than an unsolicited contribution.

9.3. Type of resource sought or provided.

Within the 238 requests, 60.9% sought 'products' while of the 397 unsolicited contributions, 63% sought 'products'. Using a Chi-square test it was established that there was no significant difference between the type of resource that teachers requested and the type of resource that teachers provided spontaneously⁴⁴.

Within the 195 *private* requests, 64.6% sought 'products' while of the 280 *private* unsolicited contributions, 56.1% involved 'products'. Using a Chi-square test it was established that there was no significant difference between the type of resource that teachers requested and the type of resource that teachers provided spontaneously in private⁴⁵. However, a significant difference was found between the type of resource that teachers *requested* and the type of resource those teachers *contributed* spontaneously *in public*. Within the 43 *public* requests, 44% sought 'products' while of the 117 *public* unsolicited contributions, 79% involved 'products'. Using a Chi-square test it was established that this difference was highly significant⁴⁶. In public, 'expertise' was significantly more requested than contributed.

9.4. Selection of exchange partner.

9.4.1. Previous acquaintanceship.

Within the 195 private *requests*, 68.2% were directed at previously known colleagues, while of the 280 private unsolicited *contributions*, 50.7% were directed at previously known colleagues. A Chi-square test showed that this difference was highly significant⁴⁷. In other words, teachers contacted strangers for requesting resources significantly less than for contributing resources to them.

Similar results were found when looking separately at the 283 exchanges involving 'products'⁴⁸ and the 192 exchanges involving 'expertise'⁴⁹ (the result for 'products' was close to significance at 0.023).

9.4.2. Professional homophily.

Within the 195 private *requests*, 84.6% were directed at teachers who taught the same subject, while within the 280 private unsolicited *contributions*, 85.7% were directed at subject colleagues. No significant difference was found between the percentage of requests sent to subject colleagues and the percentage of unsolicited contributions sent to subject colleagues⁵⁰.

The same result was found when looking separately at the 283 exchanges involving 'products' and the 192 involving 'expertise'⁵¹.

10. Comparing unsolicited and solicited sharing behaviours.

The 20 stable participants performed 597 contributions involving resources (five solicited contributions did not involve resources because they were used to prepare a reply), two thirds of them spontaneously (66.5%, n= 397).

10.1. Correlation between solicited and unsolicited contributions.

Solicited and unsolicited sharing were strongly correlated. The correlation coefficient between the number of solicited and unsolicited contributions performed per stable participant was 0.95 with $p=0$. Strong correlations were also found when looking separately at private messages⁵².

10.2. Type of communication used to contribute.

As discussed earlier, very few solicited contributions were sent publicly (6 of 123), while almost a third of unsolicited contributions were public (29.5%, n= 117). A Chi-square test carried out on the table below confirmed that this difference was highly significant with $p=0$. A solicited contribution was more likely to have been sent privately than an unsolicited contribution.

Exchange acts.	Solicited contributions (expected).	Unsolicited contributions (expected).
Private. (474)	194 (158.8)	280 (315.2)
Public. (123)	6 (41.2)	117 (81.8)
Total. (597)	200	397

10.3. Type of resource contributed.

A majority (59%, n= 117) of the 200 *solicited* contributions and almost two thirds (63%, n= 250) of the 397 *unsolicited* contributions provided 'products'. A Chi-square test found no significant difference between the type of resource contributed *spontaneously* and the type of resource contributed *on demand*⁵³.

10.4. Selection of contribution recipient.

10.4.1. Previous acquaintanceship.

Of the 194 private *solicited* contributions 57% were sent to previously known colleagues while of the 280 private *unsolicited* contributions 51% were sent to previously known colleagues. This difference was *not* significant. Teachers contributed to strangers as much spontaneously as 'on demand'⁵⁴. This result was also true when looking at the 273 contributions involving 'products' and the 201 contributions involving 'expertise'⁵⁵.

10.4.2. Professional homophily.

Comparing contributions to colleagues teaching the same subject and to colleagues teaching other subjects it was found that of the 194 private *solicited* contributions 88% were sent to subject colleagues, while of the 280 private *unsolicited* contributions 86% were sent to subject colleagues. This difference was also not significant⁵⁶. Teachers contributed to same subject colleagues and to teachers of other subjects as much spontaneously as 'on demand'. Similar results were found when looking separately at the 273 contributions involving 'products' and the 201 contributions involving 'expertise'⁵⁷

11. Previous acquaintanceship and physical distance.

Among the 2775 couples, 528 were previously acquainted *and* taught at the same school, while 1926 were previously unacquainted and taught at different schools. In other words, for most couples (88.4%, n= 2452) previous acquaintanceship and physical distance meant the same thing. For corroboration purposes, a Chi-square test of independence between these two variables was carried out and yielded a statistic of 1319.5, hence strongly rejecting independence.

In other words, it is not possible to assert whether the decisive factor influencing link creation is that teachers know each other or that they work in the same building.

This close association between previous acquaintanceship and teaching at the same school may have been caused in part by the design of the instrument used to collect the sociometric data. The questionnaire asked each teacher whether he or she was 'acquainted' or 'unacquainted' with each of the other 74 teachers. As most teachers who work at the same school building are likely to know each other at least superficially, this binary choice may have led to an artificial overlapping between previous acquaintanceship and physical distance. A different questionnaire design could obtain a richer categorisation of acquaintanceship between teachers going from superficial knowledge of each other to close personal and professional partnerships. In that case, we should expect the association between previous acquaintanceship and teaching at the same school to hold for the more

superficial categories of acquaintanceship but not for the deeper ones. An example of a three-point sociometric scale can be found in Bikson and Eveland (1990, p. 259). E-mail users in their investigations 'recognized' a third of the other users, but 'knew' only about a tenth of them.

Almost all (95%, n=39) of the 41 'new' relations (of the 121 links created during the period of study) linked teachers of different schools.

¹ Includes Promise of info on bibliography.

² Includes Info on professional contacts, which is used to obtain teaching resources.

³ Includes Offer or promise to deliver bibliography and Support to obtain bibliography.

⁴ Includes Exercise resolution and evaluation and Offer or promise to deliver teaching materials.

⁵ Includes Recommendation of bibliography and promise to deliver opinion on bibliography.

⁶ Includes Opinion on exercise resolution.

⁷ Includes Offer or promise to deliver teaching approach.

⁸ Includes Opinion on proposal for use of teaching material or approach and Opinion on teaching approach and Promise to deliver opinion on teaching approach.

⁹ Includes Opinion on the outcome of teaching projects and Opinion on proposal for teaching project.

¹⁰ Includes Info on evaluation.

¹¹ Includes Promise of opinion on educational system.

¹² Includes Offer or promise to deliver teacher production.

¹³ Includes Promise of opinion on teacher production.

¹⁴ The t-value for the constant coefficient yielded a p-value of 0.061 and for the slope or unanswered requests coefficient 0.001. (Although the p-value for the constant coefficient is larger than 0.05, it is just barely larger and does not justify its exclusion).

¹⁵ To test whether requests for 'products' were significantly more than half of all requests a 99% confidence interval (CI) was formed. Applying binomial formulas, the 99% CI for 145 of 238 covers [52%, 69%]; since it does not cover 50%, it was concluded with 99% confidence that the percentage of requests for 'products' was significantly greater than one half.

¹⁶ To test whether private requests were significantly more than half of all requests, a 99% confidence interval (CI) for the percentage of private requests was formed. Using binomial formulas, the 99% CI for 195 of 238 covers [74%, 88%]; since it does *not* cover 50%, it was concluded with 99% confidence that the percentage of private requests was significantly greater than one half.

¹⁷ The Chi-square test carried out on the table below yielded a statistic of 5.35 with one degree of freedom, and $p=0.021$.

Requests.	Products (expected).	Expertise (expected).
Private. (195)	126 (118.8)	69 (76.2)
Public. (43)	19 (26.2)	24 (16.8)
Total. (238)	145	93

¹⁸ To test whether this percentage was significantly higher than 60%, a 99% confidence interval (CI) was formed. Applying binomial formulas again, the 99% CI for 165 of 195 covers [73%, 91%]; since the interval around 84.6% is to the right of 60%, it was concluded with 99% confidence that the percentage of private requests addressed to colleagues teaching the same subject was significantly greater than 60%.

¹⁹ The Chi-square test was carried out on the table below. The statistic totalled 1.22 with one degree of freedom, and $p=0.27$.

Requests.	Products (expected).	Expertise (expected).
Previously Acquainted. (133)	82 (85.9)	51 (47.1)
Strangers. (62)	44 (40.1)	18 (21.9)
Total. (195)	126	69

²⁰ The Chi-square test statistic totalled 0.13 with one degree of freedom, and $p=0.71$.

Requests.	Products (expected).	Expertise (expected).
Same subject. (165)	108 (106.6)	57 (58.4)
Different subject. (30)	18 (19.4)	12 (10.6)
Total. (195)	126	69

²¹ To test whether unsolicited contributions involving 'products' were significantly more than half of all unsolicited contributions, a 99% confidence interval (CI) was formed. Applying binomial formulas again, the 99% CI for 250 of 397 covers [57%, 69%]; since it does not cover 50%, it was concluded with 99% confidence that the percentage of unsolicited contributions involving products was significantly greater than one half.

²² To test whether private unsolicited contributions were significantly more than half of all unsolicited contributions, public and private, a 99% confidence interval (CI) for the percentage of private unsolicited contributions was formed. Using binomial formulas again it was found that the 99% CI for 280 of 397 covers [63%, 77%]; since it does *not* cover 50%, it was concluded with 99% confidence that the percentage of private unsolicited contributions was significantly greater than one half.

²³ A Chi-square test was carried out on the table below. The Chi-square statistic totalled 18.4 with one degree of freedom, and $p=0.000018$.

Unsolicited contributions.	Products (expected).	Expertise (expected).
Private. (280)	157 (176.3)	123 (103.7)
Public. (117)	93 (73.7)	24 (43.3)
Total. (397)	250	147

²⁴ To test whether unsolicited contributions to previously known colleagues were significantly different from 68% of all private unsolicited contributions, a 99% confidence interval (CI) was formed. Applying binomial formulas again, the 99% CI for 142 of 280 covers [42%, 59%]; since it is to the left of 68%, it was concluded with 99% confidence that the percentage of private unsolicited contributions sent to previously known colleagues was significantly *less* than the expected 68%.

²⁵ To test whether unsolicited contributions to subject colleagues were significantly different from 60%, a 99% confidence interval (CI) was formed. Applying binomial formulas again, the 99% CI for 240 of 280 covers [79%, 91%]; since it is completely to the right of 60%, it was concluded with 99% confidence that the percentage of private unsolicited contributions to subject colleagues was significantly greater than the expected 60%.

²⁶ A Chi-square test carried out on the table below yielded a statistic of 0.44 with one degree of freedom, and $p=0.51$.

Unsolicited contributions.	Products (expected).	Expertise (expected).
Same subject. (240)	137 (134.6)	103 (105.4)
Different subject. (40)	20 (22.4)	20 (17.6)
Total. (280)	157	123

²⁷ A Chi-square test was carried out on the table below. The Chi-square statistic totalled 289.8 with one degree of freedom, and obviously $p=0$.

Requests received.	Answered (expected).	Unanswered (expected).
Private. (195)	142 (53.8)	53 (141.2)
Public. (432)	31 (119.2)	401 (312.8)
Total. (627)	173	454

²⁸ A Chi-square test carried out on the table below yielded a statistic of only 0.73 with one degree of freedom, and $p=0.39$.

Requests received.	Answered (expected).	Unanswered (expected).
Products. (347)	101 (95.7)	246 (251.3)
Expertise. (280)	72 (77.3)	208 (202.7)
Total. (627)	173	454

²⁹ To test whether the percentage split between answered and unanswered differed significantly between private requests for 'products' and private requests for 'expertise' a Chi-square test was carried out on the table below. The Chi-square test statistic totalled only 0.007 with one degree of freedom, and $p=0.93$. Private requests for 'products' were answered about as frequently as private requests for 'expertise'.

Private requests received.	Answered (expected).	Unanswered (expected).
Products. (126)	91 (91.8)	35 (34.2)
Expertise. (69)	51 (50.2)	18 (18.8)
Total. (195)	142	43

³⁰ To test whether the percentage split between answered and unanswered differed significantly between public requests for 'products' and public requests for 'expertise' a Chi-square test was carried out on the table below. The Chi-square test statistic totalled 3.99 with one degree of freedom, and $p=0.046$. Public requests for 'products' were answered about as frequently as public requests for 'expertise'.

Public requests received.	Answered (expected).	Unanswered (expected).
Products. (221)	10 (15.9)	211 (205.1)
Expertise. (211)	21 (15.1)	190 (195.9)
Total. (432)	31	401

³¹ A Chi-square test carried out on the table below yielded a statistic of 12.5 with one degree of freedom, and $p=0.00040$.

Requests received.	Answered (expected).	Unanswered (expected).
Previously acquainted. (289)	100 (79.7)	189 (209.3)
Strangers. (338)	73 (93.3)	265 (244.7)
Total. (627)	173	454

³² The table below presents the number of requests received for 'expertise' that were answered and ignored separating those sent by previously known people and by strangers. The Chi-square test statistic totalled 10.3 with one degree of freedom, and $p=0.0013$ leading to the conclusion that for requests for 'expertise', the association between previous acquaintanceship and propensity to answer was statistically significant. Requests for 'expertise' from previously known colleagues were answered more frequently.

Requests for 'expertise' received.	Answered (expected).	Unanswered (expected).
Previously acquainted. (139)	48 (35.7)	91 (103.3)
Strangers. (141)	24 (36.3)	117 (104.7)
Total. (280)	72	208

³³ The table below presents the number of requests received for 'products' that were answered or ignored separating those sent by previously known people and strangers. The Chi-square test statistic totalled 3.50 with one degree of freedom, and $p=0.061$. Thus, in the case of requests for 'products' the association between previous acquaintanceship and propensity to answer was *not* statistically significant.

Requests for 'products' received.	Answered (expected).	Unanswered (expected).
Previously acquainted. (150)	52 (43.7)	98 (106.3)
Strangers. (197)	49 (57.3)	148 (139.7)
Total. (347)	101	246

³⁴ The table below shows the number of private requests answered and ignored by previous acquaintanceship. The Chi-square test statistic totalled 10.4 with one degree of freedom, and $p=0.0012$.

Private requests received.	Answered (expected).	Unanswered (expected).
Previously acquainted. (133)	87 (96.9)	46 (36.1)
Strangers. (62)	55 (45.1)	7 (16.9)
Total. (195)	142	53

³⁵ The table below shows the number of *public* requests answered or ignored separating those sent by previously known teachers and those sent by strangers. The Chi-square test statistic totalled 0.26 with one degree of freedom, and $p = 0.61$.

Public requests received.	Answered (expected).	Unanswered (expected).
Previously Acquainted. (156)	13 (11.2)	143 (144.8)
Strangers. (276)	18 (19.8)	258 (256.2)
Total. (432)	31	401

³⁶ A Chi-square test carried out on the table below yielded a statistic of 36.7 with one degree of freedom, equivalent to an observed significance value of $p = 1.4 \times 10^{-9}$.

Requests received.	Answered (expected).	Unanswered (expected).
Same subject. (438)	152 (120.9)	286 (317.1)
Different subject. (189)	21 (52.1)	168 (136.9)
Total. (627)	173	454

³⁷ The table below shows the number of requests for 'products' answered and ignored received from subject colleagues and teachers of different subjects. The Chi-square test statistic totalled 33.8 with one degree of freedom, equivalent to a significance value of $p = 6.0 \times 10^{-9}$. Thus for requests for 'products', the association between professional homophily and propensity to answer was highly statistically significant. Requests for 'products' from subject colleagues were answered much more frequently.

Requests for 'products' received.	Answered (expected).	Unanswered (expected).
Same Subject. (223)	89 (64.9)	134 (158.1)
Different Subject. (124)	12 (36.1)	112 (87.9)
Total. (347)	101	246

³⁸ The table below shows the number of requests answered and ignored that were received from subject colleagues and teachers of other subject. The Chi-square test statistic totalled 5.46 with one degree of freedom, equivalent to a significance value of $p = 0.019$. Thus, among requests for 'expertise', the association between professional homophily and propensity to answer was *not* statistically significant at the 0.01 level of significance.

Requests for 'expertise' received.	Answered (expected).	Unanswered (expected).
Same subject. (215)	63 (55.3)	152 (159.7)
Different subject. (65)	9 (16.7)	56 (48.3)
Total. (280)	72	208

³⁹ The table below presents the number of private requests answered and ignored separating those sent by teachers of the same subject and teachers of different subjects. The Chi-square test statistic totalled 5.69 with one degree of freedom, equivalent to a significance value of $p = 0.017$. Thus, for *private* requests, the association between professional homophily and propensity to answer was not statistically significant at the 0.01 level of significance.

Private requests received.	Answered (expected).	Unanswered (expected).
Same subject. (165)	126 (120.2)	39 (44.8)
Different subject. (30)	16 (21.8)	14 (8.2)
Total. (195)	142	53

⁴⁰ A Chi-square test carried out on the table below yielded a statistic of 5.22 with one degree of freedom, equivalent to a significance value of $p = 0.022$. Thus, for *public* requests, the association between professional homophily and propensity to answer was *not* statistically significant at the 0.01 level of significance.

Public requests received.	Answered (expected).	Unanswered (expected).
Same subject. (273)	26 (19.6)	247 (253.4)
Different subject. (159)	5 (11.4)	154 (147.6)
Total. (432)	31	401

⁴¹ The table for previous private contributions highlights noticeable differences in the averages and also the percentage of requests received where the sender had previously (and privately) contributed to the recipient at least once. The Mann-Whitney test yielded a z-value of -10.91 and $p=0$, meaning the hypothesis of identical distributions was strongly rejected. Previous private contributions to answered requests were significantly more than for requests ignored.

	Requests received.	Average number of previous private contributions.	Median.	At least 1 private contribution.
Answered.	173	11	2	121 (70%)
Unanswered.	454	1.8	0	123 (27%)
Total.	627	4.4	0	244 (39%)

⁴² The Mann-Whitney test yielded a z-value of -1.47 and $p=0.14$, meaning the hypothesis of identical distributions could not be rejected. The distribution of the number of public contributions received before an answered request was *not* significantly different from the distribution of previous public contributions received before an ignored request.

	Requests received.	Average number of previous public contributions.	Median.	At least 1 public contribution.
Answered Requests.	173	4.5	2	139 requests (80%)
Unanswered Requests.	454	3.5	2	359 requests (79%)
Total.	627	3.8	2	498 requests (79%)

⁴³ A Chi-square test was carried out on the table below. The Chi-square statistic totalled 9.67 with one degree of freedom, and $p=0.0019$.

Exchange acts.	Requests (expected).	Unsolicited contributions (expected).
Private. (475)	195 (178.0)	280 (297.0)
Public. (160)	43 (60.0)	117 (100.0)
Total. (635)	238	397

⁴⁴ A Chi-square test carried out on the table below yielded a statistic of 0.19 with one degree of freedom, and $p=0.67$.

Exchange acts.	Requests (expected).	Unsolicited contributions (expected).
Products. (395)	145 (148.0)	250 (247.0)
Expertise. (240)	93 (90.0)	147 (150.0)
Total. (635)	238	397

⁴⁵ The Chi-square statistic from the test carried out on the table below added up to 3.14 with one degree of freedom, so $p=0.076$.

Private exchange acts.	Requests (expected).	Unsolicited contributions (expected).
Products. (283)	126 (116.2)	157 (166.8)
Expertise. (192)	69 (78.8)	123 (113.2)
Total. (475)	195	280

⁴⁶ The Chi-square statistic from the test carried out on the table below added up to 17.02 with one degree of freedom, so $p=0.000037$.

Public exchange acts.	Requests (expected).	Unsolicited contributions (expected).
Products. (112)	19 (30.1)	93 (81.9)
Expertise. (48)	24 (12.9)	24 (35.1)
Total. (160)	43	117

⁴⁷ The Chi-square test carried out on this table yielded a statistic of 13.7 with one degree of freedom, and $p=0.00021$.

Exchange acts.	Requests (expected).	Unsolicited contributions (expected).
Previously acquainted. (275)	133 (112.9)	142 (162.1)
Strangers. (200)	62 (82.1)	138 (117.9)
Total. (475)	195	280

⁴⁸ The Chi-square test carried out on the table below yielded a statistic of 5.14 with $p=0.023$.

Products.	Requests (expected).	Unsolicited contributions (expected).
Previously acquainted. (162)	82 (72.1)	80 (89.9)
Strangers. (121)	44 (53.9)	77 (67.1)
Total. (283)	126	157

⁴⁹ A Chi-square test carried out on the table below yielded a statistic of 9.14 with $p=0.0025$.

Expertise.	Requests (expected).	Unsolicited contributions (expected).
Previously acquainted. (113)	51 (40.6)	62 (72.4)
Strangers. (79)	18 (28.4)	61 (50.6)
Total. (192)	69	123

⁵⁰ The Chi-square test statistic totalled 0.04 with one degree of freedom, and $p=0.84$.

Exchange acts.	Requests (expected).	Unsolicited contributions (expected).
Same subject. (405)	165 (166.3)	240 (238.7)
Different subject. (70)	30 (28.7)	40 (41.3)
Total. (475)	195	280

⁵¹ Chi-square tests carried out on the tables below yielded statistics of 0.042 with $p=0.84$ and 0 with $p=1$.

Products.	Requests (expected).	Unsolicited contributions (expected).
Same subject. (245)	108 (109.1)	137 (135.9)
Different subject. (38)	18 (16.9)	20 (21.1)
Total. (283)	126	157

Expertise.	Requests (expected).	Unsolicited contributions (expected).
Same subject. (160)	57 (57.5)	103 (102.5)
Different subject. (32)	12 (11.5)	20 (20.5)
Total. (192)	69	123

⁵² For private messages only, the table below compares the basic statistics of the number of solicited and unsolicited contributions made by the 20 stable participants.

Act.	Number.	Average .	Median.	At least 1.	Max.
Solicited Contributions.	194	9.7	3	17 teachers	64
Unsolicited Contributions.	280	14.0	4.5	17 teachers	118

To further illustrate the degree of agreement between these two variables, the correlation coefficient between the number of *private* solicited and unsolicited contributions per teacher for the 20 stable participants was also 0.95 with $p=0$. So teachers who contributed more private solicited contributions tended to also contribute more private unsolicited contributions.

⁵³ A Chi-square test carried out on this table yielded a statistic of only 0.94 with one degree of freedom, and $p=0.33$.

Exchange acts.	Solicited contributions (expected).	Unsolicited contributions (expected).
Products. (367)	117 (122.9)	250 (244.1)
Expertise. (230)	83 (77.1)	147 (152.9)
Total. (597)	200	397

⁵⁴ A Chi-square test statistic carried out on the table below totalled 1.42 with one degree of freedom, and $p=0.23$.

Exchange acts.	Solicited contributions (expected).	Unsolicited contributions (expected).
Previously Acquainted. (252)	110 (103.1)	142 (148.9)
Strangers. (222)	84 (90.9)	138 (131.1)
Total. (474)	194	280

⁵⁵ The same analysis was performed for 'products only', then for 'expertise' only. For 'products', of the 116 private *solicited* contributions 58% were sent to previously known colleagues and 42% to strangers. Of the 157 private *unsolicited* contributions 51% were sent to previously known colleagues and 49% to strangers. This difference was *not* significant. A Chi-square test carried out on the table below yielded a statistic of 0.98 with $p=0.32$.

Products.	Solicited contributions (expected).	Unsolicited contributions (expected).
Previously acquainted. (147)	67 (62.5)	80 (84.5)
Strangers. (126)	49 (53.5)	77 (72.5)
Total. (273)	116	157

The table below was used to compare in a similar way solicited and unsolicited contributions for 'expertise' only. Within the 78 private *solicited* contributions involving 'expertise', 55% were directed at colleagues with whom the requesters were previously acquainted, while of the 123 private *unsolicited* contributions, 50% were sent to previously known colleagues. This difference was *not* significant. The Chi-square test statistic totalled 0.26 with $p=0.61$.

Expertise.	Solicited contributions (expected).	Unsolicited contributions (expected).
Previously acquainted.(105)	43 (40.7)	62 (64.3)
Strangers. (96)	35 (37.3)	61 (58.7)
Total. (201)	78	123

⁵⁶ A Chi-square test carried out on the table below yielded a statistic of 0.40 with one degree of freedom, and $p=0.53$.

Exchange acts.	Solicited contributions (expected).	Unsolicited contributions (expected).
Same Subject. (411)	171 (168.2)	240 (242.8)
Different Subject. (63)	23 (25.8)	40 (37.2)
Total. (474)	194	280

⁵⁷ The same analysis was performed for 'products only', then for 'expertise' only. For 'products' only, of the 116 private *solicited* contributions 90% were sent to subject colleagues and 10% to teachers of other subjects. Of the 157 private *unsolicited* contributions 87% were sent to subject colleagues and 13% to teachers of other subjects. This difference was *not* significant. The Chi-square test statistic totalled 0.17 with $p=0.68$.

Products.	Solicited contributions (expected).	Unsolicited contributions (expected).
Same subject. (241)	104 (102.4)	137 (138.6)
Different subject. (32)	12 (13.6)	20 (18.4)
Total. (273)	116	157

The table below was used to compare in a similar way solicited and unsolicited contributions for 'expertise' only. For 'expertise' only, within the 78 private *solicited* contributions, 86% were directed at subject colleagues and 14% to teachers of other subjects. Of the 123 private *unsolicited* contributions 84% were sent to subject colleagues and 16% to teachers of other subjects. This difference was *not* significant. The Chi-square test statistic totalled 0.045 with $p=0.83$.

Expertise.	Solicited contributions (expected).	Unsolicited contributions (expected).
Same subject. (170)	67 (66.0)	103 (104.0)
Different subject. (31)	11 (12.0)	20 (19.0)
Total. (201)	78	123

1. Collegiality among secondary school teachers in Uruguay.

1.1. Amount of collegiality.

All 15 teachers coincided in the relatively 'low' level of collegial interaction between secondary school teachers in Uruguay. As Ms. Pszt put it:

'Q: How often do you have contact with colleagues in a typical week?

A: Very little.

Q: What do you mean by "very little"?

A: Well, sometimes I may coincide in the staff room with another teacher, if we happen to have a free slot of time at the same hour of the day. Otherwise, I only see other teachers while running (she makes some gestures to emphasise that she means *actual* running) from one classroom to another (5:33)'.

Mr. Joli, one of the most experienced teachers of the group reflected (the repeated use of the verb 'to run' to describe teachers' working days should be noted):

'Collegial contacts are much less than what they should be ... Teachers keep running from one classroom to the other and from one school to the other ... They just have no time (6:33)'.

Mr. Eega discussed with the interviewer his contacts with Ms. Pszt, who was his 'closest colleague', in the following terms:

'... we do not see each other very much, although we teach in nearby classrooms; periods between classes are so short, five minutes, that by the time you go from your classroom to the staff room you already have to leave for another classroom for the next lesson, hence dialogue is scarce, I would say almost non-existent (8:11)'.

Ms. Toch reflected on her own collegial relations and more generally about collegiality among secondary school teachers as follows:

'I do not coordinate activities with colleagues and my impression is that most teachers don't ... (2:47)'.

1.2. Teaching as an isolated activity.

The feelings of isolation reported by teachers in research across different countries were present in five of the interviews. For example, Ms. Jrod, when asked about professional exchanges between teachers, responded:

'... there is no exchange ... At the end of the day, teaching is lonely ... teachers are expected to solve everything on their own (4:26)'.

According to Ms. Abra:

‘... teaching is a lonely occupation, we usually work isolated and we listen very little to each other (10:8)’.

1.3. Content of teacher communication.

According to a majority of the teachers (9), much communication between colleagues is not of a professional nature. As Ms. Toch, one of the most active users of Teachnet, commented:

‘What I always see is that maths teachers discuss everything but maths. They discuss the name of a street or the name of a tree, but they never discuss maths (2:18)’.

According to Mr. Odia,

‘Teachers usually avoid professional discussions ... We sometimes are afraid of others’ criticism ... (3:20)’.

Ms. Jrod described teacher talk as follows.

‘I never hear professional discussions in the teachers’ room. At most, a teacher may grumble about the behaviour of a student or a group of students.’

Q: There are no discussions on pedagogy?

A: Not to the best of my knowledge ... most teacher conversations gravitate towards money and salaries (4:25)’.

Mr. Skri told the interviewer:

‘... there are no pedagogical discussions between teachers. I think we, teachers, tend to keep our status quo of how to do things that may need improvement ...’ (14:27).

1.4. Cross-subject communication.

Collegial interactions were described by many teachers (9) as bounded by the subject they taught.

‘Communication takes place mainly between teachers of the same subject. (Mr. Joli, 6:28)’.

‘There is no real exchange between teachers of different subjects. (Ms. Jrod, 6:29)’.

‘We all admit that teaching should be an interdisciplinary endeavour ... but it does not happen that way (Ms. Abar, 10:21)’.

INTERVIEW GUIDELINES

I- Collegiality.

1. Views on teaching and collegiality.

Is communication with colleagues important? Why?

How do you usually get new ideas, information or teaching materials ? Give concrete examples.

Should teachers' practice be open to review and comment by colleagues? Why?

Is seeking or giving advice on teaching issues embarrassing to teachers? Why? Is it done at all? Do you ever give your opinion – praise or criticism – of a colleague' s teaching methods or handling of classroom situations?

2. Existing collegiality.

Do you have regular contact with your colleagues? With whom? Are meetings usually spontaneous or planned? Where do they take place?

What is the purpose of those contacts with colleagues? What do you generally talk about with other teachers?

To whom do you turn when you face teaching problems or need information, an opinion or feedback? How do you contact them?

Do you receive requests for information, opinions, ideas or support from colleagues? From whom? How? How often? Give examples.

3. Level of satisfaction with existing collegiality.

Would you like to increase your level of communication with other teachers? With what kind of teachers? What prevents you from increasing it?

4. Factors affecting collegiality.

If it were desirable, is it possible to promote greater interaction between teachers? How?

What are the most important obstacles preventing teachers from having closer relations with their colleagues?

II- Feelings about CMC and computers.

Are you a PC user?

Do you generally access computer networks? For what purpose? Are you comfortable communicating through a PC?

Are you comfortable communicating through the written word?

III- Use of Teachnet.

1. Access and use.

How frequently do you access the computer network to read your messages? (If he/she does not access, ask why and since when.)

Do (did) you send messages on a regular basis? Public or private?

To whom? To people you know? To people who had previously sent something to you?

2. E-mail collegial behaviour.

Have you used e-mail for *requesting* anything? How did your colleagues respond to your requests?

Have you spontaneously *contributed* information, materials or others using e-mail? Why? Did you get any feedback?

Have you received public e-mail requests? Private ones? Did you respond to these requests? How obligated do you feel to respond to e-mail requests from colleagues?

3. E-mail relations.

Have you maintained e-mail relations? With whom? Did you get to know new people?

What motivated you to establish relations with those people in particular?

What kind of relations are they? Social? Professional?

What benefits did *you* reap from those relations?

4. Factors affecting the use of the computer network.

Would you like to use e-mail more often? Why? What prevents you from doing so?

Is it easy to access the computer network? Is it easy to send messages?

Do you prefer to use public or private communication? For what? Why?

IV- Views on the value and potential of CMC.

1. Perceived benefits.

What were your expectations with regard to use of Teachnet? Has it satisfied your expectations so far?

Is having access to e-mail useful? For what? Have you gained ideas? Teaching materials? Met previously unknown colleagues? Developed closer links with known colleagues?

For teachers in general, is it worthwhile to have electronic mail available? For what purpose? Are there things that can be accomplished when e-mail is available that cannot be accomplished when it isn't?

2. CMC potential

Do you think that CMC use by teachers will increase in the future? Why?

Do you think that CMC use over the long run may have an impact on your teaching practice? In what way? Why?

In your opinion, is CMC an efficient mechanism to develop greater communication between colleagues? For what kind of collaboration?

Note: This is an English translation of the Spanish language interview schedule used in the interviews.
