SECONDARY SCHOOL TEACHERS AND COMPUTERS:

A study of the factors affecting the use of computers in three uruguayan schools

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Secondary school teachers and computers: a study of the factors affecting the use of computers in three uruguayan schools

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ABSTRACT

This study is a development of the corpus of research in planned educational change and innovation. It investigates the processes of adoption and implementation of computers for teaching in three Uruguayan secondary schools. The investigation concentrates on understanding the use of computers from the perspectives of the teachers.

The findings are compared with the conclusions of a literature review which considered theories of innovation and their applications in educational organisations, studies of the use of computers for teaching and research on the use of computers in Third World schools. The study formulates researchbased recommendations for policy makers and school directors in the areas of management of resources, teacher training and support structures.

The research consisted of two stages: a preliminary survey of computer use by all teachers of National Curriculum subjects in the three schools, and a subsequent qualitative stage based on indepth interviewing of a sample of 18 teachers of Maths, Science and Spanish. The analysis of the qualitative data consisted primarily of an attempt to construct interpretative categories to account for the events and processes embedded in the descriptive data.

It was found that less than a third of the teachers had used computers for teaching. Use of computers was significantly associated with more positive attitudes to computers and better IT training. Degree of computer use was significantly higher among teachers of Maths and Science. Teachers' decisions to use computers were based on their perceptions of the value, congruence and accessibility of the technology.

The research showed that computer uptake was a complex process, influenced by a set of interrelated factors at the teacher, school and extraschool levels. One of the most significant implications is that uptake may not depend on the effect of individual factors but rather on the result of the dynamic interplay of various forces. For example increasing the number of computers in a school should not be expected *per se* to lead to increased uptake when a set of other factors are inhibiting implementation). Teachers felt they were unable to circumvent organisational barriers constraining the use of computers and that schools' directors and national school inspectors should be responsible for providing adequate solutions to organisational problems.

A general conclusion of this study is that using computers for teaching represents a difficult change for teachers, involving challenges to long established practices and beliefs, and that school IT policies should be designed taking into account teachers' perceptions and concerns.

CHAPTER 1

Introduction

1.1. **Secondary schools in uruguay**

Uruguay's secondary educational system is highly centralised and run by a central government department, the National Education Administration (NEA). The NEA formulates the National Curriculum, regulates its implementation and follows closely the fulfilment of the regulations through reports and field inspections. The secondary educational system in Uruguay has many of the characteristics found by Hawkridge et al. (1990, p. 304) in their recent study of Third World schools: '...hierarchical formal educational systems ... curriculum centrally driven by public examinations'.

Most schools, known as 'state schools', are fully financed and managed by the NEA. Teachers in state schools are civil servants. State schools, which are free of charge, cater for 82% of the student population (CEPAL, 1990).

Nonstate schools, the 'private schools', are nonprofit institutions, each of which is run by a Board of Trustees and managed by a director or headmaster. Private schools charge fees and do not receive state subsidies. Parents who send their children to private schools are not eligible for state grants or loans of any kind. There are 62 private schools teaching at the secondary level in Uruguay (CEPAL, 1990). Private schools must teach the National Curriculum and follow most of the same NEA curricular and administrative regulations applying to state schools. Schools failing to comply are not allowed to award the 'official baccalaureate' required to enter all tertiary level institutions in the country.

The National Curriculum is composed of 'Core Subjects' (Mathematics, Science and Spanish) and 'Basic Subjects' (History, Geography, Foreign Languages, Literature, Drawing and Design and Technology). Any other course that schools wish to run must be carried out in addition to the National Curriculum. Examples of such additional courses are certain foreign languages, Computer Studies, Dance, Drama, Business Studies and Religious Studies. Instructional methods are free for schools and teachers to choose, provided all relevant NEA specifications are met.

Competition is intense within the private educational system. Many of the differentiation factors between private schools lie in these additional activities, as the NEA regulations leave little ground for curriculum innovation in National Curriculum courses.

1.2. **Information technology (it) in uruguayan schools**

One of the most prominent initiatives of private schools in Uruguay in recent years has been the introduction of computers. All major private secondary schools in Uruguay have undertaken IT initiatives in the last decade. These initiatives have been described in the media and in school internal reports and brochures. However, no researchbased study has hitherto been published and little is known about the impact of the introduction of computers on the curriculum.

The NEA has implemented a few experimental projects in state schools. However, no national policy for the introduction of computers in schools has yet been formulated.

1.3. **The international scene**

The widespread introduction of computers in schools has been an international phenomenon. Several major projects have been implemented in the UK in the recent past (Hubbard, 1986). According to Wellington (1988a), these projects have received, 'more funding than any other item of educational technology in the history of schooling'. Secondary schools in England and Wales are reported to have reached in 1991 an average of 41.1 microcomputers per school (DES, 1991). In the USA, as early as 1983, more than 90% of all secondary schools had reportedly introduced computers (CPB, 1984). France has installed more than 120 000 computers in state schools and the French Ministry of Education also decided to equip the private schools (Dieuzeide, 1987). Japan decided in 1986 to incorporate the use of computers at the lower secondary level (Nishinosono, 1987). A 1988 national survey found that 86% of Japanese secondary schools were using computers (Sakamoto, 1988).

Third World countries have also been active in the field of computers in education. Hawkridge et al. (1990) describe IT initiatives in schools in Asian, African and Arab countries. In Latin America most countries have shown interest in the field (UNESCO, 1985). For example, a major project in Costa Rica is described as covering 45% of all secondary school students in the country (Fonseca, 1990). Oteiza (1987) mentions more than 120 IT initiatives in schools in Chile alone.

1.4. **A growing concern**

The use of computers across the curriculum is widely perceived as a worthy goal. The UK Department of Education and Science (DES), for example, has recently defined a comprehensive role for IT within the National Curriculum. A recent DES document, 'Information Technology from 5 to 16', states: 'IT has a critical role in enhancing the learning process ... across a broad range of activities including but going beyond the National Curriculum' (DES, 1989, p. 2). Another DES document states one of the major aims of IT in school as 'harnessing the potential of IT for enhancing the quality of teaching... across the curriculum' (DES, 1987). Wellington (1988b) found that many schools see the use of IT across the curriculum as their main goal. Ridgeway (1986) justified the need for more research into the use of computers in schools on the grounds of 'proven sizable gains in the performances of students'.

Recent research from a number of countries has shown, however, that whilst the use of IT has increased dramatically in the area of Computer Studies, **the degree of use of computers for teaching in other subjects remains persistently low**.

The 1991 survey of IT in schools by the UK Department of Education and Science covered 500 secondary schools. It found that while 72% of Computer Studies departments made regular use of IT, the equivalent figure for other subjects was substantially lower (e.g. Maths 14%, Physics 8% and English 15%). Wellington (1988a) contacted 1010 secondary schools in England, Scotland and Wales through an electronic survey. He found that Computer Studies is still dominant as a user of the school's IT resources and concluded that '... despite huge central funding the anticipated ... change in education through the use of IT has yet to materialise'. Silson (1988), in an Economic and Social Research Council (ESRC) report, mentions a lack of impact by the new technologies on the schooling of pupils as a major issue

in the development of the secondary school curriculum. Cox (1990) recently estimated that less than 30% of secondary school teachers of National Curriculum subjects in the UK use computers.

Swadener et al. (1987) reported similar findings in their study of secondary schools in the USA: most of the reported computer use in schools was by computer classes. 'Power On!', a US Congress Office of Technology Assessment document (US Congress, 1988) reports that while 95% of public schools in the USA have computers, only 50% of teachers have ever used a computer for any purpose and only 15% of teachers use computers regularly. According to Shultz et al. (1989): 'Research indicates ... that most of the teachers with access to computers do not use them' (p. 4). In France, Dieuzeide (1987) concluded that after fifteen years of work 'most teachers still seem unwilling to entrust the computer with tasks that cannot be done by traditional means'. In Holland, Plomp et al. (1990) found that in subjects other than Computer Studies computer use has a low frequency and is applied for a small percentage of the subject matter.

1.5. **Research justification**

A growing body of research focuses on the factors that promote or inhibit the use of computers by teachers. This issue, according to many authors, should be a major concern to policymakers in the future (Wellington, 1988a). Ridgeway (1986) in his review of research needs in Computer Assisted Learning (CAL), argues that 'it will be essential to identify and overcome barriers to the diffusion of IT ... if IT is to fulfil its potential in education'. However, there is still little evidence as to what factors influence teachers' decisions about computer use (McCoy, 1989).

'Making Sense of the Future', a recent Harvard Graduate School of Education report on the use of computers in schools, states:

> **'The incorporation of a new technology into a teacher's repertoire calls attention to much more than the computer itself, (future research must also address) the constraints and opportunities that schools' realities pose to the teacher' (Schwartz, 1988).**

The individual teacher, operating within the school organisation, has therefore become a centre of attention because 'teachers are the final arbiters of classroom practice' (Doyle and Ponder**,** 1977). The study of the individual teacher is crucial in developing countries as Hawkridge et al. (1990) argues: 'In developing countries, convincing the teachers is the key to change in schools' (p. 271). According to Desforges (1988):

> **'...(computer) takeup is governed by opportunities as actually perceived (by teachers) in classrooms and ...attempts to be innovative must face up to the constraints of the classroom'.**

Several studies on the use of computers by educators have been carried out over the years. However, most of the research has hitherto concentrated on a limited number of methodological approaches and countries.

Much of the existing research is based on surveys and correlational studies. More work is needed, of a qualitative nature, to obtain a better understanding of the complex and interrelated set of issues that govern teacher behaviour. As Sage et al. pointed out in 1983: 'the factors which inhibit or promote the adoption of computers ... by teachers are not (yet sufficiently) known or understood... and case studies (are necessary) to investigate the factors which promote or inhibit the uptake'.

Qualitative studies of teacher use of computers have been published in recent years (Chandra, 1986, Chomienne, 1988, Rhodes et al., 1990 and Plomp, 1990 are only a few examples) but most of these studies were carried out in European or North American countries. **Little reference to developing countries** is to be found in the literature as several authors have noted (Fullan, 1985, Mancey, 1989). Hawkridge et al. (1990) found that:

> **'...little has yet been written about the adoption process in developing countries where microcomputers have often been quietly introduced into classrooms ... so far most developing countries have been unable, or possibly unwilling, to commit themselves to carrying out studies of computer use in their schools' (p. 261).**

Several important differences between IT initiatives in schools in Uruguay and in other countries, specially European countries or North American countries, stress the need to undertake local studies. One major difference is the role of the State. In countries such as the UK or France, national or local authorities provided largescale support in teacher training, hardware acquisition and software development (Hubbard, 1986, Dieuzeide, 1987). In other countries such as the USA or Japan corporate support has been instrumental in supporting IT initiatives in schools. The Uruguayan Government has not hitherto played any major role. Furthermore, due to economic and political considerations, it is difficult to expect largescale state or corporate support for educational IT in the near future.

Other differences lie in the organisational structure of schools in Uruguay. Agents that have been shown in related research to be highly influential, such as the District Administrator (Fullan, 1985) or the Head of Department (Chandra, 1986), do not exist.

This study thus addresses some of the issues that have been identified as important but scarcely researched so far, particularly outside of North American and European contexts.

1.6. **Research aims**

The principal aims of this study are to contribute to the understanding of how secondary school teachers perceive computers and to identify the main factors that influence their use of computers in teaching.

The research reported in this study was carried out in Uruguay. Its findings are compared with the conclusions of related research carried out in other countries. The study also discusses researchbased strategies for the introduction of computers in secondary schools.

1.7. **Research significance**

Understanding how teachers perceive computers, and the incentives and disincentives that govern computer uptake is of importance for policy makers in areas such as software design (D'arcy et al., 1988), instructional documentation (Mudd et al., 1987), training (Rhodes et al., 1990) and IT resource management (Rhodes et al., 1990). Cuban, (1986) in his study of the degree of use of several technologies in the classroom, says:

> **'The question (of the factors that influence the degree of use) is important to policymakers, practitioners and researchers because the teacher is the ultimate gatekeeper for changing what happens to students' (p. 218).**

Research into IT initiatives carried out in Uruguayan schools should therefore be of value

for national policymakers, who currently have to rely mainly on research based on foreign experiences. An investigation of the crucial factors influencing the use of IT by educators is significant at this stage of development of the educational system in Uruguay since the NEA has yet to formulate a national policy for the introduction of computers in education. As stated earlier, state schools cater for 82% of the student population and there has been pressure on the Government to take action on the growing gap between IT education provided by state and private schools (CEPAL, 1990).

Findings based on initiatives carried out in Uruguay should be of relevance for other developing countries, especially in Latin America where similar educational, social and economic characteristics can be found.

The study, based on initiatives carried out in private schools, is of interest for the national system as a whole since: a) the majority of teachers work in both the public and private systems (CEPAL, 1990) and b) NEA regulations lead to strong similarities in the organisational characteristics (i.e. wages, workloads, incentives and management structure) of state and private schools.

1.8. **Research questions**

The research questions below follow from the aims of the study and the review of the literature.

The study is based on IT initiatives carried out by three Uruguayan private schools. No relevant research had hitherto been published on these initiatives nor more generally on the use of IT in Uruguayan schools. In order to study the factors at play in determining computer uptake it was first important to investigate the nature of the potential user population (e.g. teachers' attitudes to the innovation and level of IT training) and establish the general patterns of IT use by teachers (e.g. the degree of computer use by subject taught).

This led to the first set of research questions. The quantitative nature of these questions suggested the use of a survey that constituted stage 1 of this study (see chapter 4).

1a) What are the main characteristics of the teachers who constitute the potential IT user population in the schools?

1b) What is the degree of computer use by teachers of National Curriculum subjects?

The study aims at furthering our understanding of how teachers perceive computers and identifying the factors that are critical in influencing uptake. The second set of questions is concerned with these issues. A qualitative approach was used in stage 2 since the main emphasis of the study is on explanation and on the teachers' own interpretation of the phenomena under investigation.

2a) What are the main factors affecting the degree of computer use by teachers?

2b) How can teachers' degree of computer use be explained?

Finally, it was important to broaden the study's perspectives by comparing its findings with those of research carried out in other countries and to discuss the potential implications for IT initiatives in schools.

3) To what extent are the results of this study compatible with the results of studies carried out in schools in other countries? How can the differences be explained?

CHAPTER 2

A review of related research

2.1. **Introduction**

The development of Information Technology (IT) use in education can be seen as part of the broader field of educational change. According to Cox et al. (1989): 'It has been recognised that many of the barriers to ... the adoption of microcomputers (in schools) are specific examples of the barriers to ... change in general'. A growing body of research in planned educational change has emerged since the 1960s with two main foci: studies related to theories of instruction and studies related to theories of innovation. The present study belongs to the latter stream of research which concentrates on the processes of institutional innovations and their sociological and organisational implications.

The review is presented in chronological order and concentrates on some of the theories of innovation and their applications in educational organisations, studies of computer uptake by teachers and research into the use of computers in Third World schools. The relevant literature was surveyed through library indexes and computer searches of ERIC and other databases.

2.2. **Theories of innovation**

2.2.1. **Models of development and dissemination of innovations**

A very influential writer in the field of planned change has been **Havelock** (1969, 1971). His major conclusion, after reviewing more than 4000 case studies in different fields, is that the dissemination of innovation among a userpopulation can be grouped under three models: Research, Development and Diffusion (RDD), Social Interaction (SI) and ProblemSolving.

The RDD model presents the model of change as a rational process where the innovation is sequentially invented, developed, produced and then disseminated within the user population. In this model the initiative rests with the developers while the user assumes a largely passive role.

The SI model assumes that research and development have taken place and concentrates on the diffusion stage. In this model, 'senders' bring the innovation to the attention of potential users. If the user shows interest in the innovation a series of interactions take place culminating in the adoption or rejection or the innovation. In this model the key features are the channels of communications and the place of the potential user in the network of social relations (centrality, peripherality, isolation). The rate of diffusion of innovations in an SI model is expected to follow a predictable curve with an S shape where adopters are classified as 'innovators' constituting about 3% of the population, 'early adopters' (16%), 'early majority' (34%), late majority (34%) or 'laggards' (16%).

The Problem-Solving model emphasises the needs of the user who is here an active participant. The process starts with the perception of a need by the user, followed by a search for solutions. In this model, an external agent, usually referred to as the 'change agent', assists the user in

finding and implementing the solution. Advocates of this innovation model, stress the fact that the problems of congruence and inappropriateness are avoided by definition. Critics point to the lack of rigorous research that may characterise this type of innovation (Nicholls, 1979, p. 19).

Havelock attempted to unify the RDD, SI and Problem Solving models in the Linkage model. This model emphasises the need for communication channels and links between users and resources for the provision of guidance, training and feedback.
Shon (1971) presents other models of dissemination of innovations: the CentrePeriphery and the Proliferation of Centres models.

In the Centre-Periphery model the innovation is assumed to be developed centrally prior to diffusion, and the movement is from the centre out to its potential users. Directed diffusion is the process of dissemination, training and provision of resources. The effectiveness of the model, according to Shon, depends on factors such as the level of resources at the centre, the number of points at the periphery and the length of the radii.

The Proliferation of Centres model is an elaboration of the CentrePeriphery model where secondary centres are responsible for diffusion. Secondary centres are supported and coordinated by primary centres.

2.2.2. **Strategies for innovation**

Chin and Benne (1976) describe a typology of innovation strategies. They identified three major groups of strategies: Empiricalrational, Normativereeducative and Powercoercive.

Empirical-rational innovation strategies assume that human beings are rational and will adopt innovations if shown the gains to be obtained. As described below (e.g. Gross, 1971, Nicholls, 1983), empiricalrational strategies have been shown to be less than successful, especially when the innovation requires changes of behaviour.

Normative-reeducative strategies do not deny the rationality of people but assumes human motivation as supported by their commitment to sociocultural norms. Sociocultural norms are supported by the value systems of individuals. Change, according to this view, will occur only as persons change their commitments to new norms, which implies changing attitudes and values, not just knowledge or intellectual rationales. Normativereeducative strategies recognise that the users' problems may not be solved simply by providing better technical information and support. Problems may lie in the realm of attitudes and values and therefore reeducation may be necessary to solve them. Normativereeducative strategies, which are more complex and demanding than empirical ones, are rarely found in documented accounts of innovations in schools.

Power-coercive strategies emphasise political and economic sanctions and the use of moral power (Nicholls, 1983, p.32); in the empiricalrational strategies, knowledge is the major ingredient of power. Chin and Benne argue that powercoercive strategies are more widespread than most people would admit. Nicholls (1983, p. 32) found that powercoercive strategies are widely employed at school level.

The choice of innovation strategy, according to Chin and Benne, should be defined by the nature of the innovation, the characteristics of the teachers and the school context.

2.2.3. **Stages of innovations**

Most authors have stressed the need to conceive innovations as processes, rather than products or events.

They argue that a time dimension must be incorporated in innovation models and different stages distinguished. This should be important, argues Nicholls, because 'a recognition of the existence of stages ... in the process of innovation might encourage the innovator to realise the magnitude of the task, to carry out monitoring ... and to provide support for the teachers when ... necessary' (1983, p. 36).

Carlson (1965, p.4) for example describes the innovation cycle as composed of 'its invention, development, promotion, adoption, diffusion and demise'.

Rogers and Shoemaker (1971, p.103) propose a framework composed of four stages: knowledge (where the potential user becomes aware of the innovation), persuasion (where the potential user's attitude to the innovation is shaped), decision (where the potential user adopts or rejects the innovation) and confirmation (where the potential user confirms or reverses his decision to adopt or reject).

Bolam (1975) argues that the conceptualisation of innovation processes should be extended to include Antecedent and Consequent stages besides the Interactive stage. In the antecedent stage, prior to the beginning of the innovation process, the change agent, the innovation and the user exist but separately. In the interactive stage which corresponds to the abovementioned Carlson, and Rogers and Shoemaker stages the innovation is introduced. The consequent stage looks at the outcomes of the innovation process.

Berman (1981) proposes a basic framework of three main stages: adoption, implementation and institutionalisation. Berman's framework has been widely used in implementation studies.

2.3. **Factors affecting the implementation of educational innovations**

Since the 1970s there has been a growing interest in the implementation of innovations in schools (Berman, 1981). The impetus for this interest was research that showed that many change efforts failed to have an impact on classroom practice (Gross et al., 1971, Charters et al., 1973).

'Implementation', according to Fullan (1985) is 'the process of altering existing practice in order to achieve more effectively certain desired learning outcomes'.

One of the major early contributions to the study of the implementation of innovations in schools was published by **Gross** et al. in 1971. They conducted a case study of the introduction of an educational innovation in an elementary school (Cambire Elementary) with the objective of 'increasing our knowledge of conditions ... that may serve to block or facilitate the implementation of organisational innovations (p. 42)'. The authors distinguished three major stages in the innovation process: initiation, attempted implementation and incorporation.

Their study contended that most of the research on organisational innovations to that date 'had been based on a truncated version of the process (of innovation)' (p. 42) and described the existing theories as placing 'primary emphasis on the ability of a change agent to overcome the initial resistance of organisational members' (p. 1). They argued that those formulations disregarded other major issues: a) organisational members who are not resisting

change may encounter obstacles preventing implementation, b) many of these obstacles can only be removed by the organisation leaders, who may not even be aware of them and c) organisational members that did not resist the innovation at the beginning may change their attitudes and start opposing change efforts in a later stage as a result of the presence of unsolved problems.

Gross et al. found that the majority of the teachers at Cambire Elementary had failed to implement the innovation six months after its announcement. They attributed this outcome to the presence of five barriers: a) the teachers' lack of clarity about the innovation, b) their lack of the skills needed for implementation, c) the unavailability of required instructional materials, d) the incompatibility of organisational arrangements and e) lack of staff motivation.

The authors concluded that the school principal's strategy for change was inadequate for two main reasons: a) it was based on the assumption that teachers would be able to 'figure out' the procedures given the goals and therefore failed to create the mechanisms to cope with the anticipated needs and b) they did not create information systems to identify unexpected problems. Gross et al. called the organisational innovation model derived from the Cambire case study, the 'LeadershipObstacle Course' (LOC) model.

Gross and Herriott (1979) revised some years later the LOC model on the basis of a number of new case studies.

They concluded that the LOC model had a number of limitations: a) it overlooked the possibility that events occurred before a proposed change is introduced into an organisation that may have a major impact on implementation (p. 355), b) the LOC model did not recognise the importance of factors external to the school as impediments for the implementation of organisational innovations, c) a number of staffing problems had not been identified and d) the political role of the principal was not recognised.

Based on these conclusions, Gross and Herriott proposed a new model: the Elaborated Leadership Obstacle Course (ELOC) model. The ELOC model specifies five stages in the innovation process: exploration, strategic planning, initiation, attempted implementation and incorporation or rejection.

Doyle and Ponder (1977) proposes an analytical framework for studying teacher adoption of innovations. They argue that 'if an effective change strategy is ever to be devised, it must be constructed on a more thorough understanding of the naturally existing mechanisms which operate in school environments'. They point to the high functional autonomy and relative isolation in which most teachers work and state that most educational innovations tend to disrupt this autonomy.

Doyle and Ponder (1977) classify teachers as 'rational adopters' (who should be convinced by rational arguments), 'stone age' obstructionists (who change strategies try to neutralise) and 'pragmatic skeptics' (who adapt rather than adopt innovations).

The authors argue that the perceived 'practicality' of a change is the crucial determinant in the teacher decision to adopt and implement the innovation. According to Doyle and Ponder the 'practicality ethic' is a critical link in the knowledgeutilisation chain in schools. 'Practicality', as defined by Doyle and Ponder, is based on 'instrumentality' (the innovation is realistic and clear and guidance is available), 'congruence' with existing practices, classroom conditions and the teachers' selfimage, and costs, defined as the ratio of investment to return for the teacher.

Brown and McIntyre (1982) studied the main factors that influenced the way science curriculum innovations were implemented in Scotland.

In accordance with Gross et al. (1971), Brown and McIntyre found that the issue of clarity of the innovation was crucial to secure teacher implementation. They say: '...if the concept has not been clarified, the teachers may simply ignore it and make no attempt to implement the new ideas' (p. 117). They attributed the lack of clarity (again in accordance with Gross' findings) to an assumption made by the initiators of the innovation. They assumed that 'professionally competent teachers, given the general ideas, would be able to develop appropriate procedures for themselves' (p. 129).

Brown et al. argue that innovations must make sense in terms of teachers' concerns. Teachers do not regard the definition of educational aims and principles as part of their job. They are primarily concerned with issues such as time, resources and classroom management. The authors put forward the view that:

> **'it is entirely rational for teachers ... to give priority to ensuring that they can cope fluently with the practical situations with which they are faced and meet the criteria for which they are accountable (coverage of the syllabus, maintenance of control, pupil safety)' (p. 123).**

They conclude that 'unless the innovative ideas can be translated into these terms, consideration of such ideas remain (for the teacher) ... an empty and irrelevant exercise' and that support in the form of curriculum documents, instructional materials and training must also be designed and delivered in a way that is responsive to the teachers' concerns (p. 123). They suggest that the provision of support has to take account of issues such as the value of classroom autonomy in teachers' professional status and state that more research is needed to determine the types of support teachers would welcome as not conflicting with their autonomy.

Nicholls (1983) found that early innovators were key factors in the successful implementation of innovations. Innovators play an important role in the process of change since their adoption of an innovation causes other teachers to become aware of it and if it proves successful, early skepticism may turn into a recognition of its utility.

Huberman and Miles (1984) carried out a large scale, multisite ethnographic study of twelve major innovations in schools in the USA. They conceptualised the innovation process in a dynamic model. In their model, outcomes are influenced by internal school variables (demographics, prior innovation record, organisational rules and practices and user purposes and assumptions), external variables, nature and level of assistance and characteristics of the innovation. Outcomes specified are: stabilisation of use (the degree of 'settledness' of the new practice in the users' instructional repertoires), percentage of use (the number of users in proportion to the number of eligible users), institutionalisation (the degree to which the innovation is 'built in' to the ordinary structures and procedures of the school), student impact, user capacity change (changes in users' knowledge and skills beyond the immediate requirements of the innovation) and job mobility.

The authors present a great number of conclusions in the form of causal networks, of which only some, of particular relevance to this study, are presented here.

Nearly half of the teachers adopted the innovation because of administrative pressure. The rest often invoked motives of professional growth such as establishing contact with specialists or learning new skills that could help them in general in their teaching. In brief, there was less user interest in innovationspecific benefits than in second order rewards (p. 272). Adoption, the authors note '(rarely) resulted from a perceived problem to which the innovation was seen as a solution' (p. 272).

Another important factor was the quality and quantity of assistance available to the teachers. The authors are categorical in saying :

> **'Largescale ... innovations lived or died by the amount or quality of assistance that their users received once the change process was underway ... administrative pressure by itself ... got nowhere' (p.273).**

Referring to the innovations that failed, the authors found as a common pattern the absence of 'a local advocate sufficiently committed ' (p. 269) and the low level of user commitment. User commitment, the authors argue, 'gets built through practice mastery leading to practice change, through assistance and a strong administrative presence' (p. 269).

Fullan (1982, 1982b, 1985) has become one of the most widely quoted authors in the field of planned educational change. He sees three broad phases to the change process: adoption, implementation and institutionalisation (1982, p. 39).

In his extensive review of related research, Fullan found, that not always, not even usually, are educational changes adopted because they meet a given need better than existing practices (1982, p.41). Schools, in his view, favour the adoption of innovations that are bureaucratically safe (add resources without requiring behavioural change), ease external pressure and lead to the approval of peers. In other words, schools tend voluntarily to adopt innovations which promote their image as uptodate and efficient. It is relatively easy for schools to adopt complex innovations. Complications arise when they try to implement them (1982, p. 50). Fullan cites the findings of a survey carried out by Nelson and Sieber in 679 urban schools in the USA who found that the publicity value of innovations and faddism were major reasons for adoption.

The complexity of implementation, says Fullan, is due to its multidimensionality. He identifies three major dimensions of change: teaching materials, teaching strategies and teaching beliefs, and warns that implementation must occur in all dimensions for the desired outcomes to be achieved. According to Fullan:

> **'Implementation involves the development of new teaching approaches and examination of underlying beliefs ... 'most (change) efforts ... have concentrated on 'paper' changes ... (overlooking) people (behaviour, beliefs, skills) in favour of things (regulations, materials) and this is essentially why it fails more times than not ... people are much more difficult to deal with than things (but) also much more necessary for success' (1982b, p. 249).**

Speaking on the reluctance of teachers to implement many innovations Fullan says:

> **'Teachers' reasons to reject many innovations are often every bit as rational as those of the advocates ... innovations are frequently "rationally" advocated from the point of view of what is rational to the promoter, not the teachers. Sometimes innovations ... turn out not to be translatable into practice with the resources at the disposal of the teachers...or assume conditions different from those faced by teachers. Other proposals are not clear about the procedural content. Others fail to acknowledge the personal costs it will take (for the teachers) to develop the new practices ... Implementation will occur to the extent that each and every teacher has the opportunity to work out the meaning of the implementation in practice' (1982b, p. 257).**

He concludes teachers should not be expected to implement an innovation unneeded, unclear or unrealistic in time, resource or support.

Fullan proposed a list of twelve factors as critical for implementation (see table 2.1).

Table 2.1
Factors affecting implementation

Characteristics of the innovation
- Need for change
- Clarity, complexity of the change
- The quality and availability of materials

Characteristics at the Local Education Authority level
- History of innovation attempts
- Expectations and training for principals
- Teacher input and technical assistance for teachers
- Board and community support
- Time line and monitoring
- Overload

Characteristics at the school level
- The principal's actions
- Teacher/teacher relations and actions

Factors external to the school system
- Role of the Government Educational Authorities

Factors 1, 2 and 3 have been discussed above (Gross et al., 1971, Charters et al., 1973, Nicholls, 1979). Fullan warns against 'false clarity' where an innovation is interpreted in an oversimplified way. For example, an approved textbook may come to embody the innovation itself, failing to incorporate some of its significant features. Another problem is 'superficial clarity'. In this situation an innovation may be dismissed on the grounds that 'we are already doing that' but again looking only at part of the innovation (usually materials) and ignoring changes in strategies and beliefs. Clarity, with all its bearing on implementation, is downplayed by the author as an important factor in the adoption phase. As he puts it: 'many educational changes have been adopted without any clear notion as to their specific meaning' (Fullan, 1982, p.43).

The history of previous attempts to innovate was shown first by Sarason (1971) to be of importance and relatively independent from the innovation because it is based on people's experience.

Factors 5 to 9 refer to the issues of support given to principals, teacher feedback, support and training given to teachers, parent support, monitoring systems and how teachers cope with an increase in their workload caused by the innovation. In terms of teacher training and support Sarason argues that '... it is not the amount of inservice training but the nature of it that counts' and recommends 'a taskfocused continuous professional development combining a variety of learning formats and a variety of trainers' (p. 76).

At the school level (factors 10 and 11) an active role of the principal has been shown as essential in 'virtually every line of inquiry' (1985, p. 76) in influencing the extent of implementation.

He argues that teachers' colleagues are a preferred source of knowledge and skill and therefore the lack of time to interact with each other is a prime obstacle to implementation.

2.4. **Studies of computer uptake by teachers**

Research on the use of computers in schools has boomed in the last decade. This section focuses on the most recent, relevant research.

Part of the research reviewed in this section is based on primary schools. Even though this study looks at secondary schools, it was nevertheless considered relevant since preliminary evidence seems to suggest (Fullan, 1985) that secondary level issues are closely related to primary level ones. A special section on CAL issues on Third World countries is presented later in this chapter.

Anderson et al. (1979) carried out one of the earliest investigations of computer uptake by teachers. It was designed to assess both technological and sociocultural factors influencing computer use. The investigation was based on a postal survey of more than 3500 secondary teachers in the USA. Anderson et al. refer to two competing theories as relevant for explaining teachers' adoption decisions. One theory is that of technological determinism (Ellul, 1964). In this theory, the implicit assumption is that 'as long as the facilities are available and teachers are trained in computing, adoption ... is inevitable' (p. 229).

The other is the theory of cultural and social determinism (Parsons, 1966). The sociocultural approach, according to Anderson et al., does not deny the importance of technological factors such as level of resource availability, but suggests that factors such as attitudes and roles must be taken into account. They point out that most sociologists of change take an eclectic position postulating that the decision to adopt a new technology is a function of values and norms as well as social structures e.g. organisational characteristics, communication structures and occupational features (Rogers and Shoemaker, 1971).

In assessing the sociocultural factors they divide what they consider the potential determinants into three categories: attributes of teachers (attitude towards computers, level of training, teaching experience, subject, gender), features of the work setting (grade level taught, range of levels taught, size of the school, resource availability) and community characteristics (size of the population, distance from large urban areas).

Anderson et al. found a large number of 'drop outs', i.e. teachers that had discontinued computer use. The most highly significant predictors of computer use were: a) resource availability, b) attitude towards instructional computing, c) training, d) confidence and e) teaching experience. They admit however, that regression analysis does not indicate whether adoption is affecting attitude or vice versa. They did not find any effect of gender on computer use. Men showed a more positive to computers than women but not a higher rate of computer use. The authors concluded on the basis of their results:

> **'The extreme positions of technological determinism and sociocultural determinism are inadequate. While numerous social factors were found to operate in the process of teacher acceptance of instructional technology, slightly over half of the explained variance in adoption is accounted for by technological factors (amount and availability of computer resources)' (p. 247).**

The sociocultural issues underlying the process of computer use in schools are also discussed by **Blumenfeld** et al. (1979). They argue that 'patterns of beliefs and behaviour that make up cultural systems can act as barriers to technological change' (p. 187). Conventional teaching methods, they say, provide independence, selfsufficiency and autonomy for the teacher and patterns of behaviour that have paid off in the past will be maintained until expectations of better payoffs have been envisioned.

To study computer use by teachers they use a model proposed by Niehoff (1966). In Niehoff' s model, two forces act on the process of innovation, the actions of the innovator and the reactions of the recipients. The characteristics of the first comprise: a) the methods of communication used, b) the type of participation obtained from the recipients and c) how the innovation is adapted to existing cultural patterns.

Characteristics of the recipient include: a) the need the recipients have for the innovation, b) the practical benefits the recipients perceive from the innovation and c) the participation of the recipients' traditional leaders in the innovation process.

Blumenfeld et al. argue that participation of the recipients in the planning of the innovation is critical in determining takeup by the recipients. This seems to contradict evidence found by Fullan (1982, 1985).

Blumenfeld et al. point to the issue of centralisation of computers in a separate room as a barrier to innovation since 'sending the student off to some other part of the building is perceived (by the teacher) as losing control of the student and his instruction' (p. 189). The fact is that classroombased instruction is an established pattern that cannot be expected to be modified in the short term. They state however, that 'utilisation of traditional practices should not be viewed as an undesirable compromise ... after the computer (is used) by adapting established practices, more effective and original utilisation can be attempted' (p.189).

In discussing the costreward structure of using computers the authors argue that 'the perceived benefits (of using computers for teaching) must be weighed against the risk of disrupting survival techniques' (p. 191). Finally, Blumenfeld emphasises the role of local leadership in innovation implementation, a finding supported by a number of other authors (see Fullan 1982, 1985 and Huberman and Miles, 1984).

An influential research agenda was proposed in 1983 by **Sheingold** et al. on the basis of a largescale investigation of three U.S. school districts. Their study considered four levels or contexts within which an educational innovation takes place: community, school system, individual school and classroom. A casestudy methodology was employed. They proposed six main issues as an agenda for future research: a) access to computers, b) new roles in response to computers, c) integration of computers into classrooms and curricula, d) quantity and quality of software, e) preparation of teachers for using computers and f) effects and outcomes of the instructional use of computers.

One of their main findings, confirmed in several studies in the following years (see Bliss et al. (1986), Chandra et al. (1988), Somekh (1989), Plomp (1990) among others) was that:

> **'... teachers felt inadequately prepared to use computers in their classrooms. They felt this despite the fact that in both sites there were inservice courses, opportunities for study in nearby colleges and universities, and helpful teachers or computer advisors ... Most teachers did not seem to want more or different courses. What they wanted most was more *time* to use the machines, to develop their expertise, and to review available software and plan for its use in the classroom' (p. 429, italics added).**

Referring to the crucial issue of teacher time investment, Sheingold et al. suggest even though they fail to include it as another point of their research agenda that it is important to examine the costreward structure for such an investment. They add that 'in the absence of institutional incentives ... the intrinsic factors which account for teachers' interest and commitment deserve attention' (p. 430).

Larry Cuban (1986), carried out a study of teacher use of machines since 1920 that gives a broader technological and historical perspective on the problems associated with the use

of machines in teaching. His aim was to determine 'to what degree did teachers use a series of technologies ... aimed at making teaching and learning more productive' (p. 217). In criticising part of the literature on computer uses in education, he points out that no study of teacher use of technology can be carried out without an acute sensitivity to the conditions under which teachers work in schools.

Cuban reached two main conclusions: firstly, those technologies went through a cycle that he describes as 'exhilaration scientific credibility disappointment blame (the teachers for blocking the advance of the technology and classroom improvement)'. Secondly, that teacher use of these technologies seldom exceeded a fraction of the school week on the part of even the most committed users. He estimates that teacher use of computers 'will be tailored to fit the teachers' perspective and the tight contours of schools and classroom settings' (p. 218). He adds:

> **'Within the ways the schools are currently structured (the graded school, self containing classroom, a segmented curriculum ...) teachers teach the way they do simply to survive the impossibilities inherent in the workplace. The choices teachers face are to continue to do the best they can with what they have, or to risk what seemingly works but trying to meet ... expectations that are out of sync with organisational realities...It is not (lack of) funds that spells success of failure for (educational innovations) it is the high personal costs that teachers have to pay when they try to implement different ways of teaching within current organisational structures and beliefs' (p. 221).**

Bliss, Chandra and Cox published findings based on an indepth case study of the implementation of computers in a U.K. secondary school (Bliss, Chandra and Cox**,** 1986; Chandra, 1986; Bliss and Cox, 1988). Their research looked at the factors that influence the implementation of microcomputer use in a school at the teacher, department and school levels. At the level of the teacher, teachers' experiences and views about computers and the use of computers in teaching were analysed; at the level of the department, heads of departments' computer policies were studied; and at the level of the school, distribution of resources and facilities were examined.

Using Lundgrens' Frame Factor Theory (1971), they looked at the teaching process as determined by formal rules (i.e. strategies of the decision makers), organisational constraints and solutions, goals (i.e. the curriculum) and attitudes, views and opinions of the teachers. The decision makers' strategies and leadership styles were classified using White and Lippitts' (1968) set of categories, i.e. autocratic, democratic and laissezfaire. Teachers' perceptions of the use of computers were represented as driving or opposing forces using ideas of Lewin's Force Field representations (1952).

Their research established the importance of the interplay between the teachers' attitudes and the organisational constraints of the school. As they explain: '(organisational) constraints provide the boundaries wherein teachers develop their ideas or change their attitudes about the use of computers in teaching' (p. 61). They describe seven different 'types' of teachers: a) favourable, b) critical, c) worried, d) unfavourable, e) antagonistic, f) indifferent and g) uninitiated. The existence of favourable, 'keen teachers' who make themselves available, at their own personal time cost, to stimulate and help others, was found to be a decisive factor in at least one of the school's departments. No clear pattern was identified in the perceptions of male and female teachers.

The authors found a number of factors influencing uptake. Changes to the existing role of the teachers were an important issue. Bliss et al. (1986) categorised those changes into three broad areas: changes in themselves being an authority (i.e. being confident), changes in themselves as an authority (i.e. being competent) and changes in their teaching situation.

Teachers showed anxieties and feelings of inadequacy because of the need to master a new and complex area of technology, and about the amount of commitment required in terms of time and energy to feel confident in this area. Some of the teachers perceived themselves, by their personality or abilities, as not being able to acquire this new expertise. They saw themselves as not 'logical or mathematical', 'too old' or 'too set in their ways' for this new educational technology (Chandra, 1986, p. 305).

Teachers' attitudes, according to Chandra (1986, p.289), might be considered all important in determining the uptake of computers and this may be the case in the short term. However it would seem that for the long term, additional positive forces such as 'strong leadership' are more important determinants. Autocratic leadership was effective in initial stages but a laissezfaire style served needs when teachers perceived those needs.

Organisational constraints were seen by teachers as barriers, which many of them felt could not be removed individually, but which needed cooperation from staff 'above' them. Among organisational constraints, teachers mentioned lack of training, lack of hardware and software resources, inappropriate school time tabling, lack of time and class size.

Ellis (1986) worked with teachers in an elementary school in Sheffield and later tested his results in four other schools. He found three group of factors closely associated with the use of computers for teaching: the management of computing resources throughout the school, inservice teacher training and the involvement of parents. Computers, he asserts, should be easily accessible and transportable and teachers should be kept continuously informed of all available resources.

Olson and Easton (1986) worked with eight Ontario schools to investigate how teachers were using computers in the classroom. Discussing computer use as an innovation process, they point out the different nature of procedures, such as drill and practice, that 'do not appear to strain existing routines too far', and others such as LOGO that 'is not seen as fitting in with familiar teaching routines' (p. 32). They call the former 'routine' procedures and the latter 'novel' ones and go on to argue that 'novelties' have more complex and longer implementation processes because 'teachers cannot be expected to suddenly abandon their practice in favour of teaching activities quite remote from what they are used to' (p. 32). This approach seems to coincide closely with Ponder and Doyle's (1977) discussion of 'congruence' as a crucial characteristic of the innovation.

Olson et al. studied the costreward structure of teachers' computer use. For this, they used a distinction developed by Harre (1979) between 'instrumental' behaviour (which is directed at producing student learning) and 'expressive' behaviour (which is directed at creating respect for the teacher and the subject). This distinction, the authors say, is necessary to understand teachers' responses to innovations. They mention, as an example, the use of LOGO by teachers who do not find it particularly useful or relevant but in this way hope to be seen as appreciating the social needs of the students (p. 35). They argue that 'this analysis of the symbolic elements of teaching is important because it is part of coming to understand what an innovation means in practice (for the teacher)' (p. 35).

In probing teachers' views they found that one of their major concerns was based on the challenge to the well established ground rules for providing guidance and maintaining discipline in classrooms. The management of episodes where students required individual support while working with the computer, was a 'novel' procedure. Teachers spoke about a wide range of possible causes for students' delays (such as unclear error messages and software or machine breakdowns) and how these situations affected class planning.

The authors listed a number of barriers to implementation: a) insufficient appropriate software, b) increased workload to use computers in the classroom, c) insufficient access to hardware, d) technical problems with the computers and e) slow replacement of consumables.

Eraut (1988) studied the managerial aspects of the use of computers in U.K. secondary schools. He found substantial variations in teacher uptake. He suggests an interpretation based on the presence in the school of 'cosmopolitan' teachers. He describes them as teachers who seek out opportunities for change, enjoy risktaking and are willing to work with new methods of learning.

Heywood and Norman (1988) used attribution theory (Kelly, 1983) to study the concerns of a group of 28 teachers in four London primary schools about the use of computers. They concluded that teachers' concerns were related to a lack of confidence and competence in their own ability to use computers. They stress the difference between confidence, as a formative unstable state, and competence as a summative stable state while showing their close relationship. In further discussing the problem of lack of confidence they argue that the concern is not based on a lack of confidence in the capability of technology to allow the teacher to implement a particular teaching strategy but rather on a lack of confidence in the teacher's own ability to implement it.

They found that nonusers did not state an increase in their workload, machine breakdowns or access to the computers as significant reasons for nonuse. Taking recourse to innovation theory, Heywood and Norman point to the absence of curricular strategies to support teachers as a major factor in determining uptake. Teachers, the authors say, lack competence in perceiving a place for computers within the existing curriculum and implementation will not take place until they find such a place.

The PALM project (**Somekh**, 1989) attempts to overcome barriers to IT innovation through action research. The project's approach is to 'invite teachers to make judgments based on evidence', thus stressing the lack of evidence of the real value of computer use as a major factor in teachers' reluctance to face the challenge of using the new technology.

The PALM project identifies barriers at the personal and institutional level. At the personal level they list: a) a teacher's selfimage may conflict with the innovation (e.g. being a 'nontechnology' person, b) a teacher's concept of teaching may put little value on change as opposed to expertise (this is usually associated with the belief that learning is the responsibility of the teacher rather than the student), c) an anxiety felt by the teacher, based on a feeling of incompetence (which they may feel ashamed to admit to the students) and d) teachers often experience frustration at technological failures that jeopardise a class session.

At the institutional level they found: a) insufficient access to the computers for the teacher out of class time which impede their own personal process of making sense of the innovation, b) insufficient teacher time to reflect on the use of the technology and engage in professional dialogue and c) logistical barriers based on complicated rules for the provision of consumables such as printer paper or diskettes, for instance.

McCoy and Haggard (1989) carried out a surveybased study of the use of computers for instruction in 26 U.S. schools involving 112 teachers. They found that only 7% used computers 'intensely', 32% 'regularly', 36% 'occasionally' and 25% did not use them. To examine the determinants of computer use, this variable (degree of IT use) was regressed on: gender, level taught, years of teaching experience, confidence in personal ability to use computers and perception of the value of computers in education. Their results showed that teaching experience was significant in predicting computer use while the other variables were not important.

Shultz et al. (1989) studied the use of computers by secondary school mathematics teachers in a midwest urban district in the USA. Their sample of 200 teachers was randomly selected from a total population of 325 mathematics teachers.

Some of their findings supported conclusions drawn from previous research. Approximately 90% of the teachers felt that computers were very useful for teaching (p. 8). However less than 25% of them were regular computer users. Teachers felt that the school and the district were not providing guidelines for using computers with specific curriculum topics. They also called for more hardware and software relevant to the curriculum. Some teachers felt that using computers would reduce the already scarce class time available to cover the present curriculum. Nonusers mentioned the issue of computer room scheduling and having to move to the computer room as a major reason for not using them.

Gillman (1989) carried out a metasynthesis on CAL research studies about the adoption and implementation of computers in schools. Citing work by Adkisson (1985) he says:

> **'...(when compared with principals or governors) teachers, as a group, are the most conservative with respect to the acceptance of microcomputers ... as practitioners, teachers have already developed adequate solutions to their pedagogical problems ... many teachers are reluctant to invest additional time and energy to incorporate a new technology into their methodology' (p. 3).**

Gillman cites findings of Schmizzi (1983) and Rogers et al. (1985) who stress the role of the principal:

> **'whereas individual teachers often act as innovation initiators, schools principals must take responsibility ... because as leaders and managers, only they are able to manipulate the incentives to facilitate adoption and implementation ... also the establishment of new facilities and support services represents an important change in the school's organisational structure ... and adequate compensation and incentives (for the teachers) are evidently not being tendered' (p. 5).**

Referring to teachers, Gillman argues that innovators require 'unpressured exposure to new ideas along with adequate time to assimilate, experiment and practice new procedures' (Winner, 1983). Concerning teacher education, the most important finding, according to Gillman, was the fact there is no difference in profiles of concerns between teachers who have received inbuilding, informal computer training and those who did not receive such training (Wimmer, 1984). The implication being, that unless such training is geared to the specific needs of the individual teachers involved, there will be little or no impact on their competency to use the technology.

Teachers do not use computers, says Gillman, on the basis of Johnson's findings (1986), because of 'lack of access, lack of funding, lack of participation in the decision making process and lack of time for learning'.

Blease and Cohen (1990) conducted an ethnographic study of the introduction of computers in a primary school in the East Midlands. They assert that the fundamental change required to use computers for teaching is to teachers' existing conception of the teachinglearning process and of their pedagogic role within it (p. 29). This, they argue, explains why some teachers use the new technology more readily than others.

They found, at the beginning of the study, that the teachers' 'lack of confidence in themselves as computer users' (p. 33) was the main factor in their reluctance to consider computers as part of their professional repertoire. A major part of the confidence problem of teachers was related to the fact that they felt less competent than some students in using computers.

Rhodes and Cox (1990) studied the use of computers in a group of twelve London primary schools from 1985 to 1989, with particular emphasis on the influence of teacher training upon uptake. They found the development of computer use in the schools to be influenced by four major factors: the attitude of the headteacher, timetabling arrangements, teachers' attitudes to the technology and the fabric of the school building.

Teachers' acceptance of the value of computers for teaching did not lead, in their study, to regular use. Teachers mentioned several obstacles to the use of computers: the increase in workload they believed would result, the lack of good quality software, and physical difficulties such as finding the right plugs and reorganising the classroom for cooperative learning. Computer use was much higher among male than female teachers. The uptake was highest in schools where the headteacher had actively promoted the use of computers and where the use of computers had been formally timetabled. Computer use was not found to affect teaching style.

Teacher training was a major part of Rhodes et al.'s study. They found that short INSET courses were not very effective in promoting uptake and that teachers need an ongoing training programme. A major problem was the assumption that, with courses concentrating up to 97% of the time on technical aspects, teachers would be able to use the resource effectively in the classroom having spent only 3% of the time discussing educational applications. Even teachers who used computers regularly felt the need for additional training.

Plomp, Pelgrum and Steerneman (1990) applied a combined case studysurvey methodology to investigate the use of computers in 28 Dutch junior secondary schools. They found that:

> **'In the majority of the schools computer developments even when they have lasted for several years are very modest ... and one cannot speak of any real integration of computers in the school curriculum ... computer use has a low frequency and is applied for a small percentage of the subject matter'.**

In a subsequent stage of the study Plomp et al. looked for an explanation for these results and tried to identify 'which factors determine this rather disappointing picture' (p. 164).

They identified a number of factors as barriers to a more integrated use of computers in teaching: a) the lack of a clear school policy on what the institution wants to achieve with the new technology and how it should be achieved, b) lack of hardware, software and curricular materials, c) lack of time for the teachers to get acquainted with the new technology and d) lack of a continuous process of staff development.

Teachers who used computers regularly rarely mentioned a specific educational need as a justification; in most cases they referred to more general aims such as to increase motivation, to try new technologies or to meet future needs of society. Principals asked about the reasons for introducing computers in the school also rarely made reference to specific educational needs and mentioned mainly rivalry with other schools and interest in implementing new teaching strategies.

Plomp et al. conclude by speculating that 'different educational actors seem to be waiting for each other. Schools wait for teachers to start activities; teachers, however, wait for a policy at school level. Both schools and teachers are waiting for a policy at national level ... and innovation plans at the national and school level pay little attention to factors which are known to influence the implementation of an innovation' (p. 169).

2.5. **Research on the use of computers in third world schools**

Little has been published on the introduction of computers into schools in developing countries. Furthermore, most available reports are descriptive in nature with little in the way of analytical content and researchbased results (Hawkridge, 1990, p. viii).

Harper (1985) published a report on the special conditions of computer use in schools in developing countries. A list of common problems for introducing Computer Assisted Learning (CAL) in developing countries are listed in this report: lack of stable political support, lack of uptodate centralised information on the educational system, lack of follow up planning, technical maintenance, lack of research, lack of software geared towards the local curriculum, lack of software in the local language, infrastructure problems (e.g. power blackouts) and lack of space in overcrowded schools.

A comprehensive report on computer use in schools in developing countries was recently published by **Hawkridge** et al. (1990). Working with local teachers as interviewers, Hawkridge's team gathered data on the use of computers in education from more than ten different developing countries, mostly from Asia and Africa. The authors argue that computer education policies should exist, based on clear rationales:

> **'Computers arrive anyway through donations (creating pressure on schools). This sort of pressure can be very damaging in developing countries. Without a policy computers arrive in uncoordinated fashion. Teachers are not trained. Software is scarce. Hardware is incompatible. Spares, repairs and maintenance hardly exist.' (p. 25).**

Hawkridge et al. classify the rationales behind computer education in four categories: Social (all students should be aware of the social implications of using computers), Vocational (students should be prepared for future jobs involving computers), Pedagogical (CAL should be used when appropriate to improve teaching and learning) and Catalytic (computers foster change in teaching styles). The rationale selected by each specific school has to be communicated to parents and staff by the principal. Parents were found to accept readily the Social rationale and to a certain extent the Vocational rationale. The Pedagogical and Catalytic rationales failed in many cases to gain parents' support.

Hawkridge et al. found that school principals had strong influence in the process of adoption of computers. Some of the principals, they say, place low value on computer education because the course is not part of the Ministry's formal examinations and can distract students from university entrance examinations. Principals perceived their own computer training as insufficient. Many principals were not ready to answer questions on the use of computers in their own school without the presence of the computer coordinator.

Discussing the process of adoption of the computer innovation in schools, Hawkridge et al. found that 'diffusion of the innovation of using computers is at an early stage in schools in the Third World, and cannot be said to have reached 'takeoff' (the stage when roughly 25% of potential users have adopted the innovation)' (p. 28).

Citing Eraut' s (1988) research on 'cosmopolitan' teachers, Hawkridge et al. speculate that in industrial countries, the 'early adopters' (Havelock, 1971) cooperate with innovators because they anticipate changes in the curriculum. It may not be easy to exploit this effect in developing countries.

> **'(In developing countries) curriculum planning is likely to be centralised to a degree which inhibits teachers from taking personal risks in the sense of experimenting**

> **with a new approach ... If the general expectation among teachers is for all change to be generated from the centre, then (training is likely to be perceived) as designed to tell them what they are supposed to do' (p. 83).**

A key difference between teachers who adopt the innovation and the ones who do not is, according to Hawkridge:

> **'The degree of mastery they feel they have over the technology. (Adopters) feel in control, (the others) feel inadequate ... (such feelings) can be overcome if (teachers) are given the ... time to master the computers in private ... Many teachers still think that it is wrong ever to make a mistake in front of their students ... (due to the low number of computers) teachers (in developing countries) may find it harder than their peers in industrial countries to become confident enough ...' (p. 83).**

Most teachers expressed a need for additional computer training. A UNESCO (1983) report on a Jamaican project on the use of educational technology in secondary schools states:

> **'...the lack of (training) means that attempts at change ... are not likely to be properly applied by the teachers who are not prepared for such changes and who see them more as a threat to their pedagogical working habits which have proven satisfying for themselves' (p. 89).**

Hawkridge et al. found widespread opposition to change among teachers. Objections were related to the use of scarce space and airconditioning and the impact on the procurement budgets that meant less scientific apparatus could be bought because of the money spent on computers, the pressure to finish the syllabus and the 'nonexamination' status of the computer studies.

According to Hawkridge et al., teachers in developing countries have even less time to get acquainted with computers than their peers from industrialised countries. Most teachers have to supplement their salaries by doing additional extraschool work. They conclude by saying that 'when teachers reject innovations this may reflect a general alienation from teaching' (p. 274).

Hawkridge et al. found the views of many of the teachers to be 'similar to those of industrial countries' (p. 275). Teachers expressed positive opinions about the motivation potential of the computers, criticised the quality of educational software and rejected much of it on cultural grounds. Schools in the Third World are hampered, according to Hawkridge, by a 'local courseware famine' (p. 281).

Teachers were worried about whether using computers in some cases was serious learning or encouraging students to play games. They complained about organisational and technical difficulties in using computers, especially with large classes. Many thought that having to take the students to a special computer room caused disruption. Teachers' fears of students damaging the computers inhibited use in many cases.

Cultural factors were found to cause some teachers to experience difficulties in temporarily 'handing over' classroom control to the computers. JenningsWray and Wellington (1985) reported similar findings in their study of educational technology utilisation in Jamaica:

> **'Most Jamaican teachers do not feel they are *teaching* unless they are seen to be in control of the class and dominating it with 'chalk and talk' ... as a result teachers tend to adapt the use of instructional materials to suit their own (teaching styles)' (p. 179).**

2.6. **Summary**

This literature review attempts to portray the main developments in the recent study of planned educational change with special emphasis on the introduction of computers in schools. The studies reviewed examine the nature of the innovation itself, the attributes of the teacher as a potential user of the innovation and the context in which the innovation is to be implemented.

Most of the research on change in schools before the 1970s focused on technical aspects of innovations. A majority of the studies of that period concentrated on the resistance of individual teachers, which was perceived as the main factor in the process of change. Overcoming this resistance was perceived as dependent on providing technological access and showing the technical advantages of the proposed innovation (Gross et al., 1971; Fullan, 1985).

In the last two decades a number of increasingly convergent insights into the process of change have developed. The need to study the teacher in the context of the social organisation of the school, rather than as an isolated agent, has been emphasised. Teachers' dependency on their formal leaders (e.g. principals and heads of departments) to overcome some categories of constraints imposed by the very structure of schools have been discussed by authors such as Gross (1971), Fullan (1982), Huberman and Miles (1984) and Chandra (1986).

The previous emphasis on the technical characteristics of the proposed innovation has evolved into a more contextsensitive approach focusing on how the proposed innovation fits with the teachers' working conditions and value systems. Authors such as Ponder and Doyle (1977), Brown and McIntyre (1982) and Cuban (1986) found that the clarity, congruence and costs of implementing an innovation are crucial to uptake.

This brief review indicates that few studies have been carried out on the use of computers by teachers in Third World schools and that a great deal less is known about the introduction of computers in highly centralised educational systems.

The findings of review are summarised in table 2.2

Table 2.2
Summary of the review of the literature
Factors affecting the use of computers by teachers

Characteristics of the innovation
- Perceived need for the innovation
- Reliability
- Clarity
- Congruence
- Cost

Characteristics of the teacher
- Personal characteristics (e.g. gender, age, experience)
- Selfimage
- Views on teaching and on computers in general
- Views on the value of computers in education
- Views on the impact of using computers in their work
- Confidence and competence for using computers
- Previous experience in using computers

Characteristics of the institutions
- History of innovative attempts
- Teacher participation
- Computer INSET
- Lack of time for reflection, practice and interaction
- Aims of the IT school policy
- Support structures
- School internal communications and information systems
- Principals and Heads of Departments' actions
- IT resources management (e.g. time tabling, logistics)
- Level of provision of hardware and software resources

External characteristics
- Parent and community support
- Training of principals

CHAPTER 3

Research methodology

3.1. **Choice of methodology**

The study is based on a multisite investigation of the use of computers for teaching in three secondary schools in Uruguay.

A qualitative approach was used as the main research methodology. This qualitative strategy was combined with a preliminary quantitative survey designed to help answer the first set of research questions (1a and 1b).

A qualitative approach was selected based on the nature of the main research questions (2a and 2b) which enquire into the complex field of teachers' reactions to innovations. Qualitative methods are recommended when the phenomena to be studied are complex human and organisational interactions and it is impossible to identify all the important variables ahead of time (Skrtic, 1985). As Hopkins et al. (1989) point out: 'qualitative methods are especially suited ... when the *raison d'etre* of the enquiry is understanding rather than proof'.

A report on IT in Education for the Social Science Research Council states that 'Quantitative ... techniques seem unlikely to illuminate the plethora of personal and social interactions involved (in the adoption of computers by teachers)' (Sage and Smith, 1983, 5.13.1).

3.2. **Limitations of the study**

Research projects always have limitations due to factors such as limited time and resources, restrictions in access to objects of study and willingness of participants to cooperate.

This study was carried out over only one academic year, a strong limitation in educational research where opportunities for certain actions may arise only once a year (e.g. in Uruguay INSET courses are carried out only once a year).

A limitation of the scope of the study is that most of the evidence is based on information gathered from teachers. It is clear to the author that a number of other 'stake holders' can influence the use of IT in schools, e.g. parents, school governors and especially the students themselves.

Other limitations are set by the study's restriction to general (nonvocational), private, urban secondary schools and by the concentration on National Curriculum subjects, which excludes, for example, Computer Studies.

The study, however, even within these limitations, sheds light on some complex issues related to computer use by teachers in schools in developing countries, that have scarcely been researched.

3.3. **Research stages**

A comprehensive **review of the relevant literature** was carried out between October and midDecember 1990. The literature review included some of the main theories of innovation, studies on the implementation of innovations in schools, research on computer uptake by teachers and computer developments in schools in developing countries.

Preliminary field work was carried out over four weeks in December 1990, when the author visited the 3 selected schools. Unstructured interviews were carried out with each school's director and computer coordinator and all available relevant documentation (e.g. school IT policy statements, internal evaluations) was requested. Data was gathered mainly on the history and aims of the introduction of IT into the schools, the current level of provision of hardware and software and the nature of IT use in the school.

Field work was carried out in the three schools during seven weeks from midMarch 1991. MidMarch was selected for the resumption of field work since teachers are on summer holiday from January to the beginning of March. All meetings and interviews had been coordinated previously from England in order to optimise use of the researcher's time during this second visit.

Data collection was conducted in two stages. In **stage 1**, a questionnaire was administered to all National Curriculum subjects' teachers of each school. The objectives were to establish the main characteristics of these teachers and obtain a broad picture of the main patterns of IT use in the schools.

In **stage 2**, a sample of Core Curriculum subject teachers was interviewed. In these interviews, teachers were encouraged to develop their own personal perspectives concerning the use of computers in teaching.

The stage 1 questionnaire and the stage 2 interview schedules were designed and piloted in England in February 1991 and in Uruguay in March 1991.

Analysis of the data was carried out between May and August 1991.

3.4. **Selection of the schools**

A sample of three private secondary schools was selected following a 'purposive' sampling strategy (Chein, 1981). Purposive sampling is appropriate when 'one wants to discover, understand, gain insight, therefore one needs to select a sample from which one can learn the most' (Merriam, 1988, p. 48).

In this study the three schools will be referred to by the fictitious names of Churchill, De Gaulle and Herzl to preserve confidentiality.

Several factors guided the selection of these schools:

A) They were among the first schools to launch IT initiatives in the country and had been active in the field for more than a decade.

B) They had been able to ensure sustained IT investment in hardware, software, teacher training , building costs and external advisors over the full period.

C) Their staff had been relatively stable throughout the development of the IT initiatives, thus ensuring that the informal history of the initiative was still readily accessible through primary sources. This consideration is of particular importance since few written documents and records exist concerning the initiatives.

D) They all function under the regulations of the NEA and as such their curricula and organisational designs follow patterns which are broadly similar to those of most other private schools.

3.5. **Methodological considerations**

This study was carried out in two stages. Stage 1 consisted of a quantitative survey of all National Curriculum teachers in the three schools of the sample. Stage 2 consisted of a qualitative analysis of the factors affecting the use of computers by teachers. A sample of Core Curriculum teachers was interviewed indepth in this stage. In the next sections, the specific objectives and methodologies of the two stages are discussed.

3.6. **Stage 1**

3.6.1. **Stage 1: objectives**

The objectives of the survey carried out in stage 1 were:

A) to help answer the first set of research questions (1a and 1b)

B) to obtain data to inform the selection of teachers to be interviewed in depth in stage 2 (i.e. determine the degree of use and identify the computer users and nonusers)

C) to strengthen the validity of some of the findings of the study through methodological triangulation (Cohen and Manion, 1989, p. 269).

3.6.2. **Stage 1: data collection**

All teachers of National Curriculum subjects in the three schools were asked to complete a questionnaire in stage 1. A total of 91 questionnaires was completed. Five teachers declined to complete the questionnaire or could not be reached. A room next to the staff room was used in each school to administer the questionnaire in private with a single teacher per session. The average time to complete the questionnaire was ten minutes.

Data was collected on a number of teacherrelated variables derived from the review of the literature (i.e. subject taught, gender, attitude to the use of computers for teaching, teaching experience, seniority, personal use of computers, training and perceptions about resource availability). A Likert scale designed by the author was used to measure attitudes and order teachers from ‘less positive to the use of computers in teaching’ to ‘more positive to the use of computers in teaching’. A copy of the questionnaire is enclosed as an appendix.

3.6.3. **Stage 1: data analysis**

Statistical tests are used to assess the importance of differences between means or frequencies. No generalisation to wider populations is warranted since samples are not random but 'incidental' (Guilford and Fruchter, 1978) or 'purposive' (Chein, 1981). However, the noninferential use of statistical tests is recommended by a number of authors (e.g. Winch et al., 1969, Goldstein, 1977 and Backhouse, 1984). According to the latter, 'it is possible to test an hypothesis about a nonrandom sample ... to determine whether a particular difference or association is to be regarded as a large one, given the nature of the data collected' (Backhouse, 1984).

Where parametric tests are used, the normal shape of the variable distribution was previously confirmed. The chi square test requires that fewer than 20% of the cells should have an expected frequency of less than 5 and no cell should have an expected frequency of less than 1 (Siegel, 1956, p. 178). These requirements were checked.

3.6.4. **Stage 1: validity and reliability**

Measures taken to strengthen the validity and reliability of the survey are set out below.

A) The questionnaire was piloted in England with five experienced teachers and piloted again in Uruguay with 26 teachers of a fourth school that had strong similarities with the three schools of the sample (i.e. it was private, large, had introduced computers more than 7 years before and is in the same neighbourhood). As a result of the piloting process several refinements were made to the questionnaire before its administration.

B) The questionnaire was administered by the researcher, a procedure that enabled him to give help when needed (in a nondirective way as Oppenheim (1966, p.36) recommends) and check questionnaires for completeness.

C) Questions were worded avoiding the use of any technical words or expressions that could be unfamiliar to the respondents.

D) Respondents were allowed to complete the questionnaire without time pressure and in privacy.

E) The confidential character of the questionnaire was emphasised to each respondent at the beginning of every administration.

F) It was emphasised to the respondents that there were no 'right' or 'wrong' answers, the focus of the research being the personal perspective of the teacher himself or herself.

G) Negatively worded and positively worded questions were incorporated in the attitude scale to overcome the 'acquiescence' or 'tendency to assent problem' (Oppenheim, 1966, p.117).

H) Two independent judges were asked to assess the construct validity of the attitude scale without telling them its specific purpose. One of the judges was a former Dean of the NEA National Teacher Training College with over thirty years of experience. The other judge was a senior Science teacher who had been involved in several NEA IT projects. Both concluded, with minor remarks that were taken into account, that the attitude scale would be unambiguous and that it would assess teachers' attitudes to the use of computers in teaching.

I) Item analysis was carried out to check unidimensionality. Scores for each of the twenty Likerttype items of the attitude scale were correlated with the total score using Pearson's correlation coefficient. As a result of the item analysis, two questions (questions 8 and 11) were deleted to obtain a higher Cronbach Alpha coefficient. A Cronbach alpha coefficient of 0.8728 was obtained for the 18item scale.

J) The attitude scale was administered to a group of teachers who had voluntarily enrolled in their free time in a feepaying external computer course. These teachers were considered a criterion group (Oppenheim, 1966, p.75) presumed to have positive values with respect to the use of computers in teaching. Attitude scores among the 91 surveyed teachers had a mean value of 70.2 (st. dev.= 8.06) while the scores' mean for the 25 teachers of the criterion group was 77.64. (st. dev.= 5.97). A ttest was used to check the significance of the difference between the means. The difference was found to be highly significant ($t=5.08$, $P<0.001$).

K) Reliability of the attitude instrument was assessed by administrating two halves (Form A and Form B) of the 18items scale, considered equivalent, to the 26 teachers of the fourth school used as a pilot sample. The two administrations were conducted with a delay of 15 days. Each individual who received Form A on the first occasion later received Form B and vice versa. This 'alternateform' reliability assessment method is recommended by authors such as Henerson et al. (1987, p. 148). The reliability coefficient was 0.77.

3.7. **Stage 2**

3.7.1. **Stage 2: objectives**

In this stage, the underlying factors that influence whether teachers use or do not use computers for teaching were investigated through indepth interviewing.

3.7.2 **Stage 2: sampling**

In stage 2, a sample of eighteen teachers were interviewed. The sample was composed of two teachers per Core Curriculum subject (Mathematics, Science, Spanish) per school. It was 'purposefully' selected (Chein, 1981) as to include users (6), nonusers (7) and exusers (5) with the purpose of including the widest possible spectrum of views and experiences (table 5.1 details the interviewed teachers). Exusers are teachers who currently do not use computers but have done so in the past. A list of the teachers selected is included in chapter 5.

The low number of teachers interviewed does not erode the interest of this qualitative research stage. As Merriam states:

> **'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' (1988, p. 77).**

3.7.3. **Stage 2: data collection**

Data collection was based mainly on formal interviews. Interviewing is frequently recommended when there is a need to study a relatively large number of individuals in a short period of time (Taylor and Bogdan, 1984). They 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' (Jackson, 1990).

The purpose of interviewing was not only to listen to the words, but to derive meanings, motivations and conflicts. As Patton puts it:

> **'(We interview people) to find out from them ... those things we cannot directly observe ... feelings, thoughts, intentions, behaviours that took place at some previous point in time...(in order to) allow us to enter into their perspectives ' (Patton, 1980, p. 196).**

Interviews were semistructured. They were carried out in Spanish using an interview schedule, taped with the authorisation of the interviewees and transcribed verbatim. A copy of the interview schedule is appended. Quotations from the interviews were translated by the author into English while trying to preserve the tone used by the respondents, and checked by a qualified translator. The names of the schools and teachers were considered confidential and assurance was given to all respondents that all names used would be fictitious. The purpose of the study was fully explained to every respondent. 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. Merriam's advice to be 'neutral and nonjudgmental' as an interviewer (1988, p. 75) was followed.

3.7.4. **Stage 2: data analysis**

The analysis of the interviews consisted of an attempt to construct interpretive categories and hypotheses to account for the events and processes embedded in the descriptive data. Data was categorised into variables using the method of 'constant comparative analysis' (Strauss, 1987) until all categories were saturated, that is until all additional cases could reasonably fit into the categories having thus emerged. This iterative process helps to describe the phenomenon under study in all its complexity with the assurance that the description is grounded in the field and not in the preconceptions of the researcher.

3.7.5. **Stage 2: validity and reliability**

Qualitative studies are said to be surrounded by a 'climate of distrust' from what some positivistic researchers perceive as a lack of methodological rigour (Fairbrother, 1977). But 'verification techniques are available (in qualitative research)' (Blease and Cohen, 1990) and according to Guba et al. (1981) '(qualitative research is), in regard to demonstrating rigour, not different from any other techniques'.

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). He must present his results to others 'in such a way that they can verify and validate the findings ... for themselves' (Patton, 1982, p. 326).

A) **External validity**

External validity refers to the generalisation of results. A study such as the present one, with its purposefully selected sample, offers no basis for statistical generalisation. Thus generalisation is left to the reader of the study for him or her to decide the extent to which the findings may apply to other situations.

As Walker (1980) puts it: 'It is the reader who has to ask, what is there in this study, that I can apply to my own situation?'. According to Elliot (1990) '(external) validity (of case studies) rests on ... usefulness as projective models for others in exploring their unique situations'. A qualitative study 'persuades rather than convinces, argues rather than demonstrates, is credible rather than certain' (House, 1977, p.6). Cronbach (1971) says:

> **'The ultimate issue is the validity of the interpretation, which only the reader knows for sure, the audiences must assume considerable responsibility (for interpretation)...'.**

B) **Internal validity**

Internal validity 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 observation and gives meaning to it. Useful inferences are the ones that help researchers make a decision related to their questions.

A number of strategies were followed to enhance internal validity:

1) Triangulation of sources of information

In this study, informants' descriptions of events were checked against other informants' descriptions of the same events. Informants' accounts were also compared with written documents and accounts obtained in informal conversations.

Triangulation of sources of information is recommended by most authors in the area of qualitative research. It is '... the major way to detect and correct distortion by comparing an informant's account with accounts given by other informants' Whyte (1982, p.116), '... a technique used ... to corroborate the veracity of an individual account' (Hopkins et al., 1989). According to Patton (1982, p. 232) '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 ...'. Triangulation is said by Cohen et al. (1989, p.277) to be '...at the heart of the intention of the (qualitative researcher) to respond to the multiplicity of perspectives ... and represent fairly these differing and sometimes conflicting viewpoints'.

2) Space triangulation

The study was carried out in three different schools. The multisite nature of the study strengthens its validity by helping to avoid conclusions based on idiosyncratic factors (Miles, 1979).

3) Methodological triangulation

The survey carried out in stage 1 was an independent measure of many of the same phenomena studied in the qualitative phase. The high degree of convergence of a high proportion of the findings strengthens confidence in the results (Cohen and Manion, 1989, p. 275).

4) Respondent validation

The researcher's accounts of events based on interviews and documents were shared with 10 of the 18 respondents to ascertain that his interpretations fairly reflected their viewpoints. Due to the limitations of the study this validation could not be carried out with all 18 interviewees.

This procedure is strongly recommended by authors such as Elliot (1990) who maintains that '...accounts can only be validated by an appeal to the participants..'.

5) 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 desirability of using IT in schools. This is a crucial control when using qualitative methods, where the researcher's entire person is used as the primary instrument of research (Doppert, 1982). The same author stresses:

> **'(It is crucial) to separate the datagathering 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' (Doppert, 1982, p. 43)**

Cohen warns us that

> **'There is always the possibility that an obliging participant will readily confirm the researchers' own speculations, every effort should be made to convey to the participant that one wants to know the truth as he or she sees it...' (Cohen, et al., 1989, p. 250).**

No assumption was therefore made in contacts with teachers about the use of IT. For example, no assumption was made about whether or not there should be computers in the school.

The study distinguishes description from interpretation in all accounts and makes clear all inferences used to reach conclusions.

C) **Reliability**

Reliability refers to whether the results of the present study would be replicated in future studies. Qualitative research is not seeking to establish stable causal laws, rather, it seeks according to Merriam,

> **'(to) explain the world as those in the world interpret it and ... since there are many interpretations of what is happening there is no benchmark by which one can take repeated measures and establish reliability in the traditional sense. Because what is being studied in education is assumed to be in flux, multifaceted and highly contextual, because information gathered is a function of who gives it and how skilled the researcher is at getting it ... achieving reliability in the traditional sense is not only fanciful but impossible' (1988, p. 170).**

As Walker (1980) argues, in qualitative research, we are bypassing, to some extent, the usual problems of reliability by passing responsibility for them on to the audience.

CHAPTER 4

A broad picture of the use of it in the schools

4.1. **Introduction**

In this chapter, the main patterns of IT use by teachers in the three schools of the sample are studied. The findings are used to answer the first set of research questions and inform the next stage of the research which is concerned with the second and third research questions.

Firstly, the schools and their IT initiatives are described using data collected in interviews with the schools' directors and internal school documents obtained during the first field visits in December 1990. This description is kept concise since its only purpose is to give some background about the institutions. Some matters of central interest to the study, such as computer INSET and hardware and software provision, are mentioned only briefly in this section but are further developed later in the chapter.

Secondly, data collected from a teacher survey is used to establish: a) the main characteristics of the teachers who constitute the potential IT user population and b) the degree of computer use by teachers in the three schools of the sample. All teachers of National Curriculum subjects in the three schools were surveyed.

Data was collected on a number of teacherrelated variables derived from the review of the literature (i.e. subject taught, gender, attitude to the use of computers for teaching, teaching experience, seniority, personal use of computers, level of computer training and perceptions of resource availability). The main characteristics of the potential user population are described in relation to these variables. The existence of significant associations between the degree of computer use and the teachers' main characteristics are studied using statistical techniques. When 'significant' is used in this chapter it should be understood as 'statistically significant' unless specified otherwise. Significance figures are presented only when the association was found to be significant. In all other cases only the name of the test utilised is specified.

Data is presented in crosstabulated form in several sections of this chapter. Where tables have only one figure per cell, this figure is the observed frequency. Where tables have two figures per cell, the second figure is the row percentage corresponding to that cell. In addition, most tables display marginal row and column totals and percentages. Science (Physics, Chemistry and Biology) and Maths teachers were studied together in some cases as teachers of 'scientific' subjects.

The quantitative data produced by the survey did not provide enough evidence to understand the complex interaction of factors that influence teacher use or nonuse of computers. However, it shed light on the nature of the relationship between some key variables and helped to strengthen the validity of the study through methodological triangulation (see chapter 3).

4.2. **A brief description of the schools' it initiatives**

4.2.1. **The schools**

The three schools of the sample, namely Churchill, DeGaulle and Herzl, are private institutions teaching at the primary and secondary levels in the framework of the NEA (National Education Authority). Their student populations at the secondary level are: 655 students at the Churchill School, 715 at the DeGaulle School and 412 at the Herzl School.

They are located in affluent neighbourhoods of Montevideo and even though they operate a scholarship scheme for economically disadvantaged students, their student body is generally considered to be mainly from middle and uppermiddle class backgrounds.

The schools are nonprofit institutions, each run by a board of trustees and managed by a director. Uruguayan secondary schools are not structured in subjectspecific departments (unlike, for example, schools in the UK). No formal hierarchy exists among teachers and in particular there is no position equivalent to the Head of Department, with its policymaking responsibilities.

The three schools enjoy a high reputation for innovation in teaching methodologies. They have been in the past among the first to adopt innovations such as 'new mathematics', language teaching laboratories and, more recently, video and computer technology. Their initiatives are closely followed by other private schools and the NEA Inspectorate. To the best of the author's knowledge, these IT initiatives have never been the subject of published research.

4.2.2. **The it initiatives**

Computers were introduced in the three schools more than a decade ago (1973 in the Churchill School, 1979 in the DeGaulle School and 1980 in the Herzl School).

The evolution of the computer initiatives was broadly similar in the three schools. In the first phase, a few microcomputers (two in the Churchill School, three in the DeGaulle School and two in the Herzl School) were introduced with the stated purpose of teaching optional programming courses to secondary level students. Apple machines were used in the DeGaulle and Herzl Schools and Commodores in the Churchill School.

The quantity of computers owned by the schools increased substantially over the years. In December 1990, the Churchill School had 30 IBM PC computers, the DeGaulle School 18 Frenchbuilt Micral computers and the Herzl School 20 Apple IIc computers. Computers are centralised in computer rooms in the three schools.

Computer coordinators manage the use of computers in each school. Their responsibilities include providing advice to teachers, coordinating technical maintenance, teaching computer INSET courses and teaching Computer Studies.

Compulsory Computer Studies courses are taught to all students at the secondary level. In addition, computers are expected to be used for teaching across the curriculum. A 1984 Churchill School internal policy document states:

> **'Teachers of subjects other than Computer Studies should be encouraged to look out for software that may help them with their teaching ... finding suitable software and helping teachers to use it effectively will be one of our priorities ' (cited in Cardozo, 1990).**

Suitable software is scarce. Mr Fili, senior IT coordinator at the DeGaulle School, described the software situation in the following way:

> **'It must be said that there are very few quality programs for secondary education. There is a lot of discussion about the potential of computer assisted learning but this will come about only if the standard of programs improves dramatically'.**

A large amount of subjectspecific software was donated to the DeGaulle School by the French Government in 1986. The DeGaulle School's stock of programs was the largest of the three schools. The Herzl School hired a team of external consultants in 1984 to train a few 'teacherauthors' to develop Maths and Science software for the Apple computers. These 'teacherauthors' one in Physics, one in Maths and one in Biology had a partial release from their teaching assignments to attend courses, design software with external programmers and help their colleagues learn how to use it. As a result, a small number of subjectspecific packages were available. Attempts to acquire or develop software in the Churchill School were unsystematic, based on isolated efforts of teachers and computer coordinators. The Churchill School's stock of software was by far the most limited of the three schools.

Teacher IT training has consisted mainly of optional summer courses about programming and the use of software packages such as databases, spreadsheets and wordprocessors. Courses were, in general, not oriented to specific subjects. This was resented by many teachers who felt courses were in most cases largely irrelevant to their perceived needs and concerns (see Chapter 5 TRAINING). Many teachers who registered for these courses dropped out. IT initiatives had in later phases to struggle against the 'bad reputation' engendered by these courses. Evidence related to teachers' reactions to computer INSET training is presented in chapter 5.

4.3. **A profile of the teachers**

4.3.1. **Introduction**

In this section, the main characteristics of the teachers who constituted the potential computer user population are presented based on a set of variables derived from the literature (subject taught, gender, teaching experience, seniority, degree of personal use of computers, level of IT training and perceived resource availability). Each of the three schools contributed approximately one third of the 91 teachers included in the survey.

The findings of this section are used to help answer research question 1a).

4.3.2. **Gender**

A) **Gender by school**

Almost two thirds (64.8% n=91) of the surveyed teachers were female (see table 4.1) with no significant differences between the schools (chi square).

Table 4.1
Surveyed teachers by school and gender

	MALE	FEMALE	Row Total
CHURCHILL	12	18	30
DEGAULLE	10	20	30
HERZL	10	21	31
Column	32	59	91
Total	35.2	64.8	100.0

B) **Gender by subject**

Female teachers were a majority in all subjects except Maths where 9 out of 13 teachers were male (see table 4.2).

Table 4.2
Surveyed teachers by subject and gender

	MALE	FEMALE	Row Total
Spanish	2	10	12
Science	7	18	25
Maths	9	4	13
Non-core	14	27	41
Column	32	59	91
Total	35.2	64.8	100.0

4.3.3. **Teaching experience and seniority**

A) **Introduction**

In this study, seniority is defined as the number of years working in the school. Teaching experience is defined as the total number of years working as a teacher.

B) **Experience and seniority by school**

As shown in table 4.3, average teaching experience was almost 20 years (19.7) and average seniority almost 10 years (9.9). Churchill School teachers were on average the most experienced (23.7 years) and DeGaulle School showed the longest average seniority (11.7 years).

Table 4.3
Teaching experience and seniority by school

		TEACHING EXPERIENCE		SENIORITY	
		Mean	Std.Desv.	Mean	Std.Desv.
For entire population		19.7	10.0	9.9	6.1
SCHOOL	CHURCHILL	23.7	10.1	7.7	4.8
SCHOOL	DEGAULLE	16.5	9.1	11.7	6.6
SCHOOL	HERZL	18.9	9.7	10.3	6.5

C) **Experience and seniority by subject**

Average teaching experience was significantly lower for Maths and Science teachers (16.1 years) than for teachers of other subjects (22.3 years) (t= 3.01, P<0.003). No such difference was found for teachers' seniority (ttest).

D) **Experience and seniority by gender**

Gender was not found to be associated with experience or seniority (ttest).

4.3.4. **Personal it use**

A) **Introduction**

Personal IT use was defined in this study as the use of computers at home or school for nongame and nonteaching applications such as using wordprocessors to present reports or spreadsheets for grading.

Less than a fifth of the teachers (17.6% n=91) reported using computers for personal applications.

B) **Personal use by school**

There were fewer personal IT users among the Churchill teachers (3 out of 30) than among teachers of DeGaulle (6 out of 30) or Herzl Schools (7 out of 31).

C) **Personal use by subject taught**

The proportion of Science and Maths teachers using computers for personal applications was significantly higher than for teachers of other subjects (12 out 16 personal users were Science and Maths teachers) (chi square= 10.41, P<0.01).

D) Personal use by gender

No significant association was found between gender and personal use (chi square).

E) **Personal use by experience**

Personal users were on average significantly less experienced (14.2 years) than teachers who did not use computers for personal applications (20.9 years) (t= 2.49, P<0.01).

4.3.5. **Level of it training**

A) **Introduction**

Several categories of IT training were defined on the basis of the number of hours of IT training received.

'Highly trained' teachers had received more than 30 hours of training, 'medium trained' teachers between 10 and 30 hours, 'initiated' teachers less than 10 hours and 'untrained' teachers had not received any training. In the following tables, the 'trained' category includes 'highly trained' and 'medium trained' teachers and the 'undertrained' category includes 'initiated' and 'untrained' teachers.

Almost half of the teachers (44% n=91, table 4.4) had received less than 10 hours of training and almost a fifth (19.8% n=91) had not received any IT training at all.

B) **Training by school**

The proportion of *undertrained* teachers was significantly higher in the Churchill School (63.3% n=30) than in the others (chi square= 6.84, P<0.03). However, there was no significant difference in the proportion of *untrained* teachers per school (chi square, table 4.4 below).

This shows a difference in the schools' training provision. While the three institutions provided a minimum amount of training for most teachers, only DeGaulle and Herzl Schools provided further training for a majority of their teachers.

Table 4.4
Teachers trained in IT by school

	UNDER TRAINED	TRAINED	Row
CHURCHILL	19 63.3	11 36.7	30 33.0
DEGAULLE	10 33.3	20 66.7	30 33.0
HERZL	11 35.5	20 64.5	31 34.1
Column	40	51	91
Total	44.0	56.0	100.0

	UN TRAINED	TRAINED or init.	Row INIT.=INITIATED Total
CHURCHILL	5 16.7	25 83.3	30 33.0
DEGAULLE	6 20.0	24 80.0	30 33.0
HERZL	7 22.6	24 77.4	31 34.1
Column	18	73	91
Total	19.8	80.2	100.0

C) **Training by subject**

Teachers of Science and Maths were significantly better trained in IT than the rest of the teachers. There was a significant difference between their level of training (73.7% trained n=38) and the other teachers' (43.4% trained n=53) (see table 4.5) (chi square= 7.05 after Yates' correction, P<0.008).

This could be because the content of the computer INSET courses was more appealing to Science and Maths teachers than to teachers of other subjects. This would not be surprising since most examples used in the courses were based on programs for Science or Maths and many instructors had a 'scientific' background. Evidence to support this interpretation is presented in chapter 5.

A compounding factor could be that teachers of Science and Maths might feel under stronger social pressure than other teachers to come to terms with the technology and are therefore more 'eager' to enrol in computer courses (this is further developed in the critical summary of this chapter).

Table 4.5
Teachers trained in IT by subject

	UNDER TRAINED	TRAINED	Row
OTHER	30 56.6	23 43.4	53 58.2
SCIENCE and MATHS	10 26.3	28 73.7	38 41.8
Column	40	51	91
Total	44.0	56.0	100.0

D) **Training by gender, experience and seniority**

No association was found between gender, experience and seniority and teachers' level of IT training using chi square, ttest and ttest respectively.

E) **Training by personal use**

Teachers undertrained in IT used computers for personal purposes in a significantly smaller proportion than trained teachers (chi square= 9.42 after Yates' Correction, P<0.002). Only one undertrained teacher out of 40 was a personal user (see table 4.6) while almost a third (29.4% n=51) of trained teachers used computers for personal applications

Table 4.6
Teachers trained in IT by personal use
(Do you use computers for personal applications?)

	NO	YES	Row
UNDERTRAINED	39 97.5	1 2.5	40 44.0
TRAINED	36 70.6	15 29.4	51 56.0
Column	75	16	91
Total	82.4	17.6	100.0

4.3.6. **Perceived resource availability**

A) **Introduction**

Teachers' perceptions of resource availability were assessed by asking the following question: are there computers and programs available in the school that you could use in your subject if and when you decide to use IT for teaching?

Physical resource availability (i.e. amount of hardware and software existing in the school) has been described earlier in this chapter. *Perceived availability* was a variable geared to assess teachers' awareness of the existence of the resources and their perceptions about their accessibility (see Anderson et al., 1979 for a discussion on physical and perceived resource availability).

More than a half (56% n=91) perceived IT resources as 'not available' for their subjects (see table 4.7). This points to the existence of a 'gap' between what the school considers (on the basis of documents such as Cardozo, 1990 and data collected in interviews with directors) as the level of resource available for the teachers (physical availability which has been described earlier) and what the teachers themselves perceive as effectively available for them to use (perceived availability).

IT activities had been carried out in the schools for more than a decade at the time of the survey. Teachers had been on average more than nine years working in those schools (table 4.3). Within this context, the existence of this 'gap' suggests that a) either the schools were ineffective in informing the teachers of the resources at their disposal or b) teachers were aware of the physical existence of the resources but felt they were not readily accessible for logistical or organisational reasons. The nature and consequences of this gap are discussed later in this chapter.

B) **Perceived resource availability by school**

A significant association was found between teachers' perceptions of software availability for their subject and school (chi square= 7.56, P<0.02). As shown in table 4.7, the proportion of DeGaulle School teachers perceiving IT resources as 'available' was significantly higher than in the other two schools of the sample.

Table 4.7
Teachers' perceptions of IT resource availability by school

	NOT AVAIL.	AVAIL.	Row Total
CHURCHILL	18 60.0	12 40.0	30 33.0
DEGAULLE	11 36.7	19 63.3	30 33.0
HERZL	22 71.0	9 29.0	31 34.1
Column	51	40	91
Total	56.0	44.0	100.0

C) **Perceived resource availability by subject**

A significantly higher proportion (68.4% n=38) of teachers of Science and Maths perceived IT resources as available than teachers of other subjects (26.4% n=53) (chi square= 14.19 after Yates Correction, P<0.0002, table 4.8).

Table 4.8
Teachers' perceptions of software availability by subject

	NOT AVAIL.	AVAIL.	Row Total
OTHER	39 73.6	14 26.4	53 58.2
SCIENCE and MATHS	12 31.6	26 68.4	38 41.8
Column	51	40	91
Total	56.0	44.0	100.0

D) **Perceived resource availability by experience and seniority**
No association was found between perceived resource availability and teaching experience or seniority (ttest).

E) **Perceived resource availability by level of training**

IT trained teachers perceived IT resources as available in a significantly larger proportion (56.9% n=51) than undertrained teachers (27.5% n=40) (chi square= 6.70 after Yates' correction, P<0.009, table 4.9). This was not surprising since in most of the computer INSET courses the existing programs were showed.

Table 4.9
Teachers' perceptions of software availability by training

	NOT AVAIL.	AVAIL.	Row Total
UNDERTRAINED	29 72.5	11 27.5	40 44.0
TRAINED	22 43.1	29 56.9	51 56.0
Column	51	40	91
Total	56.0	44.0	100.0

4.3.7. **Attitudes to the use of computers for teaching**

A) **Introduction**

Teachers' attitudes were measured using a purposefully designed instrument described in chapter 3. A copy of the attitude scale is included as an appendix. The 18item attitude scale allows for a total minimum score of 18 and a maximum of 90.

Teachers showed positive attitudes towards the use of computers in education. Almost three quarters (73.6% n=91) showed medium or high attitude scores (average attitude score 70.2). This reflects their views about the value of computers for teaching. Statement 1 of the attitude scale for example ('Computers can contribute positively to teaching and learning') was endorsed by virtually all teachers (95.6% n=91) and statement 3 ('Every teacher should have access to computers to use for teaching') by 88% (n= 91).

B) **Teachers' attitudes by school**

The three schools showed very similar individual average attitudes as shown in table 4.10 (Churchill 69.9, DeGaulle 69.0 and Herzl 71.5).

Table 4.10
Attitudes to the use of computers in teaching by school (scale 1890)

		Mean	Std.Desv.
For entire population		70.20	8.05
SCHOOL	CHURCHILL	69.96	7.22
SCHOOL	DEGAULLE	69.06	8.23
SCHOOL	HERZL	71.54	8.68

C) **Teachers' attitudes by subject taught**

Science and Maths teachers were significantly more positive in their attitudes to the use of computers in teaching (average attitude 73.0 n=38) than teachers of other subjects (68.2 n=53) (t= 2.8, P <0.005).

D) **Teachers' attitudes by gender**

Male teachers were on average significantly more positive in their attitudes towards the use of computers for teaching (average attitude 72.7 n=32) than female teachers (average attitude 68.8 n=59) (t= 2.23, P<0.04).

E) **Teachers' attitudes by experience and seniority**

No significant relationship was found between attitude scores and teaching experience or seniority.

F) **Teachers' attitudes by degree of personal it use**

Personal users (n= 16) were on average significantly more positive towards the use of computers (average attitude 76.9 n=16) than the other teachers (average attitude 68.8 n=75) (t= 2.19, P<0.001).

G) **Teachers' attitudes by level of training**

Untrained teachers were significantly less positive in their attitudes towards computers in teaching (average attitude 66.0 n= 18) than teachers who had received some training (average attitude 71.2 n=73) (t= 2.51 P<0.01).

Undertrained teachers were also significantly less positive (average attitude 67.0 n=40) than trained teachers (average attitude 72.7 n=51) (t= 3.52, P<0.01).

Teachers who had received the longest training showed the largest and most significant difference in average attitude scores (77.0 n= 17 vs. 68.6 n=74) (t=4.24 P<0.0001).

These findings show a strong association between level of IT training and attitude towards computers in teaching. It could be that increased training led to more positive attitudes or that teachers with negative attitudes were just uninterested in attending the available INSET courses.

H) **Teachers' attitudes by resource availability**

Teachers who perceived software resources as 'available' were significantly more positive to the use of computers for teaching (average attitude 72.7 n=40) than the others (average attitude 68.2 n=51) (t= 2.73, P<0.008).

4.4. **Analysis of the degree of computer use**

4.4.1. **Introduction**

The degree of computer use is defined in this study as the proportion of teachers using computers. In this section, the degree of computer use is analysed using the variables selected from the review of the literature.

4.4.2. **Degree of use by school**

Less than a third of the teachers (28.6% n=91, table 4.11) reported having used computers for teaching in the schools. There was no significant difference in the degree of use between the three schools (chi square).

This was an interesting finding since the schools differed significantly in their levels of training and resource availability as showed earlier in this chapter. Tentative explanations for this are presented at the end of this chapter.

Table 4.11
Users by school

	NON-USER	USER	Row Total
CHURCHILL	23 76.7	7 23.3	30 33.0
DEGAULLE	18 60.0	12 40.0	30 33.0
HERZL	24 77.4	7 22.6	31 34.1
Column	65	26	91
Total	71.4	28.6	100.0

4.4.3. **Degree of use by subject**

The proportion of teachers using computers in Science or Maths (47.4%) was significantly higher than in the other subjects (15.1%) (chi square = 9.76, P<0.001).

Maths teachers in particular, were users in a substantially higher proportion (69.2% n=13) than all others (see table 4.12). This could be connected with the fact that Maths was the only subject where the majority of the teachers were of the male sex. However, male teachers were not found (see next section) to use computers significantly more than female teachers.

Table 4.12
Users by subject

	NON-USER	USER	Row Total
Spanish	9 75.0	3 25.0	12 13.2
Science	16 64.0	9 36.0	25 27.5
Maths	4 30.8	9 69.2	13 14.3
Non-core	36 87.8	5 12.2	41 45.1
Column	65	26	91
Total	71.4	28.6	100.0

4.4.4. **Degree of use by gender**

There was no significant difference between the proportion of male and female teachers using computers (chi square). It must be noted that while male teachers were significantly more positive towards computers than female teachers, there was no significant difference in their degree of use.

4.4.5. **Degree of use by experience and seniority**

No significant difference was found between the average teaching experience or seniority of users and nonusers (ttest).

4.4.6. **Degree of use by attitudes to the use of computers for teaching**

Users were significantly more positive towards the use of computers in teaching (average attitude 73.65 n=26) than nonusers (average attitude 68.83 n=65) (t= 2.49, P<0.01). More than 80% (80.8% n=26) of the users showed medium or high attitude scores, not a surprising finding since the use of computers was not compulsory in the schools of the sample.

More surprisingly, a large majority of **non**users (70.7% n=65) also showed medium or high attitudes. This shows that positive attitudes towards IT do not necessary lead to use of the resource, suggesting that the effect of attitude on the degree of use may be limited. It could be that the effect of positive attitudes is in many cases overcome by organisational constraints (this is further developed in the summary).

4.4.7. **Degree of use by degree of personal it use**

Personal users were found to be more often ‘teaching’ users (56.3% n=16) than teachers who did not use computers for personal applications (22.7% n=75) (chi square = 5.73, P<0.01).

4.4.8. **Degree of use by level of training**

Teachers who were *untrained* in IT used computers significantly less (5.5% n=18) than teachers who had received some training (34.2% n=73) (chi square= 4.50, P<0.03, table 4.13).

There was no significant difference in the degree of use of *undertrained* and trained teachers (chi square). When teachers were grouped to isolate the teachers that had received the longest training the association between computer use and training was also not significant (chi square).

These results show that increased training did not lead to increased use. More specifically, quantity of training did not seem to have affected degree of use provided a minimum amount was provided. This could be attributed to inadequacies in the content or organisation of the computer INSET courses (this will be further developed later in this chapter).

Table 4.13
Users by level of training

	NON USER	USER	Row Total
UNTRAINED	17 94.4	1 5.6	18 19.8
TRAINED OR INITIATED	48 65.8	25 34.2	73 80.2
Column	65	26	91
Total	71.4	28.6	100.0

4.4.9. **Degree of use by perceived resource availability**

More than three quarters (78.5% n=65) of the nonusers perceived software as unavailable for their subject. This seems to point at teachers' perceptions of software shortage as a particularly influential factor in determining nonuse.

4.4.10. **Exusers**

Some of the teachers who had used computers for teaching in the schools ('users'), had done so in the past but not last academic year. They are called 'exusers' in this study. Even though their absolute numbers are not large (7 teachers) they constitute more than a quarter (26.9% n= 26) of the users.

This study does not attempt to study in depth the nature and attributes of this group of teachers in view of the limited time available and the need to concentrate on aspects more central to the study's aim. However, the identification of this distinctive group informed the selection of teachers to be interviewed in the subsequent phase (see chapter 5).

4.5. **Critical summary**

4.5.1. **Introduction**

In this section, the findings of the survey are discussed and summarised. All associations mentioned below are significant unless otherwise specified. All relevant statistical information is included in previous sections.

4.5.2. **Main characteristics of the potential user population**

A) **Gender**

Almost a third of the teachers were female (64.8%)**.** Female teachers were a large majority in every subject except Maths, where 9 out of 13 teachers were male.

B) **Teaching experience and seniority**

Average experience was 19.7 years and average seniority almost 9.9. Science and Maths teachers were on average less experienced than teachers of other subjects.

C) **Use of computers for personal applications**

Less than a fifth (17.7%) of the teachers reported using computers for personal applications. Most of these (12 out of 16) were Science and Maths teachers. Personal users were on average less experienced but better trained in IT than the rest of the teachers.

D) **Level of it training**

Almost half the teachers (44%) were *undertrained* (i.e. had received less than 10 hours of IT training) and a fifth were *untrained* (had not received any IT training). Science and Maths teachers showed a higher level of training. Teachers with higher levels of training were more positive to the use of computers. A larger proportion of the teachers trained in IT perceived IT resources as available than undertrained teachers.

E) **Perceived resource availability**

There was a gap between physical and perceived availability of IT resources. More than half of the teachers (56%) perceived IT resources as 'not available'. Teachers either were not aware of the existence of some hardware or software resources or perceived them as 'inaccessible' for logistical, organisational or other reasons. This 'gap' was lower for Science and Maths teachers.

F) **Attitudes towards computers in teaching**

A majority of the teachers showed positive attitudes to the use of computers for teaching. This reflected their perceptions of the value of computers for teaching.

Table 4.14 lists the factors significantly associated with teachers' attitude scores.

Table 4.14
Factors associated with teachers' attitudes

Subject taught
- Higher average attitude among Science and Maths teachers.

Gender
- Higher average attitude among male teachers.

Experience and seniority
- Not significant

Personal use
- Higher average attitude among personal users.

Training
- Higher average attitude among IT trained teachers.

Resource availability
- Higher average attitude among teachers perceiving IT resources as available

4.5.3. **Computer use by teachers**

The survey's findings show that in spite of a substantial increase in physical resource availability in the last decade, almost two thirds of the teachers had never used computers. Less than a third (28.6 %) of National Curriculum teachers in the three schools had used computers for teaching. There was no significant difference in the degree of use between the three schools in spite of the significant differences in training and resource availability. Some tentative explanations of the teachers' degree of computer use are discussed below. These explanations are further developed in Chapter 6.

A number of factors were found to be significantly associated with teachers' use of computers for teaching (see table 4.15).

Table 4.15
Factors associated with teachers' use of computers

Subject taught
Higher use among Science and Maths teachers.
Attitude
Higher average attitude among users.
Personal use
Higher use among personal users.
Training
Lower use among 'untrained' teachers.
No significant difference between *undertrained* and trained teachers
Resource Availability
Higher average attitude among teachers perceiving IT resources as available
Gender
Not significant.
Experience and seniority
Not significant.

There were significantly **more users among the Science and Maths teachers than among teachers of other subjects**. It could be that teachers of Science and Maths felt under stronger social pressure than other teachers to keep up with technology (Chandra, 1986 found this to be a factor in his study of an English secondary school). Hence they might have been more active in inquiring about available resources and more eager to enrol in computer courses.

Alternatively it could be that the schools were implicitly giving higher priority in resource allocation to 'scientific' subjects in terms of software procurement and teacher training due to the computer coordinators' own backgrounds. This is discussed in chapter 6.

Users were more positive about the use of computers in teaching than nonusers. Evidence was lacking, however, to establish the nature of the relationship between attitude and computer use. It could not be established from the survey's results whether positive attitudes had led to computer use or whether users had developed positive attitudes because they felt increasingly more confident in exploiting the technology.

Positive attitudes to the use of computers did not necessarily lead to actual use as the very high number of nonusers (70.7%) with medium or high attitude scores showed. An explanation for this could be that teachers' positive attitudes may express a belief in the value of computers for education in general rather than in the value and feasibility of use under everyday school teaching conditions.

Teachers with no training were significantly less frequent users of computers than teachers with some training. However, teachers who had received longer periods of training did not differ significantly from teachers who had received very short periods of IT training. This result shows that increased training did not lead to increased use; in other words, quantity of training did not seem to affect degree of use provided a minimum amount was provided. This could account for the fact that there were no significant differences in the degree of use between schools in spite of their significant differences in training (schools differed only in their proportions of teachers who were medium or highly trained in IT).

As discussed above, training seemed to yield diminishing returns in relation to the degree of computer use. This may be due to inadequacies in course design. It will be shown in the next chapter how computer INSET courses dealt mainly with technical and operational issues with specific educational applications rarely discussed. Hence, most of the course benefits were achieved at a very early stage and consisted of familiarising teachers with computers.

More than three quarters (78.5%) of the nonusers perceived software as unavailable for their subject. This suggests that **software scarcity** operated as a particularly influential factor in determining nonuse. As mentioned earlier, a 'gap' was found between what the schools' directors considered as the level of resource (physical availability) and what the teachers perceived as available (perceived availability). It is important to distinguish these because courses of action in each case should be different. An increase in software purchases would not solve teachers' lack of information or logistical problems constraining their use of the computers. Conversely, a better information policy would not be effective if there was too little software to use.

CHAPTER 5

Factors affecting the use of computers

5.1. **Introduction**

In this chapter, the main factors affecting the degree and nature of IT use by teachers are identified through analysis of data collected in 18 indepth interviews. The study intends to discover the main patterns of behaviour emerging from the data itself in the tradition of 'grounded theory' (Glaser and Strauss, 1967, Strauss, 1987). The emphasis throughout is on explanation rather than prediction and on the actors' own interpretation of the phenomena under investigation.

The degree of IT use varied considerably among the teacher sample which was 'purposefully' selected (see chapter 3) to cover a wide spectrum of views and experiences (table 5.1 details the teachers interviewed). The sample sample includes 'users', 'nonusers' and 'exusers'. 'Exusers' were teachers who had used computers in the past but not in the previous year (see chapter 3).

When italics are used in quotations, they reflect an emphasis made by respondents in their statements. At the end of each quotation, reference is made to the interview code and line number.

Table 5.1
Teachers interviewed

TEACHER	SCHOOL	SUBJECT TAUGHT	DEGREE OF IT USE	TEACHING EXPERIENCE
ACQU MR	CHURCHILL	MATHS	USER	12 years
ALAN MRS	DEGAULLE	SPANISH	USER	21 years
ARTO MR	HERZL	MATHS	EXUSER	27 years
BACE MRS	HERZL	SCIENCE	USER	13 years
CAST MRS	CHURCHILL	SPANISH	NONUSER	27 years
CLER MRS	CHURCHILL	SPANISH	EXUSER	17 years
CUNN MRS	DEGAULLE	SPANISH	NONUSER	10 years
ESCO MRS	HERZL	SPANISH	NONUSER	17 years
FERN MRS	DEGAULLE	SCIENCE	EXUSER	18 years
GILS MRS	HERZL	MATHS	NONUSER	10 years
LHER MR	DEGAULLE	MATHS	USER	15 years
LORE MRS	DEGAULLE	SCIENCE	EXUSER	4 years
MART MR	CHURCHILL	SCIENCE	NONUSER	18 years
MAZO MR	HERZL	SCIENCE	USER	12 years
MEST MRS	CHURCHILL	SCIENCE	NONUSER	6 years
PENA MR	DEGAULLE	MATHS	USER	4 years
PORO MRS	HERZL	SPANISH	EXUSER	5 years
VIAN MR	CHURCHILL	MATHS	NONUSER	12 years

5.2. **Levels of analysis of the interview data**

Examination of the interview data showed that teachers' use of computers was influenced by personal and contextual factors at the school level or beyond. **The study therefore set a threelevel framework of analysis: the individual teacher, the school and the extraschool level.**

The need to go beyond teachers' personal perspectives emerged from several interviews. Respondents described how some of the constraints on the use of IT could not be circumvented by them as individual teachers.

Mrs Poro, for example, put forward the view that a majority of teachers, including herself, were positive about the use of computers for teaching. When asked why she, and others, did not actually use them, she replied (although she would not elaborate further):

> **'Factors exist which are more powerful than teachers' wills and which restrict what the teacher can effectively do (914)'.**

Mr Vian described two different types of factors that had prevented him from using computers:

> **'The main problem is the problem of time, time to prepare classes and also finding time to use the computer room. The latter is the most frustrating of the two. As to the former, one would be prepared to sacrifice some personal time but the availability of the computer room is just not enough anyway ... (784)'.**

This is consistent with much of the related literature published in recent years on the use of computers for teaching (see Sheingold et al., 1983, Chandra, 1986, Somekh, 1989, for a few examples).

5.3. **Factors affecting the use of computers at the teacher level**

Certain factors affecting the use of computers for teaching that emerged from the interview data operated at the level of the individual teacher. These factors, which are discussed below, involved teachers' views, values and beliefs about themselves and their teaching and their assessments of the value and impact of the innovation (see table 5.2).

Table 5.2
Factors affecting computer use at the teacher level

1) PERCEPTIONS OF COMPUTERS
2) PERCEPTIONS OF SELFCOMPETENCE AND CONFIDENCE TO USE COMPUTERS
3) PROFESSIONAL VALUES AND BELIEFS
4) PAST EXPERIENCE OF USING COMPUTERS
5) PERCEPTIONS OF THE IMPACT OF USING COMPUTERS FOR TEACHING
6) PERCEPTIONS OF THE VALUE OF COMPUTERS FOR TEACHING
7) PERSONAL ACCESS TO RESOURCES AND INFORMATION

5.3.1. **Perceptions of computers**

Teachers' perceptions and feelings about computers clashed in many cases with their views of themselves, of the subjects they taught and of teaching in general (see table 5.3). These discrepancies between their personal and professional views and their perceptions of the innovation proved a major obstacle to uptake as discussed below.

Table 5.3
Factors affecting computer use at the teacher level:
PERCEPTIONS OF COMPUTERS

A) PERSONAL FEELINGS TOWARDS COMPUTERS
  1) FEAR
  2) SKEPTICISM
  3) ALIENATION
B) VIEWS OF THEMSELVES
  1) PERSONALITY
  2) GENERATION
C) VIEWS OF THEIR SUBJECTS
D) VIEWS OF TEACHING

A) **Personal feelings towards computers**

A majority of the teachers interviewed (10) expressed at least some negative feelings towards the technology. The nature of these feelings included fear (7), skepticism (4) and alienation (8). Partial figures do not add up to 10 because several teachers expressed feelings pertaining to more than one of these categories. However, it was not uncommon for teachers to hold both positive and negative feelings towards computers at the same time, when thinking about them in different contexts, e.g. computers perceived as positive symbols of progress in general but not suitable for the endeavour of education.

1) **Fear**

Teachers talked of being 'afraid of the unknown'. This fear seemed in many cases powerful enough to override the overall positive attitude that teachers had towards computers (teachers' attitudes to the use of IT were measured in the stage 1 survey and discussed in chapter 4). Mrs Cunn, for example, described her first impression of the technology in the following terms:

> **'My first impression was of wonderment at having the chance to use the very same machines that were in use in Europe but at the same time I was afraid, quite afraid at something completely unknown to me (94)'.**

Mrs Bace assessed her first computer course as instrumental in overcoming her negative feelings:

> **'I liked the course; not because I found it particularly useful in terms of actually being able to use the computers but it made me realise that computers were not *terrifying machines*. Because this is the first impression you get, isn't it? (225)'**

Most teachers attributed their fear to lack of knowledge. Other teachers attributed these feelings to a threatening perception of the potential role of computers. Mrs Cast, for example, found them threatening because:

> **'The computer is almost a competitor for us, not in the short run really, but it will be in the future ... (2094)'.**

2) **Skepticism**

Some teachers (4) were skeptical of what the technology could effectively deliver. Mrs Cler, when asked about her first impressions of computers, said:

> **'At the beginning, I saw them as totally unrelated to me, I heard the presentation politely but I did not believe at the time they could be of any use to me ... the whole thing sounded very remote to me and not very believable (105, 257)'.**

3) **Alienation**

The most widely expressed perception among teachers (8) was that of computers being 'outofreach' for themselves as individuals. They felt alienated from the technology. Mrs Bace, who had previously described computers as 'terrifying machines', elaborated on her perception:

> **'(Computers were) something I could not possibly get to use, something out of my reach (235)'.**

Mrs Cast spoke about her feeling of being alienated from the technology:

> **'My impression has been from the beginning that they (computers) have very little to do with me. I mean, they have no relevance to me as a Spanish teacher ... I have never been able to find the bridge between myself as a teacher and that device (114)'.**

Mr Mart described why he had been reluctant to use computers for many years:

> **'I thought computers were only for an elite, that computers were only for computer people, I never thought I could be part of that world (589)'.**

Mr Pena described his feelings of lack of ownership:

> **'My colleague Mr Lher, uses computers all the time and I don't; that must look odd I suppose. The problem is that I personally do not feel computers as part of myself, I don't feel that I *own* them ... (1221)'.**

B) **Views of themselves**

Many teachers saw themselves as 'unfit' or 'inadequate' to use computers because they found discrepancies between their perceptions of computers (or of the requirements to use computers for teaching) and their selfimages. Some of these discrepancies belonged to the realm of personality characteristics (7) such as audacity or intelligence and others were related to age and generation (8).

1) **Personality**

Some teachers saw themselves as '**too prudent' or 'insufficiently audacious**' to use computers.

Mr Vian explained why, in his view, he had been one of the few teachers to use computers at the beginning:

> **'We are all afraid. It happens to everybody when you face something new and unknown, but some of us are more audacious than others (338)'.**

Mrs Cler, a colleague of Mr Vian who had not used computers, concurred:

> **'My problem is definitely not one of lack of interest. I think I may be too prudent, too careful in using something I know little about (1522)'.**

Other teachers felt they were **not intelligent or creative enough.** Mrs Esco, who has never used computers, described how she perceived the technology:

> **'A: Those machines really caught my imagination, they aroused my curiosity but I have never approached them.**
>
> **Q: Why is that?**
>
> **A: Well, my impression has always been that these machines are only for very intelligent people.**
>
> **Q: You mean intelligent students or intelligent teachers?**
>
> **A: Teachers. For students guided by very intelligent teachers (56)'.**

Mr Mart felt creativity was the key issue:

> **'I admit *mea culpa* in that to be able to use computers for teaching you must be a very creative person and I don't consider myself a creative person at all (790)'.**

Other teachers made reference to what they called their '**intellectual identity'.** Mrs Cast, for example, a Spanish teacher, described herself as a 'letter person':

> **'Computers are not for me. I am a "letter person", my whole identity is linked to the book, to thinking through reading' (139).**

2) **Generation**

Feelings of being unable to cope with computers because they belonged to a different generation were expressed by 8 teachers. This feeling was mainly attributed by the respondents to the fact that they had not themselves been educated with computers or about computers at school or at the PGCE or BEd level.

> **'I had enormous difficulties, I felt inadequate because this (IT) is something my generation was not exposed to in our formative years ... I had this firm idea that I could never undertake the use of computers because I belonged to a different generation ... It is not the same obviously for our students who have used computers since they entered primary school'(Cler, 145).**
>
> **'I wasn't born with computers at home like most of my current students' (Arto, 2211).**
>
> **'At my age I thought it would be ridiculous to start with computers. I felt I would not be able to make it. I reckoned it is something you must begin at a very young age. What for us is terribly complex, for the kids is so easy, we adults complicate everything' (Bace, 255).**

> **'For us (teachers) it is difficult. Those of our students who become teachers in the future will use computers much more. There is something in me and in my generation that makes us perceive computers as a 'forbidden fruit'. There is, they say, in our brains a section, I think it is the right section, that has not been stimulated enough for us to be able to use computers or videos, for example' (Fern, 656).**

C) **Views of their subjects**

Teachers' views of their subjects were important factors influencing their use of computers. Teachers felt, in some cases (7), that the innovation was 'valuable' in a general sense but not relevant for their subject. Conversely, other teachers perceived their subjects as particularly suitable for computer use. As Mr Mazo, a senior Physics teacher put it:

> **'It is quite natural in our subject to use an external room such as the computer room and to have many different groups of students working at their own pace ... and the inspectors are used to that ... (Mazo, 1514)'.**

A view of IT as 'mainly useful for Maths or Science' was shared by many Spanish teachers:

> **'I have the impression that IT requires a type of reasoning totally different to the one I am used to ... I gather it must be something connected with Maths ... we , in Spanish, work much more with the imagination and sensitivity (Poro, 258)'.**

> **'I attended a few IT courses in the school but none of them made me change my mind. I still believe computers are more useful in scientific subjects and I am not the only one to hold this view or this prejudice if you want ... Most of my colleagues teaching Spanish share that view. We really feel that we have nothing to do with the whole business of IT (Cast, 304)'.**

> **'A: It is easier for teachers of scientific subjects**
>
> **Q: Why do you think so?**
>
> **A: Well, in those subjects they work with numbers, graphs, things that as far as I know are suitable for computers ... this is what I think but I suppose it must be prejudice after all ... I suppose this prejudiced view I have must come from seeing all those computers in the banks, I see computers and I associate them with numbers rather than letters ... (Cunn, 1255)'.**

It is interesting to note that while some of the most popular applications of computers are currently textoriented (word processing, database management), teachers still tend to associate the technology with the type of 'numbercrunching' applications that characterised computing in the 1960s. Possible sources of this prejudice will be discussed later in this chapter.

This prejudice was not limited to Spanish teachers. A number of Science teachers felt that IT was useful in the Sciences but not in *their* particular area within the Sciences.

> **'Maths and Physics teachers do not have as hard a time as we have (to use computers), Chemistry teachers have trouble with abstraction ... I think IT is better suited to Maths or even to Physics than to Chemistry (Fern, 332)'.**

> **'I have never seen much use for the computer in my subject ... Chemistry is an experimental science and our work is mainly based on the laboratory (Mest, 180)'.**

> **'I am not using computers because I am teaching Organic Chemistry this year. Last year it was easier because I was teaching the Inorganic course. In Inorganic you don't have so many topics where you can use computers because computers are useful mainly for simulations aren' t they? (Fern, 1351)'.**

D) **Views of teaching**

In some cases (4) teachers' views of the objectives or nature of teaching itself seemed to make them perceive **little or no role for nonhuman elements such as computers.**

Mrs Cler mentioned in her interview that she worked as a bank clerk in the afternoons to supplement her salary and had noticed that while most of the bank's staff (not including her) used computers regularly, only a minority of teachers in her school did so. She went on to speculate on the reasons for that:

> **'... I suppose it is because we (teachers) work with people. I mean, in our profession consequences of failing are so grave that we tend not to experiment ... (1487)'.**

Mrs Fern also made reference to this 'human nature' of teaching:

> **'You cannot compare teachers with other professionals, because we work with people. It does make a big difference doesn't it? The objective of learning is not to introduce knowledge in the students but to produce good persons and good citizens. When you work with human material, machines have no clear place, it is not essential to have access to machines. You can teach anyway, it might take more time, they may learn less Science but if you manage to produce a good person ... that is the main thing (1715)'.**

Other teachers perceived computers mainly as devices to speed up processes and therefore they found it very natural that commercial organisations were using computers more than schools. In their view teaching is an activity where time scales are not so important, where there is **little interest or need to accelerate anything**. Mrs Cunn, for example, discussed why accountants in her husband's firm used computers more than teachers like herself:

> **'The time factor is critical in accountants' operations but teaching is different. Teaching has a different pace, time is not so important, results only come in the long term. This is why it is not so important to use computers in teaching as it is in other activities (888)'.**

Mr Mazo commented on the same issue:

> **'A teacher does not achieve immediate results by using computers, in education processes take longer, evolution is slower (2315)'.**

5.3.2. **Perceptions of selfcompetence and confidence to use computers**

Teachers' perceptions of their own competence and confidence to use computers for teaching were influential factors in shaping the degree and nature of IT use. A majority of the teachers interviewed (10) cited a lack of technical competence as the main inhibitor constraining their use of computers.

Other teachers (6) expressed concerns about their students being more competent than themselves in using computers.

A) **Competence**

Many respondents (10) felt unable **to imagine applications** for the computers in their subjects.

> **'I don't reject computers, on the contrary, I am worried by my inadequacy to use them. The problem is that I have not been able to see how and when to actually use them in my classes. It is easier to see how to use video because if I show to the students a film version of one of the books we have read in class, I study in the film the same elements language, actors' movements and so on that I would study in a "normal" class ... With the computers however, I just don't see how they can be used (Cast, 1161)'.**

> **'I have been thinking of using computers but I couldn' t really find a convincing application. I suppose this is due to my ignorance. I am sure there *must* be some way to use them, I am sure of that (Cler, 994)'.**

> **'For many years, I never even thought of attending an IT course, let al.one using the computers, because I could not to conceive any useful use for them in my classes (Lore, 262)'.**

Even when teachers could devise uses for the computers, feelings of lack of competence influenced (in some cases impeded) the degree and nature of use, as illustrated below:

> **'I don't use computers because I don't know how to ... I lack the necessary knowledge to plan and implement a class (Cunn, 1143)'.**

> **'I have used computers, but I kept this activity isolated from the central, syllabusrelated activities due to my ignorance about computers and their implications ... (Poro, 92)'.**

B) **Confidence**

Feelings of erosion of their professional confidence were voiced by some teachers (6) who felt it was difficult to cope with students that were better prepared than themselves to use computers:

> **'Many of my students have computers at home. They are usually several steps ahead of me when talking about IT. They sometimes come with ideas and proposals but I just can' t follow them ... (Fern, 428)'.**

> **'It is dangerous to use the computer room. Students like to make fun of you and show off how much *they* know about computers (Lher, 665)'.**

> **'Look, when I receive my students in the fourth year, they have been learning IT for four years already and on top of that, many of them have their own computers at home. You have to be very well prepared when using the computer room because you can find yourself in the embarrassing situation that your students know more than yourself ... (Vian, 944)'**

This 'crisis of confidence' of the teachers, caused by the prospect of having to cope with students that they perceived as more comfortable than themselves with the technology is related to some aspects of the teaching ethos in Uruguay that are discussed in the next section.

5.3.3. **Professional values and beliefs**

Factors pertaining to the realm of the national teaching ethos in Uruguay appeared to have played a major role in determining computer use in a majority of the teachers interviewed (12). The use of IT clashed with the teaching ethos in several ways:

A) **Expert image**

Some teachers felt they had to demonstrate a high level of expertise in every area of their teaching visavis students, colleagues and IT support staff. This was an important factor in restraining interaction, mutual support and information sharing between teachers and inhibiting communications between them and IT support personnel.

Users of computers tended to put less value on this 'primacy of expertise'. Mr Mazo, the most experienced computer user in the sample, described his view in the following way:

> **'You must not impress your students with the breadth or depth of your knowledge but with your flexibility and skills to face new challenges (Mazo, 401)'.**

Teachers' needs to project this expert image have to be taken into account when designing support systems and training strategies. Teachers' perceptions of training requirements may be more complex than necessary from a strictly operational point of view. This will be further developed in the next chapter.

Mrs Bace and Mrs Mest stressed that it was unacceptable for a teacher to be seen by students as a beginner:

> **'Theoretically, one could use courseware with little knowledge about computers but in practice it doesn't work like that because students already know much more than us. They know very well how to deal with all those gadgets in the computer room. A teacher cannot just load a package and have the students work without himself mastering computers. I think that is not acceptable for a teacher's image (Bace, 1411).'**

> **'Maybe some other teachers are prepared to improvise but not me. If I'd go to the computer room and be told: 'OK, to use this program with your students make them press this key and then the other key etc ...' I personally would not feel satisfied. To use computers I have to feel that my advantage over the students is as strong as it is in Chemistry. Well, maybe not *that* much, after all I don't want to be a programmer, but it has to be strong indeed (Mest, 580)'.**

Some teachers felt that their professional standing would be affected if they asked for advice or help:

> **'Maybe we lack some humility. We (the teachers) think we should know everything about everything. I personally try not to be like that but it is still unusual for a teacher to go to another and say: 'I don't know, can you help me?'. It is just not done ... (Pena, 2860)'.**

'A: If I only had a computer in my classroom maybe I could get acquainted more easily.

Q: Can't you use the computers in the computer room?

A: Yes, but I don't feel comfortable exposing my ignorance in public, asking for help from the IT coordinator who is not a teacher of my own subject. I'd rather work with my colleagues in the privacy of our (Chemistry) lab (Mest, 1433)'.

Some respondents felt that using the subjectspecific programs available in the school could imply a certain erosion of their professional standing, since it would be seen as 'accepting' the pedagogical views and assumptions of other teachers. This '**not invented by me' syndrome** emerged for example when discussing with Mr Mart, one of the best IT trained teachers in his school, his use of computers:

'A: I don' t use them very often really. There is no software available.

Q: What about this program that Mrs Char (a senior teacher of the same subject in the same school) developed last year?

A: Oh yes. This software you mention is there, but you know, we are such individualists in this country ... I actually have difficulty imagining that I could use software developed by another teacher. Authors of software reflect in their products their personal views that I may share or not. I personally would rather use opensoftware that I can adapt to my own views than having to adapt myself to other teachers' ... (Mart, 1994)'.

No evidence emerged of similar negative feelings towards openended 'programs' such as spreadsheets or databases. This could be because these programs, which are not specifically designed for educational use, might not be perceived as 'trojan horses' bringing inside questionable educational assumptions.

This finding, coupled with others presented in the TRAINING section, show that teachers perceive openended and subjectspecific software differently. Openended software (e.g. spreadsheets or databases) appears to create less resistance from a professional point of view but teachers may find them more complex to use since the strategies for their use are less straightforward. Subjectspecific software is perceived as easier to integrate in teaching but is more likely to be rejected on professional grounds. This difference should be considered when developing software procurement policies or training schemes at the school or national level.

B) **Autonomy**

It emerged from the data that an active approach was needed on the part of the schools' leaders to promote the use of computers. This is explained further in the DIRECTORS' ATTITUDES and IT POLICY sections. However, whilst teachers felt that a clearer and more active attitude was needed at the leadership level, at the same time they warned that attempts to impinge on their autonomy would be counterproductive:

'I don't think 'active campaigning' by the director would be useful ... these sort of pressures on teachers are not tolerated in this country ... here we are extremely reluctant to look inside anybody else's classroom (Alan, 658)'.

'Any pressure from above to use computers would ruin the working environment in the school (Cunn, 399)'.

'I don' t think the director should start sending us signals, however subtle, on what the school would like us to do. If they start with things like: 'we'd be pleased if you ...' or 'it would be great if you ...'. In the end one stops thinking independently and starts behaving with the director's wishes in mind (Lore, 1220)'.

5.3.4. **Past experience of using computers**

In several cases (7), teachers' previous experiences of using computers shaped their behaviour towards the innovation. Some teachers had used computers and were disappointed with the results (5); others (3) perceived the technology as being unreliable.

A) **Evaluation**

Some teachers had used computers in previous years and then stopped using them, expressing disappointment at the results:

'Q: So, you used computers for teaching two years ago. What happened last year?

A: I did not use them again.

Q: Why was that? Did you find any problems?

A: No, no. The reality is that I did not find them very useful. I was, I would say, disappointed. I was expecting the students to be more stimulated, I suppose ... (Poro, 92)'.

'I used computers when they had just been introduced a few years ago but it was not a very motivating experience. My impression is that only a few bright students benefited from the whole thing ... at the end using computers was a disruption for me and my students for no clear gain for most of them ... (Fern, 422)'.

B) **Reliability**

Teachers' perceptions of the computers' reliability were an important factor, especially when coupled with an inadequate support structure, e.g. advice was not available in case a technical breakdown occurred during a class or reported failures took too long to be dealt with.

'I sometimes use the computers but I have not really increased their use because I am systematically stuck with some technical breakdown. For instance, I need to use the lightpens and it happens that kids have mishandled them in some previous class and they are unavailable ... How can I plan with confidence to use computers? I never know if the machinery will be in working condition or not (Alan, 560)'.

'It happened to me more than once that programs would not run properly, especially the ones I am more keen to use (Lher, 518)'.

5.3.5. **Perceptions of the impact of using computers**

A large number of teachers (13) expressed concerns about the potential impact of using computers for teaching. Some of these concerns (6) were related to the effects upon their students or upon teacherstudent relationships. Other concerns (10) were related to the consequences of using computers for their working conditions (see table 5.4).

Table 5.4
Factors affecting computer use at the teacher level
PERCEPTIONS OF THE IMPACT OF USING COMPUTERS

A) IMPACT ON STUDENTS
B) IMPACT ON TEACHERSTUDENT RELATIONSHIPS
C) IMPACT ON TEACHERS' WORKING CONDITIONS
1) CLASS MANAGEMENT
2) CLASS CONTROL
3) EQUIPMENT SUPERVISION

A) **Impact on students**

Concerns were expressed by teachers about the consequences of the use of computers for teaching for students' personalities and social skills. Some teachers felt that using computers at school would compound an already obsessive relationship with 'screens' developed by children who spend hours with their television sets and videogames. Teachers feared that an increase in the use of computers would come at the expense of reading and writing. They also feared prejudicial consequences for students' imagination and sensitivity.

'Some kids have a horrible predisposition to shut themselves indoors at home with their little machines. It would be very bad for them to come to the school and keep working with the machine. It's better for them to spend time with their classmates ... kids can easily become obsessed with the machine (Alan, 1330)'.

'Machines absorb kids' attention because they are novelties, they are fun, so books are relegated and that's terrible isn' it? (Cunn, 196)'.

'Computers hypnotise youngsters ... by using computers in teaching we might be impairing their capability to use their imagination ... (Vian, 1936)'.

B) **Impact on teacherstudent relationships**

Computers were perceived by some teachers as an interposition in their relationships with their students:

'Computers are not something that we (teachers) can deal with on our own, it is something interposed between the student and you ... it may harm your relationship with the kids ... since it becomes a human dialogue with a machine in the middle (Alan, 1558)'.

> **'Maths teachers are used to using calculators and so on but we (Spanish teachers) traditionally reject any technological interference in the teacherstudent relationship (Esco, 2080)'.**

Conversely, other teachers saw the use of computers as bridging a growing generation gap with their students.

> **'Using computers puts me closer to them (the students). I think it facilitates our dialog. They see that I understand the same technology that they use (Alan, 1405)'.**

> **'We (Maths teachers) can't stay away from IT because that would distance us from our students ... (Vian. 1226).**

C) **Impact on teachers' working conditions**

Many teachers (10) were reluctant to use computers for teaching because they feared that more complex and intense demands would fall upon them, requiring them to assume new responsibilities and increasing their overall workload.

Some respondents (6) perceived that class management would become more difficult because of the inherent 'unpredictability' of computerbased teaching. Others expressed concerns about discipline (5) and some (5) were worried by the prospect of students damaging expensive equipment while under their responsibility.

1) Class management

Experienced teachers felt that when using conventional methods they were able to predict most of the questions students would ask. Teaching with computers was perceived by some teachers (6) as a disruption of this 'predictable, safe environment'.

They perceived class activity when using computers as divided in many centres, each acting independently and demanding attention at the same time. They found this new environment more demanding and riskier, in the sense that the course of the class was less predetermined. Furthermore, they perceived it as a challenge to their traditional authority in managing the pace and direction of the work.

> **'I feel much more relaxed managing a traditional class. Computer programs offer the student lots of options and therefore the teacher will not have all answers and counterexamples at hand when he needs them (Mazo, 1798)'.**

> **'In a conventional lesson you are the one who asks questions and they (the students) are the ones who answer. Teaching with computers is a completely different game; students' demands would be much, much greater, they would expect individual attention ... I personally would not be able to cope with that .. (Mest, 801)'..**

> **'A computer's reaction is determined by what you answer to its questions. It can react in many different ways, it is unpredictable, you never know what can happen ... (Gils, 637)'.**

2) **Class control**

Some teachers felt that changes to the familiar 'chalk and talk' approach were bound to induce discipline problems:

> **'Any new method of teaching leads to noise and disturbances ... (Alan, 912)'**

> **'The moment the kids enter the computer room their glands start to work quicker (Acqu, 1574)'**

> **'I have used the computers with the 15year olds where discipline is less of a problem but since I was transferred to work with the 12year olds I don' t use them any more ... (Vian, 1370)'.**

3) **Equipment supervision**

Several teachers were concerned about the safety of the equipment at the hands of their students, something they perceived as an additional responsibility. This feeling led in many cases to a refusal to use the computers if the computer coordinator was not present to take responsibility. This was an important inhibitor of computer use because, as is discussed later in this chapter, support systems had not been designed to cope with this demand.

> **'He *must* be present (the computer coordinator in the computer room), I am not a computer programmer. What would happen if any of my students touch the wrong button and a machine is damaged? They are so expensive ... (Cunn, 1832)'.**

> **'If I am going to use the computers I need the (computer) coordinator to be with me. I can't assume responsibility for the safety of the machines (Mest, 1238)'.**

Teachers seemed more worried about the equipment safety in the hands of the students than about the prospect of the equipment injuring the students even though there had been cases of students getting minor electric shocks from using the school computers but no precedents of equipment damaged by students.

5.3.6. **Perceptions of the efforts and benefits of using computers for teaching**

Teachers' assessments of the efforts and benefits of computers for teaching were an influential factor in determining uptake. A number of respondents (7) considered computers as useful but not essential and found that most of computers' benefits could be achieved through different means at a lesser cost in time and effort for them and less disruption for the group. In other words **they did not perceive any essential teaching need that could be met only or best by using computers.**

Other teachers (6) expressed the view that after a few years of teaching, **inertia** develops and is a disincentive to try new methods and resources, especially if using the new methods implied an **increase in their workload**.

Table 5.5
Factors affecting computer use at the teacher level
EFFORTS AND BENEFITS OF USING COMPUTERS

A) NEED FOR THE INNOVATION
B) INERTIA
C) INCREASED WORKLOAD

A) **Need for the innovation**

Several respondents found that most benefits of using computers could be achieved using more conventional methods. They did not perceive the computers as solving concrete problems of their practice or adding pedagogical value to the process of teaching. This could be caused by misconceptions or prejudices about the potential benefits of the technology. Some Spanish teachers, for example, dismissed using word processors on the basis that photocopiers would give them the same advantages.

> **'A: I've found interesting only a handful of the programs available, most of them are series of small problems and I don' t really have to depend on the computer for that type of exercise. I can perfectly well use the XEROX machine for the same purpose ... In fact I can understand why computers are so popular in banks and places like that. They solve problems that accountants face in everyday practice.**
>
> **Q: Aren' t they useful to teachers as well?**
>
> **A: Sure, sure, but they don't solve real problems for us like the blackboard does, for instance (Arto, 682)'.**
>
> **'I think computers are geared to other subjects not to Spanish. I toyed with the idea of using a word processor some time ago but at the end it was not necessary because I can do the same with a typewriter and a photocopier (Cunn, 130)'.**
>
> **'The programs I know do not break any new pedagogical ground. Instead of doing series of exercises in their notebooks, students do them on the screen but the spirit, the substance of the work is the same (Lore, 1251)'.**

B) **Inertia**

Some teachers depicted themselves as 'too set in their ways' to be able to change without a major investment of time and effort that they could not afford. They felt 'comfortable' with their current methods that were proven, noncontroversial and required very little class preparation:

> **'I have been teaching for many years now, my lessons are prepared, my methods are well oiled, I know perfectly well how to tailor my methodology to the peculiar characteristics of each group (Alan, 511)'.**
>
> **'After a few years you find you that you have a 'script' ready for each lesson and it works. This method is proven, it has always worked for you and your students. So why change it for something new that you don't really know how effective it**

can be? ... I have so little time to prepare classes that I'd rather stick to what I feel comfortable with (Cunn, 757)'.

'One is already so experienced in teaching normal lessons, I mean, without the computer, that *no preparation is really necessary* but if you are going to use computers you can' t improvise, it has to be planned carefully (Vian, 485)'.

'After so many years teaching the same courses I don't really prepare my classes ... (Lher, 1668)'.

Teachers seemed to consider class preparation time as an initial investment to be recouped over as many years and schools as possible. Most teachers worked in state schools in the afternoons. As state schools do not currently have computers, the effort invested by teachers in preparing IT classes was worthless as far as classes in those schools were concerned.

'In the time it would take me to prepare IT classes I' d rather work on materials that I can use in all the schools I teach and not only here ... (Mest, 910)'.

C) **Increased workload**

Many teachers (7) feared that an increase in their overall workload would be inevitable if they started using computers for teaching. They perceived that using computers would require an investment of time to review software and prepare strategies for its use within the curriculum. Teachers perceived their available time as barely sufficient to meet the demands of their current activity, they were therefore reluctant to use new methods that they perceived would increase their workload.

'It takes time. Even though I was involved in designing the software I use I still have to spend hours preparing each class, there is no room for improvisation when using computers. You have to be very careful before committing yourself to increase the use of computers (Mazo, 1798)'.

'I don't use the computers more than I do because I lack the time to prepare classes, search for software and so on ... (Vian 756)'.

'I lack the time to look for suitable topics in the syllabus. There are lots of exercises and pedagogical situations that could be approached using computers but it needs lots of reflection and preparation. It has to be done properly (Acqu 1180)'.

'In the catalogue, only the title of the program is included, there is no description, let al.one a critical review. Using computers require that we (the teachers) spend lots of time reviewing software but of course we don' t have time, so we are forced to guess which program to use (Pena, 266)'.

5.3.7. **Personal access to resources and information**

A) **Personal use of computers**

A significant association between personal and school use of computers was established in chapter 4 on the basis of the survey results. The interview data provided additional insights into the nature of this association.

> **'I only 'warmed up' to the computer issue when my family bought a personal computer for reasons related to my wife' s job. When one has a machine at his disposal one can do lots of things that were impossible before. It is not the same as being shown the machine for five minutes in the school ... (Acqu, 1681)'.**

> **'A: I see it under a different light since there is a computer at home. At the beginning I didn't dare touch it but after some time my husband started needing help to enter some documents and I was forced to learn how to use it. Then, I started feeling more relaxed. I don't see it as an adversary whom I have to fight any more ... (Lore, 386)'.**

B) **Access to outside information and contacts**

Differential access to outside information and contacts was an important factor affecting teachers' attitudes to computers. According to Fullan (1982, p. 44):

> **'Teachers are much less likely (than directors) to come into contact with new ideas for they are restricted to the classroom and have a limited network of professional based interaction within their schools'.**

Later in this chapter (see SCHOOL LEVEL), it will be shown that the schools' information systems did not succeed in keeping most teachers aware of IT developments and that teacher interaction was constrained by time problems. Within this framework, teachers' personal access to outside information systems (through magazines, personal contacts, attending conferences and so on) was an important factor in determining uptake:

> **'I had been indifferent towards computers for years when a friend of mine who had emigrated to Canada returned for a visit. She is a teacher of Spanish like me and told me she had been working in teaching writing skills to illiterate workers in Montreal. That example impressed me. Only then did I see the importance that computers may have in education. (Poro, 405)'.**

> **'Nobody gave me any useful advice in the school. I am aware of the potential of computers because I subscribe to Scientific American ... but Scientific American costs US$ 140 a year, very few colleagues can buy it (Acqu, 512)'.**

> **'A: I have never used computers but I am not skeptical any more.**

> **Q: What made you change your attitude?**

> **A: I spoke to a colleague who is working in a project in the area of computers in education. She is a skillful woman and had been able for years now to concentrate on this topic. She was enthusiastic. I did not understand very much the explanations on what she is doing very much but I make an "act of faith" (Cast, 1378)'.**

5.4. **Factors affecting the use of computers at the school level**

Several factors affecting the use of computers were related to school policy, leadership, management of technical resources and provisions with regard to teacher training, time and support (see table 5.6). These were regarded by the teachers as organisational resources whose provision was the responsibility of the school.

Table 5.6
Factors affecting computer use at the school level:

1) SCHOOL POLICY, MANAGEMENT AND ORGANISATION
2) LEVEL AND MANAGEMENT OF IT RESOURCES
3) EFFECTIVENESS OF INSERVICE TRAINING
4) LACK OF TIME
5) EFFECTIVENESS OF SUPPORT STRUCTURES

5.4.1. **School policy, management and organisation**

School policy, organisation and leaders' attitudes played major roles in determining teacher uptake in almost all cases (16).

Table 5.7
Factors affecting computer use at the school level:
SCHOOL POLICY, MANAGEMENT AND ORGANISATION

A) IT POLICY
B) DIRECTORS' ATTITUDES
C) ORGANISATION

A) **It policy**

The extent to which the school IT policy objectives were known by the teachers was an influential factor in shaping the degree of computer use. Many teachers (10) felt the schools were failing to spell out with clarity their objectives and expectations as related to the use of computers. In the Churchill School, for example, many teachers seemed not to be aware that the use of computers in all subjects was a stated IT policy objective. Paradoxically, Churchill was the only school in the sample where a written policy statement existed (Cardozo, 1990).

'A: I have no idea what the school's IT policy might be. I am not sure if they even have one. I suppose their main objective is to teach Computer Science to the students.

Q: What makes you think that?

A: Well, there has been no attempt by the school to organise 'teacher committees' for example as it is customary when changes to the curriculum are planned. Actually there have been no systematic approaches to us, at least to Spanish teachers. Maybe some informal comment here and there by the director but nothing else ... (Cast, 505)'

'This school has no IT policy as far as I know. In any case it is clear to me that their intention is to use the computers mostly to teach programming to students (Mart, 707)'.

This was also the case for teachers of the other two schools:

'I don't think the school cares about me using computers or not. If they'd cared they would insist on me using them, they would tell me: 'we have bought computers, now we want you to use them'. As they don't bother to ask me anything about it, I assume they are not expecting anything from me. If they have any expectations as related to us using computers, they have to say it. (Cunn, 1755)'.

'... If the school aims at promoting the use of computers by teachers, this is not known ... From what I know, they don't seem to care very much about IT (Gils, 733)'.

'I don't know the expectations of the school. Mr Gaut (the director) has never asked me: 'are you using the computers?'. He never showed any interest at all. I don't think they are much interested in whether teachers use or don't use computers (Pena, 3065)'.

B) **Director' s attitudes and actions**

The strength of a director's commitment to the use of the technology was perceived by some teachers (5) as a contributing factor governing uptake.

'What the boss does is crucial. There may be some interest at grassroots level but if the boss does not stimulate, things don't work. Each change of boss seems to stagnate things ... (Fern, 235)'.

'In this school, the main block for innovation has been the continuous change of directors ... (Gils, 804)'.

'The director projects a certain message with his actions and attitude. For example, does *he* use a computer for his own job in the school? No, of course he doesn't'. So, what sort of credibility can he command when he suggests *we* should use it (Mazo, 2550)'?

'I don't think the director even knows whether I use the computer room or not (Gils, 733)'.

'I doubt that the director is aware of the low degree of usage of the computers (Mazo, 1168)'.

Hawkridge et al., in his study of computer use in Third World schools, had similar findings concerning principals' attitudes. They found that many principals seemed uninformed about the computer activities in their school. Some of them were not ready to answer questions on the use of computers in their own school without the presence of the computer coordinator. Many of them placed little value on computer education because the course was not part of the formal examinations.

This section's findings show the need for institutional encouragement. However, as was noted before (see AUTONOMY), there is a tightrope to be walked between the need for encouragement and friendly monitoring, and invading teachers' autonomy. The management of this conflict could prove to be one of the most complex components of introducing IT in a school.

C) **Organisation**

A number of organisational elements directly or indirectly affected the use of computers in several cases (7).

1) **Timetabling**

A NEAmandated reorganisation of timetabling arrangements had been carried out two years before the study. This reorganisation proved a powerful obstacle to teacher interaction. The objective of the reorganisation was to shorten the school day and consisted of a shortening of the period between classes from ten to five minutes. As a result teachers had to rush from one classroom to another and this stopped the small but useful conversations that the incoming and outgoing teachers used to have when changing classrooms. This reorganisation therefore compounded the already acute lack of time available to teachers:

> **'A: The very organisation of the school causes part of our time problems**
>
> **Q: In what way?**
>
> **A: Since two years ago the whole thing runs like this: 7:40 am the bell rings to start the first class of the day. At 8:20 the bell rings again and I have to start another class that may be in the other side of the building at 8:25. I have to *rush* out of the class, go to an office, leave a groupbook, take another one and *jump* into the other classroom. How can we be expected to speak about computers between ourselves in these conditions? (Arto, 504)'**
>
> **'Since two years ago we have only 5 minutes to change from one classroom to the next one. You have to run all day. As you can imagine, interaction between teachers is next to nil (Esco, 306)'.**

2) **Class size**

Class size was another organisational element that emerged as an influential factor in determining teacher uptake:

> **'I used computers last year and I considered using them again this year but then I realised I had been assigned a group of *48 students.* How can I bring 48 students to the computer room? I would need five assistants (she laughs) (Alan, 1171)'.**
>
> **'Two years ago, when I had a very small 'workshop' type group I used the computers. Since then, however, I had groups with more than thirty kids. I don't feel confident enough to deal with so many students in the computer room (Cler, 513)'.**
>
> **'I have thought about it (using computers) but my groups are too large 25 or more ... (Mest, 801)'.**

3) **Other organisational factors**

Other teachers made reference to other organisational factors that more indirectly worked against uptake:

> **'Things are not so easy. There may be computers in the school, courses etc., but you have to look at the whole picture. Education in this country is not conceived as a participative activity. Syllabi are too long, classes too short and I could continue. Let me give you an example. Take this school's new classroom seats which cost a fortune. They are big and heavy, completely unsuitable for group dynamics or any other participative techniques. Therefore, you can't consider the use of computers in isolation. Computers may be available in the school but they are inscribed in an environment that is not encouraging to use them (Mazo, 502)'.**

5.4.2. **Level and management of it resources**

Issues related to resource availability and management (see table 5.8) were found to be influential factors in determining teachers' use of computers in most cases (16).

Table 5.8
Factors affecting the use of computers at the school level

LEVEL AND MANAGEMENT OF IT RESOURCES

A) PHYSICAL RESOURCE AVAILABILITY
- 1) SOFTWARE
- 2) HARDWARE

B) PERCEIVED RESOURCE AVAILABILITY
- 1) AWARENESS
- 2) ACCESSIBILITY

C) RESOURCE MANAGEMENT
- 1) BOOKING
- 2) MOVING

A) **Physical availability**

The level of provision of the available IT resources accounted for a major part of teachers' uptake for a large number of respondents (14). The main problem was the lack of software (12) but the type and amount of hardware was also influential in some cases (4).

1) Software

Some teachers described their degree of computer use as directly dependent on the amount of high quality, useful software available:

> **'The main issue is to have programs. I currently use everything that is available, if there was more software available I would use it (Alan, 478)'.**

> **'I don't use computers because there are no good programs. I am still waiting to see one program that really satisfies me (Arto, 350)'.**

> **'I seldom use the school computers because there is no software. The little there is available consists of very primitive simulations that I would rather implement in the Chemistry lab with my students (Mart, 373)'.**

> **'I have the best intentions. I attended courses, I bought computer books but then I go to the computer room and I find that there is no software I can use. What am I expected to do? (Mest, 1882)'**

The fact that a teacher participated in the design of a program did not necessarily lead to him or her using it. Mr Arto and Mr Mazo had been seconded parttime for eight months a few years before to participate in the design of programs for Maths and Physics. Mr Mazo became an active user of computers and a source of support and advice for his colleagues. Mr Arto, however, used his program once and never used computers thereafter. It was mentioned before that some teachers found it difficult to use part of the already scarce software available because of a 'not invented by me' syndrome. Here we see that sometimes software was rejected even when designed by the users themselves.

As shown in this section, the availability of software is a key factor in determining teacher use of computers. This shows that software selection procurement may be a particularly important component of IT policy. In none of the schools were teachers systematically consulted as part of software procurement procedures. It was also mentioned earlier in this chapter (see EXPERT IMAGE) that there were differences in teachers' perceptions of openended and subject specific software. These different perceptions should also be taken into account when making procurement decisions.

Mr Acqu, for example, had the following to say about software procurement in his school:

> **'They are not prepared to invest even a dime in software. Whatever is available for my subject has been obtained by ourselves or by the students. This means that most of it has been obtained illegally, is incomplete and lacks manuals (463)'.**

2) **Hardware**

The quantity and quality of hardware available in the school affected the use of computers in two ways. In some cases, teachers discontinued their use of computers after a first attempt due to **technical reasons** (e.g. poor screens or slow disk drives):

> **'The problem in the school is that all the computers share one disk and loading programs take too long. Classes are too short to stand for that ... (Mart, 872)'.**

In other cases, teachers' concerns were related to **the number of computers available in the computer room.** These concerns were associated with different factors: a) fears about disruptions in discipline if too many students had to share one computer, b) a belief that a ratio of onestudentpermachine was necessary for pedagogical reasons and c) finding what to do with the fraction of the group that could not be accommodated in the computer room.

This problem was particularly experienced by teachers in the DeGaulle School as a result of an administrative decision taken a few years before. The DeGaulle School has 18 computers. All the equipment was concentrated in one computer room until three years ago when the director decided to create three independent computer rooms with six machines each. A consequence of this change was that some teachers, finding it difficult to work in the computer room with only six machines, reduced their degree of use of the resource.

> **'Since they divided the computers, I only use computers with a special lastyear group I teach every year because it is small enough. The regular groups have all more than**

25 kids, if I decide to use the computer room I can only take some of them, because if you put more than 2 or 3 kids in each machine they become restless. I have to subdivide them and bring only some of them with me but what would I do with the rest in the meanwhile? (Lher, 374)'.

'My problem is: what do I do with the fraction of the group that cannot go to the computer room because there are not enough computers? (Cler, 609)'.

B) **Perceived resource availability**

The level of resource as perceived by teachers was lower than the level of resource as perceived by the school leadership. Directors' perceptions of resource availability were based on physical stock (quantity of computers and programs available in the school) as described in school documents (e.g. Cardozo, 1990). Teachers' views were shaped by their capability to effectively **use** these resources. Most respondents (16) made reference to this issue.

Several factors contributed to this 'availability gap' (difference between physical and perceived availability): a) a lack of information on the part of the teachers about existing resources b) a high rate of occupation of the resources by the teachers of Computer Studies and c) logistical problems such as inconvenient opening hours or difficulties in finding the keys of the computer room. Some of these problems are inherent in the centralised model chosen by the schools for the management of the resource and are discussed later in this chapter.

The consequences of this gap are farreaching since IT planning is based on physical rather than perceived availability. Teachers' use of computers has to be understood in the light of the constraints they perceive. No improvement in the degree of computer use should be expected by introducing more computers into a school if the organisational factors that reduce resource availability as perceived by teachers are still in place.

1) **Awareness**

Internal communications failures within the schools have been mentioned earlier in this chapter as the main cause for teachers' lack of awareness of the schools IT objectives. These failures also led to many teachers (11) being inadequately informed and in some cases completely unaware of the amount and type of resources at their disposal or the procedures to use them.

'I have to admit something. I had known for years that there were computers in the school but I had no idea how many, not even a vague idea. I found out there were 30 computers last week when a student brought me to the computer room to show me something. I was amazed to know there were so many machines in a school ... (Cast, 836)'.

'Q: When did you find out for the first time that there were computers at your school?

A: Two years ago, I suppose.

Q: But there have been computers for more than 10 years, haven't there?

A: What can I say? I myself only found out 2 years ago (she looks embarrassed, she blushes, her tone is defensive).

Q: How did you actually find out?

A: Well, I was walking, well not walking but running as usual, down one corridor, going from one class to another when I saw a small sign saying: 'Computer Room'. I then asked the director' secretary about it.

Q: You just 'ran into' the computer room? (The interviewer speaks with an involuntary tone of disbelief).

A: Yes, I was told then by this secretary that the computer room had been for years in another part of the building that I don' t usually go to. It had been relocated in this wing just a few weeks before (Esco, 24)'.

'Q: How do you know about new programs becoming available to use in the school?

A: Usually I don't hear about them. We don't have much information about that sort of thing. There are no catalogues like there is for the videos, for example (Fern, 345)'.

'I have no idea whether there are programs for my subject in the school or not. Nobody has told me that there were any; so I assume there weren't any (Mest, 1274)'.

'A: For years I used only one program once a year. Then, last summer I realised that there was a whole lot of other programs that could be useful to me.

Q: Since when were these other programs available?

A: I don't know but I am pretty sure that they have been there for at least four or five years.

Q: How did you find out about them?

A: I attended an IT course last summer and the instructors used them as examples (Pena, 707)'.

2) **Accessibility**

Some teachers (7) did not use computers because they perceived the computer room as being used to capacity by the Computer Studies' teachers.

Teachers felt that the high rate of occupation of the computer room by computer classes introduced unacceptable rigidities in their teaching plan. They felt forced to accommodate their schedules according to the computer room availability instead of being able to schedule the use of the school computers when it was more convenient.

'The main problem is to be able to use the computer room the exact day that you need it (Alan, 776)'.

'Many times I desist from using the computer room because it is impossible to book it for the dates you need (Cler, 1241)'.

'The problem is that the computer room is used by the Computer Studies teachers and therefore we seldom get access to the computers. I was one of the first teachers in this school to use computers, but since Computer Studies was introduced as a compulsory subject a few years ago I practically don' t use them anymore. The computer room is permanently used by the Computer classes. I can't get a free slot to squeeze *my* students in ... (Lore, 611)'.

'A: I became interested in computers when a visiting teacher from England came to the school and showed us some Chemistry programs they use in his country.

Q: Did you use them?

A: No, No. I know the computers are so busy in the school with the programming classes that it never occurred to me that I could use them (Mest, 851)'.

'We don' t use computers as much as we would like because the computer courses occupy most of the computer room' s available time (Vian, 152)'.

Accessibility was also affected by the **logistical arrangements**. Mr Mazo, a senior Physics teacher and regular computer user who had been trying to promote the use of IT among his colleagues said:

'Teachers need to have their tasks facilitated. Cumbersome procedures and logistical problems must be avoided. I mean, all these little things that may cause trouble such as finding the key to the computer room or having the right plug at hand when you need it (Mazo, 896)'.

C) **Resource management**

The schools' computers were centralised in one room (see chapter 4) with the exception of the DeGaulle School where the 18 computers were divided between three different computer rooms with six machines each. A computer coordinator was in charge of purchases, technical maintenance, advice and support to teachers of other subjects wishing to use the computers and establishing procedures to book and use the computers. These coordinators were, at the same time, the teachers of Computer Studies.

This centralised model of management of the resource hindered the use of computers at several levels: a) the need to book the computers in advance, b) the need to move the class to a different classroom and c) the creation of an elite with near 'monopolist power' over the resource. Factors a) and b) are discussed below. Factor c) is discussed later in this chapter.

Many respondents made reference in their interviews to an 'ideal' or 'utopian' solution to this category of problems based on having independent computer rooms for each subject or at least a computer room for Computer Studies and another one for the rest of the teachers.

1) **Booking**

Some teachers (4) resented having to book the schools' computers as a prerequisite to using them, for several reasons: a) booking implied planning ahead, something that frequently clashed with current practice, as was discussed before, b) the booking system introduced rigidity in their teaching, forcing them to stick to preset dates for certain activities and c) booking procedures were not widely known and sometimes changed without notice.

> **'I teach very much on 'inspiration'. I like to change course at a moment's notice. However, to use the computers you have to make a reservation and wait days or weeks. It is so bureaucratic ... (Cler, 423)'.**

> **'You need to book so much in advance ... I can't plan so long ahead (Pena, 2037)'.**

2) **Moving**

Using the computers implies for the teachers moving with the whole class to the computer room. This was seen as problematic by some teachers (4) for two reasons: a) time was lost in bringing thirty or more students to a computer room that was sometimes in a distant part of the building and b) discipline was put at risk whenever the traditional classroom was abandoned (this was discussed earlier).

> **'Moving the whole bunch of kids elsewhere would take too much time (Cast, 226)'.**

> **'Using computers wastes precious class time because of the need to move to the computer room (Fern, 551)'.**

> **'Leaving the classroom is for the students synonymous with playing ... if one has to deal with a group which is already restless, it might be very difficult to bring them back into line once you leave the classroom (Lore, 1660)'.**

5.4.3 **Effectiveness of computer inservice training**

Training was found to be a crucial factor in overcoming teachers' fears by providing them with the necessary skills and confidence to use computers for teaching.

The schools provided computer courses for teachers within the framework of the IT initiatives (see chapter 4). In one of the schools (DeGaulle), teachers were paid to attend inschool courses.

It was found however, that some of these courses were inaccessible to many teachers for organisational reasons (e.g. inadequate dates or lack of time to attend), irrelevant to teachers' needs or pedagogically poor. Issues related to training were found to have played an influential role in shaping teachers' degree of computer use in 12 cases (see table 5.9).

Table 5.9
Factors affecting computer use at the school level:
EFFECTIVENESS OF INSERVICE TRAINING

A) ORGANISATION
B) TIME
C) CONTENT
D) INSTRUCTORS

A) **Organisation**

Problems related to course organisation were found to create barriers to training in a number of cases (6). These problems included inconvenient course hours or dates and inadequate practice arrangements.

> **'The courses were held at lunch time ... Many people started but how can you avoid lunch for more than a few days? I don't know anybody who finished a whole course (Acqu, 346)'.**

> **'I knew there were computer courses in the school that we were free to attend ... but most of them were at 7 pm. I am married, I have four kids. I can't undertake activities after 6 pm. My family life is very demanding (Alan, 365)'.**

> **'The problem in this school is that systematically, every year, they announce the schedule of teacher training courses a month after the school year started. By that time your timetable is already full ... (Pena, 1901)'.**

The training strategy implemented by the schools (see chapter 4) was incremental. Courses were planned to build on the knowledge acquired by teachers in previous courses and provide them with increasingly more specialised content. This approach failed to take into account the everchanging nature of computer technology. Schools changed their computers and software more rapidly than they changed their courses. Teachers' knowledge was in many cases obsolete by the time it had to be put into practice.

> **'Since I started to attend computer courses four years ago, the school has changed the computers. Therefore all the basic operating procedures I knew are no longer valid. I have to attend a refresher course but the school is not providing these basic courses because they say all teachers had already passed that stage (Vian, 1021)'.**

Practice arrangements were inadequate in some cases:

> **'There were not enough computers for everybody. We were forced to share a machine between two or three teachers and it doesn't work, it is distracting ... (Cunn, 1992)'.**

> **'If a machine would have been at my disposal during the course I would not have quit. I would have finished the course (Acqu, 346)'.**

> **'The course included a period of practice with available programs. One of the instructors was available twice a week in the morning to practice with us. However, *who* can go in the morning? We are all busy ... (Alan, 435)'.**

The selection of teachers attending courses was a problem in some cases.

> **'Some teachers have been using computers for years. Others like me have never even approached one of these machines. They should not draw us all together (Mest, 511)'.**

B) **Accessibility**

Many respondents (9) found that lack of time rendered training opportunities inaccessible to them.

> **'I am interested but I have too much work. I just can't find the time for courses, because you know, courses imply not only attending lectures but homework, practice etc. I would have to invest many hours in that and where can I find those hours? From my sleep? The question is that we all have constraints that sometimes prevent us from doing what we would like to do (Mest, 1150).**

> **'Having to teach so many hours a week is the problem. We don' t have enough time to receive the necessary education: It is not only that we can' t attend courses, we don' t have time to read articles or books, to attend lectures, to talk to people that know more than we do ... (Vian, 187)'.**

C) **Content**

Course content was in some cases (5) **irrelevant to teachers' needs and concerns**. Courses concentrated on the technical side of computing at the expense of the educational side. They failed to discuss the implications of the use of computers in concrete classroom situations. This is compatible with Rhodes and Cox's (1990) findings in their study of London schools, among others.

> **'I attended an IT course and it wasn't a bad course at all but there is a difference between learning about computers and seeing the actual applications computers may have in each subject (Alan, 435)'.**

> **'I started a computer course but I quit after a few classes. I could not see anything for me in it. What is the use for *me* of LOGO, BASIC and these sort of things? I only like things that are useful, that I can effectively use. The course was a 'turnoff' because it stuck to technical things, to 'cold' things such as which key to press ... There was no link to our activities in the classroom (Cunn, 278)'.**

> **'Computer courses offered by the school were about programming ... When we finished the course we were still lightyears away from mastering how to apply that in the classroom (Acqu, 597)'.**

In some cases course content was not only irrelevant to teachers' main concerns as discussed above but it was a contributing factor in **creating misconceptions or reinforcing prejudices about the use of computers** (see PERCEPTIONS OF COMPUTERS).

> **'A: I have always thought that computers were not something that concerned us (Spanish teachers).**

Q: Have you ever attended a computer course?

A: Yes.

Q: Did your opinion about computers change in any way after the course?

A: Well, I became less anxious about them after the course.

Q: Why was that?

A: Because I felt reassured that computers were not oriented to my area of teaching, that it was not just a prejudice of mine.

Q: Did the course instructor say that? (the interviewer sounds surprised).

A: Well, no, no. He did not say that explicitly but during the course he spoke mainly to the Maths teachers and *all* the examples he used were related to either Maths or Science' (Cast, 304)'.

D) **Instructors**

Instructors' own backgrounds and skills influenced teacher training and attitudes. Many teachers (5) attributed their negative feelings towards computers to negative 'first impressions' of the technology caused by course instructors showing poor command of Spanish (in the case of foreign instructors), poor pedagogical skills or poor mastery of curriculum materials.

'In my first course we had this French instructor. He was an authority in computers but he could not make himself understood. His Spanish was terrible and he was so shy, you know how computer people are ... (Cunn, 258)'.

'The man spoke in English all the time. I understand some English. I can read. However a whole course in English is too difficult for the majority of us ... (MEST, 881)'.

'The problem was that the instructors in the computer course were Maths teachers and they are as narrowminded as Computer Studies teachers. They only made reference in all their examples and explanations to mathematical concepts ... (Fern, 1084)'.

5.4.4. **Lack of time**

Most respondents (16) highlighted lack of time as a dominant concern. As Mr Acqu said:

'It is not only a matter of changing teaching methods. It is necessary to change our way of life, to change this asphyxiating system that makes us not have time for anything but teaching and teaching ... (1596)'.

Teachers considered time as a scarce organisational resource that the school had to provide through means such as the release of teaching hours, the introduction of paid overtime or

mediumterm secondments. Lack of time was found to be a major obstacle for the teachers to familiarise themselves with the technology, attend courses, prepare IT classes and especially interact with other teachers.

A) **Time to get acquainted with the technology**

Many teachers (5) spoke about a perceived need to 'get acquainted' with the technology before considering its regular use with the students. Lack of time was a major constraint in their process of 'getting acquainted' with the innovation.

> **'A: The problem is that we lack time to innovate.**
>
> **Q: What do you mean by 'time to innovate'?**
>
> **A: Time to think about different ways to teach, to think how to use the computer for example, to try things, to experiment. At the moment we are so much under pressure that we only have time to think about tomorrow's classes (Mazo, 1309)'.**
>
> **'I have no time to undertake creative activities. Using computers implies questioning the way I have been teaching all along. I need time to reflect, to sit down and understand the machine, to understand how I can use it (Pena, 1296)'.**
>
> **'To use a computer you first need a period of time in which to 'get acquainted' with it. A period in which you can 'fight' in private with it until you feel in charge (Vian, 1301)'.**

Several teachers felt this problem was compounded by the fact that their students had more opportunities to further their knowledge about computers than themselves, especially if they had computers at home. Hence, the disturbing gap (see CONFIDENCE) between teachers' and students' mastery of computers is everwidening in teachers' perceptions.

B) **Time for professional interaction**

Teacher interaction was found in the interviews to be influential in determining uptake. This has been consistently reported in the literature as a major factor affecting change. Fullan says:

> **'Change involves resocialisation, interaction is the primary basis for social learning. New meaning, new behaviour, new skills depend significantly on whether teachers are working as isolated individuals or exchanging ideas, support and positive feelings'(1982, p. 71).**
>
> **'We need to get together and discuss the difficulties we face because only through interpersonal relationships can we overcome our present inhibitions. When one speaks with colleagues you become aware of new experiences, one changes his perspective ... (Acqu, 1541)'**

Several teachers (5) felt that their lack of time to interact with their colleagues was a barrier to using computers.

> **'A: Computers have never been part of my world at school and as far as I know have never been part of most teachers' worlds.**

Q: But, were you aware that there was a group of Science teachers using them regularly?

A: Do you have any idea of what our job is like? (she laughs) There is a problem: time. Time to communicate and interact. We have no time to go to the staff room. We run *all* the time. There is actually very little contact between teachers. We barely have time to carry out our compulsory tasks let al.one speak about computers (Esco, 306)'.

'The pace of our work is the problem. We have to teach so many hours a week that it is impossible for two or three teachers to be free at the same time to go and review software for example, in the computer room or just to meet and swap notes on kids' reactions to one activity or another (Mazo, 1087)'.

5.4.5. **Effectiveness of support structures**

The three schools of the sample had set up structures to provide support to teachers using IT. Factors related to the nature and responsiveness of these support structures affected the use of computers in 10 cases (see table 5.10).

Table 5.10
Factors affecting the use of computers at the school level

EFFECTIVENESS OF SUPPORT STRUCTURES

A) TYPE OF SUPPORT
B) RESPONSIVENESS
C) ATTITUDES OF THE SUPPORT STAFF

A) **Type of support**

IT support was geared to advice teachers on how to use the existing programs. Support personnel were available two or three times a week to answer inquiries and show programs. In case of unexpected needs (such as technical breakdowns during a class), computer coordinators could be asked for help if they were not themselves teaching.

The dual role of the IT staff as support personnel and Computer Studies teachers was perceived as problematic for various reasons: a) support tasks were considered by IT staff, according to the respondents, as a second priority task 'to be carried out in their free time' and b) it gave control of the computer room to the Computer Studies teachers at the expense of the use of computers in other subjects; many teachers of National Curriculum subjects felt the teachers of Computer Studies took unfair advantage of this power.

This type of support system did not address some of the teachers' major concerns, especially their lack of confidence to manipulate the equipment in the presence of the students and be responsible for their safety. Many teachers (8) felt that the computer coordinator should be present and be responsible for the operation and safety of the equipment.

'A: There are a few programs in the school that I could use. The problem is not me but the coordinator.

Q: Why is she the problem?

A: As you can imagine, I would not use the computer room on my own, somebody has to be in charge. The (IT) coordinator must be there with me.

Q: Isn't she ready to go with you?

A: As far as I know it is not part of her obligations. She is very helpful so she would try to go if I ask her but she would be doing me a service and I can't ask for favours every week (Mest 1238)'.

'A: I first used the computers in a shared session with Mr Corm using a Maths program that the school had recently received from Europe (Mr Corm was one of the computer coordinators who is at the same time a Maths teacher).

Q: Would you have used the program in case Mr Corm was not there?

A: No, I don't think so. Everything worked perfectly because he was there. He took care of all the machine and plugs problems and I was able to concentrate on the pedagogical side (Pena, 874)'.

'A: I would be happy to use computers more often but it is difficult to coordinate with the IT people. It would be much more convenient if one of the computer coordinators was in the computer room permanently and I would be free to concentrate on the lesson and the students instead of having to worry about machine problems. This is my job after all, isn't it? (Alan, 2243)'.

'Biology and Chemistry teachers have technicians that take care of the machines in their laboratories. I need the same to use the computer room. I need somebody to have everything prepared and tested *before* the students and I get there. I can't waste half the class doing this myself (Cast, 226)'.

Some teachers felt that the support available was ineffective in relation to their subjects.

'A: We (Spanish teachers) need somebody who knows very well the programs and who could help us.

Q: Isn' t there already a group of computer coordinators that are expected to do that?

A: No. No. These people you refer to know nothing about the teaching of Spanish language or literature. They have no idea of what I need to show in a poem, for example. They are computer people or Maths teachers (Cast, 675)'.

B) **Responsiveness**

The level of responsiveness of the support structures was an important factor in promoting or inhibiting computer use. Long delays in dealing with teachers' requests were found in some cases (4) to create feelings of frustration and undermine teachers' perceptions of schools' commitments to the technology.

'I have asked Mrs Olme (the computer coordinator) about some graphics program but I have never received any feedback (Arto, 646)'.

'We sometimes request things such as programs or interfaces but it takes a year or more for them to arrive. With that sort of timescale, our enthusiasm is bound to wear down (Lher, 2412)'.

'I filled in a form requesting a particular program about eight months ago. It has not arrived yet. You see, it is too slow, there are too many steps to follow (Mart, 2164)'.

C) **Attitudes of the support staff**

Attitudes of the IT support staff influenced in several cases teachers' use of computers (6). Other factors related to the support structure are discussed later in this chapter.

In relation to the following quotations, it should be remembered that, as described earlier, IT support staff were at the same time the Computer Studies teachers.

'They (IT support personnel) don't create a climate in which I find it easy to go to them and ask them anything. They believe the computer room belongs to them, that it is *their* world. They look at us, teachers of other subjects, as trespassers when we go too often to the computer room (Cunn, 1656)'.

'The Computer Studies teachers dominate the whole business of IT in this school. The problem with them is that they think they hold some magic knowledge. They treat the rest of us with contempt (Fern, 807)'.

'Computer Studies teachers act as some sort of closed elite. Their attitude has improved in the last few years but the problem is still there. I don't feel welcome in the computer room (Mart, 707)'.

5.5. **Factors affecting the use of computers at the extraschool level**

A number of factors affecting the use of computers by teachers were linked to influences external to the school. Schools in Uruguay are heavily regulated by the NEA (see chapter 1). Externally imposed policies and overseeing procedures, especially the role of the Inspectorate, influenced teachers' use of computers as is discussed in the next sections. The most influential external factors were related to teacher assessment policies and procedures, and the syllabi.

5.5.1. **Inspectors' attitudes**

NEA inspectors are responsible for assessing teachers' performance. Promotion prospects are wholly dependent on these assessments. As a result, teachers' perceptions of inspectors' opinions are powerful factors in shaping teacher behaviour. However, since the NEA had not yet formulated an official IT policy, inspectors' opinions were largely unknown.

Assessments are based on observations made by inspectors during unannounced visits to schools. Some teachers (6) were reluctant to use computers since they felt there was a risk that inspectors would not look favourably on the technology. A teacher referred to this inhibition as 'selfcensorship' (Mazo, 515). In the highly centralised Uruguayan educational system, inspectors seemed to be more important than school directors in influencing teachers' choices of teaching methods.

'Q: Have you introduced changes in the way you teach in the last few years?

A: Not really.

Q: You didn't feel the need to introduce changes or were there any constraints that prevented you?

A: I like the way I currently teach and what is more important, the inspectors like it (Cunn, 1559)'.

'A: It is essential to have the inspectors learn about computers. They have to go on record supporting the use of computers.

Q: Why do you think that is important?

A: Because some of us are afraid of their reactions if they just come to the school and find us in the computer room.

Q: Do you think they might have a negative reaction?

A: They might think we are wasting our time and the students'; that using computers is not an objective of our subject.

Q: Could this lead to a bad assessment?

A: I don' t know ... (Esco, 754)'.

5.5.2. Length and content of syllabi

Syllabi are decided by the NEA Inspectorate and must be strictly followed by all schools. Two syllabusrelated factors were found to affect the use of computers in some cases (8): a) teachers' perceptions of the suitability of the syllabus for computer use and b) the length of the syllabus which, due to the overriding priority given by inspectors to its entire coverage, made some teachers reluctant to use techniques that they perceived as 'useful but slower' than conventional methods.

'Our syllabi are not compatible with computers. They have a theoretical basis. They will have to be revised if computers are to be used. Our syllabi go from the abstract to the concrete. When you work with computers how can you manage to present abstract concepts? It has to be done the other way around, hasn't it? (Acqu, 145)'

'We have a syllabus to cover. Syllabi in this country are not planned to include the use of games or things like that. They are planned to be taught using more or less conventional methods (Alan, 980)'.

'Our classes are too short, only 70 minutes. It is difficult to use techniques that may result in better learning but requires more time ... we are always running behind the syllabus (Cast, 210)'.

'We are too pressured by the time factor. We have to cover a long syllabus (Cler, 1160)'.

'The Spanish syllabus is so long. Using computers would require more time than we have ... (Cunn, 171)'.

'I have used computers. Teaching with computers takes more time. Learning is enhanced because topics are covered at a deeper level. However, from a practical point of view you sometimes have to do without certain things that may provide excellent results to fulfill formalities such as covering the whole curriculum ... (Fern, 551)'.

'Inspectors care only about the syllabus. Teachers must cover the whole syllabus. You get better grades for being on time with the syllabus than by teaching using better techniques. Look what happened to me. I taught a strongly participative class the day the inspector came. The students were very excited and motivated. However I got a bad grade because the inspector did not pay much attention to all that because from the start she had noticed I was behind schedule ... (Lore, 2524)'.

5.6. **Summary**

A complex set of interrelated factors emerged from the data as having affected the degree and nature of computer use by teachers. These factors constitute a system of variables which interact, the more factors supporting implementation, the more effective it is likely to be. These factors operated at different levels: teacher level, school level and extraschool level.

Table 5.11 lists the main factors in each level.

Table 5.11
Factors affecting the use of computers

TEACHER LEVEL

PERCEPTIONS OF COMPUTERS
PERCEPTIONS OF SELFCOMPETENCE AND CONFIDENCE TO USE COMPUTERS
PROFESSIONAL VALUES AND BELIEFS
PAST EXPERIENCE OF USING COMPUTERS
PERCEPTIONS OF THE IMPACT OF USING COMPUTERS FOR TEACHING
PERCEPTIONS OF THE VALUE OF COMPUTERS FOR TEACHING
PERSONAL ACCESS TO RESOURCES AND INFORMATION

SCHOOL LEVEL

SCHOOL POLICY, MANAGEMENT AND ORGANISATION
LEVEL AND MANAGEMENT OF IT RESOURCES
EFFECTIVENESS OF INSERVICE TRAINING
LACK OF TIME
EFFECTIVENESS OF SUPPORT STRUCTURES

EXTRASCHOOL LEVEL

INSPECTORS' ATTITUDES
LENGTH AND CONTENT OF SYLLABI

Teachers' perceptions of the congruence of the innovation with their personal and professional views, values and beliefs were major factors in shaping their attitude to the technology. Other influential factors operating at this level were: teachers' past experience in using the technology, their assessment of the impact and value of using computers for teaching and their private access to information and practice. Table 5.12 details the influential factors operating at the teacher level.

Table 5.12
Factors affecting the use of computers at the **teacher level**

PERCEPTIONS OF COMPUTERS
- PERSONAL FEELINGS TOWARDS COMPUTERS
- VIEWS OF THEMSELVES
- VIEWS OF THEIR SUBJECTS
- VIEWS OF TEACHING

PERCEPTIONS OF SELFCOMPETENCE AND CONFIDENCE TO USE COMPUTERS
- COMPETENCE
- CONFIDENCE

PROFESSIONAL VALUES AND BELIEFS
- EXPERT IMAGE
- AUTONOMY

PAST EXPERIENCE OF USING COMPUTERS
- EVALUATION
- RELIABILITY

PERCEPTIONS OF THE IMPACT OF USING COMPUTERS
- IMPACT ON STUDENTS
- IMPACT ON TEACHERSTUDENT RELATIONSHIPS
- IMPACT ON TEACHERS' WORKING CONDITIONS
  - CLASS MANAGEMENT
  - CLASS CONTROL
  - EQUIPMENT SUPERVISION

PERCEPTIONS OF THE EFFORTS AND BENEFITS OF USING COMPUTERS
- NEED FOR THE INNOVATION
- INERTIA
- INCREASED WORKLOAD

PERSONAL ACCESS TO RESOURCES AND INFORMATION
- PERSONAL USE OF COMPUTERS
- ACCESS TO OUTSIDE INFORMATION

A number of constraints and facilitators concerning the use of computers operated at the school level. Organisational constraints were perceived by teachers as impossible to circumvent at the individual level and dependent on strategies and resources that were the responsibility of the school leadership. School IT policy, especially the extent to which it was known by the teachers, and leadership attitudes to the innovations were found to be important factors. Other factors were related to the provision and management of computer resources, IT training provision, lack of time and the responsiveness of inschool support structures. Table 5.13 details the main factors operating at the school level.

Table 5.13
Factors affecting the use of computers at the **school level**

SCHOOL POLICY, MANAGEMENT AND ORGANISATION
- IT POLICY
- DIRECTORS' ATTITUDES
- ORGANISATION

LEVEL AND MANAGEMENT OF IT RESOURCES
- PHYSICAL RESOURCE AVAILABILITY:
- PERCEIVED RESOURCE AVAILABILITY
  - AWARENESS
  - ACCESSIBILITY
- RESOURCE MANAGEMENT
  - BOOKING
  - MOVING

EFFECTIVENESS OF INSERVICE TRAINING
- ORGANISATION
- TIME
- CONTENT
- INSTRUCTORS

LACK OF TIME
- TIME TO GET ACQUAINTED WITH THE TECHNOLOGY
- TIME FOR PROFESSIONAL INTERACTION

EFFECTIVENESS OF SUPPORT STRUCTURES
- TYPE OF SUPPORT
- RESPONSIVENESS
- ATTITUDES OF THE SUPPORT STAFF

Finally, factors that operated beyond the realm of the school were found to have affected the use of computers by teachers. These factors were related to policies and regulations of the NEA. The role of the NEA Inspectorate and the syllabi were the main factors operating at this level. Table 5.14 lists these factors.

Table 5.14
Factors affecting the use of computers at the **extraschool level**

INSPECTORS' ATTITUDES

LENGTH AND CONTENT OF SYLLABI

CHAPTER 6

Discussion of findings and recommendations

6.1. **Introduction**

This chapter considers the results of the analysis in the preceding two chapters in relation to the research questions and to the literature review. The implications of the study's findings for areas such as teacher training and support are discussed. Detailed evidence substantiating the claims and conclusions presented in this chapter can be found in chapters 4 and 5.

6.2. **The study**

This study is a development of the corpus of research in planned educational change and innovation. It investigates the processes of adoption and implementation of computers for teaching in three Uruguayan secondary schools. The research concentrates on understanding the use of computers from the perspective of the teachers.

The research consisted of two stages: a preliminary survey of computer use by all teachers of National Curriculum subjects in the three schools, and a subsequent qualitative stage based on indepth interviewing of a sample of 18 teachers. The analysis of the qualitative data consisted primarily of an attempt to construct interpretative categories to account for the events and processes embedded in the descriptive data.

6.3. **Main characteristics of the potential users**

The first research question (1a) sought to identify the main characteristics of the teachers who constituted the potential users of computers in the three schools of the sample.

Research question 1a) is addressed in detail in chapter 4. The survey's results showed a teacher population that was largely female (64.8%), highly experienced (average 19.7 years) and stable (average number of years working in the school was 9.9). A minority (17.7%) used computers for personal applications. Teachers showed, in general, positive attitudes to the use of computers (73.6% showed medium or high scores), especially male teachers. Almost half of the teachers (44%) were undertrained (had received less than 10 hours of training) and almost a fifth (19.8%) had not received any computer training. A 'gap' was identified between teachers' perceptions of IT resource availability and the actual resources existing in the schools (physical availability).

Science and Maths teachers emerged as a distinctive group within the teachers, having more positive attitudes to computers, being better trained in IT and with a higher proportion perceiving IT resources as available.

6.4. **Degree of computer use by teachers**

The second research question (1b) concerns the degree of computer use by teachers of National Curriculum subjects in the three schools. This research question is addressed in detail in chapter 4. 'Degree of computer use' was defined as the proportion of teachers who had used computers in relation to the entire teaching population of National Curriculum subjects in these schools (91 teachers). The results of the survey indicated that less than a third (28.6%) of the teachers had ever used computers.

Use of computers was significantly associated with more positive attitudes to computers and better IT training. Degree of computer use was significantly higher among teachers of 'scientific' subjects (Maths and Science), teachers who perceived IT resources as available and teachers who used computers for personal applications. Gender, experience and seniority were not found to be significantly associated with degree of computer use.

There was no significant difference in the degree of use between the three schools in spite of significant differences in training and resource availability. This may be explained by the fact that most of the impact of training (as designed and delivered in the schools of the sample) was obtained with a low number of contact hours while the schools differed significantly only in their proportions of teachers having received longer courses. In relation to the differences in resource availability, the study found that the DeGaulle School, in spite of having the largest stock of programs, failed to achieve a higher degree of use. This seemed to be related to a recent reorganisation of the schools' computers into three different rooms with only six machines each, which prevented their use with mediumsized or large groups.

More than two thirds of the teachers were nonusers. A majority of these showed positive attitudes to computers, underlining the limited impact of attitudes upon uptake in the presence of powerful contextual constraints. This is further developed in the next section.

6.5. **Analysis of teachers' decisionmaking**

The second set of research questions posed by this study (2a and 2b) is concerned with establishing the main factors affecting the use of computers by teachers (2a) and building interpretative explanations and hypotheses to account for the degree of use (2b).

The study's findings with regard to research question 2a) are discussed in great detail in chapter 5. These findings are drawn together below to answer research question 2b) in the form of the analytical framework shown in table 6.1.

Teachers' decisions to use computers were based on their perceptions of the **value**, **congruence** and **accessibility** of the technology. Uptake was more likely when teachers placed a high value on using computers for teaching and when they perceived this as congruent with their views, practices and beliefs. In addition, the more accessible they perceived the technology, the more likely they were to use it.

Table 6.1
Analytical framework for teacher decisionmaking

VALUE= Rewards Costs Risks

CONGRUENCE

ACCESSIBILITY = Availability + Support

(Availability = Awareness + Logistics)
(Support = Training + Interaction + Advice)

6.5.1. **Value**

Teachers' assessments of the value of the technology were based on the costriskreward structure of the investments required to use computers for teaching.

A) **Costs**

Two types of 'costs' of using computers were perceived by teachers: time costs and professional costs. Time 'costs' included time for training, for 'getting acquainted' with the technology, for reviewing software, for preparing classes and for covering the syllabus.

Time costs of teaching with computers were perceived as much higher than time costs of teaching with conventional methods for several reasons: a) teaching with computers was perceived as requiring far more class preparation due to the 'unpredictability' of class developments (teachers felt they had to be prepared to deal with many more alternatives, options and questions than when using conventional methods), b) experienced teachers normally invested very little time in preparing classes for conventional teaching and c) time investments in preparing computer classes cannot be 'recouped' in all the schools where the teachers work since not all schools (especially state schools) have computers.

Professional 'costs' were related to the impact of using computers on working conditions. Teachers' working conditions in Uruguayan secondary schools are characterised by a high degree of autonomy, selfreliance and privacy. The study found this privacy and functional autonomy to be highly valued by the teachers. Disruptions in these working conditions were perceived by teachers as a 'cost' of using computers.

This valued environment was perceived by teachers to be disrupted in several ways when using computers: a) the need to book the computer room for preset dates introduced rigidity in their teaching plans, b) their selfreliance was reduced by the need to depend on the computer staff for help and advice, and c) their privacy was threatened by the presence in the computer room of the computer coordinator. However, this presence elicited conflicting feelings since it was, at the same time, welcomed as a way of avoiding responsibility for the safety of the machines.

Other professional costs perceived by the teachers as inevitable when using computers were related to the need to bear additional responsibilities (e.g. ensuring equipment safety) and to

face new and complex tasks (e.g. management of episodes where students require individual support) for which they felt insufficiently prepared and which some teachers felt were not part of their contractual obligations.

B) **Risks**

Risks involved in teaching with computers were related to: a) the 'unpredictability' of class developments, b) disruptions in discipline and c) inspectors' attitudes.

Teaching with conventional methods was perceived by teachers as providing a safe and predictable environment where the teacher dictates the pace and direction of class developments. When using computers they felt many of the familiar ground rules for class management were challenged, jeopardising the success of the lesson: a) unforeseen questions from students could arise, b) programs could cause difficulties and delays (e.g. unclear error messages) and c) technical breakdowns could occur.

Teachers expressed concerns about potential disruptions in discipline caused by a) moving out of the classroom and b) working in large groups when the number of students was too large in relation to the number of machines available in the computer room.

The results of the study show that teachers perceived inspectors' reactions as the biggest risk when using computers. Teachers' professional advancement is based on NEA inspectors' assessments. Since the NEA had not yet formulated an official IT policy, inspectors' opinions were largely unknown. Some teachers were therefore reluctant to use computers since they felt there was a risk that inspectors would not look favourably on the technology. A teacher referred to this inhibition as 'selfcensorship'.

C) **Rewards**

Teachers perceived two types of rewards for using computers for teaching in the absence of institutional incentives: symbolic and pedagogical.

Symbolic rewards consisted of gains in a teacher's image that could strengthen professional standing (e.g. by being seen as a 'modern' teacher). This type of symbolic reward was considered hard to achieve since the schools' directors were perceived as uninformed and, in some cases, uninterested in teachers' use of computers. Other symbolic rewards were related to teachers' relationships with their students (e.g. a *rapprochement* with the students on the basis of being seen as part of the same 'generation').

Pedagogical rewards, consisting of concrete benefits in student learning, were unclear to the teachers. Many failed to identify specific teaching needs that could be met most effectively by using computers. Many teachers regarded most of the benefits of using computers could be achieved at a lesser cost using conventional methods and less complex technology (e.g. video, photocopier). A number of teachers who had used computers expressed disappointment at the results, considering the costs involved. Some teachers spoke of achieving 'deeper or better learning' when teaching with computers but they perceived these gains as difficult to substantiate and as having little impact on their own promotion prospects.

To understand teachers' perceptions of the rewards involved in using computers it is important to look at the duties for which they perceived themselves as accountable: timely coverage of the syllabus and maintenance of class control and discipline. The study's results show that teachers perceived that using computers did not help them meet these demands. On the contrary, using computers was perceived as an obstacle to the coverage of the entire syllabus and a threat to class discipline.

6.5.2. **Congruence**

Teachers also based their decisions on their perceptions of the extent to which using computers was congruent with their selfimages, their views of teaching and their professional values and beliefs. The study's results showed that many teachers perceived the use of computers as clashing (i.e. having low congruence) with:

A) their selfimages (e.g. not being a 'machine person'; not being 'audacious'; belonging to another generation);

B) their views of teaching (e.g. teaching is a 'people activity' where machines such as computers have little role; there should be no interposition especially machine interposition between teachers and students; computers are mainly useful for 'scientific subjects');

C) their views of the students (e.g. students in this age are already so 'hypnotised' by screens of televisions and videogames at home, that using computers in the school would compound this 'lack of socialisation'); and

D) their professional values and beliefs (e.g. need to ensure their primacy of expertise in the eyes of the students; and maintain their selfreliance which was seen as under threat from a dependency on the computer coordinator).

6.5.3. **Accessibility**

Teachers' perceptions of the accessibility of the technology were a function of the level of availability of the resource and the amount and the effectiveness of organisational support.

D) **Availability**

Schools' directors referred mainly to the physical availability of the resources (amount of hardware and software resources existing in the school) when describing the IT initiatives.

The study's findings, however, show that while physical availability influenced uptake, the level of resource *as perceived by the teachers* was more indicative of the level of uptake.

Perceived availability was a function of: a) teachers' level of awareness of the resources at their disposal and the procedures for their use and b) the logistics of using the resource, i.e. the extent to which organisational arrangements did not obstruct the use of computers by teachers. These arrangements included matters such as finding the key to the computer room, obtaining the right plugs and being able to book the computer room for specific dates.

Teachers' perceptions of availability were, in many cases, lower than physical availability, mostly due to flaws in the schools' information systems and the high rate of occupation of the computer rooms by Computer Studies teachers. This assessment of the rate of occupation of the computer room was strongly disputed by Computer Studies teachers. This discrepancy be explained by the fact that Computer Studies' teachers considered the computer room as essential for them but as an 'option' for teachers of other subjects. As a result, what they perceived as 'sufficient' computer room availability for the other teachers did not necessarily coincide with what the other teachers themselves believed they needed.

E) **Organisational support**

The level and effectiveness of the organisational support provided by the school for the teachers shaped their perception of the accessibility of the technology.

Organisational support consisted of: a) training, b) opportunities for professional interaction and c) technical advice.

1) **Training**

Training effectiveness was found to be limited due to inadequacies in organisation (e.g. inconvenient course hours or dates), content (irrelevant to teachers' main concerns) or delivery (e.g. foreign instructors with poor command of the Spanish language).

2) **Teacher interaction**

Opportunities for professional interaction were scarce due to inadequate organisational arrangements and lack of time. Professional dialogue and interaction were perceived by many teachers as crucial to overcoming inhibitions by exchanging ideas and support. Professional interaction was also important, in light of the major flaws in the schools' information systems, to help circulate information about available resources and 'success stories' about uses of computers by teachers.

3) **Technical advice**

Technical support structures did not address some important concerns of the teachers. Furthermore, in some cases, the negative or 'elitist' attitudes of the support staff inhibited teacher use.

6.6. **How can the degree of computer use be explained?**

Research question 2b) is concerned with explaining the degree of use of computers by teachers. As shown earlier in this chapter, more than two thirds of the teachers had never used computers in the schools. To understand this phenomenon, the implications of computer use are examined below from the perspective of the teachers.

Most of the teachers use methods whose 'initial costs' (time needed to prepare a course for the first time) had been largely redeemed over many years of teaching, whose 'running costs' (class preparation time) were extremely low, which were safe and noncontroversial visavis the inspectors and that were effective in helping them meet the duties for which they perceive themselves as accountable (timely coverage of the entire syllabus, class control and discipline). The study's results showed that:

A) within the existing organisational structures of the schools and in the absence of institutional incentives, for most teachers using computers entailed **high costs, high risks, and low rewards (i.e. low net value)**;

B) **congruence of the technology with teachers' views, beliefs and practices was frequently perceived as very low** due to the challenges that teaching with computers poses to the longestablished ground rules of class management and teacherstudent relationships; and

C) **accessibility of the resource was perceived by many teachers as low** due to flaws in information systems, inadequate logistical arrangements, ineffective training, lack of time and ineffective technical support.

Under these conditions, it was perfectly 'rational' (in the sense of choosing the most costeffective solution to achieve certain goals) for a majority of the teachers not to change methods.

One of the findings related to research question 1b) was that teachers of Science and Maths used computers in a larger proportion than teachers of other subjects. This could be explained by the fact that they perceived lower risks (i.e. higher value) in using computers, higher congruence and higher accessibility, as argued below.

They may have perceived the risk of using computers as lower than other teachers because: a) they are used to conducting 'practical classes' (e.g. Maths classes dedicated to problemsolving) where the pace and direction of the lesson is not fully dependent on the teacher and b) Science and Maths inspectors, being themselves experienced Science or Maths teachers, are used to participative teaching methods implemented outside classrooms.

Science and Maths teachers may have perceived a higher level of congruence between the use of computers and their practices because they are used to spending part of their teaching time out of the regular classroom (e.g. in Physics or Chemistry laboratories), using machines (e.g. microscopes) and relying on other people (laboratory assistants). They also perceived a high congruence between using computers and a widespread view among teachers that computers were 'number crunchers' and hence useful mainly for use in Maths and Sciences.

They may have also perceived accessibility as higher because most computer INSET courses addressed their concerns more effectively than the concerns of other teachers. Most examples used in computer INSET courses referred to Science and Maths concepts and instructors were, in general, themselves teachers of Maths or Sciences.

Teachers who used computers for personal applications were more frequently users of computers. This may be because using a computer for personal applications helped them compensate for shortcomings in training and reduced their dependency on the computer room for practice and software review.

6.7. **Comparisons with the literature**

Research question 3 sought to establish the compatibility of the main results of this study with the findings of the literature review.

The results of the study stress the importance of teachers' values and beliefs and the impact of the organisational context within which teachers work and interact. This is compatible with the findings of Gross (1971), Doyle and Ponder (1977), Chandra (1986), Cuban (1986) and Somekh (1989), among others.

This study therefore supports the body of research which considers theories of technological determinism as inadequate to explain the processes involved in computer uptake. These theories view teachers' decisions to adopt innovations mainly as a function of technological access, the assumption being that given enough resources uptake would be inevitable (White, 1949, p. 365).

One of the main findings of this study is that teacher decisionmaking is shaped by their perception of the value and congruence of using computers in their teaching. This coincides with findings by Doyle and Ponder (1977) who argued that the perceived 'practicality' of an innovation is the crucial determinant in teachers' uptake.

The cost-reward equation in teachers' decisionmaking has been discussed by authors such as Blumenfeld et al. (1979), who argue that 'payoffs' for the teacher will have to be more clearly envisioned before conventional teaching methods that have paidoff in the past are changed. Rhodes and Cox (1990) found that teachers' perceptions of an increase in their workload if they used computers inhibited uptake. Cuban (1986, p. 218) estimates that

> **'it is the high personal costs that teachers have to pay when they try to implement different ways of teaching within current organisational structures and beliefs that spells success or failure in processes of educational change'.**

Teachers' perceptions of the congruence of the innovation with their practices, views and beliefs have been reported as a crucial factor by Olson and Easton (1986) who refer to 'routine' and 'novel' procedures depending on the extent to which they 'strain existing teaching routines'. Similarly, Chandra (1986, p. 305) found some teachers perceived themselves as unable to acquire the new expertise because of being 'not logical or mathematical' people.

This study found that teachers' perceptions of their own confidence and competence to use computers were major determinants of computer use. Similar findings have been reported by Anderson et al. (1979), Sheingold et al. (1983), Heywood and Norman (1988), Somekh (1989) and Blease and Cohen (1990. According to Hawkridge et al., authors of one of the few recent studies on computers in Third World schools, the key difference between teachers who adopt the innovation and the ones who do not is 'the degree of mastery they feel they have over the technology. (Adopters) feel in control, (the others) feel inadequate' (1990, p.115).

Lack of time, especially time for professional interaction, was identified as a powerful inhibitor of computer use in the schools of the sample. Similar findings were reached by authors such as Winner (1983), Chandra (1986), Somekh (1989) and Plomp et al. (1990). Sheingold et al. (1983, p. 429) stressed**:** 'most teachers did not seem to want more or different courses. What they wanted most was more time'. Hawkridge (1990) found that feelings of inadequacy can be overcome if teachers are given the time to master the computers in private and that teachers in developing countries have even less time to get acquainted with computers than their peers in industrial countries because they have to supplement their salaries by doing additional extraschool work. As discussed elsewhere in this chapter, the problem of lack of time was partly created by teachers' widespread multiemployment (employment in more than one school).

The effect of teachers' attitudes to the technology on uptake was found to be important but not determinant of computer use. This coincides with findings by Rhodes and Cox (1990) whose study of London primary schools concluded that teachers' acceptance of the value of computers for teaching did not necessarily lead to regular use. Shultz et al. (1989) similarly found that while approximately 90% of the teachers felt that computers were very useful for teaching, less than 25% of them were regular computer users.

Gender was not found in this study to be a factor in determining computer uptake even though male teachers were found to hold more positive attitudes to the use of computers. This could be because male teachers feel under stronger social pressure to sound positive about the use of computers. Compatible findings of the effect of gender were reached by Anderson (1979), Chandra (1986) and McCoy and Haggard (1989). However, Rhodes and Cox (1990) found

that computer use was much higher among male than female primary school teachers. There was an indirect effect of gender on teachers' access to training. Some female teachers cited the need to return home early in the afternoon to take care of their children as an additional factor limiting their access to computer INSET courses. No male teachers made reference to this issue.

Teaching experience and seniority were also found not to have affected the use of computers in this study which is contrary to research by Anderson et al. (1979) and McCoy and Haggard (1989), who found that the number of years of teaching experience was a significant predictor of teacher use. Anderson et al attribute this association between experience and degree of use to the fact that more experienced teachers tend to have more autonomy in choosing their assignments. They may be able for example to select smaller groups or older groups where discipline is less problematic. No similar increase in teachers' autonomy occurs in Uruguay's secondary schools.

Teacher participation in IT developments was not found in this study to be a major factor in influencing uptake. Teachers seem more concerned with receiving adequate support and training than with participating in the planning process. This is compatible with evidence presented by Huberman and Miles (1984) and Brown and McIntyre (1982) showing that 'power equalisation' and teacher participation do not necessarily lead to uptake. However it differs from findings of authors such as Blumenfeld et al. (1979) and Johnson (1986).

Teacher IT training was found in this study to have had a positive but limited effect on uptake. The implication being that unless training is geared to the specific needs of the individual teachers involved, there is little impact on their use of the technology. This is compatible with studies by Fullan (1982, p. 76) for example, who argues that teacher development is a major factor in successful implementation but cautions: '... it is not the amount of inservice training but the nature of it that counts'. Chandra (1986), Ellis (1986), Plomp et al. (1990) and Rhodes and Cox (1990) also point towards the effectiveness of computer INSET courses as a major determinant in uptake.

Lack of hardware and relevant high quality software was a major organisational constraint to computer use in the schools. This is singled out by most authors as a powerful inhibitor of use, especially in developing countries. Harper (1985) argues that lack of software geared towards the local curriculum and language is an even greater barrier in developing countries. Schools in the Third World are hampered, according to Hawkridge et al. (1990, p.281), by a 'local courseware famine'.

The centralised management of computer resources was found to have a strong impact on uptake. The same finding has been reported by authors such as Blumenfeld et al. (1990), Ellis (1986) and Watson (1990). In Hawkridge et al.' s study of Third World schools, many teachers similarly indicated that having to take the students to a special computer room caused disruption which inhibited the use of computers.

While many of the results of this study are highly compatible with findings of the related literature, others differ or, in some cases, have seldom been mentioned before. Some of these differences may be related to characteristics of a developing country with a highly centralised educational system.

A factor underreported in the literature but found to be highly influential in this investigation is the role of inspectors. In the highly centralised Uruguayan educational system, NEA inspectors seemed much more influential than school directors in shaping teachers' reactions to proposals for change. Inspectors were perceived by many teachers as the main source of risk associated with using computers for teaching.

Conversely, the role of the principal seemed much less decisive than depicted in the findings of Blumenfeld et al. (1979), Fullan (1985, p. 76), Gillman (1989, p.5), Rhodes and Cox (1990) and Hawkridge et al. (1990). This could be due to the highly centralised nature of an educational system where little room for curriculum innovation is left at the school level. The main priority of directors seems to be managing the highly bureaucratic relationship with the NEA by sending all required forms and reports and ensuring that a schools' operation conforms entirely with the NEA's regulations. As a result, directors may have little time and energy left for dealing with innovatory activities (e.g. formulating and communicating policy, motivating teachers and establishing feedback mechanisms).

Another factor little discussed in the literature is the impact of multiemployment on teachers' use of computers. Virtually all teachers in Uruguayan secondary schools work in at least two different schools (CEPAL, 1990). The effect of this multiemployment is manifold: a) it reduces the already scarce spare time for personal study because of the transfers involved between geographically distant schools and b) it increases the 'cost' of teaching with computers because not all schools (especially the state schools) have computers. Therefore, teachers who invest time in preparing computer classes cannot benefit from that investment in all their places of work and they are therefore forced to have two different sets of materials for the same lesson. Even if all the schools where a teacher works have computers, the equipment may be incompatible or one school may not have the same software as the others, thus forcing the teacher to learn to operate different programs.

Another highly specific factor was the problem of language. Spanish is the national language in Uruguay but most of the software available worldwide is designed and developed in English or French. Translations are usually of low quality, incomplete (e.g. error messages are not translated) and fail to take into account local dialects. Language was also found to be a problem in relation to training. Many schools found it necessary to hire foreign instructors with valuable knowledge and experience in the use of computers in teaching that was not available locally. However it was found that the schools' directors systematically overestimated the capability of most teachers to benefit from intensive courses taught in a foreign language.

The literature on the use of computers in schools in developing countries refers to factors related to problems of infrastructure, technical maintenance, lack of software geared to the local curriculum and in the local language, overcentralisation of curriculum planning and lack of time for training (UNESCO, 1983; JenningsWray, 1985; Harper 1985; Hawkridge 1990).

Problems of infrastructure (e.g. blackouts) were not found to influence computer uptake in this study. However, as discussed above, lack of software, overcentralisation of curriculum planning and lack of time strongly influenced the use of computers.

6.8. **Recommendations**

A general conclusion of this study is that using computers for teaching represents a difficult change for teachers, involving challenges to long established practices and beliefs and requiring a high level of ongoing support.

The research showed that computer uptake was a complex process, influenced by a set of interrelated variables at the teacher, school and extraschool levels. One of the most significant implications is that uptake may not depend on the effect of individual factors but rather on the result of the dynamic interplay of various forces. While an inadequate level of resource could inhibit use, higher levels of provision (e.g. increasing the number of computers) should not be expected to lead to increased uptake if other organisational constraints (e.g. inadequate

training, lack of time, ineffective support, overlong syllabi) are inhibiting innovation. Teachers felt that solving these organisational constraints was not possible at their level. They perceived schools' directors as responsible for providing solutions for organisational constraints.

Recommendations can be made, based of this study' s findings, that could be of use for policy makers at the school or national level.

6.8.1. **National policy**

Discussions of national IT policies in Uruguay have traditionally been dominated by issues of software and hardware provision and teacher training. However, the results of this study show that most teachers perceived the reactions of inspectors as a crucial factor influencing uptake at the national level. The role of the inspectors seems not so much *repressive* (there were few concrete cases of inspectors actually giving bad marks to teachers for using computers) as having a *deterrent* effect (teachers were reluctant to use computers in case inspectors would not look favourably on the technology).

The NEA has not yet formulated a comprehensive IT policy but is looking with interest at various IT initiatives being carried out in private schools. It would be important for the NEA Inspectorate to make public its position on the subject to enable teachers to consider the use of computers with greater confidence. In the long run it should be important to introduce changes in teachers' assessments criteria. Syllabi should also be revised in the long run taking into account the problems of length in content that have been discussed in this study.

6.8.2. **Innovation strategy**

The study found that while the three schools had provided computer INSET courses and set up support structures, none of them had implemented an overall strategy to introduce the use of computers for teaching across the curriculum. The lack of an integrated innovation strategy could be partly blamed for inadequacies in schools' information systems, computer INSET courses and support structures that influenced the use of computers for teaching in the schools.

The results of the study show the importance of teachers' values and beliefs in shaping their reactions to the innovation. As a result, Empiricalrational strategies (Chin and Benne, 1976) where the emphasis is mainly on providing technical information and support may not be effective. Normativereeducative strategies (Chin and Benne, 1976) should be considered. In these approaches human behaviour is acknowledged to be influenced by the value systems of individuals. Powercoercive strategies are not recommended (Chin and Benne, 1976) since authors such as Huberman and Miles (1984) have pointed to their ineffectiveness in the longterm.

6.8.3. **Directors' actions**

The strength of a director's commitment to the use of computers was found to have some influence in determining teacher use. Directors should find direct and indirect ways to show their own belief in the value of the technology and their commitment to its use in the schools. Measures could include visibly using a computer for personal work and keeping track of which teachers are using the computer room. It could also be important for the directors and their deputies to attend computer INSET courses with the teachers.

However, directors' encouragement to the teachers to use computers should be carried out with care to avoid infringing teachers' professional autonomy. Administrative pressure should be avoided with emphasis rather on 'friendly monitoring' and the provision of incentives.

6.8.4. **School communications**

Flaws in internal communications were found to strongly affect the use of computers. Internal communication systems should be implemented to keep teachers aware of the resources at their disposal, the procedures to make use of them and the school's plans and expectations. These communication systems do not need to be complex or 'high-tech'; a simple bulletin board, systematically kept uptodate could achieve most of these results. Periodically, meetings between schools directors and teachers should be held with the purpose of discussing new investments and problems experienced by teachers when using computers for teaching.

6.8.5. **It resource management**

The centralised management of computer resources forced the teachers to change their practices in ways they found inconvenient (e.g. booking facilities and moving to the computer room).

While there are valid reasons to adopt a centralised management approach (e.g. equipment security, concentration of sufficient computers in one room to cater for a whole group) the constraints of this model should be clear. If schools regard it as important to promote the use of computers across the curriculum, alternatives should be considered when planning new investments. Some teachers wished to have their own equipment in their own rooms. This would help them use the computers to prepare classes and review software. However spreading equipment very thinly would limit the strategies that could be used with students. An alternative is to have two computer rooms: one for Computer Studies and one for the other subjects. This would not avoid the need for moving but would provide much greater booking flexibility for teachers.

6.8.6. **Support**

Support should address teachers' main concerns. In particular teachers seem to find it important that a member of the computer staff be present when they use the computer room with students. Many teachers feel that they should only be in charge of conducting the class from the educational point of view while a computer technician is responsible for the equipment operation and safety.

The policy of employing computer personnel for the dual role of computer coordinators and teachers of Computer Studies has been found to create conflicts over the administration of the resource and should probably be revised. Teachers perceived the computer coordinators as seeing their support tasks as of lesser priority than teaching Computer Studies. All computer coordinators had a 'scientific' background. When recruiting computer support staff a greater diversity in their backgrounds should be sought to provide more effective help to teachers of nonscientific subjects. Procedures for the purchase of software and other materials should be made more straightforward to avoid lengthy and demoralising delays.

6.8.7. **Computer inset**

Computer INSET provision should take into account teachers' concerns and real time constraints. Teachers expressed the need for training to be more focused on concrete educational applications rather than technical issues. Course content should reflect these needs by dedicating more time to educational applications.

Many teachers were unable to attend courses because of timetable problems. Courses should be organised with greater consideration given to teachers' time constraints. It would be highly advisable to pay the teachers for their attendance and announce course timetables *before* the school year begins to allow teachers to organise their weekly workload accordingly. It is important that computer INSET strategies consider the different needs of teachers of different subjects and ensure that course content is relevant to each subject. Finally, the selection of instructors should be made carefully ensuring that their own background does not prejudice the course outcomes.

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APPENDIX 1

Survey questionnaire
(Translated from Spanish)

Standardised introduction

I request your help in answering a few questions that I hope will not occupy more than 10 minutes of your time.

This questionnaire is part of a research degree project. As you know, schools all over the world have introduced computers in large numbers in the last few years. This phenomenon has also been common in developing countries.

A large body of research is nowadays dedicated to studying the impact of this technology in schools. No absolute answer can be yet provided today on the real value of computers for teaching. We would like to ask in this questionnaire about your experience and your view.

Your cooperation is of the utmost importance for this investigation, the first of its kind to take place in Uruguay. Confidentiality is assured.

Please do not hesitate to consult me in case you need clarification of any question.

Personal information

1) Name --------
2) Subject --------
3) Gender (m/f)
4) Years of teaching experience --------
5) Years teaching in this school --------
6) Do you usually use personal computers? (y/n)

Use of computers

1) Have you ever used computers for teaching in this school?

a.) No, I have never used them.
b.) No, I have never used them but I have considered it
c.) Yes, I have used computers for teaching.
When did you last use them (year)?

2) What are your plans for the future as related to the use of computers?

a.) I have not used computers in this school and I am not considering to start
b.) I have not used computers in this school but I will consider using them next year
c.) I have used computers in this school and I am planning to increase their use
d.) I have used computers in this school and I am planning to keep on using them
e.) I have used computers in this school and I am planning to decrease their use
f.) I have used computers in this school and I am planning to stop using them

3) If you have not used computers for teaching

a.) Have you ever used computers for teaching in any other school? Where?

Resource availability

1) Are there computers and programs in the school that you can use for teaching in your subject in case you decide to do it? (y/n/don't know) If yes, how many?

2) Could you mention your favourite program?

Training

1) Have you received any formal IT training?

a.) None at all.
b.) Less than 10 hours.
c.) Between 10 and 30 hours.
d.) More than 30 hours.

Views on the value of computers for teaching

Please circle the statement with which you associate yourself most closely. There is no "right" or "wrong" answer, it is your own view that is important.

1) Computers can contribute positively to teaching and learning.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

2) The time and effort necessary to implement the use of computers in teaching are out of proportion with the educational benefits that can be achieved.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

3) Every teacher should have access to computers.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

4) Computers enable the teacher to teach in new and useful ways.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

5) Computers allow more individualised learning.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

6) The use of computers for teaching may erode the role of the teacher in the classroom.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

7) Computer education should be part of every teacher's initial training.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

8) The introduction of computers into schools is a passing 'fad' with no longterm educational implications.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

9) Students enjoy working with computers.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

10) Computers in schools are mostly useful to teach Computer Studies.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

11) Computers are too expensive for secondary schools, especially in developing countries.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

12) I wish we could have had computers when I was a student in secondary school.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

13) There are many other things teachers should do to improve their teaching before engaging themselves in of using computers.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

14) The school should have more computers.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

15) Computers provide opportunities for more creative learning.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

16) Computers are not reliable enough to plan whole classes around them.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

17) Using computers for teaching is unfair because it creates a difference between the children who have computers at home and the ones who don't.
   a) strongly agree
   b) agree
   c) don't know
   d) disagree
   e) strongly disagree

18) Computers can ‘desocialize’ many children who get hooked to the screen.
   a) strongly agree
   b) agree
   c) don’t know
   d) disagree
   e) strongly disagree

19) Computers are one of the most important machines that have become available for schools in this century.
   a) strongly agree
   b) agree
   c) don’t know
   d) disagree
   e) strongly disagree

20) Computers can solve concrete problems that teachers face in their teaching.
   a) strongly agree
   b) agree
   c) don’t know
   d) disagree
   e) strongly disagree

Would you like to add any comment on the use of computers for teaching?

APPENDIX 2

Interview schedule

(Translated from Spanish)

Standardised introduction

I would like to talk about the use of computers in your school on a confidential basis. This study is primarily interested in gathering the teacher's perspective and without your help and openness we could never hope to understand efforts to innovate in this and other schools.

This study is fully authorised and supported by the school. A summary of this interview will be shown to you in a few weeks to ensure we have interpreted correctly your perspective. In any case your afterthoughts are welcome at any point.

Let's start with the first question

Note: the interviews were semistructured. Not all teachers were asked all the questions.

Section 1 first time

1) When did you first become aware of the availability of computers in the school?
2) Who if anyone mentioned computers to you for the first time in the framework of the school?
3) What was your first impression? Has this initial impression changed? Why?
4) What do you think were, and are, the expectations and aims of the school in incorporating computers?
5) What was the general reaction and attitude of the other teachers as far as you know? has this attitude changed?
6) Have you been encouraged in any way formal or informal to try and use computers for teaching? how? by whom?

Section 2 barriers and facilitators

1) Do you see the computers helping and enhancing your teaching in any way?
2) Can you see the use of computers hindering your teaching in any way?
3) Suppose you decided to use computers in your teaching,
   can you foresee any obstacles or problems? Any facilitators?
   Doyouthinkthoseobstaclesareonthewayofallteachersorareparticulartoyouoryoursubject?
   How do you think obstacles could be circumvented?
4) Do you think to start using computers in your teaching would involve a significant 'first time' effort (training, preparing lessons etc)? Would all that effort be worthwhile? What about after the initial period would the workload be bigger than now?

Section 3 use of computers for teaching

1) <u>For users</u>

a) <u>You have used computers for teaching last year</u>
   What was your purpose in using them?

Did you have to surmount any specific obstacle in order to use the computers? If there were obstacles how did you surmount them? Did you receive any help support?
Were you satisfied with the results?
How will this experience influence your future use?

b) Think of the first year you used computers
Why did you start that particular year?
Was there any obstacle that was previously holding you back reduced (lack of hard or soft, lack of training, lack of support, lack of time etc)?
Did any new instructional need arise?

1) For non users

a) Can you see yourself using computers in your teaching? In what ways?
b) Have you used computers for teaching in another school but not in this one? If yes, why? Are there obstacles or disincentives in this school that are not present in the other?

Section 3 **- Perceptions on the value and impact of using computers for teaching**

1) Suppose an industrialist is offering to donate a sum of money to the school for capital investment. How do you think this money should be spent?
2) Do you think the use of computers may affect your working conditions?
3) Do you think computers may benefit some students more than others (age, gender etc)?
4) Do you think computers are better suited for some subjects than others?
5) How do you compare computers with other educational resources such as video for example in terms of their potential impact, complexity for teaching in your subject?
6) What is your view of the role of computers in society in general?

Section 4 **- Self perceptions and views on teaching and the school**

1) Are you free to choose teaching methods and resources?
What are the constraints or impositions?
2) What teaching resources do you usually use?
What are the reasons to prefer these resources?
3) What would you say are the most important needs and limitations in your current teaching methods resources? How do you think these needs could be met?
4) What do you see you as your role as a teacher?
Facilitator (learn by enquiry), instructor (learn by instruction) etc.

Section 5 **- computers in the school**

1) What is the role of the director in relation to IT activities?
2) What do you think are the director's views on the use of computers in education?
3) What is the role of the computer coordinator?
4) To what extent do you think the computers are being used for teaching in the school? Why?
5) Is there any teacher in the school that you would find making good use of computers? Why?
6) How important do you think it is for the school if you use or not use computers in your teaching?

Training

1) **Confidence**

a) Do you feel qualified to consider critically the use of computers for teaching?
b) Do you feel qualified to choose software?
c) Do you feel qualified to use the school computers on your own?
d) Do you feel qualified to advise other teachers on the use of computers for teaching in your subject?

2) **Competence**

a) How would you describe the level of your competence in using computers for teaching?
b) What do you think should be the level of knowledge for a teacher to be an effective user of IT for teaching?

3) **Training**

a) What type of training did you receive?
b) Whose idea was for you to go?
c) Did the school pay for your IT training?
Was the training in your own time?
d) Was your IT training part of the regular school INSET effort?
e) Do you feel you need further training? In what area?

Information

1) How do you usually become aware of the availability of hardware and software?
2) Do you have access to information on IT activities in other schools in Uruguay or internationally?

CUESTIONARIO PARA DOCENTES SOBRE EL USO DE COMPUTADORES EN LA EDUCACION SECUNDARIA.

Fecha: 3/4/1991 Hora: 09:40
Instituto de Enseñanza: _____

INTRODUCCIÓN:

Estimado docente:

Nos permitimos solicitar su ayuda para responder unas pocas preguntas que esperamos no ocupen más de 10 minutos de su tiempo.

Su cooperación es de capital importancia para llevar adelante este proyecto de investigación, el primero de su tipo que se realiza en el Uruguay. Se asegura la absoluta confidencialidad en todos los puntos consultados.

Como Ud. Sabe, institutos de educación alrededor del mundo han introducido un gran número de computadores en los últimos años. Este fenómeno ha sucedido tanto en países en vías de desarrollo, como en países desarrollados.

Un gran número de proyectos de investigación se ha dedicado al estudio del impacto de esta tecnología en los institutos de enseñanza. Todavía no existe una respuesta definitiva sobre el real valor del uso de computadores en la enseñanza. Esta investigación se realiza con el objetivo de conocer la perspectiva específica del docente. En este marco, nos gustaría conocer su opinión personal, en este cuestionario, sobre su experiencia y su punto de vista en este tema.

Esta investigación se realiza con el apoyo de la dirección del instituto.

DATOS PERSONALES:

Nombre: *Raquel Romano Iriburo*.

Materia: *Inglés*

Sexo: masculino: femenino: *x*

Años de experiencia docente: *20*

Años en este instituto: *12*

¿Usa comúnmente computadores en su actividad personal (para escribir cartas por ejemplo?

SI NO *x*

PREGUNTAS SOBRE EL USO DE COMPUTADORES EN LA ENSEÑANZA:

NOTA: Para responder a las siguientes preguntas, la expresión **"uso de computadores en la enseñanza"** está definida como el uso de computadores a iniciativa del docente, con la participación de todos o parte de los estudiantes de un grupo. El uso de computadores puede ser durante el tiempo en que dura la clase o no; dentro del salón de clase o en el laboratorio de informática; etc..

La definición **"uso de computadores en la enseñanza"** aceptada para este estudio, **no incluye** el uso personal por parte del docente, en el cual los estudiantes no están involucrados; como podría ser por ejemplo, la preparación de clases usando un procesador de palabra o la realización de promedios de actividad estudiantil usando una planilla electrónica.

Por favor; responda las siguientes preguntas;

1) ¿Ha utilizado computadores en sus clases en este instituto?

	No, y no lo he considerado.
X	No, pero lo he considerado como una posibilidad
	Sí, he usado computadores en mis clases.

2) ¿Cuáles son sus planes de futuro en lo que respecta al uso de computadores en la enseñanza?

	No he usado computadores en la enseñanza en este instituto y no estoy considerando comenzar a hacerlo en el futuro.
X	No he usado computadores en la enseñanza en este instituto pero consideraré usarlos en el futuro.
	He usado computadores en mis clases en este instituto y estoy planeando incrementar su uso.
	He usado computadores en mis clases en este instituto en los últimos años y estoy planeando seguir haciéndolo.
	He usado computadores en mis clases en este instituto en los últimos años, pero estoy planeando disminuir su uso.
	He usado computadores en mis clases en este instituto en los últimos años, pero estoy planeando dejarlos de usar.

3) <u>Si Ud. no ha usado computadores en la enseñanza en este instituto:</u>

¿Ha usado alguna vez computadores para sus clases en otro instituto?

SI *x* NO

¿Dónde? *U.T.U.*

PUNTOS DE VISTA SOBRE EL VALOR DEL USO DE COMPUTADORES EN LA ENSEÑANZA:

Por favor, indique la opción más cercana a su opinión en la materia. No hay respuesta **"correcta"** o **"incorrecta"**; es su punto de vista el que nos interesa en esta encuesta.

	Totalmente de acuerdo	Estoy de acuerdo	No sé/ No opino	Discrepo	Discrepo totalmente
1) Los computadores pueden contribuir positivamente a la enseñanza y el aprendizaje.	√				
2) El tiempo y el esfuerzo necesarios para llevar a cabo el uso de computadores en la enseñanza es excesivo respecto a los beneficios educativos.	√				
3) Todo docente debería tener acceso a computadores para la enseñanza de su materia.	√				
4) Los computadores permiten a los docentes utilizar nuevas y útiles técnicas de enseñanza que no eran posibles anteriormente.	√				
5) Los computadores permiten una enseñanza más individualizada.	√				
6) El uso de computadores puede afectar negativamente la autoridad del docente en la clase.					√
7) La informática debería ser parte de todo programa de formación docente.	√				
8) La introducción de computadores en institutos de enseñanza es un fenómeno pasajero que no tendrá consecuencias educativas a largo plazo.					√
9) Los estudiantes disfrutan trabajando con los computadores en el instituto.	√				
10) Los computadores en los institutos de enseñanza son útiles sólo para enseñar computación.					√
11) Los computadores son demasiado caros para escuelas secundarias, especialmente en países en desarrollo.				√	
12) Me hubiera gustado tener acceso a computadores cuando era estudiante secundario.	√				

13) Para el docente en actividad, el aprendizaje de informática educativa es una necesidad a resolver en el corto plazo.	√				
14) El instituto debería invertir más en informática.	√				
15) Los computadores proporcionan oportunidades para un aprendizaje más creativo.	√				
16) Los computadores tienen problemas técnicos con demasiada frecuencia, por lo que son máquinas poco confiables para utilizarlas en clase.					√
17) El uso de computadores en la enseñanza es injusto, porque crea diferencias entre estudiantes que poseen uno en su casa y aquellos que no.					√
18) Los computadores aíslan al estudiante de su entorno social habitual.					√
19) Los computadores son una de las máquinas más importantes que en este siglo se han introducido en los institutos de enseñanza.		√			
20) Los computadores permiten resolver problemas concretos que los profesores tienen durante su práctica docente.				√	

DISPONIBILIDAD DE RECURSOS:

¿Existen computadores en el instituto que Ud. Pueda usar para impartir su materia en caso de que decida hacerlo?

si no no sé X

Si los hay, ¿cuántos? no sé X

¿Hay programas de computador (software) disponible en el instituto que Ud. Pueda utilizar en su materia?

si no no sé X

¿Podría citar cuál es su programa preferido?

ENTRENAMIENTO:

¿Ha recibido Ud. algún entrenamiento formal en el uso de computadores?

1) Ninguno
2) Algunas charlas introductorias
3) Un curso corto.
X 4) Un curso específico.

SUGERENCIAS:

¿Le gustaría agregar algún comentario general o complementario sobre el uso de computadores en la enseñanza?

"Me gustaría acceder al uso de computadoras en mis clases, hasta ahora no se ha concretado, creo que por falta de integración.
En la medida que las he utilizado, como experiencia piloto, ha sido ampliamente positiva.
El computador debería estar dentro de cada asignatura como un medio para un fin, el asistir al alumno en su aprendizaje creo que es fundamental. Lleva al alumno a tener otro interés en la materia, a investigar, a crear".

APPENDIX 3

ATTITUDE SCALE STATISTICS

Item-total	Statistics scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Alpha if item deleted
P1	67.3190	61.7148	.6300	.5573	.863
P2	68.1983	60.4038	.4851	.2857	.866
P3	67.4914	61.8869	.4558	.4066	.867
P4	67.4052	62.0170	.5694	.5390	.864
P5	67.9914	59.0173	.5192	.3962	.865
P6	67.4914	61.6434	.4975	.4098	.866
P7	67.4397	61.8137	.4925	.4337	.866
P8	67.7586	62.8282	.3618	.4157	.870
P9	67.5862	62.5403	.3710	.2262	.870
P10	67.3621	60.9112	.5819	.4118	.863
P11	67.4483	60.7190	.5651	.4831	.863
P12	68.4052	58.8518	.5830	.4325	.862
P13	67.8966	57.3457	.6715	.6032	.858
P14	68.1466	61.0131	.4868	.4550	.866
P15	68.3448	59.6888	.4057	.2797	.871
P16	68.2586	59.8282	.4573	.3199	.868
P17	67.9138	60.9490	.4450	.3828	.868
P18	68.3190	61.1235	.4306	.2964	.868

RELIABILITY COEFFICIENTS 18 ITEMS

ALPHA = .8728 STANDARIZED ITEM ALPHA = .8795

Marzo 2015