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Abstract

Young children in nursery and school at the present time are active participants in a community and a culture where the use of technology is a regular, and growing, part of daily life. This thesis discusses the possible benefits of children’s experience and awareness of ICT and examines aspects of teacher-child interaction in the context using computers to support literacy teaching in the classroom. A detailed consideration of the ‘scaffolding’ process and its role in supporting teaching and learning with ICT is made.

The thesis describes and analyses a research project carried out in primary and nursery school classes with children aged between 3 and 8 years, over a period of two years. The research was designed to explore how children use computers to read and write in the classroom and to investigate the teachers’ style of interaction when supporting children’s literacy with ICT. The research was conducted from a sociocultural perspective and a range of methods, including video recordings, observations, questionnaires and semi-structured interviews were used to gather and evaluate data from children and teachers.

After evaluation of the data, results from the project are analysed, and the thesis then discusses the findings of the study in relation to previous research and makes a number of points about the nature of teacher-child interaction around the computer during literacy sessions. The problematic nature of identifying and describing scaffolding and joint activity in the classroom is considered in detail and further areas for investigation discussed. In the concluding remarks a conceptual and theoretical position is advanced in the light of the study to determine ways forward for research in the field.
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Glossary

ACOT
Apple Classrooms of Tomorrow
A project set up by Apple Computers to demonstrate the potential for effective use of ICT in the classroom (see Dwyer et al., 1991).

BECTa
British Educational Communications and Technology Agency
A body funded by the UK government to monitor and promote ICT in schools.

BERA
British Educational Research Association

CAL
Computer Assisted Learning

CPD
Continuing Professional Development
Courses that support the professional development of teachers.

CSILE
Computer Supported Intentional Learning Environments
A networked learning environment that connects each classroom computer to a multimedia database which contains the ongoing work of the class (see Scardamalia).

Electronic Literacy
Electronic Literacy refers to literacy activities (e.g., in reading, writing, and spelling) that are delivered, supported, accessed, or assessed digitally through computers or other electronic means rather than on paper (see Topping and McKenna, 1999).

Foundation Stage
The organisation of the curriculum for 3-5 year olds in nursery and reception classes (see QCA, 2000).

IT
Information Technology
The use of machines to process information; including calculators, computers and video recorders.

ICT
Information and Communications Technology
A term adopted by the field of education (following the Stevenson Report, 1997) to recognise the communicative aspects of modern technology e.g. email and the Internet.

It should be noted that the above nomenclature has recently been the subject of a lengthy debate in the ICT community within the field of education, in the UK. It has been argued
that IT refers to the capability (skills and understanding) involved in using the technology and ICT refers to the technology itself. However, for the purposes of this study the definitions given above are used and no distinction is made between IT and ICT, except that ICT is seen as a more appropriate term that acknowledges the dynamic and communicative possibilities of the technology.

**I.L.S**  
Integrated Learning Systems  
Computer applications that are used (mainly) to support numeracy and literacy teaching. They provide individual children with a programme of tasks that can be monitored and assessed by the teacher.

**KS 1**  
Key Stage One  
The organisation of the national curriculum into stages. KS 1 includes children aged 5 to 7 years.

**KS 2**  
Key Stage Two  
KS 2 includes children aged 7 to 11 years.

**LAN**  
Local Area Network  
For example, the linking of all machines within a school.

**Literacy Hour**  
The organisation of literacy teaching in primary schools (KS1 and KS2) into a structured hour to include whole class work, teacher supported and independent activities and a plenary. The literacy hour is a feature of the NLS and is expected to take place every day (see DfEE, 1998). The literacy hour is also being adapted for work in KS3 (11-14 years).

**NAEYC**  
National Association for the Education of Young Children  
(Based in the USA)

**NC**  
National Curriculum  
The organisation of the curriculum in England and Wales into stages (KS1 etc), with detailed exemplification of content in subject areas and including a significant focus on literacy and numeracy (see DfEE, 1999).

**NCET**  
National Council for Educational Technology  
The predecessor of BECTa (see above).

**NGfL**  
National Grid for Learning
A network of education services based on the Internet intended to support teaching, learning, training and administration (see DfEE, 1997).

**NLS**
National Literacy Strategy
The framework for the teaching of literacy in primary schools in England and Wales, since September 1998 (see DfEE, 1998).

**NOF**
New Opportunities Fund
Funds from the National Lottery made available by the UK government to support the training of teachers in the effective use of ICT.

**PALM**
Pupil Autonomy in Learning with Microcomputers.
A project set up to explore the effective use of computers in the classroom (see Somekh, 1991).

**Scaffolding**
A term used to describe the support, guidance and assistance given by a more experienced learner to a less experienced learner.

**SCOLA**
Scottish Committee on Language Arts

**SLANT**
Spoken Languages and New Technology
A project developed to study how computers may support spoken language (see Mercer et al., 1991).

**UK**
United Kingdom
It should be acknowledged that whilst the UK refers to England, Northern Ireland, Scotland and Wales, the education systems are different throughout the UK. Therefore this study is mainly focused on education in England and Wales.

**VCR**
Video Camera Recorder

**VTR**
Video Tape Recording
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Bibliography
Chapter One

Introduction

Information technology has become part of everyday life and its use is now common place in both personal and business spheres, and by children from an early age. In the United Kingdom (UK) the introduction of Information and Communications Technology (ICT) into primary school classrooms has been one of the most significant changes in recent years. Although there has been considerable interest in the UK, and throughout the world, in the impact of computers on education (Collis et al., 1996; Leu, 2000; Luke, 1999; Somekh and Davis, 1997, etc), there has been relatively little published research on how the technology may best be used. As Collis et al. suggest, there is "no simple answer about how best to use computers in education" (1996: 117). Further, almost all of the research conducted, so far, into the influence of ICT in the classroom has been with secondary and older primary children. Relatively few studies have focused on the use of technology by children under eight years of age (Casey, 1997; Luke, 1997).

In light of this context, research would seem to have a particularly urgent and important role in continuing to investigate how the quality of learning in early years classrooms may be enhanced through the use of ICT, and how teachers can effectively integrate technology into their pedagogy. In this endeavour teachers themselves will need to be supported in developing forms of reflective classroom practice that enable them to make the best use of the educational and professional opportunities as the new technologies become increasingly available (Scrimshaw, 1997; The University of Warwick, 2000).
Literacy is an area of the curriculum that could be enhanced by the use of ICT. New technology, such as 'talking books', multimedia, 'talking word processors', e-mail and the Internet, could allow children far more independence from the teacher in literacy tasks. ICT may also free the teacher to focus teaching on the distinctive features of reading and the written process (Scrimshaw, 1993; Kuhn and Stannard, 1997; Moseley and Higgins et al., 1999; Barker et al., 2000). However, the development and use of communication technologies has far outpaced research on computer-mediated literacy (Reinking et al., 2000) and Leu (2000) suggests that the appearance in our classrooms of networked ICT, such as the Internet, requires us to redefine our understanding of the literacy curriculum. Research into the development and use of this electronic literacy is still very limited (Topping and McKenna, 1999; Tao and Reinking, 2000).

Early years teachers have a significant responsibility to foster children's abilities to read and write and currently they are also encouraged to incorporate technology in their classrooms Baker (2000). Although computers have now become commonplace features in early childhood classrooms many early years educators are unsure how to make the best use of them (Casey, 1997; Collins et al., 1997; Labbo and Reinking, 1999). Also, teachers wonder how to design computer activities to meet the individual needs of children at various levels of literacy (Labbo et al., 2000). There is clearly a need to investigate and demonstrate the effective use of ICT with children in the early years of education who are in the transition to fluent literacy. As ICT becomes established in the classroom it is also important that teachers learn about the effect of its influence on children's learning. Yelland (1999), for example, has raised the significant issue of the
need to consider the nature of impact of digital technology on childhood and take account of the child’s perspective of electronic media.

The new technologies such as multimedia and its educational application have generated considerable research attention recently from a sociocultural perspective. For example, Salomon (1993), Crook (1994), Wegerif and Scrimshaw (1997) and Säljö (1999), have acknowledged the influenced of Vygotsky in their research, which considers the social environment as an integral part of the process of teaching and learning with ICT. Also, other forms of networked computing are stimulating new interests in co-operative learning (Hewitt and Scardamalia, 1998; Leu 2000).

Research undertaken for this thesis has attempted to build on insights from the sociocultural perspective in order to carry out a detailed investigation of the role of the teacher in supporting children's literacy with ICT. The purpose of the study is, therefore, to describe and evaluate the characteristics of successful interaction between children and teachers, when using ICT for literacy.
Overview of the study

The thesis begins with a comprehensive review of the literature concerning ICT and pedagogy, teacher-child interaction with technology and early literacy and ICT. Each area is discussed separately under a different heading, and reference is made to a wide range of studies. In particular, those from the UK, the USA, Europe and Australia are considered, in order to present an international perspective.

Initially, insights from current research concerning ICT and pedagogy are reviewed. Studies by Somekh and Davis (1997), McFarlane (1997), Moseley and Higgins et al. (1999), for example, are given detailed consideration as they present useful overviews and summaries of literature investigating the classroom use of ICT. The University of Warwick (2000) review, despite its focus on secondary education, is also thoroughly discussed as it gives attention to issues of pedagogy with ICT that are consistent with primary and nursery education. A wider view of the social context of literacy and ICT is then expounded to draw upon recent work in the field of cognitive psychology written from a sociocultural perspective. Within this paradigm the work of Crook (1994); Littleton and Light (1999), Scardamalia et al. (1994), and Wegerif and Scrimshaw (1997), for example, has been concerned with describing and investigating the situated and distributed nature of children's learning (with ICT). Different models of teacher assistance are then examined in order to establish the role of 'joint activity', 'guided participation' and 'scaffolding' in the teaching and learning of early literacy with ICT. The theoretical perspectives on the teacher's role in supporting children's learning are allied to insights from the development and study of 'knowledge building communities'. 
These learning environments, which are designed so that ICT supports the development of knowledge through sustained, collaborative investigation, have generated increased interest over the last decade or so. The work of Scardamalia and Bereiter (1992, etc) establishing and investigating Computer Supported Intentional Learning Environments (CSILE) is the most well known, and is discussed in detail in the literature review.

The introduction of ICT into UK schools with unlimited access to the Internet (1998) and the National Literacy Strategy (1998) are considered together in Chapter Two. It would be difficult to over-emphasize the importance attached to both literacy and ICT in UK schools at present. The Government has invested a significant amount of money in the separate, but compatible, strands of literacy and ICT in schools in order to 'improve standards'. For example, the National Literacy Strategy (NLS) has been put into place in order to achieve the target of "80 per cent of 11 year olds achieving the standards of literacy expected for their age by 2002" (DfEE, 1998). Also, a National Grid for Learning (NGfL) has been developed for communication between children, schools, teachers, parents and government agencies - with the intention of connecting all schools to the Internet by 2002 (DfEE, 1997). The vital question is how the two initiatives combine so that the potential of ICT is fully utilised to support children's literacy in the classroom. It is significant to note that, apart from a few passing references to word-processing and CD-ROMs, there is surprisingly little reference in the National Literacy Strategy to the use of ICT in the Literacy Hour. The report on effective teachers of literacy (Medwell et al., 1998) also makes little reference to ICT. McFarlane (1997) has also criticised the curriculum model as being far removed from 'authentic' learning. She
argues that the NLS is unable to respect and respond to children's own ideas and
perceptions. Godwin and Perkins (1998) and Marsh and Hallet (1999), also, have
reservations about the manner in which the NLS has been imposed and prescribed by
central government.

However, it can be argued that there are considerable benefits for learning when using
ICT to promote literacy. These benefits can be realised both within all parts of the
'Literacy Hour' and at other times. The body of research evidence, particularly from the
USA (Labbo and Reinking 1999, for example), demonstrating that ICT can help children
become effective and fluent readers and writers, is critically reviewed in Chapter Two.
Currently, there are still some major issues concerning teacher's experience of ICT,
access, curriculum application, management and resources that are hindering the
realisation of this potential (Waller, 1999). Also, as Daiute (2000) argues, within the
context of ICT and electronic literacy children need to be taught critical literacy in order
to evaluate their literacy actions and to determine how these actions affect society and
support their own development. In the framework of the NLS, traditional conceptions of
literacy seem to overwhelm the new, emerging conceptions of literacy (Kamil and Lane,
1998) and, as Leu (2000) argues, current conceptions of literacy are not adequate when
exposed to the light of technological advances.

Labbo and Reinking's (1999) view of technology in literacy instruction as a set of
possibilities in relation to 'multiple realities' is considered a useful way forward. The
perspective of multiple realities allows for the consideration of the extremely rapid
advances of digital technologies and the fact that, in general, conventional schooling seems to integrate the technology at a much slower rate than the commercial world. Labbo and Reinking (1999: 481) see a more active, transforming role for technology and put forward a framework for investigating literacy and ICT in the classroom that is discussed in detail in Chapter Two.

A further issue concerns the fact that very little research has been undertaken with young children under eight years of age using computers, in general. There is a growing recognition of the impact of ICT on children's lives, particularly from the USA (Labbo et al., 2000) and Australia (Luke, 1999; Yelland, 1999), for example. They put forward the view that electronic media has a significant influence on childhood and suggest that children's early literacy and play experiences are shaped increasingly by electronic media. The developments in ICT (both hardware and software), in the last 5-10 years, that have enabled children to have much greater involvement in and personal control over, technology are considered along with an interest in comparing children's use of ICT at home and school (Downes, 1996; Facer et al., 2000; Klerfelt and Waller, 2000).

However, there are some early years educators who are very sceptical about the benefits of young children's use of computers (Barnes and Hill, 1983; Elkind, 1987, Healy, 1999). Concerns have been raised that ICT will cause harm to children's development because the computers may replace traditional play activities and increase the possibility that they become social isolates. This view is not in accordance with almost all of the published writing on ICT but it does remind us that not all adults working with young children are
advocates for technology. The review is concluded by the identification and discussion of a number of consistent themes that have emerged from the literature. Findings from this research are then drawn upon in order to identify a possible framework and methodology for the research project.

In Chapter Three a justification for the research is offered which considers ethical and political questions in detail. The impact of wider political and power dimensions on the use of ICT is considered (Apple, 1995; Giroux, 2000, etc) in order to reveal the underlying conditions that have effected the impact of ICT on the classroom practice. Critical questions concerning who participates in technology education and who benefits the most from ICT are then explored (Anning et al., 1992).

The research undertaken for the thesis has involved three phases; a Pilot Study; Phase 1 linked to a Continuing Professional Development (CPD) course focused on early years, literacy and ICT and Phase 2 following up a selection of teachers (and children) involved in the CPD course. The study was carried out with twenty-four teachers and their nursery and primary school classes with children aged 3 and 8 years, over a period of two years. Six teachers and classrooms were involved in the follow up during Phase 2 of the research. The CPD course lasted 10 weeks and ran twice, each time with twelve teachers. The teachers who attended the CPD courses were self-selected and a representative sample of this group were chosen for the follow up. The sample was arranged to include the representation of the range of year groups from 3-8, male and female teachers and children from a variety of socio-economic backgrounds.
The methodology of the study is discussed in Chapter Four, which starts by offering a thorough evaluation of a pilot study conducted with children aged 5-7. The purpose of the pilot was to test a quasi-experimental research design and a particular intervention programme involving ICT and writing (see Waller 1998). The evaluation of the pilot project pointed to a further investigation and analysis of the interaction, learning and teaching methods in the classroom, as opposed to a focus on the technology. A range of qualitative and quantitative research methods were used in the study including interviews with teachers and children, questionnaires, surveys, classroom observations and video recordings (VTR). In the methodology chapter particular attention is given to the use of VTR and a consideration of the ethics involved in using videotape for research in the classroom. The results and conclusions of the study are outlined in Chapters Five and Six, where a conceptual model of the teaching and learning of early literacy with ICT is advanced.

In undertaking this study I have drawn on the sociocultural perspective, as indicated earlier in this introduction. I have contended that this 'situative' perspective, because of its attention to the nature of social interaction, offers a view that may help to explain how teachers can best interact with children to support their learning with ICT. Also, I would want to acknowledge that my perspective is influenced by my early years background that includes teaching experience in nursery and infant schools and teacher education. Here, along with other early years' colleagues, a significant influence has been the notion of a 'developmentally appropriate' curriculum for young children (Bredekamp, 1986). This involves practice that acknowledges the child's experiences, understanding and role in the teaching and learning process.
My hypothesis, that by using software in appropriate ways with young children teachers can effectively support their literacy development, is essentially one of advocacy for ICT. As Miller and Olson (1994) point out, a great deal of the research investigating the use of technology in classrooms is from a position of advocacy; the expectation that ICT enhances teaching and learning. Clearly, this position should be acknowledged and accounted for by the researchers. I would therefore wish to firmly acknowledge, from the outset, my generally positive disposition towards the use of ICT in the classroom. However, this perspective is not a romantic view of ICT (see Beynon and Mackay, 1991) and the intention is certainly engagement in critical reflection on whatever findings result from the research.
Chapter Two

Review of the Literature on Scaffolding, ICT and Literacy

Introduction

The number of published articles on educational computing has significantly increased over the last five years. However, there is not yet a substantial research base concerning ICT and pedagogy, with particular reference to how computers are best used in the classroom. This review begins by providing an overview of some of the critical and current insights into the effective use of ICT, in general. The main part of the chapter then presents an in-depth discussion of the literature concerning literacy and ICT and, in particular, young children, ICT and literacy in order to try to identify consistent themes that are apparent from the research and studies involved. An extensive review of the research from a sociocultural perspective is offered to enable a focused consideration of the role of the teacher in supporting children's literacy and the development of 'knowledge building communities' (Hewitt and Scardamalia, 1998). This approach has emphasised the shared construction and distribution of knowledge around and through technology (Edwards and Mercer, 1987; Greeno, 1997; Lave, 1988; Rogoff, 1990; Pea, 1993). It has also argued that there is a need to take into account the wider political, social and cultural context of ICT, so as to fully understand the nature of classroom interaction (Crook, 1994; Hewitt and Scardamalia, 1998; Luke, 1999; Säljö, 1999; Wegerif and Scrimshaw, 1997). The review is divided into clear sections representing the themes discussed.
The University of Warwick has argued that:

The ever-increasing influence of the computer in schools and in the wider community will demand a far deeper reappraisal of the teacher’s role than is commonly recognised, requiring a fundamental and continual process of rethinking what is taught, how it is taught, and why.

(The University of Warwick, 2000: 1)

In order to clarify the position regarding the use of ICT in the literacy learning of young children and identify a framework for research the recent work of Labbo and Reinking (1999) on 'multiple realities' is considered. The chapter ends with the identification of research questions that will inform the agenda for this study.

1) Research into the effective use of ICT in education

There has been extensive interest, throughout the world, in the impact of computers on education (Collis et al., 1996; Luke, 1997; Reinking et al., 1998; Somekh and Davis, 1997, for example) and the number of published articles on educational computing is rapidly growing (Davis 1998). However, it could be argued that, there is not yet a substantial research base concerning the effective use of ICT in teaching and learning. Hargreaves (1997) contends that research evidence on 'what works' in the classroom, in general, is surprisingly thin. Further, there is still relatively little published research on the use of computers with children from the ages of 3-8 (Casey, 1997; Luke, 1999).

Somekh and Davis (1997), McFarlane (1997) and Moseley and Higgins et al. (1999), The University of Warwick (2000), for example, have summarised what have we learned, so far, from research into educational computing. There is a clear indication from this
literature that simply providing schools and classrooms with ICT will not change or improve the education of the children. Moseley and Higgins et al. (ibid) identify the "key messages" arising from the literature about ICT and pedagogy as follows:

1. Publications on the use of ICT in education have traditionally suffered from an excessive optimism with a high proportion of information being uncritical and prescriptive;

2. Research has been mainly conducted from experimental studies and findings do not always easy to translate into messages for effective classroom practice;

3. Researchers tend to use CAL whereas teachers tend to use open ended software;

4. There is a tension in the literature between those who see computers helping them do their jobs better [e.g. Underwood and Brown, 1997] and those who see computers as redefining teachers' roles with a move towards resource management and more independent learning by children [e.g. Papert, 1993];

5. Much of the research into the use of computers in classrooms is based on survey methods involving self-assessment and self-reporting by teachers. Little direct observation has taken place (Galton et al., 1999);
6. Knowledge and experience of computers are not enough to ensure that teachers use computers. The shift to using computers within the classroom takes time (Somekh and Davis, 1997);

7. The way in which teachers skills and beliefs and practices are related is complex (Wild, 1996).

(Moseley and Higgins et al., 1999: vii and viii)

In their detailed review of the classroom use of ICT to support literacy and numeracy, Moseley and Higgins et al. (ibid: xiv) note that little research data has yet emerged on how ICT might contribute to effective pedagogy. For example, only limited instructional research exists to evaluate the effects of the Internet on teaching and learning (Follansbee et al., 1997). Norris et al. (1999), further, argue that, in terms of ICT, the research community's findings have had little impact on the practitioner's community of the classroom. They suggest the reasons for this divide are that research articles are, by and large, written for other researchers. These studies do not go on to provide an analysis of why certain outcomes occurred. Whilst there are a number of published articles that summarise the literature and attempt to tell the practitioner 'what works', these articles tend to make quite general observations. Unfortunately, many studies do not include enough details for the study to be replicated in a real classroom. Norris et al. (1999) developed a style of augmentation, Convergent Analysis (CA), with the goal of trying to make better use of the research base in technology in education.
Collis et al. ((1996: 117) however, suggest that a preoccupation with 'what works' in one situation is misleading and that there are no simple answers about how best to use computers in education. They report on the findings of a multinational study (including three long-term international research projects) concerning children using computers in school and assert that there is "no best or right way to use computers - there is a need to fit the local situation" (ibid: 65). Further, Collis et al. (ibid: 43) argue that the 'effect' of the use of ICT in education cannot be expressed in a straightforward fashion but must be considered in the context of the complicated network of variables in which it is embedded. These variables include:

- hardware and software variations
- various characteristics of the children and teachers involved, including how the teacher integrates computer into meaningful learning experiences  
  (Collis, 1988, cited in Collis et al., 1996: 43; Salomon, 1994; Crook, 1994; Säljö, 1999)
- the influence of school, regional and national culture (Peled et al., 1989)

A more detailed discussion of these variables is given in the following section on collaboration, interaction and ICT in the classroom.

Collis et al. (ibid: 117) concluded that the whilst the impact and problems of ICT are the same across cultures, and that children are generally benefiting from and enjoying their use of computers, the teacher is a critical influence.
Teaching and learning with ICT in the classroom

As NCET (1994a) has pointed out, there is indication that the learning potential of ICT is far from being realised. There is evidence that there are large numbers of teachers, in all phases of education, who are not familiar with ICT and are therefore not using it in their teaching (Rosen and Weil, 1995; Stevenson, 1997; Goldstein, 1997). The current UK government has acknowledged the need for all teachers to receive training in the use of ICT and has invested over £230 million through the New Opportunities Fund (NOF). The objective of the training is to give serving teachers the same capability with ICT as that required of newly qualified teachers (The University of Warwick, 2000: 19). As Johnson (1995: 25) asserts, teacher development starts with the needs of the teacher in question and is best carried out in the context of the school. However, it is not clear how much of the NOF training will recognise this model of teacher development with ICT and relate to specific classroom and school contexts. Further, it remains to be seen how effective the NOF training will be in supporting the development of pedagogy with ICT, as opposed to the more limited objective of raising teacher's confidence with using ICT to support the current curriculum model.

Cuban puts forward reasons why new technologies have not changed schools as much as other institutions:

First, cultural beliefs about what teaching is, how learning occurs, what knowledge is proper in schools, and the student-teacher (not student-machine) relationship dominate popular views of proper schooling. Second, the age-graded school, an organisational invention of the late nineteenth century, has profoundly shaped what teachers do and do not do in classrooms, including the persistent adaptation of innovations to fit the contours of these age graded settings.

(Cuban, 1993: 186)
Salomon and Perkins (1998: 16) suggest that whereas computers were initially used as electronic workbooks for drill and practice purposes, "it became apparent that in fact they - very much like Trojan Horses - tend to carry with them a whole educational philosophy of knowledge construction, symbol manipulation, design, exploration and discovery". Although Salomon and Perkins suggest that ICT has often been assimilated into normal curriculum practice, they also suggest that computers can serve as "subversive instruments, their introduction promoting the restructuring of classroom learning environments, changes in teachers' way of functioning, redefinition of curricula, and new ways of assessment" (ibid; 16). Säljö (1998: 61), however, argues that the potential of ICT to significantly change interaction and learning in schools is rarely realised as classrooms may be too well 'buffered' to be much affected by computers and indeed may assimilate ICT entirely into their existing way of doing things.

The University of Warwick (2000: 1) in a comprehensive literature review, suggested that there have been three main areas of research on teachers' learning and use of ICT in the classroom. These are as follows:

- Research on factors that prevent teachers from using technology;
- Factors that encourage teachers to use technology;
- The learning experiences of teachers using technology.

The University of Warwick has argued that the research has yielded some interesting information about barriers teachers face (Cuban, 1993; Robertson, 1996), and the learning paths teachers follow when learning to use technology in environments with good technology facilities and support (Becker, 1994; Hadley and Sheingold, 1993).
However, each line of research continues, with little consideration of the others. They suggest that research therefore has had little impact on widespread teaching (2000: 19). Further, they point to the need for additional research to better understand the learning paths for teachers using ICT in context. Also, to understand and act on possible barriers on teacher learning and use of computers and the impact on children’s learning. As the University of Warwick has stated:

It would appear that reducing or avoiding barriers does not necessarily ensure the likelihood of teachers using computers. …Also it is not clear whether it is possible to create a barrier-free environment for teachers. The research also lends little insight into how identified barriers affect teachers in specific environments.

(The University of Warwick, 2000: 5)

Robertson (1996, cited in the University of Warwick, ibid: 3) suggested that teachers have a resistance to innovation with ICT in the classroom that can be categorised into the following themes:

- resistance to organisational change;
- resistance to outside intervention;
- time management problems,
- lack of support from the administration; teachers’ perceptions; or
- personal and psychological factors.

There is considerable evidence that teachers in general are resistant to change (Desforges and Cockburn, 1987; Fullan, 1991; Brown and McIntyre, 1993). This resistance to change within the profession crosses age phase and boundaries. As Galton et al. (1987) and others have shown, the practice of teachers is remarkably consistent over lengthy periods of time; maintaining the status quo is the norm.
Evans-Andris (1996, cited in University of Warwick, ibid: 2), however, acknowledged a more complex pattern of teacher's reaction to the advent of ICT in the classroom. She studied teacher's computer use over an eight-year period, in elementary schools located in a large metropolitan area of the USA, and identified three styles of computing use among teachers: avoidance, integration and technical specialisation. Evans-Andris argued that these styles play a significant role in children's access to ICT. She found that the dominant style of computing used by teachers in her study was that of 'avoidance'. This style was characterised by teachers who distanced themselves from computers and generally limited the number of ICT activities. These teachers generally were characterised by a low level of interaction with children while they worked with ICT and the children in these classrooms tended to be involved in limited and repetitive use of programs intended for drill and practice or word processing. Teachers who were identified as having a style that involved 'integration', accepted technology and generally incorporated ICT into their teaching methods and curriculum. Teachers identified as involved in 'technical specialisation' "embraced computers and viewed the technology as a challenge" (The University of Warwick, ibid: 2). These teachers tended to be involved in advocating and advancing the use of ICT throughout their school. For Evans-Andris, they were characterised by the ability to demonstrate highly successful teaching practice with ICT and these teachers were also concerned to teach children about the appropriate technical aspects of computer use.

McFarlane (1999), Underwood and Brown (1997) and Wood (1998), for example, have investigated the introduction of Integrated Learning Systems (ILS) into schools. ILS are
programs that are designed to provide an individual curriculum for children through ICT, usually in the subjects of English and maths. The system is organised so that teachers can manage and monitor the progress of individual children and the whole class. Brown and Underwood (ibid) suggested that ILS was most useful to support learning in maths. In general, they found improved teacher attitudes and use of computers. Underwood et al. (1996) identified five aspects of teaching where ILS made a positive impact. These were ICT development skills, classroom practice, learning styles, reflective practice and levels of collaboration. For Underwood et al., ILS is not seen as a substitute for teachers, rather it is a tool to aid them in their work. In addition, for a few teachers, using the ILS led to a rethinking of their pedagogy. However, the use of ILS in UK schools has, so far, been mainly in secondary and upper primary classrooms. Many early years educators would see a limited potential for such systems because of the model of learning underpinning the design, unless as McFarlane (2000: 91) notes, normal teacher-child interaction is not discarded.

Further, Dawes (1999) provides an alternative view on the integration of ICT into the classroom. She is critical of the notion of ‘teacher resistance’ to change as a result of the introduction of ICT in the classroom. For Dawes, the notion of 'teacher resistance' is too simplistic and has resulted in the labelling and stereotyping of the profession that has arisen from a lack of understanding of classroom practice with ICT. She believes that teachers draw on their professional knowledge to make informed and rational choices about resources that they are expected to integrate into their teaching. Dawes, therefore provides a more positive interpretation of the way that teachers have used ICT in their
teaching. In this view, teachers are considered to be 'selectively welcoming' of suitable change through ICT, rather than 'resistant' to it.

**Stages in teacher's professional development with ICT**

The studies discussed previously in this chapter present evidence of the factors that encourage teachers to use computers. For some, Clariana (1992, cited in the University of Warwick, 2000: 10), for example, it would appear that there are clearly identifiable stages that teachers go through in appropriating ICT and embedding it into their pedagogy. In relation to the use of ILS in teaching, Clariana (1992), following Schnitz and Azbell (1988), proposes a five-stage model. These are:

1. Novice non-participatory (the teacher leaves a class in the ILS lab);
2. Novice participatory (the teacher attends the class but is not familiar with ILS);
3. Practitioner (where the teacher uses the ILS progress reports to support children);
4. Integrator (who manipulates the ILS so that it better matches the classroom instruction);
5. Extender (who has fully integrated the ILS and classroom curricula).

As the University of Warwick (ibid: 10) suggests, this model may be helpful in looking at the integration of other forms of educational software into the curriculum. The well-known Apple Classrooms of Tomorrow (ACOT) project, in demonstrating the potential for effective use of ICT in the classroom, also identified stages in teacher's professional development with ICT. Dwyer *et al.* (1991) and Sandholtz *et al.* (1997, cited in the University of Warwick, ibid: 15), reported on the longitudinal research programme involved. The project focused on supporting teachers' professional development with
ICT in "technology-rich contexts" and the research identified an "instructional evolution", that usually took place over five years. Initially, the teachers progressed through the Entry phase where there was little change in their practice and they tended to encounter technical problems, to the Adoption phase in which ICT was used and the focus tended to be on teaching children to use the technology. In this phase teachers' beliefs about ICT became more positive and they also increased their self-confidence in the use of technology. Later in the Invention phase were confident to experiment with new teaching and learning methods, including promoting collaborative learning through ICT.

Research suggests a noticeable relationship between teacher's beliefs about technology and their practice, although in general, there is some debate about which comes first; a change in belief, or a change in practice (Fullan, 1991). Moseley and Higgins et al. (1999: xiii) found a "clear link between teachers' attitudes to ICT, their self reported skills and their effectiveness". Where they were confident in the use of ICT, or offered appropriate support, the teachers were willing to try new approaches and adopt or adapt, these approaches as they saw necessary. Fullan (1991) suggests that individual teachers accept new ideas and practices on the basis of whether or not the new idea or practice matches their beliefs and understandings. Further, Veen (1993) established that if the software matched the teachers' pedagogy they used it.

Heppell (1993: 232) identified a clear pattern in the beliefs of teachers about ICT and classroom learning that have taken place since 1982:
Stage 1 - exposure to computers improves learning;
Stage 2 - exposure to specific computer applications improves learning;
Stage 3 - computers allow children to solve problems;
Stage 4 - awareness that computers not only bring something new to the environment but also change it and change learners, too.

Heppell (ibid) anticipated that new technology had the potential to allow for much more independent learning in the classroom and argues for an environment where teachers can "support interests rather than manage activities". He suggests that education in the United Kingdom has mainly advanced to stage two and has been slow to respond to the challenges posed by new modes of learning. In other words ICT has simply been bolted on to the traditional curriculum.

If Heppell's model of teacher's views on ICT is compared with data about practice it is possible to develop a typology. Table 2.1, over, demonstrates a possible correlation between teachers' beliefs about ICT and their practice, suggesting a possible evolution of pedagogy. The table shows the development of teacher's beliefs about ICT (Heppell, 1993) alongside the stages of teacher participation in ILS (Clariana, 1992) and the stages of instructional evolution defined by ACOT (Sandholtz et al., 1997). Whilst the typology has been constructed with the intention of synthesising and clarifying information from a range of literature regarding the evolution of pedagogy with ICT, it should be stated, however, that the table is only intended as a rough classification and guide.
<table>
<thead>
<tr>
<th>ICT CATEGORY</th>
<th>Beliefs</th>
<th>Teacher participation in ILS</th>
<th>Instructional Evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Avoided</td>
<td>(ICT is not beneficial to learning/ICT is neutral)</td>
<td>Novice non-participatory the teacher leaves a class in the ILS lab</td>
<td>Entry Phase instruction remains primarily unchanged</td>
</tr>
<tr>
<td>2. Embraced</td>
<td>Exposure to computers improves learning</td>
<td>Novice participatory the teacher attends the class but is not familiar with ILS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exposure to specific computer applications improves learning</td>
<td>Practitioner the teacher uses the ILS progress reports to support children</td>
<td>Adoption Phase teachers began using technology in their classrooms</td>
</tr>
<tr>
<td>3. Integrated</td>
<td>Computers allow children to solve problems</td>
<td>Integrator the teacher manipulates the ILS so that it better matches the classroom instruction</td>
<td></td>
</tr>
<tr>
<td>4. Embedded</td>
<td>Awareness that computers not only bring something new to the environment but also change it and change learners too.</td>
<td>Extender teacher has fully integrated the ILS and classroom curricula</td>
<td>Invention Phase teachers experiment with new instructional patterns</td>
</tr>
</tbody>
</table>

Table 2.1 Beliefs and stages in teacher development with ICT

Not every teacher would necessarily be expected to progress through the same stages at same rate, and in same order. Clearly, it is likely that a teacher would have to see the benefits of integration in order to build ICT into their classroom practice, for example, but as previously discussed, belief does not always follow practice. Following Collis et al. (1996), the use of ICT in education cannot be easily articulated in a clear-cut manner.
but must be considered in the context of the complicated network of variables in which it is embedded (1996: 43).

Watson (1993), in a large scale study on the impact of IT clarified the need for the sustained professional development for teachers and Somekh’s (1991) Pupil Autonomy in Learning with Microcomputers (PALM) project advocated that teachers took ownership of their own professional development through action research. In the PALM project the teachers were involved in researching the educational potential of computers and as a result were encouraged to experiment with ICT in their classrooms. In this context ICT was seen as a catalyst in helping teachers re-examine their pedagogy - the teachers took time to reappraise the whole process of teaching and learning in their classroom before finding new ways of using their ICT resources. When the project started few of the teachers involved had any experience or skills with ICT but, as the action research evolved, Somekh (ibid) found that, with support, the teachers became much more confident and adept at using computers in the classroom.

Somekh (1997: 122) identifies three ways in which teachers can use the computer to support learning. In the first level the computer is used as a *tutor*; the software is designed to teach subject specific content (for example, ILS). Thus the child receives knowledge from the system, although there may be opportunities for teacher interaction and assessment. The second stage, which Somekh sees as an intermediate stage, is when ICT is used a *neutral* tool. For example, use of a word processor - especially for the limited task of copying up writing already drafted by pencil or pen. Thirdly, the
computer is used as a *cognitive* tool to support child directed inquiry. For example, the use of open-ended software such databases and spreadsheets to explore questions about the length of dinosaurs (see Smith, 1999: 168). Somekh acknowledges that the step from 'neutral tool' to 'cognitive tool' is massive. In practice many teachers make progress as they gain confidence in using a greater range of ICT applications. In using ICT to store, process and present data, new approaches to teaching are implicit (Smith, 1999: 9).

Children are more likely to be motivated to engage in challenging inquiries if presented with authentic tasks, modelled on real-world problems.

BECTa instigated a pilot study concerning the development of personal and professional teacher competence and confidence with ICT (see Youngman and Harrison, 1998). The study involved around 1150 teachers in 575 primary and secondary schools who were each provided with a multimedia portable computer, subscription to the Internet and a range of educational software. It was concluded that this provision led to a significant enhancement of the ICT skills of the great majority of participating teachers. The research highlighted four conditions that were ascertained to contribute to the successful use of ICT:

1. Initial and immediate success with ICT, through the hands-on demonstration and the provision of user friendly hardware and software;
2. Personal ownership and exclusive use over an extended period;
3. The portability of the equipment so it could be moved between work areas and between home and school;
4. Formal and informal support – the combination of the ownership and portability provided teachers with the flexibility to access a greater variety of support from peers and other sources.

The University of Warwick (2000: 18) questions whether the findings about CPD and teacher learning are generalisable to schools that do not have access to significant technology, resources, and support. One problem, as the University of Warwick has pointed out, is that the research findings do not give insight into the individual teacher’s learning process, including both the cognitive understanding of technology and teaching. Even though there are recent examples of a ‘more rigorous use’ of classroom ICT there is little evidence of teachers working beyond a performance enhancement stage and moving on to use ICT to develop new ways of thinking and learning (Underwood, 1994: 6; Goldstein, 1997). Miller and Olson (1994), too, argue that we should be cautious about making inferences between the use of ICT and effective teaching. Rather than looking at technology to explain practice they feel we ought to look at the context and what the teacher has done in the past. In the end the context is revealed by understanding what the teacher is trying to achieve in the classroom. This is a significant observation. The computer being placed in the classroom will not improve education. The teaching methods - which determine how that computer will be used, will be the driving force for learning progression. Somekh and Davis (1997) too, recognise that the teacher holds the key to learning with ICT in schools. It is the teacher that facilitates and manages the learning process. They argue that the effective use of ICT as a learning tool will be dependent on the development of the profession of teaching.
Scrimshaw (1997) discusses the changes that the computer is bringing to the classroom and some of the implications for the professional development of teachers. In particular, he describes how electronic technology has significantly increased the availability and volume of information and knowledge available to children, leading to a "redefinition of public knowledge" (ibid: 109). Scrimshaw also acknowledges that the learning group is widened by electronic communication and that the number of 'teachers' available to children is increased by the Internet. He argues that the role of the teacher should be carefully reappraised in the light of the introduction of ICT into the classroom, in order to enable the teachers to challenge traditional assumptions about pedagogy and to consider possibilities for organising classrooms in new ways. The implication of these changes for Scrimshaw (ibid: 112) is that "teachers need to teach the process of learning rather than its products". In this model, a significant role of the teacher is to assist children to learn to collaborate and co-operate with each other in the context of using ICT. Scrimshaw (ibid: 112) argues that for this to happen, teachers themselves will need further opportunity and support in using ICT in collaborative contexts and time to reflect upon and research what is happening in their classroom.

Following Moseley and Higgins et al. (1999: ix) the overall conclusion reached from the analysis of the available literature suggests that "there were clear possibilities for ICT but that there were no guaranteed solutions as to what would work in a particular context". A further noticeable trend (Collis et al., 1996 and Luke, 1999, for example) is relatively little concern about the impact of the computer on the child. A considerable body of work (University of Warwick, 2000) has focused on the barriers teachers face when using ICT in the classroom and identifying teachers' learning experiences with technology.
However, much of this work, apart from Veen and Somekh, has focused more on teachers' personal competence than their pedagogical competence. Further, a simplistic model of 'teacher resistance' to ICT is an inappropriate explanation of the generally more positive teacher attitude to the introduction of computers into the classroom found by Collins et al. (1997) and Dawes (1997).

Moseley and Higgins et al. (1999: xiii) also identified a "clear link between teachers' attitudes to ICT, their self reported skills and their effectiveness". Evidently, a more confident teacher with ICT is likely to be a more competent one, but it seems that reducing or avoiding barriers does not necessarily ensure the likelihood of teachers using computers effectively (the University of Warwick). The use of ICT in the classroom is also dependent upon a range of contextual variables (Collis et al.). These involve not only a teacher's particular skill and confidence in using the technology, but also their understanding of how ICT can be beneficial to learning, and crucially the participation, skill and understanding of the children. The possibility of children developing an appropriate ICT capability depends on their access to computers at both home and school and it should be recognised that in some schools there are limited resources and there is also a variable provision at home (Downes, 1996; Sanger, 1997).

In future, a great deal more work needs to be undertaken on investigating the pedagogy of teaching and learning with ICT and further research is needed to better understand the learning paths for teachers and children using ICT in a particular context. Very few studies have focused on the individual teacher's and child's use in the classroom. As Scrimshaw (1997) has argued, teachers will need to be encouraged, supported and given
the opportunity to research and reflect on teaching and learning with ICT in their own classrooms.

2) Collaboration, interaction and ICT in the classroom

Over the last twenty years, or so, the common sense assumption that cognition resides 'in the head' has been challenged (Hewitt and Scardamalia, 1998: 75). Following on from the work of Vygotsky, who articulated the social construction of knowledge and the process of the mutual understanding, Greeno (1997), Lave (1988), Edwards and Mercer (1987), Rogoff (1990), Salomon (1994) for example, have put forward a prospective of cognition as distributed over both individuals and surrounds. They argue that human activity is heavily influenced by context, which includes artefacts, and other people.

According to Hewitt et al. (1998: 3) this "holistic perspective" means that new meanings need to be attached to old words like 'knowledge' and 'learning'. They suggest that if we move from a constructive to a situative view of the world, we need to rethink these terms. For Hewitt et al., 'knowing something' is not concerned with storing ideas in your head that can be applied to different situations. Rather 'knowing' is tied to context, distributed across the individual, situations and other people. Similarly, 'learning' is no longer conceived as the personal acquisition of knowledge, but is instead understood as participation in an activity system. The fundamental basis of their (situative) position is that the interactions between individual intellect and the environment are so intertwined that our surrounds must be viewed as an integral part of what we know and how we learn.
For Salomon and Perkins (1998), also, knowledge is not transmitted or internalised, nor something one constructs on his or her own. More accurately, knowledge, understandings, and meanings gradually emerge through interaction and become distributed among those interacting (rather than being individually constructed or possessed). Participation, as contrasted with acquisition, is therefore a key concept here.

**Scaffolding**

Through the process of 'scaffolding', the adult guides and supports the child's learning by building on what the child is able to do (Wood *et al*., 1976; Bruner, 1978; Wells, 1987; Tharp and Gallimore, 1991). Originally, little attention was paid to the means by which the transfer of responsibility from the adult to the child was accomplished. As Tharp and Gallimore (1998: 99) point out, there are various means of assisting a child's performance and they are all qualitatively different. More recent discussions of the term scaffolding have, therefore, included a greater emphasis on the specific mechanisms of transfer (see Bruner, 1993). Stone (1998) identifies a move from an emphasis on relations in which the adult is directing to an emphasis on mutuality. This trend can be discerned in the terms used to describe the scaffolding process: guided participation (Rogoff, 1990), instructional conversation (Tharp and Gallimore, 1988) and guided co-operative learning (Brown and Palinscar, 1989).

Cook and Finlayson (1999: 96) have suggested that teachers need to make decisions about the use of ICT before children are involved and that these advanced decisions about how software supports the learning activity can be termed 'pre-scaffolding'. For Tharp
(1993) assisted performance begins with a child's current level of thinking and understanding, consequently allowing the child a meaningful role in the setting of the instructional task or goal. The process includes helping behaviours by the teacher that assist the child to pursue these goals and move from one level to the next; by pulling performance from the child, so a productive communication or creation by the child is the vehicle for instantiating new knowledge (Tharp, 1993: 272). In assisting children's performance teachers need to have a clear view of learning goals and recognise that their role is that of supporting learners in such a way as to allow them gradually to do more for themselves. The amount of assistance offered, and the manner in which support is given, will vary from child to child, across time and in relation to the difficulty of the task (Bruner, 1985). Tharp outlines seven strategies that can be used by teachers to assist performance so that an instructional conversation can be established.

- **Modelling**: allowing the child to observe the way an experienced person accomplishes a task,

- **Contingency management**: the teacher makes use of rewards and sanctions so that the learner is supported in completing the task,

- **Instructing**: especially useful when the learner cannot manage everything alone, the teacher provides information or asks for a particular response so that the learner can help make decisions which help them forward,

- **Questioning**: the teacher tries to help the learner think through ideas to make a talk response which is more significant than could have been made without the 'probe'.

- **Cognitive structuring**: the teacher offers structure or explanation which helps the learner make sense of their new learning.

- **Task Structuring**: the teacher organises the task so that learners, with this support, are able to operate in the ZPD when, without this help, the task would be too much for them.
• Feedback: this allows the learner to judge how close his or her effort is to the target to be achieved.

(Tharp, 1993: 272)

The most effective of all these strategies, is according to Tharp, that of providing feedback because this allows the child to assess how close her or his efforts are to the objective to be achieved.

Scaffolding and ICT

The role of the computer in supporting educationally valuable and collaborative activities has been reported in a number of recent studies, influenced by the sociocultural perspective (Crook, 1994; Littleton and Light, 1999; Scardamalia et al., 1992; Wegerif and Scrimshaw, 1997, for example). In particular, Mercer and Fisher (1997a) examine the role of the teacher in supporting children's learning through ICT. They consider how teachers scaffold children's learning at the computer and argue that contextual factors are a highly significant influence on this process. For Wegerif and Scrimshaw (1997: 3), the sociocultural perspective is centrally concerned with the role of computers in supporting the talk between teachers and learners that carries the development of understanding in the classroom. In terms of teaching and learning with ICT the focus of the research within the social constructivist approach has, therefore, been on observing and analysing the interpersonal interaction shaping children's response to cognitive challenge; with the emphasis being on talk between children in the context of collaborative computer activity.
The quality of understanding that learners acquire through the use of information technology in the classroom is not, and never will be, determined by the quality of the 'interface' between the learner and the technology. Quality of understanding, the nature of educational knowledge is determined by a much more complex contextual system which is inseparable from how education is defined in our culture...this culturally-based contextual system is continually created and re-created in the classroom through interactions between teachers and learners.

(Mercer, 1993: 37)

The sociocultural perspective is, as Säljö (1998) points out, concerned with how computers uniquely transform the way in which human cognitive activity is organised. This view is also concerned with how technology reorganises the interactions of children and teachers. Cole and Griffin (1987: 45) consider the possibility of information technology transforming the classroom. They distinguish two metaphors for the interaction between students and computers. The first metaphor they discuss assumes that the computer is an instrument, operating as a 'partner in dialogue'. This view implies that the student - computer relationship can be viewed as comparable to the student - teacher relationship, with the computer replacing the teacher. In this framework it is the computer's potential for providing structured hints, well timed feedback, and an abundance of factual knowledge that is significant. Cole and Griffin (1987: 46) suggest that this perspective underlies the bulk of research on information technology and education. The limitations of this approach are illustrated by Steel (1991, cited in Mercer, 1992: 221-222), for example, in research concerning children's talk around computers. She observed that:
We had rather naively assumed that just because the children were gathered round the computer together that they would be actively collaborating. Closer observation of what was actually taking place revealed some disturbing findings....Dominant personalities and fast readers dictated the rate of progress through the programs.... this was not an atmosphere of active collaboration but one of competitiveness within groups and a very limited range of talk.

(Steel, 1991: A223)

Thus, when Steel and her colleagues reflected on the above they decided to intervene to promote collaborative experiences away from the computer and to develop children's awareness and analytic understanding of group work. Cole and Griffin's second metaphor, therefore, focuses on the potential of computers for 'reorganising interactions among people' not replacing them, creating new environments in which children can be educated and grow and by discovering and gaining access to the world around them. This metaphor emphasizes the potential of computers for reorganising instruction within the classroom and for making possible the extension of education beyond the classroom.

As Säljö (1998: 59) points out, it is the second metaphor, that of the computer as 'medium', which is of interest from the sociocultural point of view. This metaphor is now explored in more detail.

Mercer and Fisher (1997a: 196), draw on the sociocultural perspective to present an analysis of specific examples of teachers' interventions in children's computer based activity. They suggest that neo-Vygotskian theory is valuable because it offers both a theory of learning and a theory of instruction and awards significance to the communicative and cultural contexts in which learning takes place. Mercer and Fisher assert (1997a: 208) that the concept of 'scaffolding' is helpful in discerning how teachers
use talk to successfully influence children's activities, and how well a teacher can actively organise and support children's learning with the computer, without relying on didactic instruction. The concept of ZPD is less useful, they contend, for research directly connected with teaching and learning in classrooms because ZPD is concerned with individual rather than collective learning. Their focus is therefore on how well the class, or group of pupils and their teacher function as a 'community of enquiry'. Mercer and Fisher show how teachers use talk to influence children's activities so that the success or failure does not hinge entirely on the relationship between the children and the computer (1997b: 126). They argue that with some computer-based activities the software itself could be seen to provide an element of 'scaffolding' for children's learning. Adventure games and problem solving programs, for example, offer structure and guidance for the activity and feedback to children on progress. However, this feedback tends to be limited and Mercer and Fisher do not feel that the term scaffolding is appropriate. They observed that children quite often get into difficulty despite the on screen guidance and it is often precisely at such time that teachers supportive intervention is sought and received (1997b: 121). The SLANT Project (Spoken Language and New Technology) was set up in 1990, in the UK to investigate the talk of primary children collaborating on computer based activity. The focus of the project was also on the kinds of intervention that teacher's make in pupils' activity in order to help them continue and complete the learning task in hand. The project emphasized the need to examine the total activity, including the way that the teacher has set up the task and how she supports progress (Mercer et al. 1991).
A range of recent publications and studies investigating the use of the computer in the primary classroom has suggested that research has not paid sufficient attention to the wider context of shared experience and meaning developed through discourse in all classroom activity (Wegerif and Scrimshaw, 1997; Littleton and Light, 1999). Much of this research has been influenced by the well known work of Edwards and Mercer (1987) which described how talk in the classroom between teachers and learners leads to the development of shared understanding and common knowledge. Crook (1999: 103) also, argues that the study of social processes in relation to computers has been too narrowly pursued and the broader social context of the classroom needs to be considered alongside the interaction around the computer. Each class of primary school children is an educational community characterised by a variety of shared experiences that will impact on teaching and learning with the computer. Littleton and Light (1999), further, point out that classrooms are communities framed by their distinctive physical locations and social rules, and the patterning of social action and interaction is shaped over considerable periods of time. They assert that collaborative experiences are typically more than just the localised sessions of joint activity and, in the classroom, as elsewhere they are informed by the broader social context in which they are located. For Säljö (1999), the computer itself needs to be seen as a 'cultural tool', an embodiment of social practice and process, capable of mediating social relationships in new ways.

As well as reorganising interactions between people, computer technology has the potential to create new educational environments. Although, it should be pointed out that, when it comes to computer use, many children often have more expertise with
computers than their teachers and therefore can take on positions of leadership in the classroom (Shrock and Stepp, 1991). This may be especially important for children who are underachieving in literacy and other abilities. Using technology, such as word processing and the Internet, can involve children in communication activities that support written language. In particular, by engaging them in using text to display and extend their expertise (these aspects of ICT are discussed in more detail in the following section). The use of technology in the classroom may therefore facilitate a different kind of social dynamic between pupil and teacher.

Cook and Finlayson argue that the combination of learning support with ICT is a significant 'joint activity' (see Table 2.2, over). They see this as:

The way that learners and the learning support mechanisms of teacher, computer program and fellow group members work together so that the highest possible level of performance becomes achievable.

(Cook and Finlayson, 1999: 100).

Table 2.2 demonstrates the possible contribution of different support mechanisms in a classroom with ICT.
<table>
<thead>
<tr>
<th>Strategy</th>
<th>Teacher</th>
<th>Computer Software</th>
<th>Peer Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelling</td>
<td>Through whole class demonstrations of software, offers a model of the process</td>
<td>Can take a pupil step by step through a procedure</td>
<td>Children often model for each other particular techniques or moves in problem solving tasks</td>
</tr>
<tr>
<td>Feedback</td>
<td>Indicates to children the acceptability of their problem-solving approach and procedural steps</td>
<td>Offers information to the learner which allows for self correction</td>
<td>Children guide the thinking of others by their comments, suggestions, corrections</td>
</tr>
<tr>
<td>Contingency</td>
<td>Celebrates success as part children reporting phase to encourage a desired behaviour in others</td>
<td>Success with tasks or the application of specific tasks or problems solved is highly motivating</td>
<td>Peer pressure influences the behaviour of group members</td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructing</td>
<td>Part of the teacher's introduction and task setting</td>
<td>Often, programs re-offer problems in a Way or request learners to carry out specific activities</td>
<td>Children direct others as a result of their own experiences</td>
</tr>
<tr>
<td>Questioning</td>
<td>Requires from the learner a verbal response which comes about as a result of more sophisticated thinking</td>
<td>Programs contain specific problems Which must be solved before moving onto the next phase</td>
<td>Children challenge each other by their questions about actions, techniques or world knowledge</td>
</tr>
<tr>
<td>Cognitive</td>
<td>Part of the teacher's task-setting decision making, making goals clear, explaining procedures</td>
<td>Provides clues, offers suggestions uses formats known to the children</td>
<td>Peer tutoring activities, when one child gives hints to others</td>
</tr>
<tr>
<td>Structuring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Structuring</td>
<td>Helping learners to work through component parts of the task so that they are actively working in the ZPD</td>
<td>Breaking down the task into component parts and representing these as a series of manageable steps</td>
<td>Help with suggestions about actions drawn from their own experiences.</td>
</tr>
</tbody>
</table>

Table 2.2 Tharp's (1993) Strategies for assisted performance, related to ICT (Adapted from Cook and Finlayson, 1999: 100)
However, this model deviates from Cook and Finlayson's original in that ICT is recognised as a tool and a 'medium' (Cole and Griffin) and therefore placed in italics. The reason for the change is that ICT is not an equal partner; there is a danger that if the skilled assistance of the teacher and peer group is subtracted, only the computer software is left for support. In this case the assisted performance is not the same, and whilst a learning model based only on computer aided instruction may please some administrators and politicians, it is far removed from authentic learning (McFarlane 1997). Whereas the combination of assisted performance illustrated in the table represents a useful synergy, the reciprocal roles of the teacher and child are the most significant and, arguably, should be happening anyway.

The moot question is what does ICT add to the possibilities of assisted performance? How does the presence of technology encourage and facilitate teacher's and peer's engagement in assisted performance, and in a more productive way than might otherwise happen? A crude model for this process is illustrated below in Fig 2.1.

Assisted Performance

![Figure 2.1 The role of ICT in assisted performance](image-url)
A problem with the model illustrated in Figure 2.1. is that it doesn't fully consider the situated and distributed nature of knowledge (Pea, Greeno etc). In order to expound a model of the complex process of interaction that is the focus of the situative perspective, Hewitt et al. (1998: 4) refer to the work of Engestrom (1990). For Engestrom human activity is socially-bound and not simply the sum of individual actions. He proposes a model of an 'Activity System' that conceptualises human activity as an interdependent system involving the individual (subject), tools, a problem space (object), the community of people who are similarly concerned with the problem, the division of labour between community members, and the conventions (rules) regarding actions (Figure 2.2, below).

![Diagram of Activity System](image)

**Figure 2.2** The Components of an Activity System.
(Engestrom, 1990)

The activity of the individual (top three components) is, therefore, not considered in isolation, but is seen as attached to the larger cultural context. Engestrom also views the
system as continually changing and evolving. It is therefore dynamic. In the model movement and change at any one point produce waves and occasionally significant changes across the system. For example, alterations in the design of a tool may influence a subject's orientation to an object, which in turn may influence the cultural practices of the community. Or, changes in cultural practice may inspire the creation or modification of a tool.

However, what the model appears not to fully consider, is the significance of the power relationship between each of the components within an activity system. Clearly, for learning in schools, each component of Engestrom's model does not have an equal effect on change or development within the activity system because of the power ascribed to the teacher and the central role of the curriculum (especially in UK schools). If, for example, the model is applied to the use of ICT in the classroom then it may seem reasonable to suggest that the availability of e-mail may influence the cultural practice of writing. However, factors that will also come into play are, the previously established rules of the class and school, the planned curriculum, time, location and control of ICT by the teacher. Thus the availability of e-mail on its own will not necessarily effect the cultural practices of writing because of the dominance of other components in the activity system, especially the tightly controlled and prescribed curriculum for literacy. Indeed, there is currently very little evidence of the widespread use of e-mail for writing in primary schools, despite its increasing availability at home and school (Waller, 1999).
The benefit of Engestrom's model, as Hewitt et al. (ibid) point out, is that it proposes that researchers should work towards understanding and improving classroom practice by studying the activity system of particular classrooms (see Cole, 1995). Research aimed at isolating individual cognitive processes is therefore seen as incomplete and less useful for informing an understanding of teaching and learning in the classroom. Situated learning theory, therefore, suggests that 'learning' is a process of improving one's participation in systems of activity, particularly social systems (Lave and Wenger, 1991). For Hewitt et al. (ibid: 4), this model provides a 'composite view' that recognises both the socially distributed nature of human activity and the transformative nature of the activity system in general.

**Technology and communities of shared understanding**

Crook (1994) analyses the different ways in which computers can be part of the collaborative experience of learning. He proposed a taxonomy of the various ways in which computers can support the joint activity of children (and teachers):

- collaboration **at** computers
- collaboration **around** computers.
- collaboration **through** computers
- collaboration **in relation to** computers

Crook's first point is that interactions **at** computers may acquire a collaborative quality where two or more learners gather at a particular place to solve problems together. An example might be two children helping one another with e-mail software. Secondly, interactions occur **around** computers offering the possibility of more casual and
improvised exchanges. For Crook (1999: 110), "material environments will constrain
and facilitate a whole range of social interactions that can occur within them". For
example, collaboration between children who happen to be individually working on
computers in the same room may be encouraged or discouraged by the room layout. The
third possibility is interactions through computers. Collaboration through computers
means collaborating through networks, including the Internet. It can range from
straightforward collaboration through e-mail and the web, through to video conferencing
and the virtual classroom. Crook (ibid: 110) suggests that "the networking of the
technology creates a novel opportunity for users to construct a degree of common
knowledge". Crook argues that our concept of collaboration has to include circumstances
in which collaboration is dislocated in time and when participants are not co-present.
This is a central feature of interacting through computers. His fourth point concerns the
possibility of interaction in relation to a particular computer application. Crook puts
forward the view that common knowledge is developed by collaborators being able to
reference experience that was previously shared at the technology. For example, in the
playground, children may become involved in discussion about an aspect of a 'talking
book' program they had been previously using. The discussion is then carried on the
classroom and picked up by the teacher for further consideration in a plenary session.
Here, the teachers' contributions are more indirect and they make only intermittent
contact with the task or refer to it on occasions when it is not actually in progress (1994:
100).
A key issue, for Crook, involves looking at how new technology can mediate forms of activity that create communities of shared understanding. He argues that:

Understandings that are held in common need not be exclusively relevant to the short-term goals of working together on localised problems. There are circumstances where mutual knowledge provides a general underpinning relevant to a whole range of collaborative encounters: this arises in situations where people are held together in communities that share a common set of concerns - such as might sometimes arise within institutionalised education.

(Crook, 1994: 193)

'Missed opportunities for distributed cognition'

Hewitt and Scardamalia (1998: 78) however, suggest that some of the inefficiencies associated with school practices include "missed opportunities for distributed cognition". They argue that these missed opportunities are a result of the teacher's dominance of high-level operations, and failure to put student knowledge artefacts to authentic use. In traditional classrooms the social conventions place heavy restrictions on the amount of talking allowed or the amount of movement between desks, thus restricting opportunities for children to share understanding and participate in distributed cognition. However, Hewitt and Scardamalia recognise that these are problems are difficult to overcome. They suggest that teachers could try to make better use of student expertise by determining what expertise is available. Brown and McIntyre (1993), for example, demonstrate that distributed expertise can be engineered through the skilful combination of 'Reciprocal Teaching' and 'Jigsaw'. If, as previously discussed, the fundamental nature of learning from a situated perspective involves an awareness of group practices and how the learner can engage in those practices, there are few if any computer environments that provide overt support for these kind of operations (Hewitt et al., 1998: 5).
Clearly, e-mail systems, the Internet and bulletin boards, for example, all provide opportunities for communication and collaboration. But, as Hewitt et al. point out, none of these packages 'facilitate' learning in the situative sense of the word. Further, they suggest that:

New tools are needed to help learners analyse the activity of the collective and to contrast that activity with their own involvement. In the same sense that metacognitive computer tools permit reflection about cognitive processes, so should group cognition tools be developed to permit reflection about social processes and one's own role in them.

(Hewitt et al. 1998: 5).

However, for Hewitt and Scardamalia (1998), the increase of online and networked computer systems (LAN) offers considerable potential to develop understanding and thinking around distributed cognition. This is because of the ability of networked technology to allow many people to work simultaneously in a common environment on common problems. Hewitt and Scardamalia (1998: 78) suggest that this 'many to many' form of communication avoids many of the organisational limitations associated with large face to face discourse. Also, significantly, information technology provides a medium within which students can store the knowledge artefacts created by their peers.

**Knowledge building communities**

Crook (1999: 111) discusses how he established and maintained a technology based community resource at a primary school, over a period of seven years. The resource involved organising classroom computers, so that they were linked into a local area network (LAN), with access to a common file server. The database was then held on this server and could be referenced from any computer on the network, thus allowing a
history of the community to be archived and referenced. So, for example, teachers could reference computer based discussions between children and there would be common access to work carried out in previous projects. Crook (1999: 110) called this resource "a classroom resource to support collective remembering". However, in practice, Crook asserts that the LAN requires careful management and involves considerable costs and resources to maintain (a budget that may be beyond most primary schools). He therefore suggests that the development and use of 'virtual network' programs (a network on a single computer hard disk) offer the advantages of an organised and friendly system for accessing a central database and archive and avoid the difficulties of the cost and complexity of real network (1999: 112). Crook (1999: 113) argues that "what happens on any particular occasion of joint activity is resourced by and motivated by pupils' awareness of shared events experienced at the level of classroom community". Crook proposes that the potential of this resource to support collaboration lies in the way that it "represents the 'location' of the community (in time and space) and how it captures and organises the products within a community" (ibid).

Scardamalia and Bereiter (1994) have developed a model of classroom activity that they call a 'Knowledge-Building Community'. In this model, the children in the class develop and grow into a research team that is organised to develop knowledge through sustained, collaborative investigation. Children were involved in the project from around the age of nine years. Tasks were originally concerned with investigative science and students contributed notes on their work to a communal database. The intention of Scardamalia and Bereiter (1994: 1) was progressively "to turn over high level operations to the
student, encourage more authentic peer discourse and to emphasize understanding over memorisation”. Scardamalia has developed and refined a program called CSILE to support this practice. CSILE stands for Computer Supported Intentional Learning Environments and is a networked learning environment which connects each classroom computer to a multimedia database that contains the ongoing work of the class (see Scardamalia et al., 1989). All files are located in a common area, that can be accessed and viewed by everyone, and facilities are provided to allow students to link to each other’s notes. Authors are notified when comments have been made or when changes in the database have occurred. Various note formats and supports have been designed to enhance the potential of the communal database for collaborative knowledge-building (see the discussion of 'Knowledge Maps', over).

The consequence of open access is that all children and teachers are able to share information and answer each other's questions, without waiting for their turn (as in spoken conversation). Scardamalia argues that because children are able to work simultaneously on investigative tasks a highly intensive form of peer collaboration is permitted that would be problematic without the information technology. A further feature of the CSILE software is that it provides a permanent database and record of interactions. The commercial version of CSILE, named 'Knowledge Forum', was released in August, 1997 and is being used in workplaces and in educational settings, ranging from primary grades to graduate school in a variety of locations across Canada, the U.S., Japan, Finland, and the Netherlands. Similar examples of learning environments, which are based on collaboration and oriented towards the solution of
complex, real-life problems, utilising a variety of technological means are; Brown and
Campione's Communities of Learners (Brown, 1994), Anchored Instruction and other
designs of the Cognition and Technology Group at Vanderbilt (1996), or the SELA
project in Israel (Salomon and Almog, 1998). Examples of related work in the UK are

The CSILE research is concerned with investigating the following questions:

- What kinds of distribution are educationally effective?
- How should the classroom environment and classroom practices be redesigned?
- How can technologies be harnessed to support educationally productive processes?
- To what degree can students function in such an environment?
- What sort of structures do they need?
- How does it change the role of the teacher?

(Hewitt and Scardamalia, 1998: 75)

For Hewitt and Scardamalia (1998: 78), what is significant about a knowledge building
community is "not formal association, or physical proximity but rather a commitment
among members to invest their resources in the collective upgrading of knowledge".

Hewitt and Scardamalia (ibid.) have identified a number of general strategies that seem
effective in CSILE classrooms:

1. Provide a supportive social climate;
2. Focus students on communal problems of understanding;
3. Encourage exploration;
4. Encourage connectivity.
Collaboration and connectivity was, however, not automatic in the CSILE classrooms. Despite the encouragement of the teachers, the children often had only a marginal knowledge of what their peers were working on. The children were therefore still working independently and missing opportunities for collaboration (Scardamalia and Bereiter, 1990). Consequently, a 'Knowledge Map' was developed to help the teacher promote collaboration. The Knowledge Map assists children in locating areas of classroom activity and in investigating clusters of connected work. They can then view their own contributions, on screen, which Scardamalia and Bereiter (ibid.) argue, may lead to improved levels of communal coherence.

A further research observation made by the CSILE team is that a group focus on common problems facilitates a mutual scaffolding between participants (Scardamalia and Bereiter, 1996). Scanlon et al. (1999) report on the complex role that conflict plays in children's collaborative learning. They discuss examples of when conflict has produced positive outcomes, particularly where the conflict has engendered task engagement. Scanlon et al. also refer to occasions where different interpretations of the task have led to conflict which hindered learning. For Hewitt and Scardamalia, the need to come to a common understanding places greater demands on students to clarify ideas, refine theories and answer each other's questions. Rogoff (1990: 170) emphasizes the value of co-operative classroom learning, in which peers work together on academic tasks and provide one another with motivation, guidance, and feedback. Damon (1984) and Slavin (1987), also, point out that in circumstances in which children have practise in interaction they might be very helpful to one another. Peers can serve as guides in academic activities in the
classroom, especially if such interaction is encouraged in the classroom social structure, giving children experience as onlookers and in co-ordinated parallel activity, guidance and collaboration. When teachers encourage and support peer interaction, children may develop skill in academically useful forms of interaction.

Evaluations comparing CSILE and non CSILE classrooms at the elementary level have shown some advantages for CSILE on standardised test scores in reading comprehension, vocabulary, and spelling, the quality of questions and depth of explanation and graphical literacy (Hewitt et al., 1998). Previous studies have also shown that children in CSILE classes can become more reflective about their own work and the work of classmates than do children in non-CSILE classes (Lamon et al., 1993; Scardamalia et al., 1994). Further, Lamon et al. (1993) claim that collaborative knowledge building in CSILE changes the goal of a school from a task orientation to a learning orientation and consequently changes children's approach to learning from a shallow passive one to a deeper active one. However, as Burtis (1997) points out, while the CSILE technology has linking features that support a whole-class, community approach to knowledge building, the knowledge building approach is sometimes difficult to implement in the classroom. Also, it is so far removed from the usual individual and competitive classroom culture that it is often a challenge for teachers and students to create and sustain a knowledge-building environment.

The real distinctiveness of CSILE, however, lies in the integration of the research-based software and teaching methods that have grown up together, each influencing the other.
Hewitt and Scardamalia encourage teachers to extend the CSILE research through their own trials in the classroom and to help to develop knowledge building communities through online collaborations with other teachers. They suggest that "a careful interweaving of computer supports and new educational practices can bring about a more effective use of distributed resources in the classroom" (1998: 83).

Hewitt et al. (1998) argue that in most learning environments children are merely afforded opportunities for group interaction. They believe this is not enough for the development of a true knowledge-building community. The Knowledge Map was designed as an initial attempt to investigate ways of applying situative theory to CSILE design. More recently WebCSILE was developed. This is a utility that allows CSILE databases to be accessed by a normal web browser and permits users to read all database notes, to create new notes, and to collaborate with others using CSILE’s commenting and discussion facilities. However, Hewitt et al. report that following the use of WebCSILE in a graduate-level class concerns were raised over aspects of group cohesion. After two or three weeks, it was felt that the class was not properly co-ordinating their efforts and the tutor decided to allocate some class time for face-to-face meetings so that the organisational concerns could be quickly settled. As a result, the students’ online interactions became much more productive. Hewitt et al. (1998: 10), therefore, assert that a co-ordinated effort in the research community is needed to invent other "group cognition tools" that could be effective in bringing higher levels of coherence to online collaborative knowledge-building. What is also needed is "a set of tools that permit the individual to monitor communal activity and their own participation in that activity"
These tools would help children locate the key centres of activity and identify who is working with whom and the new ideas that are currently receiving the most attention. The tools would also help students to participate in advancing the work of the collective.

The interest shown by writers adopting a sociocultural perspective in the context of interaction with ICT in the classroom has revealed worthwhile insights about the effect and use of ICT in teaching and learning. The recent work of Crook (1994 and 1999), Säljö (1999) and Scardamalia and Bereiter (1994, etc), for example, on interaction around and through the computer has argued that the role of the teacher in facilitating learning experiences at the computer is highly significant. Future research into the nature of interaction and scaffolding around computers in the classroom can also build on insights from knowledge building communities. These insights can be allied to the work of Mercer and Fisher (1997a and 1997b) and Wegerif and Scrimshaw (1997) concerning scaffolding, talk and ICT.

3) ICT and literacy

One area of learning that could be enhanced by the use of ICT is children’s development of literacy. New technology such as ‘talking books’, multimedia, ‘talking word processors’, e-mail and the Internet; could allow children far more independence from the teacher in literacy tasks and free the teacher to focus teaching on the distinctive features of reading and the written process (Scrimshaw, 1993; Kuhn and Stannard, 1997; Moseley Higgins et al., 1999; Barker et al., 2000). However, the development and use of
communication technologies has far outpaced research on computer-mediated literacy (Reinking et al., 2000) and Daiute, (2000) suggests that ICT is currently under-exploited in the teaching of literacy. Further, Leu (2000) and Labbo and Reinking (1999), for example, argue that whilst the current educational focus on book technologies has been a very important and useful one, the technologies of literacy are rapidly changing and children need to be prepared for much more than book literacies. Leu (2000: 1) suggests that "the rapid appearance in many of our classrooms of networked information and communication technology (ICT), such as the Internet, requires us to fundamentally redefine our understanding of the literacy curriculum". This is because the rate at which the Internet is appearing in school classrooms in many countries far exceeds the rate at which any other technology of literacy has ever appeared in our history. For Leu (ibid), "it is not that the new literacies of the Internet replace traditional book literacies; instead, they build upon them. However, the Internet demands new ways of thinking about literacy and insights that only the literacy community can bring to school classrooms" (2000: 2). The Internet has much potential for increasing interaction among its users and the materials available online. Moore and Kearsley (1996), for example, have identified a typology for distance education programmes delivered through technology. They suggest that there are three aspects of successful practice: learner-content interaction, learner-instructor interaction, and learner-learner interaction.

**Electronic Literacy**

Electronic Literacy refers to literacy activities (e.g., in reading, writing, and spelling) that are delivered, supported, accessed, or assessed digitally through computers or other
electronic means rather than on paper. Topping and McKenna (1999) discuss electronic literacy as a selection of activities that are digitally accessed through computers. They offer a typology of electronic literacy and suggest that current developments in computer-based electronic literacy can be considered in a number of categories: (a) electronically supported reading; (b) electronically supported writing; (c) electronic audiences, (d) electronic literacy assessment, feedback, and management; and (e) electronic direct speech-text conversion (1999: 3). As Topping (1997) has noted, the term 'electronic literacy' should not be confused with 'computer literacy'. Computer literacy refers to the knowledge and competencies gained in using ICT generally. For example, mouse and keyboard skills, awareness of the Windows environment, and so on. For Topping (ibid), electronic literacy is not just an additional aspect of the existing definition of 'literacy'; it has the potential to transform the whole definition. 'Literacy' implies both an area of competence and a level of competence. Topping suggests that the definition of what it is to be 'literate' is changing all the time. He argues that in the 21st century electronic literacy will largely supplant 'paper' literacy for many everyday purposes. The development of transferable skills in the 'new' literacy will be essential for socio-economic success, for both individuals and nations (Reinking et al., 1998). Further, Topping (ibid), suggests that teaching writing in schools might become much less significant as software is developed that can reliably transform speech directly into writing (and vice versa). An implication for schools is that teaching dictation skills might become much more important than teaching writing.
I would concur with Topping in that ICT and electronic literacy reduce the significance of transcriptional elements in the written process, but feel that schools will still need to teach composition in the context of developing children's awareness of the social aspects of literacy. Rivalland, for example, argues for a concept of literacy that recognises the possibilities for children who will grow up in what she calls a 'multimodal world'. She advocates the teaching of:

- a literacy which encourages children to be aware of the values in all texts;
- a literacy which recognises that technology can reshape the social relations of doing literacy, ..., and which will provide children with the social capital and critical awareness to make use of these texts within appropriate contexts.

(Rivalland, 2000: 1).

Recent research is now reviewed under the specific categories of reading and writing in order to demonstrate, explicitly, the possible benefits of ICT. A wider view of the social context of literacy and ICT is then expounded to include Labbo and Reinking's (1999) view of technology in literacy instruction as a set of possibilities in relation to 'multiple realities'.

**ICT and learning to read**

There is a developing body of research evidence from Europe, the USA, Australia and New Zealand that indicates that ICT will help children learn to read if used in the right way. McKenna (1998), Medwell (1998) and Underwood (1998) and Lewin (2000), for example, examined the use of 'talking books'. They suggested that using talking stories increases children's word reading accuracy, both in the context of the story and out of context; improves children's understanding of the stories and supports children's reading
by offering them access to the meaning of the stories and the way sentences work. They also point out that these programs are more effective for boys who seemed to show greater increases in word accuracy than girls when using talking stories. Collins et al. believe that talking books are not only accessible and highly motivating but also:

have the potential to develop reading skills by giving children the overview of the story prior to reading it, by supporting children's independent reading through sounding out unrecognised words and by encouraging collaborative reading in front of a public 'page'.

(Collins et al., 1997: 34)

Further, Medwell (1998) argues that the use of this particular type of software offers the following benefits for young readers:

- giving children the overview of the story prior to reading it;
- supporting children’s independent reading through sounding out unrecognised words;
- making the features of narrative explicit;
- encouraging collaborative reading in front of a public ‘page’.

The combination of speech and text has, therefore, the potential to support children's reading. Medwell (1996) found that when children explored the talking stories prior to reading with the teacher there was a significant increase in word accuracy. Hartas and Moseley (1993) and Davidson and Noyes (1995) report on the beneficial effects for reading when pupils use a speech feedback facility in a word processor and Miles et al. (1998, cited in Moseley and Higgins et al., 1999: viii) have examined the effect of speech input software on children's literacy development. Moseley and Higgins et al. (1999: ix) suggest that a clear progression is identified by the literature. Beginning
readers are helped by addition of speech for word recognition (e.g. talking books). Speech support then assists with writing and spelling by encouraging children to re-read (or have the computer read) their work to identify where improvement was possible. More fluent readers are encouraged to extend their reading comprehension through the spoken support for new words and the availability of a spoken dictionary. Moseley and Higgins et al. (ibid: ix) also review illustrations of "effective pedagogy with ICT" and assert that the children involved "made significant progress over a term in reading age, word recognition and spelling age".

Barker et al. (2000) discuss the Dockland's Learning Acceleration Project. The project was organised by the National Literacy Association and worked with six hundred 7 and 8 year olds in school and at home. Results from the project suggest that using multimedia and portable technology, as well as more traditional methods, could raise the levels and expectations of children’s literacy. Collins et al. (1997) do, however, point out that this potential is rarely realised because the effective use of software is dependent on the teacher providing appropriate support or 'scaffolding' for learning. Whatever the suggested benefits of a particular type of software (or hardware), it is when the teacher assists and guides the child's learning that these benefits are fully realised, as discussed earlier (Mercer and Fisher, 1997a and 1997b; Waller, 1999). Medwell (1996), also, concludes that talking books are used most effectively to support reading with the teacher, not as a replacement for the teacher. Technology on its own does not enhance learning; teachers need to incorporate ICT very carefully into the curriculum. The potential for teaching and learning is much greater with multimedia systems connected to
the Internet, but even old RM 186 and BBC programs can still be used very effectively. 'Developing Tray', for example, is an old program that is still very useful for text completion or text disclosure (Cloze Procedure) and is best used collaboratively or alongside the teacher (see Scrimshaw, 1993: 130). Also, as Moseley and Higgins et al. (ibid: ix) argue, "the indication in the literature that speech support was beneficial needs further analysis to understand where, how and for which pupils it might be helpful".

**ICT and writing**

A significant body of research conducted in the USA has been concerned with investigating aspects of the integration literacy instruction and technology (for example, Daiute, 2000; Leu, 2000; Reinking and Bridwell-Bowles, 1991; Reinking et al., 1998). One area of this research examines the impact of word processors on written expression (Cochran-Smith, 1991; Edinger, 1994; Labbo, 1996). While some research has found either no significant results or mixed results with regard to the effect of word processors on literacy development (Hunter, 1990; Joram et al., 1992), most studies have shown word processors to be beneficial. However, there is, as yet, only limited research evidence to support this assertion in terms of early writers (Kuhn and Stannard 1997).

In the UK, Underwood and Underwood (1990) and Wray and Medwell (1991), for example, have pointed to measurable gains in children's writing performance being made when using a word processor. Word processing has had a particular effect on improving children's motivation (NCET, 1994b) and writing tends to become longer, more elaborate and read more often. In a study by Hoot and Silvern (1988), 4- to 6-year-old writers who
composed with talking word processors became more sensitive to phoneme/grapheme correspondences, as measured on independent assessments, than children who did not hear what they wrote read aloud as they composed. This study also indicated that benefits from using ICT as a writing tool can be significant for writers struggling with form and fine motor coordination. Chang and Osguthorpe (1990) have demonstrated how ICT mitigates the difficulties young children often experience with the fine-motor control necessary for letter formation and Baker and Kinzer (1998) have shown how ICT facilitates revision in writing.

Further, MacArthur (1996) found that the difficulties with written expression encountered by students with learning difficulties were reduced by a range of ICT including the use of word processors, spell checkers and speech synthesisers. Other studies indicate that word processors can increase collaboration and active involvement among children (Baker et al., 2000), help children to focus on the content they are writing about (Cochran-Smith et al., 1991), and increase cohesion and promote metacognitive talk (Jones and Pellegrini, 1996). Research that focuses on the impact of the Internet and electronic communication on development of writing suggests that through Internet technologies, children can find support for their writing efforts (Anderson-Inman, 1997), increase their awareness of audience (Gallini and Helman, 1995), and gain useful feedback (Guhlin, 1996).

Although these studies offer valuable insights into the effectiveness of various technologies for fostering children's reading and writing abilities, they do not offer systematic examinations of the instructional approaches used in literacy programmes that
integrate those technologies. Robinson (1994) also, suggests that the potential benefits of word processing do not appear to be as fully realised in composition as in transcription. There is evidence (Ofsted 1998, for example) that word processors are used in the classroom mainly for copying up and presenting text already written by hand. Robinson suggests that unless writers understand the writing process then they will not fully appreciate the technical facilities available to them. As Owston (1993) has pointed out, in the absence of suitable in-service training, teachers have been left to make their own connections between the way they teach and the way children learn to write in classrooms with computers. Chandler, as long ago as 1984, cautioned against the uncritical use of computers and questioned whether computers will really alter the writing curriculum for the good. Peacock, also, commented after observing teachers work with children to develop their writing that:

If there is an uncritical response to the word processor and an assumption that it will by itself usher a golden age of writing then we will be missing an opportunity to examine the way that children write.

(Peacock, 1993: 97)

**Collaboration, writing and ICT**

The computer, because of the public nature of the screen, can become a natural focus for interaction and collaboration among writers. Peacock and Najarian (1993), have suggested that one of the effects of bringing word processors into the classroom has been to encourage teachers to develop collaborative writing more than they might otherwise have done. This is because the computer screen offers a context for collaborative writing that is much easier to use than paper. According to NCET (1994b: 24) what has been
written on a computer screen is more likely to be seen as a collaborative product when compared with a hand written text that is more clearly owned by the member of the group who did the writing. Resource constraints have also led Potter (1994) to recommend that the most appropriate niche at present for the word processor is for the collaborative production of short public, non-narrative texts (for example class news etc). Clearly this is a very appropriate application of the word processor in the classroom but that there is also a use for word processors to support the shared writing of narrative texts. Shared writing is where the teacher works with a group to compose stories etc and acts as the scribe to discuss and model the writing process. This is an activity that features strongly in the NLS Framework for Literacy and one that I have found to be particularly beneficial in the classroom (Waller 1998). Scrimshaw (1993) also, emphasised the particular contribution that ICT can make to collaborative writing by facilitating brainstorming, composing, conferencing and publication. When composing with a partner, children have the benefit of experiencing the role of writer and reader as they respond to a partner’s suggestion of specific text sequences and listen to a partner’s reactions (Daiute et al., 1993; Dale, 1997, cited in Daiute, 2000: 7).

Baker (2000) examined the inquiry and process writing approaches a fourth-grade teacher used in a classroom where literacy instruction and technology were 'successfully' integrated. With the process approach to writing instruction, children of all ability levels brainstorm, draft, edit, revise, and publish their own writing (Graves, 1983; Harste et al., 1988). The teacher carefully observes writing activities and provides mini-lessons for individuals, small groups, and the whole class when children demonstrate the need for a
skill at different stages in the writing process. This approach fosters collaboration by providing young authors with opportunities to share their writing, at which time they receive feedback and together explore the reading-writing connection (Tierney and Shanahan, 1996). Baker's study is consistent with other investigations that have found that technology can empower the learner (Beach and Lundell, 1998; Labbo and Kuhn, 1998), foster collaboration (Apple, 1991; Daiute, 1985; Labbo and Kuhn; Sheingold, 1991) and develop children's awareness of audience (Baker et al., 2000).

For Daiute (2000) collaborative writing with a partner involves children in composing processes that make explicit the social nature of writing. Children engage in a range of playful and metacognitive strategies when composing with peers (see Brown, 1978). She asserts that "collaborative writing is a socially embedded use of word processors" (2000: 1). As tools that allow writers to merge and revise ideas in text, word processors can be integral to creative and critical composing. The benefit of the word processor is that individual contributions can be merged into one via typing, merging, and editing facilities. The collaboration is, thus, embodied in the word processed text. Furthermore, Daiute has argued that peer collaborative writing on the computer has been associated with more improvement than has writing with only the teacher (Daiute et al., 1993).

Daiute and Morse (1993) and Sharp et al. (1995) showed that multimedia programs can also support literacy. Multimedia composing tools have the potential to transform children's writing because they combine image and sound processing with word processing. Daiute and Morse (ibid) note that using graphics engages children who
would not otherwise be attentive to textual features that provide support for their writing. Further, images include details and nuances that are more difficult for beginning readers to glean from text. Visual images can also serve as a focal point for shared discussion, and assist children to develop their ideas in a socially mediated context.

**ICT and the ‘Literacy Hour’**

Although the National Literacy Strategy (NLS) has very little to say about ICT - clearly ICT can be used to support reading at word, sentence and text level within all parts of the literacy hour. As Dombey (1998: 41) points out, learning literacy in the early years is perhaps more complex than the prescriptive view of the NLS allows. She suggests that the NLS has not given adequate consideration of the factors that move children into literacy and the changing nature of literacy as ICT influences practice. Also, Dombey suggests that the whole agenda of the NLS is unable to respect and respond to children's own ideas and perceptions. Goodwyn *et al.* (1997) and Marsh and Hallet (1999), also, have reservations about a 'nationally imposed, narrow and highly prescriptive strategy'. They advocate an approach which considers a far more complex and broadly conceived model of literacy that recognises the many varied practices involved in meaning making and includes the spoken word and written and visual text. Further, along with Whitehead (1999), the emphasis is on literacy practices that are located within a meaningful context where purpose is the prime consideration.

Although there is concern amongst many early years educators that the introduction of the NLS is evidence of increasing prescription in the language and literacy curriculum for
young children (Marsh, 2000), ICT can be used effectively as a resource to teach the NLS Framework during the literacy hour, and at other times. However, whilst there maybe some overlap of experience when children are practising or consolidating their IT skills, knowledge and understanding through their use of the technology, lesson objectives are centrally concerned with literacy, not information technology. Barker et al. (2000) have found that using ICT in the literacy hour can:

- provide a change of approach to tried and tested ideas
- offer structure and support for less able children
- extend those at the top end
- give new insight to vocabulary and word work
- show children a more positive approach to drafting and editing
- motivate and encourage a fresh response to the skills of reading and writing.

In particular, Barker et al. (ibid) discuss ways in which schools working with the National Literacy Association Project team have incorporated technology into their group work activities in the literacy hour.

**Children in control?**

Owston (1993) and Daiute (2000) have argued that the relationship between the computer and the teaching of writing is complex: it varies over time; it is embedded in the classroom social context; and it depends on the teacher's instructional goals. One of the ways that new technology can change the classroom culture and influence the writing process is that the programs put children firmly in control of the process. This has not
traditionally been the case with early writing. Once they have started school many children can become reliant on the teacher when writing. An example of this is what Graves (1982) has called the 'writing welfare system'. Typically children will queue up for the teacher to provide the spelling of words for their writing. The teacher therefore spends much time acting purely as a consultant for the transcriptional aspects of writing and, in fact, may only comment on and assess spelling and punctuation. As Hall (1987) points out, this does not help children to read, write or think. Hall argues that most children learn to speak at home without being deliberately instructed. They also learn much about writing in the same way - but there are, however, significant differences between speech and writing. Young children need to begin learning how to communicate with a non-present audience and how to develop explicitness and coherence in their writing. SCOLA (1982) report that children do not necessarily acquire these competencies through maturation and along with Bereiter and Scardamalia (1987) argue that children needed to be taught. Their concept of teaching, however, embraces a more complex model than simple instruction and they argue forcefully (1987: 171) for 'knowledge transforming' as a teaching goal. They suggest that children need to become aware of the explicit cognitive processes involved in writing through teacher support and scaffolding, and that in general this does not happen in the classroom. They contend that this is the reason why ICT has not helped children to adopt more sophisticated composing strategies. The technology on its own is clearly not enough - it is the style of teacher pupil interaction that is crucial to the development of successful writers. There is also a need for greater evidence that writing using ICT helps young children develop competence in their ability to use a more explicit, coherent and structured style of
composition and how the wider availability of new technology in schools may help facilitate this development.

In much of the discussion about technology and writing throughout the last twenty years, the computer has been described as a tool, and this metaphor has evolved in relation to theories of writing as a cognitive process (Adams and Brindley, 1998). Daiute (2000) offers two ideas about how various computer tools can be used to enhance the cognitive aspects of composing: distributed composing and transformational composing.

- **Distributed Composing**

  For writers, distributed cognition means imagining and anticipating readers’ responses, and, one of the difficulties of learning to write is to engage in composing processes with imagined audiences (Bereiter and Scardamalia, 1987; Daiute, 1985).

  For Daiute (2000), distributed composing is interactive composing that sets the writer’s thought and action in broader social and physical contexts. For example, a writer reflects on his or her audience as the basis for deciding on a text revision and then carries out a revision using the word processor. The word processor presents the text in a form the reader can view immediately on the computer monitor or later on a printout.

- **Transformative Composing**

  Transformative composing is the deliberate use of composing interactions, contexts, and tools to enhance learning.
Daiute takes a sociocultural perspective and draws on Vygotsky's explanation that symbolic acts transform thinking. "As speech and the use of signs are incorporated into any action, the action becomes transformed and organised along entirely new lines" (Vygotsky, 1978: 24, cited in Daiute, 2000: 8). For Daiute (ibid), transformative composing is the conscious use of composing interactions, contexts, and tools to enhance learning and she argues that "writing with symbolic tools like word processors and e-mail engages young people in yet another set of cultural symbols".

Daiute (2000: 1) suggests that using computers for writing development is complex. Clearly, ICT can be used as a tool to support written language, yet using ICT requires literacy. Also, the context in which ICT is used can enhance children's motivation for learning to write. However, Daiute (ibid) argues that when children are involved communicating through ICT they will confront "social and ethical challenges", requiring that they understand and control the contexts, purposes, and processes of written language. Children are therefore involved in critical literacy as they develop towards fluency in written language. Communication technologies make context and knowledge explicit, but, Daiute (ibid: 10) argues, children need to be "socialised to critical literacy, to evaluate their literacy actions and to determine how these actions affect society and support their own development".

The development and use of communication technologies has far outpaced research on computer-mediated literacy. Many studies have investigated aspects of the integration of literacy instruction and technology, but few have examined the instructional approaches
used for such integration Baker (2000). Although these studies offer valuable insights into the effectiveness of various technologies for fostering children's reading and writing abilities, they do not offer systematic examinations of the instructional approaches used in literacy programs that integrate those technologies. Leu (2000) suggests that research time might be better spent on exploring issues of how to support teachers' efforts to unlock the potentials of new technologies, and not on demonstrating the learning gains from technologies we already know will be important to our children's success.

The introduction of Internet technologies into classrooms will not prepare children adequately for the new literacies they require (Topping, 1997; Leu, 2000). Leu (2000: 6) makes the significant point that while the technology in classrooms has rapidly increased the leadership necessary to prepare teachers to use ICT for teaching is often lacking in nations around the world. Leu (1997) suggested that no one person can know everything there is to know about these new technologies for literacy instruction, as they change too quickly for any one person to keep up. However, all teachers have information that is useful to others. Leu (2000: 6) puts forward the view that the 'connectivity' that characterises literacy on the Internet permits educators to learn from one another in ways never before possible. As a result, the more members of the literacy community that use electronic literacy, the more insights that can be gained into teaching and learning with ICT. As Leu (2000) points out it is the teachers who are experienced at using the Internet in their classrooms who are likely to provide us with important direction. These teachers have already experienced the challenges others will soon encounter. Most important,
they have developed highly effective instructional strategies and resources, tested in the classroom, to solve these challenges (Karchmer, 1999, cited in Leu, 2000: 7).

Independent learning can be supported by new technology if children are taught how to use the technology and how to research. Collins et al. point out that unstructured browsing of software (and web sites) may be counterproductive. This point is also made by Barker et al. (2000) and Wray and Medwell (1994: 78), who argue that teachers and children need to negotiate to formulate purposes for finding information and using it. They continually stress the need for children to be led towards autonomy in the development of their literacy - but this does not mean leaving children to work on their own on the computer without teacher support or collaboration with peers. Further, communication technologies make context and knowledge explicit, but, as Daiute (2000) argues, children need to be socialised to critical literacy.

Labbo and Reinking (1999) offer a useful way forward. They view technology in literacy instruction as a set of possibilities in relation to 'multiple realities'. They contend that "our orientation to technology and its implication for literacy continually change as technology and its use advance rapidly, often undermining long-standing assumptions and perspectives that have arisen from print-based literacy" (1999: 479). The perspective of multiple realities allows for the consideration of the extremely rapid advances of digital technologies, how quickly they become integrated into society as a whole, what technologies mean to those who use them, and in some cases how much more slowly they become integrated into conventional schooling. For example, they argue that, "the
differential availability and use of e-mail and the Internet in society when compared to schools, not to mention differences among schools, create multiple realities that can change quickly over time and across specific contexts and that make it difficult but not impossible to create any meaningful, stable research-to-practice connection" (1999: 480).

Labbo and Reinking (1999: 481) see a more active, transforming role for technology, and have generated a framework of five goals for integrating technology with literacy teaching:

1. New digital technologies should be available for literacy instruction;

2. New digital technologies should be used to enhance the goals of conventional literacy instruction;

3. New digital technologies should be used to positively transform literacy instruction;

4. New technologies should be used to prepare students for the literacy of the future;

5. New technologies should be used to empower students.

It should be noted here that the use of the term 'instruction' by Labbo and Reinking is taken to mean teaching and learning in a wider sense and not a narrow definition often
used in UK education, which infers that 'instruction' involves the teacher directing the whole class.

Labbo and Reinking's framework is also useful for guiding and interpreting research in relation to practice. They believe that viewing the research-to-practice connection in terms of negotiating multiple realities has several advantages. Firstly, it reinforces awareness of the complexities of instructional practice; it reveals why there can be so many debates about what research has to say about practice and it suggests that both researchers and practitioners need to be conscious of the different realities that shape their actions (1999: 489). As, Labbo and Reinking advocate:

> Ongoing literacy related technology practice and research must continue to be designed, cultivated and disseminated in consideration of multiple complex realities presented across a broad spectrum of unique cultural contexts.

(Labbo and Reinking, 1999: 489)

Future research into the nature of interaction and scaffolding around computers in the classroom can build on Labbo and Reinking's framework. However, in terms of early education I would want to include a further category: *New digital technology should be used in ways that are developmentally appropriate, and that build on young children's experience of ICT.*

Labbo and Reinking's goals for integrating technology with literacy instruction can be usefully allied to insights from the work of Labbo *et al.* (2000) on early literacy, Mercer and Fisher (1997a and 1997b) and Wegerif and Scrimshaw (1997) concerning scaffolding, talk and ICT and Hewitt and Scardamalia (1998) on knowledge building
4) ICT, literacy and young children

This section presents a justification for using technology in the teaching and learning of literacy with young children. It also discusses the critical issues of access and equity and gives examples of recent research highlighting the effective use of ICT for the literacy development of young children.

Although computers were becoming commonplace features in early childhood classrooms by the early to mid-1990s (Becker, 1993), early years educators have articulated two main concerns about the use of ICT with young children. Firstly, many teachers were uncomfortable with how to make the best use of them (Casey, 1997; Collins et al., 1997; Labbo and Reinking, 1999; U.S. Department of Education, 1999). In particular, teachers wonder how to design computer activities to meet the individual needs of children at various levels of literacy ability (Labbo et al., 2000).

Also, for some early years educators, there has been a concern over whether computers actually belong in early years classrooms at all. The main issue revolves around the possibility that computers will replace other activities, drawing children away from play thus 'robbing' children of their childhood (Barnes and Hill, 1983; Elkind, 1987 and 1996, Healy, 1999). Concerns have also been raised that computers will cause children to have less interaction and become social isolates (Barnes and Hill, 1983). However, when
computers are placed in the classroom, research confirms that there are as many social interactions as in other activities (Lipikinski et al., 1986, Clements and Nastasi, 1992). Also, the social effects of using computers in the classroom are overwhelmingly positive (Bergin et al., 1993). Clements (1994, cited in Haugland and Wright, 1997: 8), further, found that computers actually helped facilitate social interaction and support the development of social skills.

Healy (1999) argues that introducing technology in the early years wastes money and is damaging. For Healy classroom time used up with computers in the early years is a distraction from important developmental tasks. It may also reinforce bad learning habits and lead to poor motivation and even symptoms of learning disability. Healy, therefore, feels that young children should be warned off computers and encouraged to play traditional games that help language skills. Healy argues that for under-sevens there are few tasks which a computer would enable them to do better and it is not until after the age of seven that combining computer and manipulative activities may result in better learning. Heppell disagrees. He states:

To say no kids under seven should use the tools that will be a part of their civic, creative and economic lives seems to me to be robbing a generation. Even four-year-olds use computers in 'astonishing' ways.

(Heppell, 1999; cited in Johnston, 1999: 4)

Yelland (1999) points out that developments in technology have moved with extreme speed over the past few years and argues that there is a need to consider new definitions of what it means to play with both physical objects and digital ones. She contends that traditional activities can now be complemented with different experiences that have been
made possible with the new information and communications technologies. For Yelland, these technologies, and the activities that children may engage in with them, have the potential to extend learning in new and exciting ways.

As early childhood educators, we need to be aware of the potential of such environments as contexts for play. In this way, we can facilitate the learning process and help children to make sense of their world in ways that were not possible up to this time.

(Yelland, 1999: 220)

The potential of digital play is discussed in more detail later in this chapter.

Whilst I would support an argument against over-romanticising the possible educational benefits for the technological support of literacy the critical issue about technology and young children is not if it should be used but how it is best used to enhance their development. Further, the wider social context of the classroom use of computers may be influenced by what Luke (1999) has identified as four crucial issues concerning the current influence of electronic media on childhood. She suggests that:

1) Children's early literacy and play experiences are shaped increasingly by electronic media;

2) Because of the influence of advertising on children's educational and entertainment software choices, their critical IT skills are as important as technological skills;
3) Pre-school and primary media must now be expanded to investigations of how fairy and folktales are constructed in other media forms (for example, interactive CD-ROM etc);

4) Access remains a critical issue. As children from affluent socio-economic backgrounds usually have greater access to new technology it becomes vital that schools equip children, at all levels, with the appropriate ICT skills and experience.

Luke's points are now discussed in more detail and a justification for the use of ICT in early learning is offered.

**Why use ICT to teach young children literacy?**

There are four strong arguments for using ICT to support literacy learning with young children under the age of eight.

1. *ICT is a tool which many children are familiar with.*

   Young children in nursery and school at the present time are active participants in a community and a culture where the use of technology is a regular, and growing, part of daily life. It is this experience and awareness that has potential for teachers to build on in the classroom, in order to help young children towards literacy. Luke (1999), for example, has argued that electronic media has a significant influence on childhood. She suggests that children's early literacy and play experiences are shaped increasingly by electronic media. Developments in ICT (both hardware and software) in the last 5-10
years have enabled children to have much greater personal control over technology. This is because they no longer have to rely on knowledge of a code or use of the standard QWERTY keyboard to get access to programs. With the development of the graphical user interface (GUI) and the Mouse, the advent of CD-ROM and the combination of speech and text in multimedia programs have led to a much greater range of software that young children can access independently. Access to programs is therefore not restricted to fluent readers with keyboard skills and I have witnessed my own son at two years of age confidently using the mouse to click on icons to run a variety of early learning programs. At the same time programs to support literacy such as 'talking books' have been developed and become available to some children at home, and, at school. Collins et al. (1997: 99) suggest that "the use of multimedia systems at home is a significant factor in encouraging its use in school". A problem for some children is that the computer they use at home is much newer and more useful than the one they have in the classroom. The increase of home use, which will be effected by the full implementation of the NGfL, has, according to Collins et al., enormous implications for the teacher's role, expectations and position of authority. This could be because ICT has only recently become part of experience for young children at home and school.

2. ICT may help to provide the motivation for some children who find reading and writing difficult.

Collins et al. (1996) point out that the majority of studies into ICT and pedagogy confer that children are highly motivated when using ICT. Observers such as Underwood (1990) Wray (1994) and Straker (1997) have suggested that children no longer have the
same 'fear of technology' that is expressed by many adults. Children find that using computers is generally an interesting and positive experience. Also, when it comes to computer use, many children know more than their teacher (Shrock and Stepp, 1991). If this is the case teachers need to build on this confidence in the classroom.

Further, as discussed previously in this chapter, there is evidence that children are motivated to read through interactive and talking books (Medwell, 1998; Collins et al., 1997, etc) and that word processing has had a particular effect on improving children's motivation for writing (NCET, 1994b; Potter, 1994; for example). These positive features of literacy learning with ICT can be particularly helpful in supporting children with learning difficulties. Topping (1997: 1), for example, argues that the 'new' electronic literacy has enormous potential for "remediating and bypassing" the current difficulties of those with learning disabilities. Further, Casey (1997: 12) suggests that a speech-enhanced word processor plays a key part in the development of written literacy, thus helping to prevent early failure. However, Casey cautions against the use of the technology as an electronic workbook - and advocates it's use to "empower children's own written language. Our goal is now to offer every child this unique learning tool and to help teachers understand the power of this tool to create the best possible learning environments for all students" (ibid: 25). Cohen (1997: 45) asserts that because of the possibility of supporting children with learning difficulties the new technologies are also an important factor in promoting equity amongst children.
3. There is a growing body of research evidence that demonstrates benefits of ICT for teaching and learning.

As discussed in the previous section on research into the effective use of ICT, Moseley and Higgins et al. identify a number of possibilities for ICT to impact beneficially on learning, especially in literacy (these are discussed in more detail earlier in this chapter) and numeracy. They point out that current research literature suggested three key areas where ICT may enhance the curriculum:

- The capacity to present or represent ideas dynamically or in multiple forms (e.g. showing word endings joining in a slide show presentation, zooming in on a dynamic number line or comparing numerical data in tables with a graph of the same data);
- The facility for providing feedback to pupils as they were working (e.g. through text-to-speech or by checking pupils' responses in a mathematics program);
- The capacity to present information in easily changed forms (e.g. editing text in a word-processor or updating information in a spreadsheet).

(Moseley and Higgins et al., 1999: viii)

4. It is no longer enough to teach children to read traditional texts.

Clearly, children need to be taught to read and understand traditional texts, but as discussed in the previous section, Moore and Tweddle (1992), Heppell (2000), Topping (1997), Labbo and Reinking (1999) argue, this is no longer enough; they need to become familiar with the range of texts that are significant in adult life today, including screen and web based texts. Screen texts are different to traditional text: they cannot be seen all at once. Screen texts can also change and move in ways that book texts cannot. Further, the Internet is a tool that provides a real audience and an almost immediate response to
children's written communication. The Internet is also a vast publishing house, where children can have their work published internationally and receive back comments from anywhere in the world. Sefton-Green and Buckingham (1998) and Sefton-Green and Parker (2000), for example, explored the connections between print literacy and media literacy, in particular using a computer to edit moving images. They argue that the literacy development of young children (KS1 and 2) can benefit from teaching and learning strategies that involve the development and exploration of screen based narratives, and that such activities "should form part of the essential twenty-first century curriculum" (2000: 54).

**Play, literacy and ICT**

Influenced by the work of early childhood educators such as Montessori, Isaacs, Froebel and Steiner, the role of play in young children's learning has long been considered to be of primary importance (Bruce, 1986; Athey, 1993; Moyles, 1994 etc). Early childhood programmes have therefore been characterised by curricula that provide plenty of opportunity for young children to play and interact with materials, ideas and people. Yelland (1999) considers the impact of the new information technologies on play and as play. She suggests that ICT has the potential not only to enhance learning, but also to promote engagement with ideas in new and dynamic ways. For example, the availability of digital toys which enable the child to engage in fantasy contexts as well as to create interactions which have personal significance.
Yelland contends that the nature of the concept of 'toy' has changed considerably over the last few years as a result of new technologies which have given children's play objects a more dynamic and interactive role in the play. For example, Internet 'pets' that can communicate their emotions to children are now available and Yelland suggests that these electronic devices may sometimes have more appeal to children than the traditional ones. Papert (1996, cited in Yelland, ibid: 220) recognised the potential of digital toys especially ones that were able adopt personalities that have been defined by the child, rather than the developer of the product. Further, Papert suggests by using such toys children may "take risks and create new identities and stories that stimulate, excite and promote learning in a different dimension" (ibid). Yelland (ibid: 222) asserts that "the challenge for parents and educators is to maintain a balance between the physical (3D) toys and the new digital ones". Clearly, this 'balance' will involve using the potential of digital play in early literacy development. However, Sanger (1997) discusses the use of digital technologies in children's informal learning and culture. He argues that some teachers and parents are extraordinarily ignorant of the ways in which children use computers, videos and games in their own time.

Chadwick (1995, cited in Cook and Finlayson, 1999: 111), Casey (1997), Haugland and Wright (1997) and Cook and Finlayson (1999: 38) give examples of how ICT can be successfully used to enhance the activities associated with imaginative play and early literacy development. One activity involved children and their families taking home one of a pair of teddy bears for an overnight stay. Each bear was equipped with a bag that included various items along with a note pad computer. When the bear returned to school
the other children and the staff learned about the visit through verbal accounts, photographs and written messages.

Luke (1999) and Yelland (1999) etc, therefore present an argument that the use of digital play opportunities can strengthen everyday literacy teaching and learning in early childhood classrooms. However, as Dombey (1998 and 1999) and Roskos and Hanbali (2000) point out, there is a concern amongst early childhood educators that the important role of play in the process of learning to read and write might be misunderstood, if not overlooked altogether. They argue that the current reality of early literacy practice is that it involves intensely instructive activities that are seen as best led by adults who impart essential literacy knowledge and skills that children must learn.

> After all, children need to develop phonemic awareness, learn letter names, practice recognizing words, and participate actively in storybook reading to acquire basic literacy concepts. Certainly this is serious business, and the time and energy it demands can overwhelm thoughts of play.

(Roskos and Hanbali, 2000: 1).

Long-established play and literacy activities in early years classrooms can now be complemented with different experiences that have been made possible with the new information technologies. These technologies, and the activities that children may engage in with them, have the potential to extend learning in new and exciting ways and strengthen everyday literacy teaching and learning in early childhood classrooms. In this context learning is not only fun but children actively construct their own meaning and make sense of the world in their own ways. It is a direct contrast to much of the current literacy practice, where the learner is often passive and the teacher acts as the conductor of content and actions. If the potential of ICT is not exploited in this way it seems that
there is a possibility of a mismatch between the learning process of children and teaching method (Yelland, 1999).

There are therefore two problems faced by early years teachers: firstly maintaining an appropriate literacy curriculum that includes suitable opportunities for play and then including activities that allow children to draw on their experiences of digital technology in their play.

**Access and Equity**

As Moseley and Higgins et al. (ibid) have asserted, ICT will only enhance learning if there is adequate regular access to necessary equipment by children and teachers, and the teachers are confident and competent users of ICT in their classroom teaching. There are thus obvious problems of access and equity.

Downes (1996) and Topping (1997), for example, argue that, wealthy schools and families will be more able to provide an electronic advantage for their students. There is a serious concern that electronic literacy will merely further the advantage of the already advantaged, creating further divisions and widening gaps in society. Thus giving rise to the emergence of an 'information underclass'. Topping (1997), therefore, puts forward the view that those disadvantaged by socio-economic circumstances and, or, learning disabilities should be the subject of positive discrimination. He suggests that "they need a 'head start' in electronic literacy, if they are not to be left even further behind. This implies exposure at a very early age and continuing high-quality support" (1997: 4).
For Rivalland (2000), the challenge for governments, policy writers and educators is to resource schools in such a way that powerful forms of electronic literacy can be made available to all children, most particularly those children who are already marked with the inequities of poverty, illness and other forms of social inequity. She asserts that:

No longer can any of us who are involved with childcare, preschools or schools be excused for blaming the homes and parents of these children, because such children make up a large sector of our population. Finding ways of connecting to the interests and literate practices of these children is an essential part of the early literacy work to be done by all of us who work with children.

(Rivalland, 2000: 8)

The increase of home use, which could be effected by the full implementation of the National Grid for Learning (NGfL) has, according to Collins *et al.* (1997), enormous implications for the teacher's role, expectations and position of authority. Computer games are readily used by many children and form an important part of a social network outside school. The problem is that teachers don't always recognise the benefits of experience with games and girls are often excluded from this culture (Culley, 1988; Dawes, 1997). The Equal Opportunities Commission and the NCET (1994a) have long recognised the need for more positive images of women using ICT and teachers need to ensure that the technology in the classroom is not dominated by boys (see Loveless, 1995:102). It may be that experience and confidence gained by children using the computer at home before they come to school will be valued and supported by teachers in the same manner as early reading experience. Yelland (1999: 223) argues that large corporations are marketing toys to accompany blockbuster movies which come with defined personalities and actions that are not appealing to everyone. "Such toys can lead to play that is not creative or imaginative and in fact, set to the scripts of those movie
moguls who are motivated by profits, not the interest and welfare of young children" (ibid). She asserts that it is particularly important that children get access to digital toys that where the characters can be instructed or shaped by the user and such identities can be changed as the child chooses.

Although the number of homes with access to ICT has increased significantly over the last five years only 34 per cent of homes in the UK have access to the Internet (Office of National Statistics, June 2001). It is now possible to access e-mail and the Internet through a television but the majority of homes still have no computer. There is clear evidence of a 'digital divide'; only 3 per cent of homes in economically deprived areas have online access, whereas in the wealthiest areas online access is over 50 per cent (ibid). Also, there is a gender divide as only 36 per cent of women have access (ibid). Many local public libraries have installed computer terminals with Internet access for free use by community children and adults. However, as Topping (1997) points out, access to a machine and support in learning to use it are both needed. Lynch (1998) demonstrates how ICT can be used to promote successful links between schools and the local community. The technology and expertise of the school acts as a resource for the entire community and children are able to develop their ICT capability with greater understanding and support from home. Hughes and Coyne (1996, cited in Topping, 1997: 12) described computer-based literacy learning for 58 Head Start families who were transported to a centre for the purpose. Parents and teachers attended sessions together. They started by exploring software for young beginning readers, developing individualised electronic books for the children with photos, text, and sound (recorded in
their own parent's voice). Having parents and teachers work together with young children is likely to enable informal peer support and help reduce adult anxiety and technophobia.

Leask et al (2000) discuss a number of projects in the UK to linking home and school use of ICT, in particular, the Dockland's Learning Acceleration Project in London (see Barker et al., 2000). The project was organised by the National Literacy Association and worked with six hundred 7 and 8 year olds in school and at home. Results from the project suggest that using multimedia and portable technology, as well as more traditional methods, could raise the levels and expectations of children’s literacy.

Access and equity are significant issues in the use of ICT with young children. Haugland and Wright (1997: 92) have argued that ICT can play an important role in developing and facilitating an 'anti-bias curriculum' when teachers utilise a range of software that is anti-bias, promote gender equity and provide experiences in cultural awareness. Downes (1996), also, provides a useful discussion of equity issues concerning the use of ICT in the classroom.

As Topping and McKenna (1999) point out, expensive software and hardware are not effective if not used or not used well. Thus a highly motivated child who is hungry to learn may only need a small marginal increment in available technology to make substantial progress. Topping and McKenna also argue that the trend towards the provision computer suites outside of the classroom might inhibit wider access and the
perception of computers as an everyday all-purpose tool. They further point out that teacher in-service training and awareness and actual use of computers can lag far behind the availability of the latest hardware.

**Research into the effective use of ICT in early literacy**

Whilst there has been far more published research on the use of ICT with older primary children (e.g. Ager, 1998) there is an increasing body of work giving examples of effective use with young children (from two to eight years). Minns (1991), in an early example, discusses the successful use of overlay keyboards in supporting story writing with children in a nursery class. Bilton (1996), also, considers the use of the computer in nursery schools and classes. Cohen (1997) reports on three long-term projects in France which have investigated the use of ICT to support the development children's written language from the ages of three to ten. For Cohen these projects demonstrated the following possible benefits of the use ICT in young children's literacy learning:

- greater motivation to become involved in written language;
- an earlier self sufficiency (particularly since the advent of speech feedback software);
- the prevention of later 'school failure' by the early use of technology.

Cohen (1997: 45) argues that because of the possibility of supporting children with learning difficulties the new technologies are also an important factor in promoting equity amongst children.
Eisenwine and Hunt (2000) report on a project that involved using a computer in literacy groups with emergent readers. Following two years of experimentation, they discovered various methods to incorporate a single computer effectively in reading and writing activities with small groups of children. They used 'Hyperstudio' and 'Kidpix' software to create their own 'talking' books for the children. Eisenwine and Hunt (2000: 463) found the hypertext programs to be a motivational tool with children; these programs offered a "refreshing, new way of looking at print for many children". Programs such as Kidpix also have the potential to engage children with early literacy experiences that are very different from those that they could create without the technology. For example, they may use the drawing palate to develop a series of pictures that tell a story and then record the storyline with their own voice as an accompaniment. This has proved to be a very powerful and dynamic early literacy experience for children in their first year of school (Yelland, 1999). Caroff et al. (2000) also, describe how multimedia software, used with teacher and with parental guidance, can support kindergartners' sense of story. In the classroom application, teachers assisted children in creating a class story using computer-generated texts.

Hutinger et al. (1998) report the findings of a three year study on the effects of an Interactive Technology Literacy Curriculum (ITLC) on emergent literacy knowledge and abilities of children (ages 3 to 5) with mild to moderate disabilities. Using a case study approach, 16 pre-school classes in four types of classrooms in West Central Illinois communities were studied using qualitative and quantitative data from the children, their families, and the staff. Hutinger et al. (ibid) argued that children made 'significant gains'
not only in emergent literacy behaviours, including communication, but also in positive interactions.

Medrano and Nivela (1997) show how the development of a computer corner in a nursery could help to foster interaction and cooperation amongst peers and promote literacy development. They aimed to integrate the computer corner into the "dynamics of the classroom" (1997: 51). It is interesting to note that they also aimed for children to foster collaboration with peers, with a maximum independence from adults. The results of their study suggest that the "computer facilitates cooperative work and helps children to tutor their peers because the children know they are the ones who control the computer" (ibid: 53). They further suggest they observed a different and more egalitarian interaction between peers than between an adult and a child. For Medrano and Nivela (ibid: 53) "without the adult, working on a problem and actually solving it is motivating in itself and holds the child's attention without any external help". In terms of literacy they suggest that the use of the computer corner led to improvements in spatiality and letter recognition but they did not advance a detailed explanation of how the computer supported these developments.

Labbo et al. (2000) report on ethnographic research into young children's opportunities for literacy development in a kindergarten classroom through the use of a computer centre. They describe how, a kindergarten teacher and a university-based researcher collaborated to design literature-based computer-related activities to meet the varying literacy needs of the children within the kindergarten classroom. Significantly, Labbo et
observed that many children with low literacy abilities were not benefiting from interacting with programs designed to provide them with practise on literacy skills (e.g., alphabetic order, letter identification, sound-symbol relationships). They found that children often engaged in non-strategic game playing (e.g. attempts to control the mouse etc) when they interacted with programs that tended to be too difficult or complex. That is, they randomly clicked on the screen until they happened upon a correct response. Interviews with the children indicated that they did this not to learn about the correct response or the literacy skill, but to play the game in a way that allowed them to see the resulting reward for getting the right answer - usually a multimedia special effect. In other words, the children's objective was to play the game, not to learn.

Taking cues from their observations of non computer-related classroom life Labbo et al. considered how best to fit the computer into the literacy curriculum. Following on from these observations, they proposed that involving children in brief, highly focused activities at the computer centre could be beneficial to their literacy development (2000: 9). Labbo et al. (2000: 10) argue that this type of activity provides children with opportunities to develop "richer understandings of concepts, discover inter-textual connections, and engage in interactive, multimedia practice supportive of their literacy needs". As a result of their research Labbo et al. recommend that the most effective use of ICT to support literacy is when the teacher finds ways to use the technology to support children's literacy needs and to enhance the thematic units and literature-based activities occurring in the classroom. For Labbo et al. it also became evident that teachers need a thorough working knowledge of software content and features if successful computer-
related activities were to be designed. The teacher involved in the project came to believe that she needed to become as familiar with the software as she is with some of her favourite children's literature. Labbo et al. argue that while it is undoubtedly time consuming to preview and try out all aspects of the available software, the results for children are certainly worth the effort. This point has significance for the NOF training that all UK teachers will undertake within the next two years - will the training facilitate opportunities for early years teachers to develop a thorough working knowledge of appropriate software for early literacy?

Thus far electronic literacy has been discussed within the context of its application in schools. However, Topping and McKenna (1999) point out, for those with access, the potential for flow of world-wide information direct into the home is enormous. There are two possible developments:

1) Schools can support and promote the development of electronic literacy in the home.
2) Electronic literacy activities can develop independently in the home irrespective of any school involvement.

International research has demonstrated how parental involvement in reading can support and enhance children's reading progress (Auerbach, 1995; Topping, 1995; Topping and Wolfendale, 1987). For Topping and McKenna (1999), the family literacy movement is a progression from parental involvement in reading in that it embraces all aspects of literacy. Topping and McKenna define family literacy as:

   typically involving parent, child, and teacher as collaborative partners in engaging with print in the family's environment for the family's own purposes, to improve the achievement and motivation in many areas of
literacy of the children and adults in the family, on a mutual and reciprocal basis.

(Topping and McKenna, 1999: 10).

The integration of electronic literacy with family literacy has been termed 'family electronic literacy' (Topping, 1997; Topping et al., 1997). The aims are similar to those for family literacy, but set in an electronic environment. In addition to literacy gains, participants might develop some transferable skills in the use of ICT. The effectiveness of these more recent developments has been less well documented as yet, although some early indications are encouraging. Labbo and Watkins (1996), for example, report on a successful programme, involving kindergarten children taking laptop computers home to produce pictorial responses to literature using a computer drawing package. In the UK the Dockland's Learning Acceleration Project involved children and families at home in the effective use of hand-held pocket book computers to develop story writing (see previous section on access and equity).

The research and evidence discussed above demonstrates how ICT can be integrated into teaching and learning to transform literacy practice in the early years. Learning to be literate involves developing an understanding and familiarity with electronic literacy; this is a necessary accomplishment for both children and teachers. Access and equity are significant issues in the use of ICT for promoting and supporting literacy, although paradoxically the technology can help increase access through libraries and family electronic literacy projects. The critical issue about technology and young children is not if it should be used but how it is best used to enhance their development.
Haugland and Wright (1997: 9) argue that for young children to benefit from computers it is essential for them to be used in developmentally appropriate ways. They contend that this involves the use of developmentally appropriate software that is open-ended and exploratory. Haugland (1992) assessed the effect of developmental and non-developmental (drill and practice) software on children's cognition, creativity and self-esteem. All children exposed to computers had gains in self esteem but Haugland found that children exposed to just non-developmental software (e.g. electronic worksheets) actually suffered significant losses in their creativity. Critically, Haugland (ibid) found that it was when children were exposed to developmental software, supplemented by concrete activities, that the most significant gains occurred.

Haugland and Wright (1997: 10) also suggest that when technology is used in 'developmentally appropriate' ways (see Bredekamp, 1986) "children are participatory learners" and that "teachers who provide children with developmentally appropriate computer environments capitalise on children's intrinsic motivation". Sheingold (1986, cited in Haugland and Wright, 1997: 14) applied Vygotsky's ideas regarding adult assistance of children's learning to computer based activities and suggested that computers could provide children opportunities to master tasks that would be difficult or impossible otherwise. Haugland and Wright (1997: 15) claim that this scaffolding effect of developmental software help's to make children's learning possible. However, as Crook, Labbo et al. and Mercer and Fisher etc have shown it is the interaction between the child, teacher and the technology that is a crucial determinant of the learning that may take place.
Summary and Conclusion

This chapter has presented an in-depth discussion of the literature concerning young children, ICT and literacy. It has considered research into the effective use of ICT in general and specifically focused on providing an overview of the teaching and learning of literacy with and through ICT in early years classrooms. The sociocultural approach taken in the chapter has emphasized the shared construction and distribution of knowledge around and through the technology (Cole, 1995; Greeno, 1997; Lave, 1988; Edwards and Mercer, 1987; Rogoff, 1990; Pea, 1993). It has been argued that there is a need to take into account the wider political, social and cultural context of ICT, so as to fully understand the nature of classroom interaction (Crook, 1994; Hewitt and Scardamalia, 1998; Luke, 1997; Säljö, 1999). This approach enabled a focused consideration of the role of the teacher in supporting children's literacy with ICT (Mercer and Fisher, 1998; and Wegerif and Scrimshaw, 1997) and the development of 'knowledge building communities' (Scardamalia and Bereiter, 1994; Hewitt and Scardamalia, 1998).

In this review a large number of studies in each of the areas identified above have been looked at in order to try to ascertain what factors may be involved in the guidance and assistance of children's literacy learning with ICT. A number of consistent themes have emerged from the literature review and these are now briefly reviewed in order to clarify the position regarding the use of ICT in literacy learning of young children, identify gaps in the research and identify an appropriate research agenda.
a) Further insight is needed into instructional approaches with ICT.

As Baker (2000) has pointed out, a considerable body of research has investigated aspects of the integration of literacy instruction and technology, but few studies have examined the instructional approaches used for such integration. Following Moseley and Higgins et al. (1999: ix) the overall conclusion reached from the analysis of the available literature suggests that "there were clear possibilities for ICT but that were no guaranteed solutions as to what would work in a particular context". The use of ICT in the classroom is dependent upon a range of contextual variables (Collis et al., 1996; Bruce, 1997). These involve not only a teacher's particular skill and confidence in using the technology, but also their understanding of how ICT can be beneficial to learning, and crucially the participation, skill and understanding of the children. Labbo et al. (2000) offer a model for investigations of early literacy and technology in the classroom, where ICT is integrated into normal practice and Haugland and Wright (1997) argue that this practice must be developmentally appropriate for children's learning to benefit. The critical issue about technology and young children is not if it should be used but how it is best used to enhance their development. The possibility of children developing an appropriate ICT capability depends on their access to computers at both home and school and it should be recognised that in some schools there are limited resources and there is a also a variable provision at home (Downes, 1996; Sanger, 1997).

In future, a great deal more work needs to be undertaken on investigating the pedagogy of teaching and learning literacy with ICT and further research is needed to better understand the learning paths for teachers and children using ICT in a particular context.
As previously noted, very few studies have focused on the individual teacher's and child's use in the classroom. Scrimshaw's (1997) point about teachers needing further opportunities and support for using and reflecting on ICT in collaborative contexts is still extremely relevant in the year 2001.

b) Consideration of how ICT impacts on children and the world of childhood is important

A noticeable trend within the literature on ICT and learning (Collis et al., 1996; Knezek et al., 1996 and Luke, 1999, for example) is that there has been relatively little concern about the impact of the computer on the child. Luke (1999) has argued that digital and electronic media has a significant influence on childhood and she suggests that children's early literacy and play experiences are shaped increasingly by electronic media. The work of Yelland (1999) concerning the influence of digital toys on children's play experiences is a useful starting point for investigations of their early literacy development. Further, as Daiute (2000) points out, communication technologies, including the Internet and computer writing tools, are useful because they make explicit some of the social and cognitive aspects of writing. Children can use communication technologies to connect with people from different parts of the world as soon as they can write, but access to these tools requires critical thinking. Using communication technologies therefore requires critical literacy. Critical literacy is an awareness of issues of equity and power in the forms, functions, and contexts of literacy (Freire and Macedo, 1987). For Daiute, teachers and students need to be reflective, critical users of literacy and communication technologies.
e) The potential of electronic literacy to support communities of learners' needs to be further investigated

As Topping (1997), Labbo and Reinking (1999), and Leu (2000) argue, through the introduction of the Internet and e-mail, the technologies of literacy are rapidly changing and children need to be prepared for much more than book literacies. Screen texts are different to traditional text and the Internet offers children extensive opportunities to write and publish for a real audience, with an immediate response from anywhere in the world. Leu argues that every teacher must begin now to integrate the Internet with their work to support children's literacy development. Topping and McKenna (1999) have highlighted the potential for 'family electronic literacy', although along with recent classroom based innovations such as the Internet and e-mail this is relatively new and further research is needed to identify how the technology may be used to build on existing literacy practice. For example, little of the e-mail research has been conducted by literacy researchers and relatively little has been published in mainstream literacy journals (Kamil and Lane, 1998). Tao and Reinking (1998 and 2000) argue that e-mail communication has been demonstrated to have positive effects on students' learning and holds promising prospects for facilitating literacy education. However, future research will be needed to further our understanding of the nature of effects that e-mail applications in classrooms have on literacy education.

d) The scaffolding process involves teachers, children and ICT.

The role of the teacher in facilitating learning experiences at the computer is seen as highly significant. The teacher is the main defining influence on the structure and
outcomes of a computer based activity (Mercer and Fisher, 1997a). The teacher shapes the children's learning through setting up the activity, interventions made during activity and the ways (before and after time at the screen) children are enabled to relate the activity to other educational experience (1997a: 210). Mercer and Fisher discuss a conception of scaffolding that offers a signpost for further educational research. Their conception of scaffolding is one where teachers support children's problem solving without taking over responsibility and use specific discourse when intervening in children's learning. Mercer and Fisher, however, do not consider how teachers' cognitive support may be planned and designed in terms of computer related activities and this is something that could be usefully pursued in future research. They suggest that

If we can describe and evaluate the ways that teachers attempt to scaffold children's learning with computers then we might be able to help teachers understand and perform their role in supporting children's computer based activities."

(Mercer and Fisher, 1997a: 210)

Scanlon et al. (1999), argue for a methodology in which the data collection also focuses on children's and teacher's perceptions of the purpose of the tasks set and the history of the interaction and collaboration of the community of enquiry.

Future research into the nature of interaction and scaffolding around computers in the classroom can build on insights from knowledge building communities that can be allied to the work of Mercer and Fisher (1997) and Wegerif and Scrimshaw (1997) concerning scaffolding, talk and ICT. However, in order to identify and fully explain the nature of situated and distributed cognition involved, the research must also recognise the wider context (Luke, 1999), as well as collecting data which analyses the classroom context in
which children and teachers are working and learning. Crucially, the research will need to take into account the children's and teacher's perceptions of this context (Scanlon et al., 1999).

Finally, Labbo and Reinking's (1999) view of technology in literacy instruction as a set of possibilities in relation to 'multiple realities' offers a framework for research. The perspective of multiple realities allows for the consideration of the extremely rapid advances of digital technologies that make it difficult, but not impossible, to create any meaningful, stable research-to-practice connection. Further, they support the view of Leu et al. (1999) who advocate explorations of computer-related literacy innovations that are conducted throughout a network of teachers who are willing to form a learning community that extends beyond the walls of the classroom or school environment.
Chapter Three

Justification and Rationale for the Research Project

Introduction

A review of the literature has revealed that very little research has been undertaken with young children using computers in general. This could be because ICT has only recently become part of experience for young children at home and school. Published writing and research evidence for ICT and literacy has been mainly concerned with studying writing with children over 8. Reinking et al. (1998), also, identify a dearth in published research concerning literacy and technology. They contend that a possible reason for this lack of research is the pace of technological change, which makes research difficult. The technology is often introduced faster than the research that might study it (Kamil and Lane, 1998: 328). Interest in the technological aspects of literacy is relatively new and Reinking et al. (1998: xxvii) suggest that early (1980s) work that focused on "using computers to enhance conventional curricular goals has slowed the development of theoretical dimensions that might be drawn on to guide research".

Reinking (1995: 326) has also suggested that as technology transforms literacy it can threaten the validity or relevance of existing bases of research. Kamil and Lane (ibid) however, maintain that it is mistaken to conclude that very little research on literacy and technology is actually taking place. It may be that as the availability of journals, particularly electronic journals, increases the research is reported in an increasingly wide range of publications. They also suggest that often the focus of research has been on
other areas, such as staff development, and that the role of ICT has not always been fully acknowledged. Consequently they argue that the relation of technology to literacy "has not made a detectable impact on the thinking of literacy researchers in the problem conceptualisation stage" (1998: 328).

Miller and Olson (1998: 343) discuss how features of ICT interact with features of classrooms in order promote children's literacy. They argue for a methodology that involves intensive case studies of closely watched classrooms and assert that the most complete understanding comes from multiple sources of inquiry. They assert that the significant issues, such as collaboration, receive attention in large-scale projects but can only be fully understood by intensive case studies such as Crook (1994) and Labbo (1996). Miller and Olson argue that close observation of classroom use of ICT contributes to our understanding in several ways:

- The role of prior experience in using computers
- How existing routines, techniques and classroom environments influence computer use
- How teacher's theories of computer use are tempered by the realities of the classroom
- How informal literacy learning transpires in a computer environment
- How unintended consequences that affect learning negatively may emerge because of the inherent features of some types of software.

(Miller and Olson, 1998: 357)

They identify problems that may be encountered with situated learning studies. These concern the extrapolation and application of any findings, but Miller and Olson contend that intensive case studies are best seen as highlighting the complex issues involved in using the computers to enhance learning that have to be addressed by educators in unique ways (because each educational setting is different). Thus, the lesson learned from
closely observed classrooms are, for Miller and Olson, best characterised as consciousness raising.

Scrimshaw (1993), Kumpalainen (1994) and Wegerif and Scrimshaw (1997), for example, have shown how the computer, because of the public nature of the screen, can become a natural focus for interaction and collaboration among writers. Recent research on reading and ICT (Collins et al., 1997; Medwell, 1998; Underwood, 1998) has investigated the potential of talking stories to support literacy development. The use of this particular type of software has been shown by the above studies to offer the following benefits for young readers:

- giving children the overview of the story prior to reading it;
- supporting children's independent reading through sounding out unrecognised words;
- making the features of narrative explicit;
- encouraging collaborative reading in front of a public 'page'.

The combination of speech and text has, therefore, the potential to support children's literacy. Hartas and Moseley (1993) and Davidson and Noyes (1995), report on the beneficial effects for reading when pupils use a speech feedback facility in a word processor and Miles et al. (1998) have examined the effect of speech input software on children's literacy development. Moseley and Higgins (1999: ix) suggest that a clear progression is identified by the literature. Beginning readers are helped by addition of speech for word recognition (e.g. 'talking books'). Speech support then assists with
writing and spelling by encouraging children to re-read (or have the computer read) their work to identify where improvement was possible. More fluent readers are encouraged to extend their reading comprehension through the spoken support for new words and the availability of a spoken dictionary.

However, as Moseley and Higgins (1999: ix) point out, "the indication in the literature that speech support was beneficial needs further analysis to understand where, how and for which pupils it might be helpful". It will be contended that whatever the suggested benefits of a particular type of software (or hardware), it is when the teacher assists and guides the child's learning that these benefits are fully realised. It is the intention of the research reported in this thesis to examine these issues further and attempt to clarify the interactional aspects of the complex situation of teaching and learning literacy with ICT.

When teachers' classroom behaviour and organisation in relation to ICT is studied Miller and Olson (1998: 355) point to the "tendency towards a dichotomy"; it is analysed in terms of either enhancing or inhibiting the use of computers. Miller and Olson acknowledge this tendency in their own research. However, they argue that whilst it is important to consider prior and normal literacy practice without the use of ICT, it is not necessarily an inhibiting factor. In England and Wales, currently, this consideration is more problematic because of the introduction of the National Literacy Strategy (NLS) in 1998 at the same time as more widespread availability of computers and expectations of their use in teaching and learning in primary schools. Waller (1999) and the University of Warwick (2000), for example, have identified a tension between the two separate
innovations of the NLS and ICT in primary classrooms in the UK. As Kamil and Lane (1998: 328) point out researchers clearly need to conduct studies that not only account for the rapid innovation, but also consider the far slower pace of adoption of technology by schools. This may entail re-thinking the way in which these problems are researched. The focus is, therefore on what is delivered rather than the technology itself. Labbo and Reinking (1999), argue that the question of what basic cognitive processes are involved in using present technologies related to literacy has not yet been addressed.

Further, current conceptions of literacy will not suffice either practically or theoretically when exposed to the light of technological advances. It is likely that several versions of literacy, based both in printed and digital environments will coexist in the near future (Leu, 2000). There is an urgent need for research in conventional educational settings where traditional conceptions of literacy seem to overwhelm the new, emerging conceptions of literacy (Kamil and Lane, 1998)

**Ethical considerations**

Decisions prior to field entry involve the need to consider ethical issues as they relate to the rights and concerns of participants and others involved at the field site. Concern for the purposes and ethical issues together make up the preliminary plan, or vision, for the research study conducted (Miles and Huberman, 1994; Ratcliff, 2000, etc). In undertaking the research for this doctorate I have endeavoured, from the outset, to adhere to the British Educational Research Association (BERA) ethical position. This states that "all educational research should be conducted within an ethic of respect for persons,
In response to increasing restrictions by government agencies on the conduct and dissemination of educational research, BERA drafted ethical guidelines for funded research in 1992 (see Appendix A). The BERA guidelines consist of the following four aspects of ethical practice: responsibility to the research profession, responsibility to participants, responsibility to the public, intellectual ownership.

Evidence of responsibility to the research profession and intellectual ownership will, hopefully, be demonstrated by the style, clarity and honesty of this thesis. However, Miller and Olson (1998) identify a problem of advocacy. They believe that a great deal of the research investigating the use of technology in classrooms is from a position of advocacy; the expectation is that ICT enhances teaching and learning. They argue that if researchers adopt a position of advocacy before undertaking the research there is a danger that computers may become the objects of research rather than only one of a number of factors influencing the teaching and learning of literacy in the classroom (1998: 343). They give the example of a number of 'lighthouse projects', such as the Apple Classroom of Tomorrow, where ICT was seen to enhance teaching and learning. Miller and Olson point out that the evaluations of these projects often failed to consider important factors such as teachers participating in these projects who were selected because of their interest in technology. Therefore, whilst it should be pointed out that many researchers in the field will be investigating the use of ICT because they have a positive disposition towards technology, this position should be acknowledged and accounted for by the researchers.
In the introduction to this thesis I acknowledged, from the outset, my generally positive disposition towards the use of ICT in the classroom. I would also wish at this point to reaffirm that this perspective is not a romantic view of ICT (see Beynon and Mackay, 1991) and the intention is certainly engagement in critical reflection on whatever findings result from the research.

In terms of responsibility to participants and the public, it is important to establish procedures for achieving the principle of 'informed consent', whereby research subjects are aware that they are in a study and that their participation is given voluntarily (Goodwin and Goodwin, 1996: 118). As Hopkins (1985) indicates, there is a crucial need to involve the participants in decisions about the gathering of research data and how it is used. Miles and Huberman (1994: 290) identify informed consent as one of a number of issues that they suggest should be addressed before, during and after qualitative studies. They raise the significant question of the possibility of a hierarchy of consent (children, parents, teachers, administrators) and how this may affect decisions concerning how permission is freely given. Robson (1993) notes that issues of informed consent may be particularly difficult when dealing with children. As minors children have the right to be protected from exploitation and be made aware of their part in the research process. A particular problem might arise in video based research if one of the children to be filmed had not been given permission by their parents. The researcher would not be able to film whilst this child was in the class. Fortunately, this problem did not occur during the research reported here. Researchers also have a responsibility to be mindful of religious, cultural, gendered, and other significant differences with the research population in the planning, conducting and reporting of their research (BERA 1992).
Eisner (1991) and Wax (1992, cited in Miles and Huberman, 1994: 290) argue that truly informed consent is impossible in qualitative studies because events in the field and the researcher's actions cannot be anticipated. In order to promote voluntary and informed decisions about the researcher - researched relationship, Erickson (1986) and Smith (1990) argue for dialogue and ongoing negotiation. For Wax (1982) this reciprocity is seen as far more important than informed consent, although Miles and Huberman (1994: 290) assert that weak consent usually leads to poorer data. Teachers will therefore need to give their explicit authorisation for any material submitted for publication and will retain editing rights. Teachers taking part in the research, and as part of the CPD course, will need to give their written permission for the collection and use of data, as will Headteachers and parents of the children involved. This is particularly important in the use of video material.

As Erickson (1992) and Bottorff (1994: 252) demonstrate, several ethical issues are particularly involved in undertaking research in the classroom using video recordings (VTR). Ratcliff (2000) points out that this is an important aspect of the research process, that can help protect those being studied, as well as the researcher. The major considerations concern confidentiality and permission. Raymond (1991, in Ratcliff, 2000: 7) particularly questions the use of videotaped data after the completion of research, without the permission of those participating. Teachers (and parents) may be concerned that explicit details of their (children's) classroom activities having been recorded and might be exposed inappropriately to others. Erickson (1992: 211), therefore, recommends that they be given assurances that access to videotapes will be
strictly limited. Confidentiality is also an issue because of the possibility of sanctions and discipline by headteachers and governors. Erickson also emphasizes that legal proceedings can result from not limiting access to videotapes and Schaeffer (1975, cited by Ratcliff, 2000: 6) argues that videos should be stored in a manner that protects confidentiality. As a result Erickson (ibid: 213) recommends storing videotapes by retrieval codes rather than site names and names of participants. Schaeffer also advocates that an undertaking is given to participants for them to be able to review and even destroy videos, if complete confidentiality is not possible.

Consequently, in order to protect the confidentiality of the children and teachers the following procedures were followed during my research in the classroom. Firstly detailed exposition of the research project and possible involvement of teachers was given at the outset, including the ethical position, the right to anonymity and the possibility of non-participation. One teacher, who participated in the CPD course declined to take part in the research. Consent was sought from each school where research was conducted and written permission was obtained from parents for video and photographic material. Further, participants were informed of the rationale for using VTR and how the data collection would proceed. Assurances were also given that the recordings would remain confidential and that if any videotapes were used to report or illustrate research it would only be with the explicit written permission of the participants (including children and parents). The identity of the participants would be protected. If necessary, to avoid any embarrassment, the video recording would be stopped at any time if a teacher or child wishes and also sequences may be erased.
There is a further consideration regarding the context of teaching and learning with ICT, though. One of the weaknesses of small-scale research at a micro level is that it can fail to take into account the impact of wider political and power dimensions (Apple 1991, 1993 and 1995; Giroux 2000, etc). Kamil and Lane (1998: 339) make the point that the agendas and agenda-setting factors of research in these areas have been ignored. One critical need is to assess the various agendas that affect the way in which research is conducted and the implementation of technology that is chosen for investigation. A discussion of these matters now follows.

Zuga (1994: 8) asserted that research in technology education is "narrowly defined and inwardly focussed". Petrina (1998: 104) argues that most of research into technology education over last 20 years has been quantitative and that "if technology education in the USA is going to overcome its past of conservatism and isolation to become a vibrant enterprise, researchers will necessarily have to critically engage with an epistemological world outside their immediate cultures". Zuga (1996) further, points out that there has been little minority participation in research into ICT in education and little that translates into minority interest. According to Zuga, women, like other visible minorities in technology education, are notably under-represented in research.

Petrina undertook a content analysis of research concerning technology education in USA journals over a period from 1989 to 1997. This analysis revealed that 68 per cent of authors are teacher educators, 84 per cent are from the USA and 87 per cent are male. Over 90 per cent of the authors are affiliated with secondary teacher education. None of
the studies in the Journal of Technology Education (JTE), according to Petrina, reflected a sustained commitment to ethnographic research. Further, Petrina maintains that an understanding of the interplay among data, method, theory and substance has not been demonstrated by a large majority of JTE authors - critical issues of the way technology supports and plays out inequities of class, gender and 'race' have been largely ignored. For Petrina (1998: 108) this evidence suggests that "researchers have aligned themselves with industrial and economic needs".

I am not aware of a content analysis of the technology education journals in the UK, although such an analysis may be a fruitful project for the future. However, there has been some concern in the UK to consider the ethical, political and economic questions raised by the expanding use of ICT in schools. Beynon and Mackay (1991: 212), for example, asserted that 'teachers need to appreciate the non-neutral character of technology' and that computers have cultural values built into them. Beynon (1993) argued that technology is primarily a cultural issue and that computers are best regarded as products defined by social processes rather than machines. Cockburn (1991), too, maintained that technology has been designed as a 'male territory', an argument taken up by feminist writers who identify male ways of thinking in both the design and deployment of individual technologies (see Collins et al., 1997).

Petrina and Zuga argue that the apparent systematic exclusion of visible minorities from ICT orientated research is central to the maintenance of status quo and power and 'conservative whiteness' in technology education. They point out that critical social
science theorists, such as Apple, Foucault, Giroux, Lave etc, are rarely mentioned.

O'Riley (1996) demonstrated how these socio-historical, gendered and racial structures are manifested in curriculum practice in schools. Anning et al. (1992: 21) asserted that ICT research agendas have ignored the power dimension - "If technology education is to have substance and inform the educational practice outside of its field, researchers are going to have to reconsider their work in the its immediate context in the politics of research practice". For Anning et al. (1992: 22) the central research questions are: "Who participates in technology education and why or why not?" In the current context in UK primary schools I would pose a further question - who benefits the most from the £1 billion being spent on ICT in schools? Is it the children, teachers, administrators or, hardware and software suppliers?

The argument is that technology education is not best served by uncritical insular research. An analysis of the wider political context of ICT and primary education will help reveal the underlying conditions that have restricted the impact of ICT on the classroom practice. Situated learning does not take place in a vacuum and the wider political context needs to be taken into account in the research.
Chapter Four
Methodology

Introduction
This section discusses and analyses the methodology and design of the research project investigating the use of information and communication technology in the classroom, by children between the ages of 3-8. The research has focused on the use of ICT to support literacy and has been devised to explore the following general question:

What are the characteristics of successful interaction between children and teachers when using ICT for literacy?

Research Design
The research has involved three phases; a Pilot Study; Phase 1 linked to a Continuing Professional Development (CPD) course focused on early years, literacy and ICT and Phase 2 following up a selection of teachers (and children) involved in the CPD course. The study was carried out with twenty-four teachers and their primary school classes with children aged 3 and 8 years, over a period of two years. Six teachers and classrooms were involved in the follow up during Phase 2 of the research. The CPD course lasted 10 weeks and ran twice, each time with twelve teachers. The teachers who attended the CPD courses were self-selected and a representative sample of this group were chosen for the follow up. The sample was selected to include the representation of the range of year
groups from 3-8, male and female teachers and children from a variety of socio-economic backgrounds.

**Pilot Study**

Initially, a pilot study was undertaken in order to establish an appropriate methodology to inform the main research project. The pilot was conducted in a town lower school, located in an area of recently developed private housing and carried out over a six-week period. Two parallel Year One classes of children, aged 5 and 6, in the same school were used in the research. These particular classes were chosen because they followed the same programme of teaching. The children were organised into ability groups for writing and had access to multimedia technology. The researcher was concerned to focus the pilot project on the teaching and writing of narrative as his own observations of classroom practice had led him to believe that children are not always given sufficient support and guidance in this genre. Teachers' comments and assessment of children's written narrative are often centred solely on spelling and punctuation. As Tann (1991: 190) reports, the characteristics of story structure are often recognised by children at an early age but not always incorporated in their writing because of transcriptional problems. The use of ICT in writing could help make the narrative structure more explicit to children and allow them to be more creative and imaginative in their writing. Further, in view of the short time scale and small sample the research would be more useful if only one aspect of writing was focused on.
The research design for the pilot project was experimental. A true experimental design depends on the random selection of participants from the entire population of interest. (Campbell and Stanley, 1963). However, because it is the norm in educational research to face intact groups such as classes of children that cannot be broken up to allow random assignment to an experimental or control group, quasi-experimental research designs are used. Most empirical studies in educational settings are, therefore, 'quasi-experimental' (Cohen and Mannion, 1989: 193). The term 'quasi-experimental' describes studies where intact groups are compared, rather than a true, randomly controlled group. Kerlinger (1970) has described quasi-experimental situations as 'compromise designs' because the random assignment of schools and classrooms is quite impracticable. In spite of uncertainty associated with quasi-experimental research designs (Campbell and Stanley), such methods offer researchers tools for studying all manners of classroom life, including the effective use of ICT (Tellez 1993). Campbell (1969: 411) noted that "where randomised treatments are not possible, a self-critical use of the experimental designs is advocated. We must do the best we can with what is available to us".

Also, the pilot study was conducted in order to analyse the benefits of using this type of quantitative method for research into the effective use of ICT in the classroom generally. One of the strengths of the experimental approach is that it allows research to focus on particular factors, and to test hypotheses about their significance for the outcomes of the learning process (Campbell and Stanley, 1963). Light (1993), for example, demonstrates that experimental methods can identify particular patterns of data that have direct implications for collaborative learning with computers in school. However, according to
Light, experimental research studies are often criticised because they are abstracted from real life educational settings and may appear to be designed only to advance theoretical understanding. He identifies a tension between the "goal of maximising the power of the experiment by keeping it as simple as possible and the goal of making it valid in relation to real contexts" (1993: 55). Light suggests that this tension can be addressed if researchers work closely with practising teachers. The pilot study was, therefore, planned in consultation with teachers and focusing, as far as possible, on normal classroom contexts. Teachers were involved in the assessment of the children's writing before and after a planned intervention programme.

The research design therefore allows for the results to be compared between an experimental group and a control group, in order to take into account any improvement in writing the children make that is the result of other factors such as normal maturation and non ICT activity. The pilot project would be classified as a 'non-equivalent' control group design because of the administration of a pre test and a post-test to both groups, and a non random assignment of subjects to the groups (Campbell and Stanley, 1963). Random assignment of subjects to the experimental and control groups was not possible as the children chosen for the pilot study were already in teacher selected ability groups based on the National Curriculum for writing (DfE, 1995). It was decided that the intervention programme would be best carried out with one of these teacher-selected groups so that the normal working pattern of the children would not be disrupted.
This particular design was chosen in order to investigate the hypothesis that 'the use of interactive technology by young children will enable them to enhance their ability to understand and use the forms and functions of written language'. One class was given an intervention programme (the experimental group) and the other parallel class (a control group) was not. The intervention programme was planned with the teachers and involved activities that enabled the observation and investigation of writing as part of normal classroom activity, but where the use of ICT is particularly relevant to the purpose. The programme included, for example, teacher led activities and shared writing using the computer to write stories and books, multimedia presentations of stories and small group and individual work with talking stories. An initial assessment of all children in both classes was made. Six children from each class were matched for ability in the composition of narrative and their progress was compared after the intervention programme. There was a gender balance between the groups. The objectives of the pilot study were therefore: to observe and teach children using interactive technology to write (and read) in the classroom; to measure and analyse children’s progress in their written narrative, for content, explicitness, coherence and structure; to distinguish and evaluate appropriate research techniques for investigating how ICT is used for the effective teaching of literacy.

The results of the pilot indicate, at a very simplistic level, that according to the criteria used, all the children in the experimental group made progress in their writing during the study. Further, none of the control group made any significant progress in their writing, although this may be partly explained by experimental mortality (see below). Two of the
children (Adam and Katy), in particular, made significant progress in written narrative. The pilot study also demonstrated how ICT can be carefully planned and integrated into the mainstream of classroom activity and that shared writing with ICT is a useful tool for developing self-esteem, motivation to write and awareness of the writing process. A fuller discussion and analysis of the children's writing is provided in Waller (1998); a brief evaluation of the research undertaken in the pilot study, linking to recommendations for the main research project now follows.

Evidence collected in the pilot study did not firmly quantify the benefits in using ICT to support writing because of the flaws in the research procedure. Conditions that threaten the validity of experiments have been summarised by Cohen and Mannion (1989: 200). They discuss the work of Campbell and Stanley and Bracht and Glass (1968) and point out that validity is more of a problem in quasi-experimental research because the effects of the independent variables on treatment and measurement can be less accurately controlled by the researcher. According to Borg and Gall (1983: 683), "the main threat to the internal validity of non-equivalent control-group experiments is the possibility that group differences on the post-test are the result of pre-existing group differences rather than to a treatment effect". The independent variables that threaten the validity of the pilot study are history, 'experimental mortality', statistical regression, instrumentation and maturation. Firstly, factors significant between the pre-test and the post-test that may produce effects that could, mistakenly, be attributed to the intervention were:

- the different teachers and their different styles of interaction with the children
- children's access to, and use of, a computer at home
- parental support for literacy,
- children's attitude to writing

'Experimental mortality' may also have been a factor in the case of children in the control group as two children were ill for a number of days and another child went on a family holiday for 2 weeks during the period of the research.

Assessing the creative aspects of written composition, and attitude and confidence is clearly problematic. According to Campbell and Stanley, Borg and Gall etc, unreliable tests can cause serious errors in experiments. Instrumentation was therefore a significant difficulty experienced in the pilot study. In order to administer the pre-test and the post-test, a suitable instrument for the measurement and assessment of written narrative had to be found. Assessing the composition of writing is notoriously problematic - as to a certain extent teachers are making judgements about the children's creativity and imagination. It was decided that the National Curriculum level descriptions for writing were too broad and inappropriate for the pilot as they incorporate both the compositional and transcriptional aspects of writing. As the focus of the assessment was on the compositional aspects of written narrative it was therefore decided, in consultation with the teachers, to use a more developmental approach and two different formats that clearly identified different stages in the writing process were utilised. These were SCOLA (1982) and Fox (1994) (see Waller, 1998). If this experiment were to be repeated on a larger scale suitable assessment materials for the purpose will need to be established and trialled.
Maturation may also have been an important variable as chronological age is clearly a significant factor in the development of literacy. For the children involved in the pilot study there could have been up to an eleven-month difference in the age of children within the control or experimental group. However, the groups were matched for age in that both the experimental and control groups contained the youngest children in their respective class. These summer born children can sometimes be behind their peers in literacy development, not an unusual factor in many Year 1 and 2 classes (see Browne, 1996).

The main threats to external validity encountered by the pilot study concern the lack of full consideration of the independent variables (discussed above) and the 'Hawthorne effect'. Bracht and Glass argue that the behaviour of the researcher must be carefully controlled so that it does not affect the activities being investigated. A weakness of the pilot study was that the researcher actually taught the experimental group and then researched the effects! Any improvement in the children's writing following the experiment may, of course, have been as a result of working with an enthusiastic, experienced teacher who was expecting the intervention programme to succeed and who was confident with ICT. This 'experimenter bias effect' was first identified by Rosenthal (1966) and could be overcome by organising research so that several teachers are involved (this is the intention for the main research project). The context in which the experimental group received their intervention programme; one teacher working all afternoon with one small group of children without having responsibility for a much larger class, was not usual. It is not likely that this context will be replicated across
several classrooms in the full project. What was demonstrated was the value of having more than one experienced teacher in the classroom and the use of the particular writing and ICT activities followed in the intervention programme. A further criticism that could be levelled at the pilot, and a major threat to both internal and external validity, was the fact that the researcher did not work with the control group at all. This was due to lack of time, but if the researcher had taught the control group for writing in the same way as the experimental group, but not using ICT, then the effects of experimenter bias may have been countered. Any improvements in the writing of narrative by the experimental group could then have been more closely associated with the use of ICT.

One of the most serious weaknesses of research studies (Borg and Gall, ibid: 357) is that they fail to make maximum use of the data. In the pilot study data was not collected on all the other variables at the time of the experiment, although some of the information such as access to a computer at home would have been relatively easy to collect at a subsequent point. One of the main difficulties found during the pilot was identifying a suitable instrument to measure children's progress in the compositional aspects of writing (as discussed above). The dilemma experienced was in trying to quantify essentially qualitative aspects of the writing process such as attitude, self esteem and interaction - which during the pilot the researcher became far more interested in. For example, the following comments regarding these qualitative aspects were noted in the researcher's diary at the time:

Week 2. 'When the children made the presentations of their story on Kidpix they were all extremely proud of their work, in way that I have not
observed before. Adam and Samantha were particularly keen to share their writing with a 'critical friend'.............The teacher, too, commented that the 'children were more than usually keen for their parents to see their written work on display in the classroom'.

Week 3. Both Adam's and Samantha's parents reported that their children asked or chose to write stories at home - which they had never done before. Again the teacher commented on the increased enthusiasm of the children for writing (although this may have been because they were being given extra attention). Children not involved in the intervention programme keep asking Me when it was their turn to use the computer for writing!......We must make sure that the control group children experience the same computer based activities at a later date.

If the pilot study was replicated all the appropriate data would need to collected and subjected to statistical analysis. The usual method of overcoming the problems of the pre-existing differences between control and experimental groups is analysis of covariance, although Sirkin (1995) discusses a range of further statistical procedures that can be used for analysing non-equivalent control group data. Normally multivariate correlational methods are used to describe and explore the relationship between three or more variables (most educational research is not affected by a single factor). Multiple linear regression is the statistical tool used for exploring the strength of the relationship between several independent variables and one dependent variable (see Borg and Gall, ibid: 369). The fact that the size of the sample involved in the pilot project was very small (6 children in each group) would have been problematic in any statistical inference. It is not the intention here, therefore, to provide a detailed statistical analysis. In future, if the experiment in the pilot study was to be replicated, a suitable instrument for quantifying progress in the compositional aspects of writing would need to be identified and used, and all the data on the independent variables collected. Full statistical analysis
of the relationship between the treatment effect and the other variables could then be undertaken.

The pilot study was set up to test a quasi-experimental research design and a particular intervention programme involving ICT and writing. Following the pilot and its subsequent analysis, discussed above, the researcher would support Scrimshaw's assertion (1993: 187) that "experimental studies often provide a spur to reflection and further enquiry but not a source of answers to the problems of classroom implementation". During the pilot, it became more apparent that the research goals were not so concerned with measuring and quantifying children's progress in written narrative, but more with analysing qualitative factors such as self-esteem, motivation, social interaction, scaffolding and collaboration between teachers and children using ICT. Along with Bereiter and Scardamalia (1993: 171), it was found that "what began as a focus on compositional abilities turned into a view of writing as a way of processing and developing knowledge". As a result of the pilot the research has become much more concerned with investigating the nature and the quality of teacher-pupil, and pupil-pupil interactions when using ICT in literacy. It has become clear that what should be investigated and analysed by educational research is not the technology but theories of learning and teaching methods in the classroom (thus moving into the realm of Heppell's stages 3 and 4 - see the literature review).

Quasi-experimental research, is therefore, probably only going to provide a small sample of data concerning ICT and literacy and the research design would have to have a much
tighter control on internal and external validity. Qualitative data from the pilot study, however, provided a useful demonstration of how ICT can be planned and integrated into the mainstream of classroom activity. In particular, the use of shared writing with ICT as a tool for developing self-esteem, motivation to write and awareness of the writing process was seen as significant. This information will be developed in the next phase of the research that is linked to a CPD course for teachers. Further, the next phase of the research will pay much more attention to the children's own thoughts about their writing, drawing on the growing literature on metacognitive awareness (Rogoff, 1990; etc). It will investigate the 'scaffolding' process and the development of self-esteem in the teaching and learning of literacy using ICT. Exploration will focus on how ICT could be used as a teacher intensive activity for cognitive development and used within the 'Literacy Hour' to support writing. This would seem timely and could prove beneficial to teachers - enhancing knowledge of the way literacy can be effectively supported by ICT.

**Phase 1 and Phase 2**

The evaluation of the pilot project pointed to a further investigation and analysis of the interaction, learning and teaching methods in the classroom, as opposed to a focus on the technology. As a result this phase of the research involved developing a methodology to examine the nature and the quality of teacher-pupil, and pupil-pupil interactions when using ICT in literacy.
The following questions were investigated by the research in Phase 1 and 2:

1. **What is the difference between literacy learning with, and without, ICT?**
   - Does ICT change the nature of learning to be literate?
   - Does ICT change the nature of what is worth learning?
   - How does the use of ICT in the classroom change the teaching and learning of literacy?

2. **What is the role of the teacher in literacy teaching and learning with ICT?**
   - How can the ways in which teachers attempt to scaffold children's literacy learning with computers be described and evaluated?
   - How do teachers successfully build on children's experience of ICT outside school during literacy sessions?
   - How does electronic literacy support the learning community in the classroom?

A range of qualitative and quantitative methods would need to be used to investigate these research questions. However, as the focus was on the situated context of teaching and learning with ICT the methodology used was mainly qualitative. Qualitative research, broadly defined by Strauss and Corbin (1990: 17), means "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification". Hoepfl (1997: 48) has argued that qualitative inquiry accepts the complex and dynamic quality of the social world. Qualitative research is not about the verification of theories and hypotheses but rather with discovery. A qualitative study has
a focus but that focus is initially broad and open ended, allowing important meanings to
be discovered (Maykut and Morehouse, 1994: 43). According to Hitchcock and Hughes
(1995: 296) the qualitative researcher is looking for patterns and themes, consistencies
and exceptions to the rule.

There are several important reasons for deciding to adopt a mainly qualitative research
methodology. Strauss and Corbin (1990) claim that qualitative methods can be used to
better understand any phenomenon about which little is yet known. The introduction of
computers into the nursery and infant classroom, particularly in the UK, has received
very little attention from researchers, so far (as previously discussed). In order to begin
to carefully investigate, describe and analyse the impact and effect of technology on
teaching and learning qualitative methods would seem to offer many benefits. The ability
of qualitative data to more fully describe a phenomenon is an important consideration,
not only from the researcher's perspective, but also from the reader's perspective as well.
As Lincoln and Guba (1985: 120) point out, if you want people to understand better than
they might otherwise, provide them information in the form in which they usually
experience it. This research is certainly concerned to produce findings which would help
teachers better understand and use computers in the classroom through identifying and
clarifying their perceptions of teaching and learning with ICT as well as those of the
children they taught.

Hoepfl (1997) presents a description of features of qualitative research that is a synthesis
These characteristics are considered to be interconnected (Patton 1990: 40) and mutually reinforcing (Lincoln and Guba 1985: 39). A selection of these descriptions that are particularly relevant to this study will now be discussed.

1. Qualitative research is informed by the natural setting as the source of data. According to Hoepfl (1997: 3) "the researcher attempts to observe, describe and interpret the settings as they are", maintaining what Patton (1990: 55) calls an "empathetic neutrality". Qualitative researchers are interested in understanding people's experiences in context. Personal meaning is seen as tied to the context and through the enquiry researchers draw on their development of explicit and tacit knowledge about the subject or phenomena (Polyani 1959). Tacit knowledge is more basic, unarticulated knowledge and explicit knowledge is or can be written down.

2. The researcher acts as the human instrument of data collection. For Hitchcock and Hughes (1995: 298) the researcher is perceived "as a collector and culler of meaning from the data". Lincoln and Guba (1985) identify the characteristics that make humans the 'instrument of choice' for naturalistic inquiry:

- humans are responsive to environmental cues, and able to interact with the situation;
- they have the ability to collect information at multiple levels simultaneously;
- they are able to perceive situations holistically;
- they are able to process data as soon as they become available;
- they can provide immediate feedback and request verification of data;
- they can explore atypical or unexpected responses.
Glaser and Strauss (1967) and Strauss and Corbin (1990) have identified a need for 'theoretical sensitivity'. This is the ability to recognise what is important in data and give it meaning. Strauss and Corbin judge that theoretical sensitivity comes from a number of sources including professional literature, professional experiences and personal experiences. The authority and reliability of the reporting of qualitative research relies heavily on the confidence the readers have in the researcher's ability to be sensitive to the data and to make appropriate decisions in the field (Eisner, 1991; Patton, 1990). Polyani (1959) suggested that this explicit knowledge is subject to critical reflection as long as it is written down and reported.

3. Qualitative research has an interpretive character, aimed at discovering the meaning of events for individuals as they experience them, and the interpretations of those meanings for the researcher. According to Geertz (1973) ethnography is about thick descriptions - the main problem is concerned with the extent to which the analysis of often small-scale research can be generalised. Belenky et al. (1986) use the term 'interpretive-descriptive' research to refer to exploratory studies which rely on other peoples words or meanings as the data for analysis. The outcome of studies is not the generalisation of results but a deeper understanding of experience from the perspective of the participants selected for the study.

4. Qualitative research has an emergent (as opposed to a predetermined design) and researchers focus on this emerging process as well as the outcomes or product of the research. According to Hoepfl (ibid) it is important to emphasise the emergent nature of
qualitative research design. Because the observer seeks to observe and interpret meanings in context, it is neither possible nor appropriate to finalise research strategies before data collection has begun. Important leads are identified in the early phases of the data analysis and pursued by asking new questions, observing new situations or previous situations with a different focus. However, for Hitchcock and Hughes (1995: 296) it is possible to employ a non emergent design where the focus of research is pursued using qualitative methods but the data is collected and then analysed [see, for example Säljö, 1984].

Scanlon et al. (1999: 64), usefully, discuss the work of Issroff (1996) who has identified the following further methodological issues that arise in studying computer based collaborative learning. Firstly the time period for the research is significant. Many investigations are based on snap shots - a longer time span is needed to study interaction (for example, Salomon and Globerson, 1987 and Kraut et al., 1988). The effects of collaboration also take time to appear. Secondly, the structure of the learning situation is seen as an important consideration. Issroff emphasizes the need to conduct investigations in real life situations where the tasks and computer tools are designed to promote collaborative learning.

Further, research on collaborative learning with technology necessitates consideration of social and psychological factors as well as cognitive ones. For example, Joiner et al. (1991, cited in Scanlon et al., 1999: 64) have shown how social and psychological factors can affect the nature and motivation of interactions. Although the focus of these studies
is mainly on collaboration between children, rather than interaction between children and teachers, they do nevertheless raise some valid points concerning the collection and analysis of data when investigating interaction around ICT. Scanlon et al. (1999: 65) argue that naturalistic research is necessary to comprehend collaborative learning and that locating such research in the classroom gives the researcher a better opportunity to study the influence of context on learning. Their approach was therefore to "enter the context and to then discern through an evolutionary process what was salient".

However, it should be pointed out that for Salomon (1991) and Newby (1997), for example, the distinction between qualitative and quantitative research should be transcended. Salomon asserts that both an 'analytic' approach (which assumes that discrete elements of complex educational phenomenon can be isolated for study, leaving all else unchanged) and a 'systemic' approach (which assumes that all elements are interdependent, inseparable and cannot be studied as single variables) should be employed by educational researchers, as complementary to each other. Salomon (1991: 16) argues that each of the two approaches complement each other by informing and guiding the other. He gives the following example to support his theory in relation to the inclusion and use of computers in the classroom:

Our controlled experiments show that computer tools can offer the learner a mode of thinking that can be internalised and hence provide at least one theoretical and empirically based rationale for their inclusion in the latter. On the other hand, our systemic research suggests that the attainment of any worthwhile effects by the inclusion of computers necessitates the redesign of the whole learning environment.

Salomon (1991: 16)
Salomon (1991: 12) therefore, argues for a methodology that transcends the quantitative and qualitative divide and he proposes "a whole dynamic ecology" that uses a methodology that respects the systemic nature of the classroom. For Salomon, recognition of the interdependence of qualitative and quantitative research is essential for any applicable, fruitful and valid outcomes to be maintained in educational research. Through the use of two different, but compatible, methodologies Salomon has identified two of the most salient issues concerning ICT in classrooms. That is, how do teachers use ICT to facilitate children's learning and thinking and what environment best supports this learning? Kamil and Lane (1998) and Miller and Olson (1998) also argue that a range and variety of research methods are needed to inform educators about how to integrate new technologies into literacy teaching and learning.

Methods

The following range of qualitative and quantitative research methods were therefore used to gather data in Phase 1 and Phase 2 of the study:

- questionnaires;
- diaries compiled by the researcher and the teachers;
- interviews with teachers and children;
- video recordings of classroom interaction;
- field notes compiled by the researcher.
Each of these methods is now discussed in more detail below, with significant attention being given to a consideration of the use of video recordings that would help discern the nature of teacher child interaction.

**Questionnaires**

Questionnaires for teachers were devised and used at the beginning and end of the CPD course (see Appendix B). The first purpose of the questionnaires was to help the researcher build an understanding of the teachers' knowledge and practice of early literacy and ICT in their classroom and school context. Participant's answers could be compared with each other and a range of colleagues from the same school, who were not undertaking the course. The data provided by the teachers then provided areas for further investigation during interviews.

Goodwin and Goodwin (1996: 34) provide a useful list of steps involved in the development, use and analysis of questionnaires in early years research and further advice on questionnaires from Munn and Drever (1995) was followed. The questionnaires were piloted and then given to teachers at the outset of the course - so as to influence the outcome as little as possible. By comparing each participant's initial answers with their response on completion of the course a measure of any changes in understanding and practice could be made. Research data based on questionnaires tends to be suited to easily quantifiable information such as numbers of computers as well as the kinds of software and hardware and when used (Ratcliff 2000). As Goodwin and Goodwin (1996: 35) assert, this type of survey research enables the collection of
considerable data relatively quickly. This knowledge base can then be used to conduct other forms of investigation. However, as with all research techniques, questionnaires have their limitations. As Munn and Drever (1995) point out, they tend to describe rather than explain events and the information can be superficial. A further problem is the use of questions that seek to measure more qualitative or subjective data. This data is open to differences in interpretation (Hoepfl, 1997). There are clearly dangers of relying too heavily on questionnaire information and, for example Bennett’s (1976) study of teaching style was criticised because it was based primarily on questionnaire responses rather than upon observation of teachers’ behaviour (see Hammersley, 1986: X). Questionnaires have been used by Dupagne and Krendl (1992), for example, to elicit teachers' views on computer influenced change in the classroom. But, as Ratcliff (2000) argues, this change is not measured systematically and there is a danger that reported findings may suffer from misperception or self-fulfilling prophecies. Further, he suggests that "measuring the changes that computers bring may be in fact no longer really possible and instead a focus on the evolution of classroom practice or snapshots of practice in different schools may be the best way to determine effects of the on-going changes in classroom cultures" (2000: 4).

**Diaries**

Research diaries were kept by the researcher from the outset of the research and also by the teachers once they had started the CPD course. The intention was that towards the end of Phase 1 of the project the diaries would be compared and discussed in some depth with the teachers to enable issues to be clarified and explored further in Phase 2. The
diaries allow for both an emic perspective (the teacher's and researcher's in the classroom context) and an etic perspective (the researcher's analysis of all data), Goodwin and Goodwin (1996: 110), for example. The acceptance of multiple realities is an essential feature of ethnographic research (Fetterman, 1989; Patton, 1990) and as Boyle (1994: 166) points out, both views are significant in the development of conceptual and theoretical interpretations. The elaboration of the multiple realities in the classroom is also seen by Labbo and Reinking (1999) as central to their framework for investigation literacy and ICT (as discussed in the literature review).

Hoepfl (1997) argues that analysis of documents such as diaries provides invaluable information to qualitative researchers. Hansen (1995), for example, analysed journal entries and memos written by participants, in addition to interviews during his investigation of technology teachers in training. Cooper and Brna (2000), in their study of the interaction between human and electronic communication in the classroom, use diaries to assist the development of a 'participant design methodology'.

**Interviews**

Semi-structured interviews were conducted with six selected individual teachers before and after video film of classroom interaction, in Phase 2 of the research. Groups of children from the same class were also interviewed in order to develop a fuller understanding of the context of early literacy and ICT and assist triangulation. The decision to use semi-structured interviews also reflected the fact that children were not able to produce significant amounts of data in writing. Also, as Brooker (2001) and
Walsh et al. (1993) suggest, formal interviews with young children can be quite difficult. The interviews with teachers were carried out in six schools and originally linked to video data (see above). Each interview was taped (sound only) and transcribed for evaluation and analysis. Interview questions were divided into the following categories: general questions about ICT and teaching and learning, and ICT and literacy. Teachers were also asked to try to discern their style of interaction when teaching with ICT using the model of teaching developed by Palinscar and Brown (1984) [see previous section]. The intention was to compare teacher's perceptions of their style of interaction by using interview and video data.

Interviews allow the researcher to gain insights into others' perspectives (Goodwin and Goodwin, 1996: 134) and can be used either as the main strategy for data collection, or in conjunction with observation and other techniques (Bogdan and Biklen 1982). Patton (1990) categorises interviews into four types: informal conversational interviews; semi-structured interviews; standardised open-ended interviews and closed field response interviews. An interview guide or 'schedule' was prepared to insure that generally the same information was obtained from each person, but there were no predetermined responses. In semi-structured interviews the interviewer is free to investigate and explore within these predetermined inquiry areas (Hoepfl, 1997). As Lofland and Lofland (1984) suggest, the use of interview guides can ensure productive use of interview time; and make interviewing multiple subjects more systematic and comprehensive. They can also help to keep interactions focused. Interview guides can be modified over time to focus attention on areas of particular
importance, or to exclude questions the researcher has found to be unproductive for the goals of the research (Lofland and Lofland, 1984).

Interviews were also conducted with two groups of four children chosen randomly by the teacher from each class. The children were interviewed in a separate room and the dialogue was tape-recorded. The groups of children selected were mixed, with a gender balance and 'rules' established before the interview started. The children were asked questions in turn and then invited to join in the discussion when a classmate had completed their response. As with the teachers, the children were asked general questions about computers and questions about ICT and literacy (see Appendix C for interview schedule). Maykut and Morehouse (1994: 104) define group interviews as "a group conversation with a purpose". Morgan (1988) prefers the term 'focus group' as the term highlights the dynamic nature of the group interaction. Morgan believes that group interviews are especially useful for investigating what people think and for uncovering why they think as they do. The two main decisions to be made before undertaking the interviews concern who should be interviewed and what questions they should be asked. The children interviewed in this study were randomly assigned by their teacher to include a gender balance in the group. The interview structure and questions came out of the survey data and questionnaires, and as a result, I became particularly interested in the children's views of their computer experience at home in comparison with their ICT experience at school. I decided to limit the interviews to 15-20 minutes, at most, including replaying the tape, because of the age of the children.
According to Maykut and Morehouse (1994: 108) the researcher's role is characterised as a moderator - however, for Maykut and Morehouse the moderator is more effective if the researcher genuinely demonstrates high interest in the subject. To this end the researcher had deliberately worked with the children (who were to be interviewed) to support them on a computer based activity in the classroom before interviewing them. It was considered to be important to demonstrate interest in ICT before the interviews and also have some contact with the children in their natural setting so that they would feel more comfortable about taking part in the interviews and to elicit a range of useful comments. Further, Maykut and Morehouse suggest that very early on in the interview it is useful to ask a general question that is easy to answer and which produces some useful information so as not to undermine the conversational quality. It was decided to set some ground rules for the child interviews in order to help the children feel secure that their turn would come and their view would be recorded. Each child was asked to take it in turns to answer a particular question first - the others would then be invited to contribute if they wanted to.

The use of videotapes in research
Extensive use of videotaped recordings (VTR) has been made by researchers engaged in quantitative studies of behaviour (Kendon, 1979; cited in Ratcliff, 2000: 2; Dowrick and Biggs, 1983; for example). Over the last twenty years, as the cost has become less excessive, the availability of equipment has increased and, crucially for research, the quality of the recording has improved. Consequently, Collier and Collier (1986: 139, cited in Ratcliff, 2000: 11) suggest that "film and video have become essential for the
study of human behavior". Boffen (1994: 245) believes that the requirements and techniques are gradually becoming clearly defined as VTR is used more frequently to provide a comprehensive analysis of behaviours.

The crucial technical requirements for using VTR in the classroom research are a clear picture and sound. As a result careful decisions need to be made about the location of the video camera, and the use of sound and lighting; also, whether to use a fixed or moveable camera or two cameras for back up. Ratcliff (2000) compares the benefits of the etic (uninvolved and distant) and more emic perspective. He suggests that:

Placing the camera in a corner and letting it run without adjustment represents a more extreme etic perspective, while turning the camera and making adjustments to follow specific events and people makes it a bit less etic. An even more emic perspective is possible by carrying the camera on the shoulder or in the hands, so that it becomes an extension of the participant observer holding the camera.

(Ratcliff, 2000: 6)

In his own research in elementary schools he asked the children to conduct interviews with each another as he carried a running camera on his shoulder. Ratcliff argues that the two perspectives are complementary; the distanced, stationary, long running wide-angle overview as well as the mobile, involved approach that zooms in and out regularly. Each of these approaches will provide data the other can miss and together give a bigger picture of the whole. Ratcliff also identifies the inclusion of participants' perspectives in what is recorded as a significant recent trend in VTR research. He suggests that the purpose is to gain an emic perspective, to attempt to record the opinions and values of participants.
Consequently, as Simco and Warin (1997) and McPake (1998) argue, VTR can also be a rich source of data for qualitative research. However, they point out that the full benefits of VTR for research are only realised if use is accompanied by awareness of the limitations and issues concerning assumptions made about the data provided by the video recordings. Scheflen (1966: 270, cited in Bottorff, 1994: 258) suggests that "We do not decide beforehand what is trivial, what is redundant, or what alters the system. This is a result of the research". From this point of view video recordings are seen as essential to investigate patterns of behaviour or interaction. The advantages of using a qualitative approach to analyse observational data in the form of VTR accrue from ensuring that the context can be used to enrich descriptions of behavioural patterns. As a result, it is not just the presence or absence of behaviours that is important in qualitative methodology but the interpretation of behaviour within the context in which they occur (Bottorff, 1994; McPake, 1998; Simco and Warin, 1997).

From the sociocultural position the data provided by the VTR is therefore one aspect of the context but it needs to be analysed in the light of the total 'activity system' (Engestrom, 1990 - see Figure 2.2 on page 41). The use of the camera in the classroom, also becomes part of the activity system that is being researched. To illustrate, an example is provided by an episode from a previous research project. Here nursery children were being filmed using a 'talking book' program. The camera was left running unattended and during this time the children discontinued with their focus with the computer program and started to play with the camera (Waller 1998).
The benefits of using VTR for classroom research

Grimshaw (1982, cited in Bottorff, 1994: 245) identified the two main benefits of using VTR for research in general as *density* and *permanence*. The density of data collected through VTR features a wealth of information that can involve the capture of interaction through language and gesture (Ratcliff, 2000). For Beresin (1993: 161) the videocamera records subtle details not observed by the human eye, including latent aggressive and affectionate gestures. Collier and Collier (1986: 77) sum up the strengths of the density of data provided by VTR. They point out that "the basic aspects of human interaction can be recorded and studied in detail, including body space, continuity and change across time, and kinesic variables such as gestures and posture". In the classroom VTR is able to record the whole range of movement and activity, including teacher and child interaction in whole class, small group and individual organisations. Videotape data is therefore seen as incredibly 'rich', as a range of data can be included simultaneously.

Grimshaw argues that in comparison to the participant observer, who also has access to all verbal and non-verbal behaviours the subjects demonstrate, the data provided by VTR is greater. Erickson (1992: 210) notes that normal field observation tends to emphasize events that occur frequently, since there is more data on them to be compared, while videotape of a rare event can be repeatedly observed and explored. An example of the possible benefits of the density of data is given by Bottorff (1994) who used VTR to study the ways in which nurses use touch to care and comfort patients. She used an inductive qualitative approach to identify the significant behaviours that should be observed in touch episodes and to facilitate the development of rich descriptions that
could serve as a conceptual basis for productive conductive research. For Bottorff, the use of direct observations was insufficient to understand all the dimensions of touch. VTR film and soundtrack evidence of interactions were employed for repeated viewing, so that the complexity of behaviours forming the interaction of touch behaviour were accurately recorded and examined.

The potential of VTR to record intimate details of interaction between children and teachers was a major consideration in the decision to use video recordings as one of the research instruments for this project. The capacity for a more thorough and complete analysis than is possible in other methods is seen as a major strength of VTR. Analysis can be demonstrated to others, replications made and alternative hypotheses can be evaluated (Bottorff, 1994; Erickson, 1992; Grimshaw, 1982). Because the record on VTR is permanent events can be reviewed as often as possible, in slow motion, and frame by frame. By using slow motion certain behaviours may become apparent that were not at full speed. They can also be subject to analysis and re-analysis before the final stage where detailed description is developed. Drummond (1981) and Eibl-Eibesfeldt (1989) point out that the analysis of data is also not constrained by sequence of events in real time, but because it is time based VTR can lead to the generation of useful quantitative data. McPake (1998) identifies the retrievability of information collected on VTR as being a significant factor in allowing a variety of different analytical methods to be used to check the validity of findings giving the opportunity of a range of differing interpretations.
Data analysis with VTR

Ratcliff (2000: 20) believes that the analysis of VTR data has many advantages over analysis of other kinds of qualitative data. Significant sections can be extracted and repeatedly viewed for details by a single observer, or a segment can be viewed by several different observers for analysis. Ratcliff argues that multiple viewings of the same event are not possible in standard fieldwork without a video or film recording device. Bottorff (1994) contends that the use of VTR allows a level of analysis that has not been possible with traditional observation methods. This is because, as video recordings are reviewed, the researcher asks questions about recorded events to identify distinctive behavioural clusters or interactional segments. For Bottorff (1994: 255), it becomes possible to identify changes in the meaning of any item of behaviour according to the relationship it has with other behaviours that occur concurrently as well as sequentially. VTR can therefore be used to identify and characterise basic behaviours, which in turn would be used to construct higher levels of behaviour. Or, the VTR can be used to analyse behaviour by moving downward through the behavioural organisation, starting with the identification of complex goal-directed behaviour and analysing these to identify their component parts. According to Bottorff, many qualitative researchers choose the latter and guidelines in Bottorff reflect this preference.

Videos can also reveal new variables and thus provide questions to be raised during later interviews (Collier and Collier, 1986: 79). Ratcliff (2000: 3) suggests that "as a result of these many possible variations and unique views, video tends to change the way people watch events". It is possible that new angles of observation are perceived that can be
attempted and tested for data value. Sequences, including antecedents and consequences, become more salient, although qualitative researchers have often been less concerned about sequence and prediction than quantitative researchers (Agar, 1986: 16). A significant advantage of VTR is, therefore, analysis by several people (Schaeffer, 1975; Ball and Smith, 1992, cited in Ratcliff, 2000: 24) and videotapes can be made specifically to illustrate concepts for use in a classroom (Hockings, 1975, cited in Ratcliff, 2000:2). Bottorff (1994) used short videotaped segments in her interviews to elicit perceptions of interaction and subjective reactions to experience. Consequently videotape segments were effective in helping participants remember the events and frequently stimulated valuable comments, thereby enriching and augmenting interview data. Others such as McKay et al. (1990, cited in Bottorff, 1994: 247) have used this approach. A further benefit of videotaping is to create a stimulus to which participants respond (Krebs, 1975; Van der Does et al., 1992; cited in Ratcliff, 2000: 5). This provides interviewed individuals with a common reference point (Collier and Collier, 1986: 105; Beresin, 1993: 162, cited in Ratcliff, 2000: 9). Ratcliff (ibid) also cites examples from Mehan who played a videotape of classroom events for teachers who stopped the tape whenever an interesting event was observed (Lancy, 1993: 94-95), and likewise teachers were asked to comment on their observed teaching methods in a study by Leinhardt (Lancy, 1993: 225).

Lincoln and Guba (1985: 314-316) point to the possibility of using video segments as a stimulus for participants as part of a 'member check'. The objective is to consider if the researcher's constructs and hypotheses fit with participants' ideas of the situation, as they
watch videotape segments that relate to those constructs and hypotheses. Beresin (1993: 23) also, used videotape segments to obtain teacher reactions to her study of children at break times. A further advantage of VTR is the permanence of the record as a demonstration that the research was actually conducted in the manner described by the researcher, thus countering any concerns of fabrication and misrepresentation of research, as it is difficult, though not impossible, to fabricate a video record.

Some researchers argue that the use of VTR requires new theoretical assumptions, methodological procedures and criteria for evaluation (Hood et al., 1980, cited in Bottorff, 1994: 253). Doyle proposed a four stage process of analysis using VTR:

1. A focused narrative record consisting of a detailed account of the activities;
2. The production of an activity analysis;
3. The comparative analysis between case studies using organising categories;
4. Transform comparative analysis into a 4th stage speculative model.

(Doyle, 1982; cited in Simco and Warin, 1997: 665)

Simco and Warin (ibid: 665) "loosely adhered" to Doyle's model but found that at each stage difficulties concerning validity became evident. The nature of these difficulties relating to validity in VTR research are now expounded in more detail.

**Issues concerning validity and reliability**

One of the major limitations of VTR is that it is selective (Erickson, 1992; McPake, 1998; Ratcliff, 2000). Videotape cannot capture all data - so it is never complete
evidence on its own. As not everything occurring in the classroom is observable, however much detail of classroom interaction and activity is filmed, no single record is ever complete. The researcher therefore has a significant role in selecting and recognising regularities within the data, and this factor should not be underestimated (Simco and Warin, 1997; Ratcliff, 2000). LeCompte and Preissle (1993: 232) suggest that frequently more information is collected than can be interpreted, so researchers have to be selective. Mehan (1979: 16) points out that sometimes researchers can lack rigour by analysing a small number of video segments in considerable detail. Not only does this have the potential for misrepresenting the whole in terms of typicality or frequency, but also the relationship of the behaviour to the context is not determined. There is the tendency to select evidence supporting prior assumptions or initial hypotheses (ibid: 20). Ratcliff (ibid) suggests that these weaknesses are not unique to videotaping, but perhaps researchers are more prone to them with this medium. Erickson (1992: 210) notes that if analysis is conducted after videotaping is completely finished, there is no opportunity for testing emerging hypotheses with participants. The key to addressing this difficulty is to do much of the analysis before leaving the field. Erickson argues that important contextual details may be missing in the video record, an issue that needs to be addressed by a survey of contextual details at the beginning of the research. Also, he suggests that limitations can be overcome by analysing demographic and historical data and by combining other data collection methods such as open-ended interviews and participant observation. Collier and Collier (1986: 29-62) encourage mapping and surveying the area surrounding the research site during the initial stage of video research, and making a cultural inventory of the site. The cultural inventory includes the groupings of objects
and use of space that reflects values and feelings. This methodology is consistent with a socio cultural perspective (see the Literature Review).

Whilst the VTR may not capture everything, as Bottorff (ibid) and McPake (1998) suggest, the overwhelming density of the data collected on VTR is actually a serious practical drawback because it is extremely labour and resource intensive and it can be difficult to index and locate information. The collection and analysis of data by using VTR can be expensive and time consuming; 5 minutes of interaction can take 2 or 3 hours to analyse. Ratcliff (ibid) further points out several mechanical restrictions with VTR. For example, microphones may not pick up all verbal discourse, and individual cameras focused on facial expressions would not simultaneously be able to pick up gross motor movement. After discussion of this problem with a technician I decided that an ideal VTR method for this study would involve two cameras; one focused on the interaction around the computer another focused on the screen so that interaction could be aligned with particular episodes on the software. However, the addition of another camera into the classroom was seen to be too intrusive and may have constrained interaction. The presence of a camera operator in addition to the researcher may be also be seen as too intrusive in the classroom (Collier and Collier, 1986: 133; LeCompte and Preissle, 1993: 232). Therefore, for the purposes of this study, in order to minimise disruption in the classroom only one camera would be used. It would be operated by the researcher, myself.

A further issue concerns how researchers compare opposing interpretations of the same observation or evaluation. Simco and Warin (1997) reflect on the trustworthiness of
research derived from image based data. As VTR contains a vast amount of information, and because as soon as a researcher enters the classroom decisions are made about the location of the camera, they point out a number of methodological problems concerned with validity and reliability that are indicative of issues within qualitative research generally. Further, Simco and Warin (1997: 662) argue that image based research provides "a site for the exploration of critical questions concerning validity as an appropriate measure of the quality of research". For Simco and Warin, the interpretation of non-verbal behaviour on VTR is determined by a subjective or individual response, leaving too much to be interpreted or, too much room for interpretation. The use of different kinds of language forms in the written transcripts of video data is also problematic. For example, the use of adverbs in descriptions, such as "crouched down assertively". They also query the status that the interpretation of non-verbal data has in a discipline of words. As Prosser (1995, cited in Simco and Warin, ibid) argues, language is the dominant form of communicating findings in social research.

This led Simco and Warin to pose the following five critical questions concerning validity as an appropriate measure of the quality of research:

1. How full a description can be made of the complexities of each event? (As VTR contains much more detail than audio recording or field notes.)

2. What do we bring to bear on our interpretations of the data? (Is the status of the interpretation of the data limited by the written words? Why does it feel more subjective to analyse non-verbal data?)

3. If reliability means replicability, then how much detail should the researcher report, in order to fully communicate the research process?

4. How can we promote our own reflexivity as researchers?
5. How can we develop a consensus with the participants over our findings? (What is the intention of the researcher in seeking out meanings given to events by the respondents? To corroborate or challenge? Is it desirable to get inter-observer agreement regarding the interpretation of the video data?)

(Simco and Warin, ibid: 663)

Reid et al. (1994, cited in Simco and Warin, 1997: 663) focus on the problem of internal validity using VTR in classroom research. They discuss multiple and competing interpretations of different classroom events by making comparisons between the field notes of a team of researchers with video recordings of the same proceedings. For Ratcliff (ibid) and Mehan (1979: 22) videotape is particularly helpful in aiding the convergence of participant and researcher perspectives, which they see as central to establishing qualitative validity. Ratcliff argues that:

"Validity moves us beyond consistency in observation to congruence between perspectives, establishing credibility and trustworthiness of research, so that data from different research tools, observers, studies, and theories may be triangulated into a more comprehensive picture of the whole phenomenon studied."

(Ratcliff, 2000: 20)

He asserts that VTR evidence is appropriate to support any of these sources of congruence. Further, Ratcliff argues that a number of other factors in videotape research can also help assure a degree of internal validity. These include extending the time of videotaping, the self-monitoring of the researcher, an openness to data, a search for exceptions ("negative cases") of an emerging trend, member checks, and an audit trail.

Warin (1997, cited in Simco and Warin, p668) used VTR as one method of data collection in her study of the development of self-concept in children aged 3-7 years. She filmed the children in the classroom and playground that led her to identify a number of
issues involving the problematising of validity and reliability. For example, Warin argues that in reducing the VTR to a written format the researcher inevitably omits details and reduces the amount of information that is communicated to the reader. Ratcliff, on the other hand proposes that:

> Perhaps most significant to qualitative videotape validity is that the images formed by a camcorder are more direct and mechanistic reflections of reality...and thus tend to be more believable and credible because of the assumption that "pictures cannot lie. Credibility and believability of a record is ultimately the bottom line in the quest for validity.

(Ratcliff, 2000: 20)

Along with Watling (1995, cited in Simco and Warin, 1997: 670), Simco and Warin, however, locate the traditional concepts of reliability and validity within a positivist tradition and question whether these concepts are appropriate for evaluating the trustworthiness of image based data. They therefore put forward the following set of five criteria for assessing the trustworthiness of research outcomes, which they argue is aimed at developing a synthesis of tradition and a more modern position.

- **Completeness.**
  *The extent to which a narrative or transcript is a full record of the event which it attempts to represent.*

- **Adequacy of interpretation.**
  *A process of description, questioning and redescription.*

- **Transparency**
  *The explicit communication of every stage of the research methodology from conception to publication.*

- **Self-reflection**
  *The capacity for researchers to situate themselves within their own processes.*

- **Aggregation of conflicting interpretations.**
Validity as a deliberate and conscious search to locate the sources of challenge

(Simco and Warin, 1997: 670-671)

Whilst the above ideals set out by Simco and Warin were devised for analysing the research outcomes for image based data, they would seem to be appropriate for the range of qualitative research methods used in this study. However, as Simco and Warin (ibid: 671) point out, it is relatively easy to produce a list of values for conducting video-based research and much harder to develop practical strategies and methods to put these values into action. A further benefit of this study could therefore be in assisting the development and articulation of the criteria for checking validity and reliability of research in the classroom using VTR.

Video recordings offer a capacity for a thorough and detailed analysis of teacher child interaction in the classroom, to support other research instruments such as field notes and interviews. A further benefit is the possibility of repetition and viewing by a teacher and children after the event, here the VTR can be used as a stimulus for responses from research participants. Because this analysis can be demonstrated to others, replications can be made and alternative hypotheses can be evaluated (Erickson, 1992; Grimshaw, 1992). For Ball and Smith (1992: 56), the interpretation and analysis of videotape data is constructed reflexively, and is a product of the researcher interacting with the site context and those in that context. The use of video recordings may therefore provide the researcher with an invaluable method for developing situated knowledge (Simco and Warin, ibid: 671). However, as Ratcliff (ibid) and McPake (1998) point out VTR does
not provide complete evidence; videotape recordings are only the beginning of the making of meaning. The camera is not objective because the camera is very much influenced by the researcher's attitudes; and the image produced is always a selective portion of the classroom activity (Collier and Collier, 1986: 7-9). Therefore, the validity and reliability of VTR based research is problematic (Simco and Warin) and needs careful appraisal of the 'truth value' of the research outcome (Lincoln and Guba, 1985).

Field Notes
In this study field notes were written by hand in the classroom and used to support video data, recorded at the same time and in the same context. Hoepfl (1997: 6) describes field notes as "running descriptions of settings, people, activities, and sounds". Field notes may include drawings or maps. Lofland and Lofland (1984) point out the difficulty of writing extensive field notes during an observation. They recommend jotting down notes that will serve as a memory aid when full field notes are constructed. Ratcliff (2000) advises that the full notes are written as soon after observation as possible, preferably the same day.

The presence of an observer is likely to introduce a distortion of the natural scene which the researcher must be aware of (Hoepfl 1997). Crucial decisions regarding the legal and ethical responsibilities associated with naturalistic observation must be made (as discussed previously in this chapter). There are several observation strategies that the classroom researcher could use. Each of these strategies has specific benefits and concerns that must be carefully examined by the researcher.
(Schatzman and Strauss, 1973). For example, in some contexts it may be appropriate and desirable for the researcher to watch from another room, without being observed.

A further possibility would be to maintain a passive presence, aiming to be as unobtrusive as possible and not interacting with the children or teacher. As the research was taking place in an early years classroom, with young children, the strategy chosen when taking field notes in this research was to engage in limited interaction, intervening only when further clarification of actions was needed.

Ratcliff (2000) recommends that field notes taken at the site should emphasize events and descriptions; inferences, generalisations and vague terms should be avoided. This is to ensure that the researcher has data from which to generalise. As Ratcliff points out, research relies upon carefully documented data from which conclusions are formed. Hoepfl (ibid) suggests that a skilled observer is concerned with the process of monitoring the range of verbal and non-verbal cues, and in the use of concrete, unambiguous, descriptive language. Sours’ (1997, cited in Hoepfl, 1997: 57) study of teaching and learning styles provides a useful model of descriptive language applied when observing the use of technology in the classroom. However, as Goodwin and Goodwin (1996: 132) argue, while the focus of field notes is descriptive, they also include comments based on the researcher's perceptions. The main purpose of developing observations from field notes in this particular study was to provide deeper understandings than those arising from interviews and VTR alone. Field notes afford a knowledge of the context in which events occur, and may enable the researcher to see things that participants themselves are not aware of, or that they are unwilling to discuss (Patton 1990).
**Conclusion**

A summary of the varying instruments for data collection and how they have been used to investigate the research questions is presented in **Table 4.3**, over. The summary, following Scrimshaw et al. (2000) is drawn together to demonstrate how the multiple methods used in the study allow triangulation (Denzin, 1988 and Patton, 1990). Triangulation is the process whereby data collected by one strategy is compared to data collected by other strategies to ensure the accuracy of the information. The position of using a range of methods to best fit the research question is seen as 'pragmatic' and 'complimentary' by Goodwin and Goodwin (1996: 162) and combined quantitative and qualitative designs have been presented by several researchers, notably Creswell (1994), Miles and Huberman (1994) and Patton (1990).

**Table 4.3** shows that whilst a range of qualitative data will be generated by this study, the majority of data can be classified as both quantitative and qualitative. As Savenye and Robinson (1996, cited in Scrimshaw et al., 2000: 2) argue, the research of educational ICT should not be limited by methods, but determined by the focus of the questions investigated. Thus a number of researchers investigating literacy and ICT in the classroom have successfully combined quantitative and qualitative methods (see for example Lewin 1997; Scimshaw et al., 2000 and Snyder, 1993).
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<th>Research Questions</th>
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<td>1. What is the difference between literacy learning with, and without, ICT?</td>
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<td>• Does ICT change the nature of learning to be literate?</td>
<td>Questionnaire</td>
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<td>Interviews with T+C.</td>
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<tr>
<td>• Does ICT change the nature of what is worth learning?</td>
<td>Questionnaire</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interviews with T+C.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• How does the use of ICT in the classroom change the teaching and learning of literacy?</td>
<td>Questionnaire</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interviews with T+C.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Video Data</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaire</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interviews with T+C</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2. What is the role of the teacher in literacy teaching and learning with ICT?</td>
<td>Video Data</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• How can the ways in which teachers attempt to scaffold children's literacy learning with computers be described and evaluated?</td>
<td>Observation</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaire</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interviews with T+C</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• How do teachers successfully build on children's experience of ICT outside school during literacy sessions?</td>
<td>Video Data</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observations</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaire</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interviews with T+C</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Survey</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• How does electronic literacy support the learning community in the classroom?</td>
<td>Video Data</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaire</td>
<td>✓</td>
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<tr>
<td></td>
<td>Interviews with T+C</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Diary</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3  A summary of the range of instruments used to investigate the research questions (Following Scrimshaw et al., 2000: 8)
Chapter Five

Results and Analysis

Introduction

In order to identify any patterns or relationships and discern themes arising from the data, information relating to teachers and information relating to children are discussed separately. Analysis will then consider the wider situated context of the classroom use of ICT to support literacy and provide a summary of both sets of data.

The Teachers

Twenty-four teachers attended the two CPD courses at University College Northampton (UCN). One teacher left during the course to take up a teaching position in another part of the UK and another declined to provide information for the research. Data from the twenty-two teachers who participated in the full length of the course is therefore discussed here. The teachers have a range of teaching experience from six months to twenty-nine years. The schools they teach in vary from a small village Primary School (children aged 4-11), to town Infant schools with a Nursery Unit (3-7), a Nursery School (3-4) and large town Lower Schools (3-9) [Northamptonshire has a complicated system of schooling, which is currently under review. Schools in Northampton town are nursery, lower, middle or upper. Elsewhere in the county the schools are nursery, primary - sometimes separate infant or junior and secondary. There are a significant number of small village primary schools in the county]. Some of the participants were former students of UCN and fifteen were known to me before the course. All the teachers
involved teach in schools that are part of a formal partnership with UCN for the initial training of teachers. Three of the teachers are male. A further notable factor was that fourteen of the teachers attended the course with a colleague from the same school, including four teachers from the same infant school.

Data was collected from questionnaires completed by participants before and after the course and by colleagues who taught in the same school, but who did not attend the course. Audio-taped interviews were then undertaken with a selection of six teachers who attended the course. A video film (VTR) of the teacher interacting with a class or group of children using ICT for literacy was also made in the same classroom.

The teachers involved in the research generally conveyed a positive attitude towards the use of ICT in literacy sessions through their responses to the questionnaires, interview questions and actions recorded on VTR. They stated that they believed children benefited from its use. All the participating teachers reported that they used ICT for individual work and with pairs, during literacy. The nursery and reception teachers (who did not follow the NLS) did not organise group work around the computer because they felt the children were too young to work in this way. All participating teachers also said that they used ICT for teacher intensive (joint activity) activities during literacy sessions. However, only four of the teachers reported that they used ICT everyday to support literacy - the most common frequency being once a week (fifteen teachers). Fourteen teachers followed the Literacy Hour in their classes but this figure is distorted by the fact that four of the teachers were from one school that did not follow the Literacy Hour. Of
the teachers who did follow the Literacy Hour only one teacher said that they did not use
ICT during the hour. After the completion of the CPD sessions there was a marked
increase in the reported use of ICT to publish children’s books and stories and all
teachers stated that they now use ICT to support the composition of writing.

The Questionnaires (see Appendix B)

Questionnaires were completed by all the participating teachers at the beginning and the
end of the CPD course. Further, a sample of twenty-two colleagues teaching at the same
schools as the participating teachers also completed one questionnaire each, for
comparison. The questionnaires involved asking teachers questions about their personal
and educational confidence with ICT, experience of different types of ICT in and out of
the classroom and their use and organisation of ICT for literacy.

1. Confidence with ICT

In the questionnaires completed at the start of the CPD courses, as would be expected,
more recently qualified teachers were more confident with ICT and it was three teachers
who had been teaching over 20 years who were among the least confident. In Figure 5.1
(below) the reported length of teaching in years is represented by blue on the vertical axis
(maximum 29) and compared to the teacher’s personal confidence with ICT rating
represented by red (a scale of 1 to 10 - with 10 being the most confident). For example,
Teacher B has taught for 25 years and has assessed her confidence level with ICT as
being 3 out of 10.
There was also a gender difference in that all the male teachers expressed high levels of confidence—though a sample of three is too small to be significant. In questionnaires completed by the teachers who were not on course, male teachers were again the most confident—but for this group there was no correlation with length of teaching and confidence with ICT. A higher number of these teachers had access to a computer at home.

When comparing personal and teaching confidence with ICT, eight teachers felt equally confident with using ICT for personal use and supporting learning in the classroom whilst nine felt they were more confident personally with ICT. Interestingly, five teachers felt they were more confident with ICT in the classroom than personally—though this may

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**Figure 5.1** Length of teaching compared to personal confidence with ICT (before CPD course)
have been because they did not have the use of ICT outside the classroom (see Figure 5.2 below). Personal confidence is represented in blue and teaching confidence by red.

![Graph showing personal confidence compared to teaching confidence with ICT (before the CPD course)](image)

**Figure 5.2  Personal confidence compared to teaching confidence with ICT (before the CPD course)**

There was no apparent correlation between personal confidence with ICT and the production of ICT made resources by the teachers, for example, or the use of ICT for administration and the availability of computers at home (Q7). Confidence with using ICT for supporting learning (Q5) was varied - with four teachers rating their confidence highly (7-9 on the scale). However, this is clearly a very subjective judgement and did not always correlate with my own observations. For example, two teachers who I had observed during the CPD course and had previously visited on several occasions in school to supervise a student in their class rated themselves as a '6' on the scale. I would
have judged their confidence with using ICT to support learning in the classroom as high (9 or 10). In the questionnaires completed immediately after the course all teachers apart from one rated their personal ICT confidence more highly. Nine teachers felt equally confident with using ICT for personal use and supporting learning in the classroom, seven felt more confident personally with ICT and five indicated that their classroom confidence was higher than their personal use of ICT [see Figure 5.3, below].

Following the course all teachers indicated that they used ICT to make resources for the classroom and confidence with using ICT for supporting learning increased in 20 out of the 22 cases (Q5).

![Figure 5.3 Teaching experience compared to personal confidence with ICT (after the CPD course)](image-url)
2. Experience with ICT

The questionnaire revealed that the teachers' experience of different types of ICT (e-mail etc) was limited both inside, and outside, the classroom (Q6). I noted in my research diary at the time I was surprised by the teachers' general lack of experience with modern communicative technology! For example, on the first CPD course, only one teacher had used e-mail with the children at school whilst six had used e-mail personally. Further, only two teachers had previously used the Internet in the classroom. This could have been because their school was not linked up to the Internet at the time. (All Northamptonshire schools were online by the end of the year 2000). Less than half the teachers (six) had the use of a computer at home before the start of the course. This compares very unfavourably with the children's access to computers at home (see below). Following the course the number of teachers with access to a computer at home went up from six to nine - possibly demonstrating that these teachers had realised the benefits of ownership for personal and professional confidence and the production of resources etc.

3. Beliefs about ICT

The teachers were asked to complete the initial questionnaire before any discussion or input was made on the course so that responses would not be influenced by knowledge and experience gained on the course. Heppell's categories (1993: 232), as discussed in the literature review (page 23), were used to code the beliefs of teachers about ICT and classroom learning. These are:
Stage 1 - exposure to computers improves learning;
Stage 2- exposure to specific computer applications improves learning;
Stage 3 - computers allow children to solve problems;
Stage 4 - awareness that computers not only bring something new to the environment but also change it and change learners, too.

A fifth category that ‘exposure to computers makes no difference to learning’ was added to the questionnaire and the teachers were asked to indicate the category that best matched their own beliefs.

One teacher cited all stages and several teachers felt that their beliefs coincided with more than one stage. Eighteen teachers felt that their own beliefs best matched Stage 4. This did not necessarily match up with what these teachers, and the children they taught, later said about their practice. In comparison with teachers who were not on course there was some difference in beliefs about ICT and learning (see Figure 5.4, above). The majority of these teachers (twelve) chose Stage 2 as the best match. After the course
some of the participating teachers changed their category and four chose Stage 2 with fourteen staying with Stage 4. There was a small change in the number of teachers who felt that exposure to specific computer applications affects learning, thus moving backwards through Heppell's Stages. This factor could be influenced by the time the teachers spent on the course reviewing software and possibly be attributed to the teachers not having clarified their beliefs about ICT before hand.

4. Use of ICT in the classroom

All the participating teachers used ICT for individual work and with pairs - three teachers did not organise group work around the computer. After the course the same three teachers still did not have groups for ICT - they felt the children (aged 3) were too young to work in a group. The majority (twenty) teachers said that they used ICT for teacher intensive activities, compared with the teachers who were not on the course, of whom only fourteen used computer for teacher intensive activities. Following the course, all participating teachers used ICT for teacher intensive activities. The teachers’ assessment of the children’s confidence with ICT (Q11) revealed a mismatch with the children’s own perceptions. All of the children in the survey felt that they were confident using the computer whilst nine of their teachers rated only some of their children confident.

5. ICT to support Literacy

Only one of the teachers used ICT everyday to support literacy - the most common occurrence being once a week (eight teachers). These figures increased after the completion of the course when twelve teachers stated that they used ICT once a week to support literacy. Only thirteen teachers followed the Literacy Hour (Q13) in their classes
but this figure is distorted by the fact that four of the teachers were from one school that
did not follow the Literacy Hour. Of the teachers who did follow the Literacy Hour
(Q14) nine out of the thirteen used ICT for teaching within the hour - this later increased
to twelve out of thirteen teachers, following the course. Only seven teachers participating
had used ICT to publish children’s books or stories (Q15) and this figure was matched by
their colleagues who were not involved in the course. After the completion of the CPD
sessions there was a marked increase in the use of ICT to publish children’s books and
stories and all teachers stated that they now use ICT for composition of writing.

**Interviews** (see Appendix D)

The interviews were carried out with six of the participating teachers before and after
video recording and observation in classroom literacy sessions. Each interview was
taped (sound only) and transcribed for evaluation and analysis. Interview questions were
divided into the following categories: general questions about ICT and teaching and
learning, and ICT and literacy. I also asked teachers to try to discern their style of
interaction when teaching with ICT, with the intention of using video material for
comparison. The four-stage model of the teaching process described by Palinscar and
Brown (1984) [demonstration, joint activity, supported activity and individual activity].
was used as it is consistent with the style of teaching promoted by the NLS (see Wray
a. General questions about ICT

When asked about the impact of ICT in their classroom over the last two to three years there was a variation between those who experienced benefit. For example,

Teacher I (Year 2): Having a computer has made a difference. The software is now much better and more reliable.

Teacher M (Reception): The children have become more confident.

Teacher G (Reception): The children are already computer literate when they come to school.

There was concern expressed by some of the teachers about access and resources:

Teacher D (Year 1): This is the first school where I have been able to use ICT. Often computers are not modern enough to use.

Teacher G: We are limited because of the equipment.

Teacher L (Year 3): A main drawback has been not having equipment to use in the classroom.

Teacher I: I would prefer portable computers in the classroom to a computer suite.

In terms of the perceived future impact of ICT on learning the teachers could foresee beneficial changes and were consistent in their answers about what might hinder teaching and learning with ICT, all mentioned resources and training. For example,

Teacher A (Year 3): The computer will be used more in teaching but this has implications for long-term training. Lack of resources and teacher expertise could hinder progress. An IT Coordinator is essential to guide teachers who are not very confident.
Teacher I: The new (NOF) training should make an impact. Software designed by teachers and access to machines is important - laptops for all children would help.

When asked what would help them become better teachers with ICT two common themes occurred in the answers that were given - access to a personal laptop computer and time to review the range of software. The less confident teachers suggested that they would benefit from further ICT training.

b. ICT and literacy

The teachers were introduced to Palinscar and Brown's model (1984) [see above]. They were then asked to refer to the model to describe the main style of interaction they adopted when using ICT to teach literacy. Some teachers found it difficult to discern the type of interaction they used for ICT and literacy. For example,

Teacher N (Nursery): The style of interaction depends on the objective for the session.

Other teachers stated that they used all the styles of interaction with ICT and literacy:

Teacher A: Initially it is whole class instruction, then question and answer and discussion.

Teacher U (Reception): It depends, with a large group it’s more demonstration and instructing, because you are actually showing them a program and telling them how you do it. If you are working with a small group or on a one to one it’s getting them to try things like 'what happens then' or asking questions 'what does this button do', 'what if you press on there'. It’s more open-ended and to a certain extent you could do that with the whole class by saying 'what do you think might happen if I press on this icon'.
Teacher S (Year Two): It varies, mainly demonstration or supported activity.

Teacher R (Year Two): Demonstration- I explain how they could set the program up for writing and then support the children by encouraging them to think about what words they could put in. I use ICT activities to involve children in questioning.

The questionnaire also revealed that some teachers chose not to use ICT for intensive teaching, such as:

Teacher D: The children tell me what to do - they work independently.

When asked whether their teaching style was different or enhanced through the use of ICT the response was varied:

Teacher L: ICT makes it fun for the children - they enjoy it and think it’s easier as well enabling greater focus on the literacy skills that children need to concentrate on. Yes, its more immediate, the children’s responses and ideas are immediately apparent. They don’t have to laboriously concentrate on writing and drawing.

Teacher I: ICT makes you aware of how important small steps are, you can’t rush in.

Teacher U: You need to demonstrate more with ICT. You have to instruct on how to use the mouse and how and how to use the keyboard, as well as the software.

The perceived potential use for ICT in literacy teaching was generally very positive:

Teacher A: Teachers could do a lot more with ICT, personal understanding and resources can hinder what they do. It fits quite naturally into the literacy (NLS), with the guided writing especially.

Teacher G: ICT can support all areas of literacy.
Teacher U: Have it as your teacher focus group and have groups come to you to use your ICT. If your focus that week was phonics you would have a phonics program on the computer.

One teacher made a comment about the curriculum and ownership:

Teacher L: If IT was more integrated into the curriculum children would be more in control of their own learning agendas so that they could go and do the activity they are the weakest at on their own. Generally they do not have enough opportunity for computer use on their own.

The last comment about time coincided very much with what the children interviewed commonly felt about the use of ICT in school (see below). In general, the participating teachers did express a belief that ICT should be of value to them and their children. Teacher R, for example, commented that the main impact of ICT on teaching and learning in her classroom over the last two-three years was an increased motivation of children and in particular said that individual children who struggle with reading are motivated by using ICT.

Video Data

Following the CPD courses six teachers and their classrooms were identified in a stratified sample for further research involving videotaping (VTR) of literacy sessions that included ICT. This phase of the research concerned two nursery teachers, one reception, one Year 1, one Year 2 and one Year 3. Each classroom was visited for the equivalent of four literacy sessions, where VTR was made and field notes were taken. For the nursery and reception settings, a morning or afternoon session was recorded, as they did not follow the NLS. The Year 1, 2 and 3 classrooms were visited when the
literacy hour was taking place and ICT had been planned to support literacy. The teachers were asked to carry on with their normal programme and not change anything during the research. Different locations were used for the ICT support for literacy. The two nursery and reception classes had access to multimedia computers in the classroom and they were used regularly by a range of children, with and without teacher support, for different activities. The Year 1 and Year 3 teachers (different schools) both used a computer suite to support literacy with ICT. Although both these classrooms had access to computers these machines were older and, according to the teachers, did not run the appropriate software for literacy. The Year 2 class investigated in the research had access to two computers in a shared annex/library area outside the classroom.

The VTR was analysed using the categories identified by Palinscar and Brown (1984) in their model of teaching. Field notes were also taken at the same time. Analysis was structured in twenty-minute segments to be consistent with the various components of the literacy hour. On the VTR analysis sheets a category was assigned if teacher interaction was longer than 30 seconds. An example of the VTR analysis is given over in Table 5.1.

Table 5.1 shows teacher interaction over a twenty-minute period in a nursery class. The teacher sat with three children, each child operating a computer. The children were engaged in making books using the program 'Bailey's Bookhouse'. At the start of the period the children were using the programs independently. After four minutes the teacher sat down next to one of the children and another child came and sat on her lap. The teacher was then engaged in a variety of interaction with the children. After 14 minutes one child finished her book and the child sitting on the teachers lap moved onto a
chair to start using the computer. Teacher W then talked through the procedures necessary to operate the program (demonstration) with this child.

<table>
<thead>
<tr>
<th>Time</th>
<th>Demonstration</th>
<th>Joint Activity</th>
<th>Supported Activity</th>
<th>Individual Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>01:00</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>02:00</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
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<td></td>
<td>✓</td>
</tr>
<tr>
<td>04:00</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>05:00</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>06:00</td>
<td>✓</td>
<td></td>
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</tr>
<tr>
<td>07:00</td>
<td>✓</td>
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<td></td>
</tr>
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<td></td>
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<td>09:00</td>
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<td>✓</td>
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</tr>
<tr>
<td>20:00</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 5.1 VTR Analysis Sheet Teacher W PM (Nursery)

One of the features of this sequence (along with other recordings made in nursery and reception classes) was the significant amount of time the teacher was engaged in joint activity (7 minutes). Compared to the Year 1, 2 and 3 classes, the time spent in joint activity in Nursery and Reception was much higher. The number of adults that are available to support children in the classroom is clearly a variable that could affect the time a teacher can engage in joint activity. In the nursery and reception classrooms observed the number of adults present always included a teacher and two nursery nurses.
or classroom assistants for each 'class' of up to 30 children. Thus giving an adult child ratio of 1:10, or better. In the KS1 and KS2 classes observed, there was only one occasion where an adult other than the teacher was present. This was in a Year 3 class where a Special Needs Support Assistant was working with a child who had Cerebral Palsy. The adult child ratio in these classes was therefore in excess of 1:25.

**Figure 5.5  Frequency of Observed Interaction (by type)**

*Figure 5.5* (above) shows the frequency of observed interaction for literacy and ICT. It is noticeable that joint activity was significantly higher in nursery and reception classes (42) and individual activity is much higher in Years 1, 2 and 3, especially Year 3 (KS2).
Figure 5.6 (below) shows that the nursery and reception teachers spent 36 per cent of the observed time engaged in joint activity and 28 per cent of the time supporting children. Demonstration and individual activity were equally distributed at 18 per cent.

In comparison, the KS1 and KS2 teachers spent 20 per cent of their time in demonstration, 15 per cent on joint activity, 22 per cent supporting children's learning and for 43 per cent of the time the children were involved in individual activity (see Figure 5.7, over).
A more detailed analysis of the joint activity was undertaken using a combination of the categories of assisted performance identified by Tharp (1993) and Palinscar and Brown (1984). Joint Activity is defined using the following characteristics:

- proximity
- time
- style
- attention

Style was further broken down into the consequent teacher behaviours:

A. Starts with a child's current level of thinking and understanding

B. Allows the child a meaningful role in the setting of the task
C. The teacher assists the child through skilful helping behaviours, discourse strategies
and feedback

D. A productive communication or creation by the child is the vehicle for developing and
maintaining new knowledge

Each episode of Joint Activity identified in the VTR was then coded. For example, in

Table 5.2 and Table 5.3 (below).

<table>
<thead>
<tr>
<th>Proximity</th>
<th>Time</th>
<th>Style</th>
<th>Attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>9 mins</td>
<td>A, C, D</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 5.2 Teacher W (Joint Activity Session 2 pm)

<table>
<thead>
<tr>
<th>Proximity</th>
<th>Time</th>
<th>Style</th>
<th>Attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>3 mins</td>
<td>C, D</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 5.3 Teacher R (Joint Activity Session 1)

The data revealed, once again, a significant difference between the Nursery and
Reception teachers and those in KS1 and KS2. In terms of time, interactions were
shorter on average for KS1 and 2 teachers. Analysis of style resulted in Nursery and
Reception teachers consistently demonstrating characteristics A, C and D. Whilst the
KS1 and KS2 teacher's Joint Activity is mainly described by characteristic C (see Table
5.4, over).
Table 5.4  A comparison of Joint Activity between Nursery/Reception and KS1 and 2 Teachers

<table>
<thead>
<tr>
<th>Nursery/Reception</th>
<th>Proximity</th>
<th>Time (over 20 min)</th>
<th>Style</th>
<th>Attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Ave 7 mins</td>
<td>Mainly A, C, D</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>(some B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Ave 2.5 mins</td>
<td>Mainly C, (some D)</td>
<td>All</td>
<td></td>
</tr>
</tbody>
</table>

Interviews were then conducted with the teachers after the VTR was made. These involved showing the teachers selected sections of VTR followed by a semi-structured interview that was audio recorded. Teachers were asked about their style of interaction and how the evidence recorded on the VTR compared to their previous perception of their interaction. Two features emerged from this phase of the research:

1. A common response was that the teachers expressed surprise at how little time they were directly engaged in joint activity with the children. Also, they were concerned by the amount of time they were involved in dealing with technical support (printing etc).

For example,

Teacher A: (Class newsletter using MS Publisher)
After demonstrating the activity, I had planned to support the children's ideas, but when I saw the video I could not believe that I moved around the computer suite so much. I was mainly responding to what I thought were technical problems, like children losing text or coming out of the program. I am sure that some of the children could sort this out themselves.

2. Several teachers commented about how well some of the children supported each other when they were engaged elsewhere.

Teacher R: The video was really interesting. I had never really noticed how well Liam and Jane worked together on...
the computer, before. Jane is much more dominant in the classroom. With the book review on the computer they collaborated well.

Analysis

From the observations, interviews and video recordings made in the six classrooms three features concerning teacher interaction emerge from the data analysed.

1. Joint Activity

Relatively little evidence of any 'joint activity' or 'scaffolding' was actually observed or recorded, except in nursery and reception classes. Generally, teachers tended to instruct children in the use of a program, sometimes used ICT for demonstration, and then tended to leave children to work on computers independently, unless a technical problem occurred. Only one class in the research sample had access to a large screen for whole class teaching and this was not used during the observations. The focus of the teacher language and interaction tended to revolve around management or technical matters concerning the functioning of ICT, such as printing. During the 24 observed sessions ICT was used mainly for individual activity in the teaching and learning of literacy, as shown in Figure 5.5.

When ICT was used in the KS1 and KS2 classes, it tended to be for individual activity that quite often involved copying up and printing out using a word processor. In both nursery classes and the reception class the use of ICT to support literacy was observed on every visit. Other classes made variable use of ICT in the classroom (or just outside).
On only three occasions was a computer suite observed for literacy activities; twice in a Year 3 class using MS Publisher to produce a class newspaper and once in a Year 1 class using Clicker 3 to support individual word level work.

A typical sequence is described by Teacher C (a Year 1 teacher). She was asked to describe how she used ICT in her literacy teaching.

Teacher C: I teach it as a whole class, I sit the children down and show them how to use it and perhaps ask some out to do examples. They have free access in using the program that is set up and I might go over and ask questions as and when I notice them getting stuck or have a problem. My major problem with ICT is that children get out of the program and then are in something else which is totally inappropriate like the Internet or some word processing package they have no concept of and they manage to loose things like a picture on a screen.

Also, I asked a reception teacher (Teacher U) if she thought her teaching style was different when using ICT.

Teacher U: You need to instruct more. You have to instruct on how to use the mouse and how and how to use the keyboard.

These comments support the assertion that a major focus for teachers, when using ICT for literacy, is to ensure that the children are able to successfully access and use a program. Once this competence is achieved teachers, involved in the research, then tend to leave children to work on computers independently, unless a technical problems occur.
2. Age Specific Teaching Style

The teachers who were involved more in joint activity with children tended to teach in the younger end of the age range, particularly in the nursery classes. In the nursery there were several recorded incidents of joint activity taking place over fifteen minutes. From Year 1 up the common time for interaction was fifteen to thirty seconds with one and a half - to two minutes the maximum observed interaction (see Table 5.4). A range of factors may have contributed to this observation. Nursery (and reception) teachers tend to have more adult support in the class and the organisation and curriculum may allow for a more interactive and facilitating style of teaching (Meade, 2000). It may also have been because these teachers had more freedom because they were not constrained by the NLS. Certainly the infant and KS2 teachers were observed in joint activity during the literacy hour, but not involving the computer.

The different experiences of the children in the nursery were also recognised by teachers of reception classes. For example,

Teacher U: In the nursery their equipment is better (up to date) and then the children come from nursery to here and it’s a disappointment. They’ve got all the programs plus more adults to interact with the children.

Thus, whilst an 'Age Specific Teaching Style' is most clearly demonstrated by the different approaches between teachers involved in teaching the Foundation Curriculum (QCA, 2000) and those involved in teaching the National Curriculum (DfEE, 1999), there was also a discernible difference between Nursery and Reception classes in the research sample.
3. Difference between belief and practice

The teachers involved in the research acknowledged the role of joint activity in literacy with ICT, but were not often observed putting it into practice! For example, Teacher R (a Year 2 teacher) discussed the types of interaction that she thought take place between her and the children, when using ICT to teach literacy.

Teacher R: I explain how they could set the program up and what words they could put in it. I use the activity to involve children in questioning.

Teacher R suggested that the features of successful literacy teaching using ICT involve teachers interacting with children to provide feedback, and that the children gained more out of the activity with teacher support. Ironically, this teacher was not observed interacting with children using ICT, after she had set up the activity on any of my visits. Her actions may partly be explained by the location of the computers in a corridor outside the classroom, a factor that could have limited her opportunity to interact with the children using ICT. When I discussed this with Teacher R in a follow up interview she expressed surprise at her lack of interaction that was revealed by the video evidence. She offered the following explanation for her lack of joint activity with children using ICT in literacy sessions:

I tailor lessons to suit ICT, but I can see that I do not use the full potential.

What does this 'potential' involve, in terms of ICT and literacy? Interacting more with children at the time and providing feedback. The children really seem to enjoy using ICT, but get more from teacher involvement I think. I need to build ICT into...
guided reading and shared writing more, which means having J (the Classroom Assistant) working in the classroom to keep an eye on the children.

*What has prevented you from doing this more often?*
Lack of time and confidence. More (CPD) courses would be good.

Thus the evidence from this study suggests that, whilst teachers recognise that the potential of ICT in literacy sessions is best fulfilled through teacher interaction and joint activity, not only do teachers need to believe that ICT is a valuable tool, they also need to carefully and creatively plan for joint activity around the use of the software.

**4. Software knowledge**

The teachers recognised that it was important to have a detailed knowledge of a range of programs that support early literacy. When I asked the teachers what would help them become better at integrating ICT into their literacy practice, the factor they all commented on was the need for time to explore and learn about the relevant software for themselves (as with Teacher R, above). The CPD course evaluations also highlighted the value of time spent investigating software and the relevant web sites. For Labbo *et al.* (2000), the teacher's knowledge of software was also seen as a significant factor in the success of their teaching. This question needs further exploration. Does the teacher's knowledge of software have any bearing on how, and how well, they interact with children using ICT? Is knowledge of software linked to the teacher's ability and willingness to integrate ICT into the literacy curriculum? For example, I asked Teacher S if she felt that anything hinders teaching and learning with ICT? She replied:
Having time to look at resources and what is available.

What would help you become a better teacher with ICT?
Being able to sit and look at all the programs, having facility to have a central bank of resources where programs are available. That seems to be the weakness - not having software available to know if it’s relevant.

The responses in the interviews indicated above, in addition to those revealed in the questionnaires, have implications for the training of teachers in the use of ICT, both at ITE level and for CPD, especially NOF. The teachers involved in the research recognise that competent teaching with ICT involves specific and detailed software knowledge as well as curriculum application, thus linking with the previous point concerning the need for careful planning. Effective teaching of literacy with ICT is, therefore, not solely concerned with confidence and competence in a range of generic IT skills. As Labbo et al. (2000) suggest, teachers need to become as familiar with the appropriate literacy software as they are with children’s literature. A further possibility is the increased involvement of teachers and children in the design of educational software in order to structure programs to meet the needs of particular learning environments and social contexts (see Wegerif et al., 1998).
The Children

The children involved in the research were aged from 3 to 8 years and were taught in a variety of classroom organisations from single class groups based on age, to mixed age classes and team teaching in open plan classrooms. Interviews and teacher designed surveys of children’s attitude and experience of ICT outside school were the primary data source. Evidence from the VTR was also available. During the CPD courses I asked all the participating teachers to make a survey of children’s computer use at home. A total of 846 children were on the class registers (186 children attended the two nursery settings researched). 823 completed the survey, which revealed that 73 per cent of the children said they had access to a computer at home and 19 per cent had access to online computers. All the children without exception said they enjoyed using a computer. These figures indicate that, in terms of the number of machines and the number of machines online, the children’s home access to ICT was much greater than access to ICT in their classrooms. However, what the surveys did not reveal was how much time each child used the computer at home and what they actually used ICT for. The surveys are, therefore, of limited use in this research.

Interviews (see Appendix C)

Interviews were conducted with two groups of four children chosen randomly by the teacher from each class. The children were interviewed in a separate room and the dialogue was tape-recorded. The groups of children selected were mixed, with a gender balance and ‘rules’ established before the interview started. The children were asked questions in turn and then invited to join in the discussion when a classmate had
completed their response. All children apart from one who were interviewed said they had access to a computer at home. As with the teachers, the children were asked general questions about computers and questions about ICT and literacy.

1. General questions about computers

When the children were asked about the frequency of their computer use in school their response was generally once a week or sometimes, although in one class (Class I) the children replied usually everyday. When the children were asked what they enjoyed best about computer use at school there was a marked gender difference with writing and painting being stressed by girls and games by boys. For example,

Victoria (Class M): I write a letter to Aunty Alice who lives in Australia. We sent e-mail at home to friends and cousins a long way away.

I asked all the children interviewed ‘how do computers help you to learn?’

Class I: It has got reading and you play word games and helps you to write.

Class M: There is loads of stuff you can work on, numbers and letters and they show pictures which help you learn. We had a computer in the Nursery.

The older children made the following comments about the difference computers have made to learning in the classroom since they were in the reception class:

Class I: No change.
Class A: Computers are harder to use and we don’t have any more programs.

Class L: You get to remember things, computers help children learn when they are really struggling.

When asked what changes do they think computers might make to learning in future classrooms, typical replies were as follows:

Class I: Computers will be easier to use, there will be more programs. You can pretend to go where you want - simulation.

Class L: E-mail and shopping.

2. Computers and literacy

When asked if they thought that computers help people to learn to read and write most children were affirmative and quite specific in their answer. For example,

Class I: Yes - there is a dictionary to help you spell. You put it on reading and it helps you read. Sometimes the computer reads to you, which helps reading.

Class M: Yes, we write on the computer and then print it off. Yes, they show you things. They help you with your reading books.

The children were asked what sort of literacy activities involved working with their teacher on the computer. Interestingly children in Class M discussed aspects of collaboration rather than commenting on the actual activities:

Class M: He helps us to learn how to get on with each other they have to teach us how to do it.
Otherwise there was a varied response concerning the teacher’s role with computer.

When asked if their teacher changed her teaching when using the computer, children in Class L replied:

Yes, the teacher doesn’t have to give you much help because the computer tells you what to do.

This was an interesting comment, as I had witnessed the teacher on a previous visit spend twenty minutes very carefully giving an exposition and demonstration of how to use Microsoft Publisher, whilst in the computer suite. When we discussed the VTR evidence she said that she spent too much time supporting technical problems (see page 18). When the children were asked if they would like more time on the computer there was a consistent plea for extra time. For example,

Class I: Yes - especially multimedia.
Class M: Yes, yes please!
Class A: Yes, to e-mail people
Class L: Yes, to write poems, use the Internet and e-mail people.

When the children were asked if they should be allowed to choose more computer programs for themselves, there was general agreement that they should, although some children in Class L suggested: Yes, but we wouldn't learn any thing though without the teacher. Thus seemingly contradicting what their classmates had said in response to the teachers style of teaching with the computer. It is a particularly interesting comment as it suggests that these children, if not others, recognise that the role of the teacher in learning with ICT is crucial. Finally, the children were asked if they thought the computer will
ever replace books. Once again their answers were consistent and, in this case, strongly in favour of retaining books:

Class M: We will always have books. It would be a bad thing because we want to learn out of books.

Class L: I like books more than computers - you need a book to tell you how to use the computer - although you could have instructions on the screen.

One child, a boy aged 8, however, differed from the consensus when he replied:

Computers are better than books because you can do more things on the computer.

Analysis

As reported by their teachers, the children generally expressed a very positive attitude towards computers and many were observed to be very confident users of ICT. A number of themes can be identified from the data.

a. Assisted Performance

When they experience teacher support the children appear to be aware of value of the joint activity. In the classrooms where significant joint activity was observed children commented favourably on their teacher's support, and recognise its value.

Class K: They help you when you're stuck on it. They help you do some reading or if the computer crashes. She breaks up the words for you so you can read it......Mrs C helps us send e-mails to Mrs M in Australia, who was our old class teacher. I really liked that.

Class B: She shows me how to play on it.
In other classes where less joint activity was observed the children made comments like:

They don’t help us we do it on our own.

_They don’t help you?_
No, sometimes they just play with the other people and we just play on the computer on our own.

However, the validity of the interviews is questionable. For example, in Class B (age 4 and 5), where joint activity was observed, some of the children interviewed commented that the teacher did not work with them at all on the computer and just worked with other groups on a table.

b. Computer assisted learning

Even the youngest children appeared to be aware of how programs could support their literacy development. For example, children in Class C (aged 5 and 6) when asked if they thought computers helped them learn, said:

Yes, to follow instructions. PB Bear will tell you what to do.

_Does the computer help you to read and write?_
Yes.

_How does it do that?_
You put words in and when you click on it, it tells you the word. Then you get to learn it, if you don’t know it.

Also, when children in Class U (aged 4/5) were asked if they thought they might be making some books in literacy sessions, they commented:

Yes.

_Will the computer help you do that?_
Yes, it might have some words to show you.

_To show you what letters to use?_
Yes, I might print out some pictures too.

The children here are demonstrating knowledge of themselves as learners with ICT, and at a metacognitive level, are showing signs of learning to regulate their own thinking about how ICT can support their literacy development (Brown and Palinscar, 1986; Galton et al., 1999).

c. 'Mouse Wars'

Some of the children were more concerned with using the computer mouse to establish control. As with Labbo et al. (2000), I observed that some children appeared to be centrally concerned with gaining control of the mouse and then appeared to click randomly around the screen until they highlighted the correct response by chance, thus not reinforcing any literacy learning, such as sound-symbol correspondence. In particular, four boys (in Class U) who were at an earlier stage than their peers in literacy development, were observed using literacy programs in this way. At no stage during the observations did the teacher interact with these children concerning literacy. Independent activity, in these cases, did not appear to result in any learning gains. This observation is an example of the important role the teacher has in engaging children in joint activity, helping to focus their attention and providing a model of literate behaviour, etc. The observation also helps to identify an issue that has implications for future research into literacy instruction - how can teachers effectively support children's ICT experiences and link them with the literacy curriculum, in general?
Labbo et al. (2000), in their case study of a kindergarten computer centre, suggest that an effective use of the technology is when the teacher supports children's literacy needs by targeting time in the computer centre. Here, through joint activity children's comments and thinking are linked to the cross-curricular themes (what Labbo et al. call 'thematic units') and literature-based activities occurring in the classroom. They argue that as a result of these 'targeted moments' the children in the class have common purposes, goals and processes, when using literacy software in the computer centre. The conditions that are established by the teacher in the 'targeted moments' allow children to collaborate successfully with each other thus avoiding mouse wars and thereby focusing on concepts that were supported by the content and interactive features of the software. For Labbo et al. (2000: 4) "These type of activities provide children with opportunities to develop richer understandings of concepts and discover inter textual connections".

Summary
The data generated by the research, through the questionnaires, interviews, surveys, classroom observations and VTR, has revealed a range of interesting and useful information that has helped to address the research questions. A large quantity of data was generated by the focus on teacher-child interaction and as a result this chapter has given considerable attention to the various perceptions of this interaction. In particular, the research has started to unpick the style and characteristics of joint activity between children and teachers, when using ICT for literacy. These are seen to be variable and determined by context, especially 'Age Related Teaching Style', but involve conscious decisions to plan in 'targeted moments' for ICT and literacy. It is clear that KS1 and 2
teachers also feel restricted by the NLS and the location and arrangement of computer suites.

Children have different motivations for using literacy-based software. Some children, especially boys, were focused on gaining control of the mouse. Children's motivations were also quite often different to those of the teachers who were concerned to complete literacy teaching objectives (especially those prescribed by the NLS). However, the children in general were highly positive about ICT use and understood the benefits of teacher interaction and assisted performance during literacy sessions. They all requested more time for computer use within the classroom routine.

Teachers generally advocated using ICT to support literacy and are aware of the benefits of software knowledge but are not building it into their teaching programmes. However, there was evidence that these beliefs did not always match their practice. Electronic literacy in terms of e-mail and the Internet has had a very limited, variable impact on learning in classrooms, so far. This study has found relatively little evidence that ICT has influenced a change in the classroom teaching and learning of literacy. The research has started to evaluate the role of the teacher in literacy teaching and learning with ICT and to describe ways in which teachers attempt to scaffold children's literacy learning with computers. Conclusions to be drawn from the research are made in the following chapter, which provides analysis of the data and a synthesis of information from children, teachers, VTR and observation.
Chapter Six
Conclusions

The final part of this thesis will discuss the findings of the study in relation to previous research and make specific points about the nature of teacher-child interaction around the computer during literacy sessions. The problematic nature of identifying and describing scaffolding and joint activity in the classroom will be considered in detail and further areas for investigation discussed. In the concluding remarks a conceptual and theoretical position will be advanced in the light of the study to determine ways forward for research in the field.

The impact of ICT on the teaching and learning of literacy

The evidence collected and examined during the research for this project suggests that, so far, ICT has not had a significant impact on literacy learning in the classrooms investigated. There was a noticeable difference in time and style of interaction between nursery and reception teachers and those in KS1 and KS2 classrooms, categorised as 'Age Specific Teaching Style'. A feature of Age Specific Teaching Style was that the nursery and reception teachers spent much more time engaged in joint activity with children. The infant and junior teachers' practices, however, were subject to and influenced by the National Curriculum and the NLS. In the KS1 and KS2 classrooms observed, ICT was found to be used mainly for independent activity by children.

As Cuban (1993) and Säljö (1998) have pointed out, classrooms may be too well
'buffered' to be much affected by computers and indeed may assimilate ICT entirely into their existing way of doing things. For Säljö (1998: 61), "although computers have the potential to reorganise learning interactions in a variety of significant ways, everyday experience suggests that social institutions have remarkable capacity for neutralising the effects of new developments, technological or otherwise". A further challenge for early years teachers in the UK, is that at the same time that the availability of new technology that can support literacy has increased, the NLS has been introduced. Dombey (1998), for example, questions whether 'developmentally appropriate practice' is encouraged by the NLS. Haugland and Wright (1997: 10) have argued that when technology is used in developmentally appropriate ways "children are participatory learners" and that "teachers who provide children with developmentally appropriate computer environments capitalise on children's intrinsic motivation". This approach was seen as a characteristic of the Age Specific Teaching Style followed by the nursery and reception teachers whose classrooms were investigated. However, because of the time-scale for activities and expectations of children's performance, it may well be that the literacy curriculum and associated practice in KS1 and KS2 restricts opportunities for teachers to engage in much joint activity with ICT during literacy. Further, the history of the particular classroom learning community and style of interaction was largely determined before ICT was added to the context. In the classrooms investigated, therefore, it appeared that teachers were not necessarily changing their teaching as a result of ICT.

My original hypothesis that the use of ICT facilitates greater opportunities for scaffolding early literacy is, therefore, not proven in this study (if the age range for early literacy is
determined as 0-8 years). The question of why ICT has not led to a significant change in primary classroom environments in the UK has been consistently posed over the last decade or so (see, for example, Heppell, 1993 and McFarlane, 1997). This critical question needs to be examined in the light of the political control over schools, the power relationships in the classroom, the global influence of multinational computer companies and emerging cultural practices associated with the Internet.

Scanlon et al. (1999) argue for a methodology in which the data collection also focuses on children's and teachers' perceptions of the purpose of the tasks set, as discussed in Chapter Two. The findings of the research suggest that the children's and the teachers' perceptions of the purpose of the tasks set were quite often different. The two different groups also expressed two different perspectives on the use of ICT, when interviewed. The children frequently commented that they wanted more time for ICT in literacy lessons, whilst the teachers' main concern was to enable children to complete all the planned activities within the framework of the NLS. Also, several of the participating infant and junior teachers expressed concern at the recent increase in popularity of 'computer suites' in primary schools. These are dedicated ICT rooms used by different classes on a rota basis. Whilst these rooms may have some benefits in terms of teaching ICT skills to large groups, the teachers argued that they hinder the integration of ICT into the literacy curriculum and, as Galton et al. (1999: 196) point out, are seen as an inefficient use of the technology. Several teachers expressed the opinion that if a number of machines from the suite were placed in each classroom ICT would more effectively support literacy. Topping and McKenna (1999) argue that expensive software and
hardware are not effective if not used or not used well. Further, they also contend that the trend towards the provision of computer suites outside of the classroom might inhibit wider access and the perception of computers as an everyday all-purpose tool.

The role of the teacher and the problematic nature of scaffolding

Research undertaken for this project would confirm that the situative perspective is one that can reveal worthwhile insights into the nature of teaching and learning literacy with ICT. This perspective recognises the role of the teacher in facilitating literacy learning experiences around the computer as highly significant. However, whilst Mercer and Fisher (1997a: 210) argue that the teacher is the main defining influence on computer based activity in the classroom, it should also be acknowledged that children bring expectations and experience to the context of using ICT for literacy. The children involved in the research recognised that computers assist their learning, both in general and with literacy. Also, when the children were involved in joint activity they welcomed the context of assisted performance. However, it was apparent that in many classrooms children do not receive much adult support in their computer activity, once they have learned to access the software (a similar deduction to Downes, 1996). As with Facer et al. (2000), this study found that many children feel that they have IT skills and that they gain them outside school. The following scenario, taken from my Research Diary, is an indication of the potential for children supporting literacy learning with ICT outside the classroom.

During the second session of the CPD course I was discussing with the teachers the possibilities and techniques of using MS Publisher for the
collaborative writing of a class news letter (a common use of ICT I assumed!). Teacher L, who in the questionnaire had rated her personal confidence with ICT as high (8), and who had used MS Publisher on her computer at home, had previously not considered using it with the children at school. With my encouragement she taught a whole class lesson using the program on the computer suite and the children's response was very positive. Some of the children then carried on with these ideas and produced their own news-letters on MS Publisher at home. They then brought the newsletters into school and discussed their layout and style etc with the whole class. This raises some very interesting possibilities about the learning with ICT outside the classroom- which I feel is in danger of being seriously underestimated by the teachers.

There is therefore a strong argument that the role of the teacher changes as a result of the introduction of ICT into the classroom. This new role includes providing opportunities and contexts to exploit the potential of children's experience of electronic literacy in the wider community.

The emphasis is on the way in which teaching strategies are necessarily based on, and responsive to, the state of understanding achieved by particular children (Lepper et al., 1997; Rogoff, 1991; Rogoff and Gardner, 1984). For Maybin et al. (1992: 187) the metaphor of scaffolding is assumed to be useful to teachers because it directs attention to the quality of their participation in the learning process. Here the opportunity to develop 'mutuality' is important (Stone 1998). However, translating to the classroom context a term originally defined in child psychology for use in one to one interactions with a parent or adult care-giver (e.g. Rogoff and Gauvin, 1986), is problematic.

One of the major problems, as Tizard and Hughes (1984) and Donaldson (1978) point out, is that teacher child relationships, and the discourse within them are unlikely to be characterised by the same degree of emotional intimacy and intuitive understanding as
parent child relationships. One to one relationships in the classroom tend to be more truncated than interactions between parents and children. Parents' utterances tend to respond directly to, and to extend, the communicative intent of their children, whereas teachers' interventions may be more consciously informed by curriculum related learning objectives. Tharp and Gallimore (1998), also, noted that accurately tuned adult assistance does not always occur in the classroom. A major variable is the nature of the task or performance. If efficient production is needed then the adult will be more likely to be more directive and less tolerant of costly child errors. But when the development of independent child skill is defined as a goal then the pattern of assistance provided by the adult is more responsive, contingent and patient. In terms of literacy, the NLS implies considerable teacher direction to achieve pre-determined targets (Whitehead, 1999). It was noticeable in this study that, in the KS1 and KS2 classrooms following the NLS, teaching appeared heavily focused upon pursuing established learning objectives, rather than evoking and assisting children's responses. However, Tharp and Gallimore (1998) argue that even when instructional practices allow for increased use of assisted performance (as in the case of the nursery and reception teachers involved in the research), it will not necessarily appear as a regular feature of the teacher's activity. Teachers need to be trained to use it.

A further problem is to decide what counts as scaffolding and what is only help.

In the research it was necessary to analyse each VTR episode and data collection sheet several times in order to establish the nature of the teacher child interaction. Mercer and Fisher's conception of scaffolding (1997a), discussed in the literature review, is relevant
here. In this model the teachers support children's problem solving without taking over responsibility and use specific discourse strategies when intervening in children's learning. However, whilst the purpose of this study was to describe and evaluate the ways that teachers attempt to scaffold children's literacy learning with computers, a major difficulty was encountered in attempting to identify and interpret teacher behaviour and joint activity with children around the computer. As Stone (1998) and Maybin et al. (1992), for example, have argued, whilst the concept of scaffolding is extremely appealing it can be very difficult to identify in practice. The characteristics of assisted performance (proximity, time, style, attention) identified by Tharp (1993) and Palinscar and Brown (1984) that were used to define joint activity and analyse the VTR did seem appropriate. However, as a result of interviews with teachers after the filming, it is apparent that a further defining characteristic of assisted performance is that of 'intention'. The teachers observed did not engage in joint activity by accident - they intended to use ICT as a context for assisting children's performance in literacy. Where joint activity did not take place, it was, in the main, not planned for.

Future research needs to consider how joint activity may be planned and designed, in terms of ICT and literacy. Further investigation into the nature of interaction and teachers' cognitive support around computers in the classroom can also build on insights from knowledge building communities (Scardamalia etc). However, in order to identify and fully explain the nature of situated and distributed cognition involved, research must also recognise the wider context (Luke, 1999), as well as collecting data which analyses the classroom context in which children are learning.
The situated context of literacy and ICT in the classroom

Two main issues concerning the wider context of ICT and literacy in the classroom can be discerned from the data collected and analysed. Firstly, the impact of the computer in the general community and the comparative inability of schools to keep up with these developments have given rise to two different ICT experiences and cultures for many children. The evidence from interviews with children and surveys of their ICT access at home suggests that there is therefore a mismatch between ICT in school and outside school. Learning with ICT at home (for those who have access) is not constrained by issues of time, space, curriculum and access to up to date equipment, as it is in school (especially in KS1 and KS2). Collis et al. (1996: 117) concluded that the whilst the impact and problems of ICT are the same across cultures, and that children are generally benefiting from and enjoying their use of computers, the teacher is a critical influence on how ICT is used in the classroom. Secondly, there is a need to consider teacher capability and the pedagogy of teaching and learning with ICT. The teachers involved in the project were generally positive about ICT and have a conception that computers should be of value to them and their children. However, the questionnaire responses, interviews with children and VTR revealed that teachers are underestimating many children’s experience and confidence with ICT and appear to be unwilling to take risks with their classroom practice.

The expectation from much of the literature on teaching and ICT, reviewed in Chapter Two (for example, Johnson, 1997), is that the higher personal confidence equates to higher teaching confidence with ICT. In this study there was, however, no apparent
correlation between personal confidence with ICT and the use of ICT in literacy sessions (as discussed in Chapter Five). Teachers can be personally confident but not necessarily pedagogically or educationally confident. According to the questionnaire responses, the CPD course increased the confidence of the teachers and did lead to greater use of ICT in the teaching of literacy. However, I noted in my research diary after the first CPD session that the teachers were not as interested in theory of why and how to use computers as I thought they would be. I wrote: "The teachers seemed to relish the opportunity to explore software, but seemed less interested in why and how to use it".

A considerable number of studies have focused on the barriers teachers face when using ICT in the classroom and identifying teachers' learning experiences with technology (The University of Warwick, 2000). However, as indicated in Chapter Two, much of this work, apart from Veen (1993) and Somekh (1997), has focused more on teachers' personal competence than their pedagogical competence. The problem is how teachers gain both technical competence and teaching competence with ICT. As McFarlane has argued:

I feel that there is a serious cultural issue at the heart of this problem. Teachers who have no experience of using IT as learners have difficulty in appreciating what a powerful learning tool IT can be. Additionally the imposition of IT in the National Curriculum left some teachers feeling that the computer was something they had to use to satisfy the ‘computer bits’ in the curriculum. IT was not presented, as it could have been, as a tool to help teachers and children achieve some of the more difficult objectives they already had.

(McFarlane, 1997: 178)

Sealy (1997) contends that teachers should reflect on the goals and methods they use for learning and find a match between their personal theory and their pedagogical approach
and that fostered by the software as a tool assumed to promote learning. Somekh (1997) discusses this problem, categorised here as 'Software Knowledge', and identified two levels of computer skills needed for educational purposes:

- technical level - being able to use the machine and software effectively
- higher level skills - use the computer to support learning (either one’s own or children’s)

She suggests that "a major problem with teaching technical level computer skills is that most peoples needs are immediate and specific" (1997: 141). This study would concur with Somekh that once teachers have learned to use a program successfully they do not necessarily transfer that skill into their ICT teaching in the classroom. 'Software Knowledge' is taken to include the ability to integrate the program into teaching and learning in the classroom. From the teacher's responses in interviews before and after VTR it appears that this has more to do with a positive attitude towards the learning potential of the ICT rather than the skill of using it. Being proficient at a technical level with ICT does not guarantee successful teaching with computers. In the literature review, Table 2.1 presented an overview of beliefs and stages of teacher development with ICT. The category of 'embedded' was developed to describe teachers with awareness of how to integrate ICT into the curriculum and displaying a willingness to change their teaching as a result. It could be argued that, following this research, joint activity could be included as a further aspect of an embedded pedagogy, as it maximises the potential of both the ICT and children's knowledge of it.
Moseley and Higgins et al. (1999: xiii) identified a "clear link between teachers' attitudes to ICT, their self reported skills and their effectiveness". Evidently a more confident teacher with ICT is likely to be a more competent one, but it seems that reducing or avoiding barriers does not necessarily ensure the likelihood of teachers using computers effectively (The University of Warwick, 2000). In the UK, the current training of teachers in ICT (NOF) may well help teachers to become more confident users of hardware and software but this will not necessarily lead to a change of practice in the classroom. For the training to be effective it will need to be school based and support teachers in reflecting on how they can establish a learning culture in the classroom that takes full account of children’s experience and confidence with ICT.

Scrimshaw (1997: 112) has asserted that "teachers need more opportunity and support in using new technology in collaborative contexts so that they can identify problems and possibilities and find ways for them to model these activities in their own practice with learners". Further, Scrimshaw argues that it is no use just giving children access to ICT - teachers have to carefully bring its use into their teaching technique and method. Clearly, teachers need to be competent and confident users of both the hardware and software but, as Somekh (1997) has pointed out, on its own this is not enough. Teachers need to know their children's capabilities and interests, understand how to organise their classroom and to structure the teaching of their children so that ICT resources become an integral part of the learning.
Developing a conceptual model of literacy and ICT

In analysing ways in which ICT is used in the teaching and learning of literacy at school this study has drawn on the sociocultural perspective. Edwards and Mercer (1987), Lave (1988), Rogoff (1990), Salomon (1994), Greeno (1997) and Säljö (1999), for example, have put forward a prospective of cognition as distributed over both individuals and surrounds. Following on from the work of Vygotsky (1978 and 1986), who articulated the social construction of knowledge and the process of the mutual understanding, they argue that human activity is heavily influenced by context, which includes artefacts, and other people (Cole and Engestrom, 1993). As Crook (1999: 103) has pointed out, the wider social context of the classroom needs to be considered alongside the interaction around the computer. Also, the situation of the child's computer use and involvement in joint activity with a teacher is taken to be a major determinant on the learning. The technology is seen as part of the context and not the most significant factor in determining its use. A view still held by many teachers and education researchers, however, is that it is the software that defines the nature of any computer-based activity (Mercer and Fisher, 1997a: 209).

The range of contextual factors considered in this study is represented in Figure 6.1 (over) which, following Bronfenbrenner (1977) is an attempt to describe an ecology of literacy and ICT in the classroom.
SPECIAL NOTE

THIS ITEM IS BOUND IN SUCH A MANNER AND WHILE EVERY EFFORT HAS BEEN MADE TO REPRODUCE THE CENTRES, FORCE WOULD RESULT IN DAMAGE
Figure 6.1 An ecology of literacy and ICT
In the model, which draws from Bronfenbrenner's concept of ecological systems, the microsystem refers to relations between the child and the immediate environment, which would include teacher interaction and joint activity, the time-space interface and type of software etc. Here, the child's experience and confidence with ICT, as well as their confidence with literacy are central to learning. The second level or mesosystem concerns the links between home and school experience with ICT and literacy. The exosystem is represented by the wider social and cultural context such as the Foundation Curriculum, National Curriculum, NLS and the commercial world of ICT. The cultural values and laws concerning early childhood, schooling, literacy and ICT are part of the macrosystem that influences all levels of the learning context. Ecological systems theory represents the child's development with literacy and ICT as multi-layered and the benefit of this model is that it places the child and the child's experience and confidence with literacy and ICT at the heart of the learning process. However, whilst Bronfenbrenner recognises the dynamic possibility of change through his idea of chronosystems, one of the problems with the ethological model is that it does not fully represent the complex interaction between the different components of the learning context. Engestrom's concept of activity systems, discussed in Chapter Two, recognises the complex, multiple levels of the learning context and his model informs Figure 6.2 (over).

The analysis of the data, made earlier in this chapter and in Chapter Five, put forward a perspective suggesting two sets of potential for literacy and ICT in the classroom. The first potential can be shown in terms of the child and the ICT. Here the child, typically, has the confidence and expects to succeed, to learn and enjoy the task, but may not have
much opportunity in school literacy sessions. The second, far richer, potential is the child using ICT in joint activity with the teacher. The critical time and space interface allowing joint activity is influenced by teacher style, the relations between the teacher and the child, classroom culture, ICT access and the planned curriculum. In Figure 6.2, (over) therefore, a more dynamic and complex model is presented. This model allows for the possibility of variable power differentials between the different components (as discussed in Chapter Two) and multiple realities (Labbo and Reinking 1999). For some children in some classrooms ICT is used as an independent skill based activity, and for some other children in other classrooms the potential of ICT is realised through joint activity with the teacher.

The situation of literacy and ICT in the classroom

For Labbo and Reinking, the perspective of multiple realities allows for "the consideration of the extremely rapid advances of digital technologies, how quickly they become integrated into society as a whole, and in some cases how much more slowly they become integrated into conventional schooling" (1999: 479). Future research into the nature of interaction and scaffolding around computers in the classroom can build on Labbo and Reinking's framework. However, I would include a further category: new digital technology should be used in ways which are developmentally appropriate, and that build on young children's experience of ICT (NAEYC 1996, cited in Haugland and Wright, 1997: 115-124). This research could usefully help to identify the culturally valued processes involved in the context of using ICT for literacy, such as the tendency for teachers to interact less with children if the technology is working.
Figure 6.2 The situation of literacy and ICT in the classroom
Concluding remarks

On reflection, my study began from the position of seeing the teachers as the 'problem' in the effective use of technology for learning. I then moved to a position, through the description and analysis of the data, where the problem was seen as a more complex interaction between the children's experience and expectations and curriculum restrictions. Mac an Ghail (1993) shows how the use of qualitative research methods can effect a change in the initial focus of the research, generating what he hoped would be more grounded theory. Mac an Ghail enters an enduring debate in special and educational research about the nature of problems. He began his research by accepting that Asian and African Caribbean students were a problem - a view that is the 'white norm'! By rethinking this theory and by placing the students at the very heart of his study he was able to move effectively beyond the white norm. Essentially, through the use of a range of qualitative and quantitative methods, I have been through a similar process to Mac an Ghail. I would, on reflection, change the focus of future research to place the children at the heart of the study of the use of ICT for the teaching and learning of literacy.

Several weaknesses in the research can be discerned. Firstly, I did not have time to analyse the data after each visit. Analysis and evaluation did not take place until after all the visits had been completed, due to other commitments. I was therefore unable to follow up any issues that were identified, or check the reliability of some of the data. Also, I focused solely on gathering information about literacy teaching. I did not observe or record data that could inform an understanding of the whole classroom environment.
For example, aspects of the teaching and learning before and after the literacy sessions could have been filmed and observed. Further, some of the VTR analysed is of poor quality for research. As Collis et al. (1996: 53) point out, using and analysing videotapes can add to the strength and depth of the data but it adds considerable time loads to the research. A further problematic factor was that I was the only researcher involved. Consequently, when I visited classrooms I had to balance my time between controlling the camera and writing observations and field notes. In future research involving VTR the use of a camera technician would be very beneficial. A range of important data concerning teacher's beliefs and practice with ICT was revealed by the questionnaires. However, there are clearly dangers of relying too heavily on questionnaire information. For example, Bennett’s (1976) study of teaching style was criticised because it was based primarily on questionnaire responses rather than upon observation of teachers’ behaviour (see Hammersley 1986: X). Observation and VTR of the teachers involved in this study revealed that there was a difference between some teacher's beliefs, as stated in the questionnaires and their practice. Thus questionnaires are more useful for research when used in addition to other sources of data and in this research responses helped to identify certain themes for further investigation. For example, the responses by the teachers suggest that there is not necessarily a link between the personal experience of teachers with ICT and their confidence to use ICT in their teaching in the classroom.

This thesis has presented an in-depth discussion of the use of ICT in early literacy development. It has contended that teachers have an important role in supporting early literacy through joint activity around a computer. This joint activity is characterised by
reciprocity that acknowledges the child's experience and confidence with ICT at home and leads to assisted performance that is recognised by the child. Further, it is clear that simply placing new technologies in our classrooms will not prepare children adequately for the new literacies they require (Topping, 1997; Leu, 2000), they have to be integrated effectively into classroom practice. Access and equity are significant issues in the use of ICT for promoting and supporting literacy, although paradoxically the technology can help increase access through libraries and family electronic literacy projects (Topping and McKenna, 1999). The critical issue about technology and young children is not if it should be used but how it is best used to enhance their (literacy) development.

The sociocultural approach taken in the paper has emphasized the shared construction and distribution of knowledge around and through the technology. Tharp and Gallimore argue that:

> Emerging instructional practices provide some hope for increased use of assisted performance; the increase of small groups, maintenance of positive classroom atmosphere that will increase independent task involvement of students, new materials and technology which students can act independent of the teacher.

(Tharp and Gallimore, 1998: 107)

However, whilst this view of the potential of ICT to enhance classroom learning is attractive, it is contended here that there is a need to take into account the wider political, social and cultural context of literacy and ICT, including children's experience of digital play; so as to fully understand the nature of classroom learning and interaction. It is the teachers, as Leu (2000) points out, and the children who are experienced at using the
Internet in their classrooms and homes who are likely to provide us with an important direction. The instructional strategies, interaction and resources, tested in the classroom and home need to be further articulated and clarified to resolve the challenge of achieving the real potential of ICT to support the teaching and learning of literacy.
Appendix A

BERA Ethical Guidelines for Research
Appendix A

BERA Ethical Guidelines for Educational Research

Responsibility to the research profession
Educational researchers should aim to:

i. avoid fabrication, falsification, misrepresentation of evidence, data, findings or conclusions

ii. report findings to all relevant stakeholders and refrain from keeping secret or selectively communicating their findings

iii. report research conceptions, procedures, results, analyses accurately and in sufficient detail for other researchers to understand and interpret them

Responsibility to participants

1. Participants in a research study have the right to be informed about the aims, purposes, and likely publication of findings involved in the research and of potential consequences for participants, and to give their informed consent before participating in research.

2. Care should be taken when interviewing children and students up to school-leaving age; permission should be obtained from school, and if they so suggest from parents.

3. Honesty and openness should characterise the relationship between researchers, participants and institutional representatives.

4. Participants have the right to withdraw from a study at any time.

5. Researchers have a responsibility to be mindful of religious, cultural, gendered, and other significant differences with the research population in the planning, conducting and reporting of their research.

Responsibility to the public

1. Educational researchers should communicate their findings and the practical significance of their research in clear straightforward and appropriate language to research populations, institutional representatives and other stakeholders.

2. Informants and participants have the right to remain anonymous. This right should be respected where no clear understanding has been reached. Researchers are responsible for taking appropriate precautions to protect confidentiality of participants and data. Participants must also be made aware that in certain situations anonymity cannot be achieved.

Intellectual ownership

Authorship should be determined on the basis of the following guidelines; all those regardless of status who have made a substantive and/or creative contribution to the generation of an intellectual product are entitled to be listed as authors of that product.

(Research Intelligence, Summer 1992, p.19-21)
Appendix B

Questionnaire completed by the teachers
Appendix B

Questionnaire Completed by the Teachers

Please answer the questions below as honestly as possible - the information given will not be identified to you personally or used without your permission.

Q1. How long have you been a qualified teacher?..................Years.

Confidence with ICT

Q2. How confident are you when using ICT for personal use?  
(Please circle the most appropriate number on the scale below  
1 = Not very confident, 10 = Extremely confident)

1 2 3 4 5 6 7 8 9 10

Q3. Do you use ICT to make resources for your teaching?  Yes/No

Q4. Do you use ICT to help with the administration and planning of your teaching? Yes/No

Q5. How confident are you in using ICT to support learning in the classroom?  
(Please circle the most appropriate number on the scale below  
1 = Not very confident, 10 = Extremely confident)

1 2 3 4 5 6 7 8 9 10

Q6. Do you have experience of using any of the following?

a. Multimedia computers  
   For personal use Yes/No  
   In the classroom Yes/No

b. Email  
   For personal use Yes/No  
   In the classroom Yes/No

c. The Internet  
   For personal use Yes/No  
   In the classroom Yes/No
Q7.
Do you use a computer at home?  
Yes/No

Beliefs about ICT

Q8.
Which statement best describes your beliefs about ICT and learning?  
(Please tick)

a- exposure to computers improves learning............

b- exposure to specific computer programs improves learning............

c- computers allow children to solve problems............

d- computers not only bring something new to the environment but also change it and change learners too..................

e- exposure to computers does not affect learning ............

Use of ICT in your classroom

Q9.
When using the computer do children work:

   individually?  Yes/No

   in pairs?  Yes/No

   in small groups?  Yes/No

Q10.
Do you use ICT for teacher intensive activities?  Yes/No

Q11.
How would you assess your children’s confidence with ICT?  
(Please tick the most appropriate)

  none........

  some.......

  most.......

  all ........

  of the children are confident users of ICT in my class.
Q12. How often would a child in your class use the computer to support literacy activities? (Please tick)

a. Every activity ................
b. Every Day ....................
c. Every week ..................
d. Infrequently .................

Q13. Do you follow the Literacy Hour? Yes/No
If yes - answer Question 14

Q14. Do you use ICT to support the Literacy Hour? Yes/No

Q15. Have you used ICT to publish children's books? Yes/No
newspapers? Yes/No

Q16. Do children use ICT to compose writing in your class? Yes/No

Q17. Does your reading scheme include talking stories on disk or CD-ROM? Yes/No

Q18. Software - which types of software do you use to support literacy?

Word processing Yes/No
Desk Top Publishing Yes/No
Talking Stories Yes/No
Story writing Yes/No
Interactive CD-ROMs Yes/No

Other ...........................................................................................................(Please Specify)
Q19.
Which aspect of ICT and literacy are you most interested in learning about on the course and why?

................................................................................................................................................................

................................................................................................................................................................

Thank you for your cooperation with this questionnaire, do you have any questions about literacy and ICT that you would like to ask me?

Tim Waller.
Appendix C

Interview schedule (children)
Appendix C

Interview Schedule - Children

Procedure

- Start by introducing myself
- Establish ‘Rules’
- Explain that I am interested in what children think about using computers in school
- Explain Process
  (Take it in turns to answer - no right answer, if not sure move onto next person)

Interview (audio taped)

General questions about computers

1. How often do you use computers in the classroom?
   more than once a day/ everyday/every other day every week?

2. What sort of things do you enjoy best when using the computer at school?

3. What sort of activities do you feel are best suited for the computer?

4. How do you use computers to help you learn?

5. What difference have computers made to your learning in the classroom, since you were in the reception class?

6. What changes do you think computers might make to learning in future classrooms?

Computers and reading and writing

7. Do you think that computers help you to learn to read and write?

8. If yes - how?

9. How do you use the computer for reading?
   (Please give an example............)

10. How do you use the computer for writing?
    (Please give an example............)

11. What sort of activities does the teacher do with you on the computer - for reading and writing?
12. Does your teacher change her teaching when using the computer?
13. If so - how?
14. Would you like more time on the computer?
15. Should children be allowed to choose more programs themselves?
16. Do you think the computer will ever replace books?

Thank you for answering the questions - have you any questions you would like to ask me?
Appendix D

Interview schedule (teachers)
Appendix D

Interview Schedule - Teachers

Procedure

■ Start by assuring confidentiality - no right answers
■ Assure teachers that they can see the transcript if they wish
■ Explain Process

Interview Questions (To be audio taped)

General questions about ICT

1. How confident would you say you were when using ICT in your teaching?
   Extremely/Very/Fairly/not very/not at all?

2. How do you use ICT in your teaching?

3. What sort of activities do you feel are best suited for ICT?

4. What has been the impact of ICT on teaching and learning in your classroom over the last 2-3 years?

5. What impact do you think ICT might have in the classroom over the next 2-3 years?

6. What do you feel, if anything, hinders teaching and learning with ICT?

7. What would help you become a better teacher with ICT?

ICT and Literacy

8. How do you use ICT in the teaching of literacy?
   (Please give an example...........)

9. What difference, if any, does ICT make to the teaching of literacy?

10. What types of interaction take place between you and the children, when using ICT to teach literacy?

   [refer to Palinscar and Brown’s (1984) model of teaching]
11. How would you describe the main style of interaction you adopt when using ICT to teach literacy?

11a. Does it vary over the task/with the task?

12. Is your teaching style different because of ICT?

13. Is your teaching style enhanced because of ICT?

14. What do you think are the features of successful literacy teaching using ICT?

15. What are children’s responses to your teaching style?

16. What are the children’s main responses to using ICT?

17. Do you think it matters when children have open access to the Internet during lessons?

18. In your opinion do teachers fully use the potential of ICT for the teaching and learning of literacy?

19. If not - why not?

20. How could the potential of ICT be best used for literacy?

Thank you for answering the questions - have you any questions you would like to ask me?
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