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A systematic review of the impact of networked ICT on 5-16 year olds' literacy in English

Review conducted by the English Review Group

e PPI Evidence for Policy and Practice
Information and Co-ordinating Centre

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SUMMARY

Prefatory note

This report is the result of two linked pieces of work undertaken between March 2001 and May 2002. A mapping study was conducted up to November 2001 and identified the range and type of research studies addressing the impact of Information and Communication Technologies (ICT) on literacy learning in ages 5 to 16. An in-depth review then addressed one area identified in this mapping – the impact of *networked* technologies on literacy learning in English 5 to 16. Results from the in-depth review are reported in Chapter 6 and Appendix C. The in-depth review is the first of a number planned by the English Review Group in the field of ICT and literacy. Further in-depth reviews will take place in 2002 and beyond on evidence from experimental studies from 1990 to the present; the moving image and visual literacy; English as an additional language (which includes English as a second language); literature teaching; and word-processing.

Background

There is considerable interest in the impact of information and communication technologies (especially computers, networked computers, mobile phones) on learning in young people. The present study focuses on the impact of ICT on literacy learning in the English language for 5 to16 year olds.

There is particular significance in the selection of such a topic for education policy in England and Wales. The year 2003 marks the end of the New Opportunities Fund/Teacher Training Agency initiative on training teachers in the subject application of ICT. A computer-literate teaching profession will need to know about the impact of ICT on literacy learning in order to encourage the best use of resources in the raising of literacy standards. Policy-makers will need to know the results of our research in order to shape future policy with regard to ICT in the curriculum. Parents concerned about their children's education in the digital/information age will find the results of the study useful, especially with regard to the home/school dimension. So, too, might young people find the study helpful in avoiding unnecessary time spent with practices that are less than useful or enjoyable.

There has been much literature on the topic that is exciting and speculative. Much of this literature emerged in the early 1990s as the internet began to become more widely used, especially in schools. The government in England, for instance, has invested a large amount of money over a number of years in the provision of computers to schools. Equally, many (not all) families use computers at home and young people are increasingly using them to research, word-process, compose and present homework – and for a number of other functions. Questions remain, however, on what impact ICT has on schooling and in particular on literacy learning. The particular focus of the present study is on the impact of networked technologies – the internet, email – on literacy learning.

The English Review Group, as one of the review groups set up by the EPPI-Centre, has investigated the impact of ICT on literacy learning by systematically reviewing an international range of research studies dating from 1990 to the present. It started its work with the definition of key terms in the study: 'ICT', 'literacy' and 'impact':

- *ICT* is taken to include stand-alone computers, networked technologies with a multimodal interface, mobile phones with the capacity for a range of types of communication, and other technologies which allow multimodal and interactive communication.

- *Literacy* can be defined narrowly, as the ability to understand and create written language. It is, however, frequently defined in two broader senses, and both are included in the present study. Firstly, the scope can be expanded so that written language becomes written language and graphical or pictorial representation. Secondly, the skill can be treated as social, rather than psychological; in this view, literacy is the ability to operate a series of social or cultural representations.

- *Impact* was defined as the result on end-users (here, children between 5 and 16 years old) of an intervention aimed at improving the teaching or learning of literacy. It may also be the result of a non-intervention activity which could reasonably be expected to increase or decrease literacy.

Aims of the review and review question

The present report's main aim is twofold: first, to identify a number of studies that might shed light on the impact of ICT on literacy learning in English for 5 to 16 year olds. The fulfilment of this aim has resulted in a study mapping the field of ICT's impact on literacy learning.

The second aim has been to undertake an in-depth review of the papers that were identified as being on the impact of *networked* ICT on literacy learning in English for ages 5 to16.

Review question

Deriving from the above aims, the main review question for the overall study (which will continue for a further year) is:

- What is the impact of ICT on literacy learning in English for 5-16 year olds?

The main review question for the in-depth review presented in the present report is:

- What is the impact of *networked* ICT on literacy learning in English for 5-16 year olds?

Methodology

Initially, a protocol or plan was written to set out the parameters for the systematic literature review. This protocol established the main aims of the research, its research questions and the methods that would be employed to answer the questions. A key document in the development of the protocol was one that set out the inclusion and exclusion criteria for the review.

Searches of international literature then took place, both electronically and 'by hand', exploring a wide range of journals, reports, books and other formats. From searches in a number of internationally recognised databases, 1,871 post-1990 studies were identified that were of possible relevance to the larger review.

These 1,871 studies were screened, following the explicit criteria in the protocol, to identify relevant reports. Most of the screening was completed on the basis of abstracts provided by databases or with the papers identified as being of interest to the study. 188 studies were found that met the criteria in the protocol. These studies were then keyworded, or indexed, and the results filed on an electronic database (a resource that is also publicly available on the REEL database).

From the database, a map of the field was drawn. This 'mapping exercise' is an important stage in the process of the review and is reported in the sections of the report headed 'Identifying and describing studies'. The map provided the review team with an overall picture of the field, which enabled us to identify one particular area that we would examine in an in-depth review.

Of the 188 studies relevant to the mapping study, 16 pertained to the topic of the impact of networked ICT on literacy learning. Data were extracted from these 16 studies and have provided the basis for an in-depth review. Of these, half were outcome evaluations (evaluations of the results of an experiment or innovation), seven were process evaluations (evaluations of how an intervention was delivered, rather than whether it worked or not) and one was a needs assessment.

Methodologically, there is a wide variety of study types in the in-depth review, characteristic of education research in general but not reflective of the types of study found in the overall mapping study on the impact of ICT on literacy learning – the majority of which, unsurprisingly, are outcome evaluations. The range of study types in the in-depth review on the impact of *networked* ICT on literacy learning makes synthesis difficult. Meta-analysis was not possible because only one of the studies with quantitative outcomes was judged to be sound; and also because of the heterogeneity between the studies. The synthesis is therefore narrative in nature.

The methodology was devised by the Evidence-Informed Policy and Practice Coordinating Centre at the Social Science Research Unit, Institute of Education, University of London. At every stage of the process, the English Review Group as a whole has been consulted. As it consists of parent governors, teachers, parents and policy-makers as well as researchers, it provides a broad constituency for ensuring that the direction of the review is sound. Furthermore, there has been independent peer reviewing of the process at the stages of the protocol-writing and the submission of the draft report. Considerable improvements have been made as a result of such input.

Results

The study has identified 188 papers published since 1990 that examine the impact of ICT on literacy learning in English for 5 to 16 year olds. Most of these originate from the USA, though a significant minority arise from research in the UK, Canada, Australia and New Zealand. Of the total, 67% are set in primary/elementary schools (especially in the 7-11 age range), with about 44% set in secondary/high schools (some studies were conducted in both types of setting). About two-thirds of the studies assume a psychological representation of literacy: that is, they assume that literacy development is an individual matter concerned with writing and reading processes. One-third adopts a more sociological conception of the practice: that is, one that assumes that literacy development is a matter of the academic and social communities in which you learn. Of the 188 studies, 57% are focussed on writing, graphical or pictorial production, whereas 46% have an interest in reading (again, studies could have more than one focus).

As far as the in-depth study on *networked* ICT goes, results are inconclusive.

Many of the studies focus on the primary/elementary school sector, with at least four concentrating on 4th/5th graders (i.e. 9 to10 year olds). Three of the studies look at out-of-school activities, and only two (and both indirectly) turn their attention to the impact of ICT on literacy at secondary or high school level. The principal areas of interest for the studies are reading and writing, but those twin aspects of literacy are often narrowly conceived, so that we are looking at the impact of new technologies on old practices rather than at the symbiosis between new technologies and new forms of literacy. Four of the studies look at word-processing; two at new conceptions of literacy; and one each on speaking and listening, and on special educational needs.

Few of the studies in the in-depth review provide a firm basis for accepting their findings and therefore can have little bearing on the answering of the main research question for the in-depth review. Of the remainder, two provide theoretical and practical insights into widening conceptions of literacy; five suggest increased motivation and/or confidence in pupils as a result of ICT use with regard to literacy development; and one sees empowerment and ownership as an important factor to bear in mind in an increasingly diverse digital world. In general, these studies assume that a positive impact is made on literacy development by networked ICT, and explore *how* that impact is made; in most of the studies, the conception of literacy is narrow, based on pre-digital notions of reading and writing. The results are therefore suggestive rather than conclusive.

The strengths of the review are in its transparent processes, its breadth of reference and its systematic approach. These have resulted in an accountable, authoritative attempt to answer the main research questions. It has maintained a balanced and open view of study types, not wishing to commit itself to either the quantitative or qualitative camp, but preferring to ask a question – on *impact* – that enabled it to gauge a social and educational phenomenon with a degree of rigour.

Its weaknesses lie in the fact that although there were a large number of studies identified for the mapping stage of the review, not many were identified as being relevant to the focus on networked ICT in the in-depth

review. Of those that were about networked ICT, the quality was not high overall. An analysis of the weight of this evidence reveals that there cannot be much confidence in the results of these studies in terms of answering the questions about impact. The clear implications of such a result are that there needs to be more and better research in the field; that we need to revisit the main questions to take account of the symbiotic nature of the relationship between ICT and literacy; and that we cannot, at this stage, come up with a clear answer to this review's research questions.

Conclusion and recommendations

As far as policy and practice go, the recommendations of this review are highly tentative and take the form of implications or pointers. With regard to policy, they are to focus research funding for large-scale studies; to give consideration to the balance of study type expertise in research teams; and to give consideration to the fact that the provision of computer hardware and software to schools, and the application of ICT in teaching and learning, need to be informed by research and evaluation. In terms of practice, more attention needs to be given to the ways in which ICT is used in the classroom in support of teaching; teachers need to take more account of the ways in which young people work at home on computers; and ICT needs to be seen as one tool among many for the improvement and support of literacy learning.

Recommendations for research are more robust.

Recommendations are made to investigate further by covering the ground mapped by the in-depth review. There needs to be a stronger link between theoretical models and data from primary research, as well as more explicit accounts of methods used to gather and analyse data.

In terms of content areas to research more fully, the following were identified:

- email, conferencing and the internet in relation to new literacies
- writing and composing multimedia within a wider conception of literacy
- reading on screen and via networked computer systems
- hybridity, especially between the verbal and visual in multimedia

The maintaining of a range of study types is suggested in order to build a fuller and sharper picture of the interface between ICT and literacy development.

We need large-scale randomised controlled trials (experiments with two parallel randomly-selected groups, one of which receives the intervention and the other acts as a 'control' group) in order to gauge effect. We also recommend that a series of small pilot trials be undertaken to evaluate other uses for networked technologies with a view to informing the design of large pragmatic trials. Given the paucity of experimental data more randomised trials are needed.

We also need more research with qualitative outcomes. Small-scale studies (e.g. evaluated case studies) are needed as they are able to provide multi-factor analyses of the use of ICT in literacy teaching and learning. Because the field of research in ICT applications is young, there is also a need for more process evaluations.

There is a need for a large-scale longitudinal study, focused on literacy development, to complement the work currently being undertaken by the ImpaCT2 project, mentioned in the background section (Chapter 1).

Furthermore, more work needs to be done on the compatibility of results from quantitative and qualitative research in education.

1. BACKGROUND

The broad focus of this review is the impact of Information and Communication Technologies (ICT) on literacy learning. In this chapter, we provide working definitions for these and other key concepts used within this review.

1.1 Definitions

ICT includes stand-alone computers, networked technologies with a multimodal interface, mobile phones with the capacity for a range of types of communication, and other technologies which allow multimodal and interactive communication.

Literacy can be defined narrowly, as the ability to understand and create written language. It is, however, frequently defined in two broader senses, and both are included in the present study. Firstly, the scope can be expanded so that written language becomes written language and graphical or pictorial representation. Secondly, the skill can be treated as social, rather than psychological; in this view, literacy is the ability to operate a series of social or cultural representations. Since sets of expectations and norms differ depending on the situation, the social view of literacy entails a number of different 'literacies'. The concept of literacy was chosen for this review for a number of reasons: first, to delimit the field of enquiry to reading and writing; second, to distinguish literacy learning from the subject English as taught in the National Curriculum for England; third, because as a term (especially in its pluralistic sense of 'literacies') it is both narrowly definable and open to wider interpretation; and fourth, because it allows us to review research that takes place outside formal education, e.g. in homes and other communities in which young people operate. While acknowledging its importance, the current project does not focus on 'ICT literacy' in the sense of "students' applications of their [ICT] knowledge and skills in real life situations" (OECD, 2001, p2).

Impact was defined as the result on end-users (here children between 5 and 16 years) of an intervention aimed at improving the teaching or learning of literacy. It may also be the result of a non-intervention activity which could reasonably be expected to increase or decrease literacy. Either can be considered as 'literacy-related activities'. A research study which focuses on teachers' or learners' perspectives, opinions or strategies, may be considered to deal with the impact of ICT on literacy as long as it refers to a specific literacy-related activity. 'Impact' was chosen rather than 'effect' as we wished to determine the broader aspects of the influence of ICT on learning in English rather than merely attempt to measure effect. The term 'impact' allows us to examine strategies and processes as well as outcomes. The authors recognise that literacies can impact on ICT as well as vice versa. The focus of the mapping and in-depth review described in this report, however, is unidirectional.

1.2 Background

The impact of ICT on literacy is a topical and important issue. There is a need for a systematic study of research in this field, not least because governments worldwide are investing heavily in the provision of hardware and software to educational institutions as well as in the training of teachers and students of all ages in the application of ICT in literacy learning.

There is particular significance in the selection of such a topic for education policy in England and Wales. The year 2003 marks the end of the New Opportunities Fund/Teacher Training Agency initiative on training teachers in the subject application of ICT. A computer-literate teaching profession will need to know about the impact of ICT on literacy learning in order to encourage the best use of resources in the raising of literacy standards. Policy-makers will need to know the results of our research in order to shape future policy with regard to ICT in the curriculum. Parents concerned about their children's education in the digital/information age will find the results of the study useful, especially with regard to the home/school dimension. So too, young people might find the study helpful in avoiding unnecessary time spent with practices that are less than useful or enjoyable.

In terms of the use of ICT in subject English (and other subjects in the curriculum), the National Curriculum for England suggests that "pupils should be given opportunities to apply and develop their ICT capability through the use of ICT tools to support their learning" and they "should be given opportunities to support their work by being taught to (a) find out things from a variety of sources, selecting and synthesising information to meet needs and developing an ability to question its accuracy, bias and plausibility, (b) develop their ideas using ICT tools to amend and refine their work and enhance its quality and accuracy, (c) exchange and share information, both directly and through electronic media and (d) review, modify and evaluate their work, reflecting critically on its quality, as it progresses" (DfEE/QCA 1999 (English), p. 52).

Interest in the relationship between ICT and literacy in English has been strong in the 1990s, particularly in the USA and Australia. Some of the key books on the topic have been Lanham's *The Electronic Word* (Lanham 1993), Haas' *Writing technology: Studies on the materiality of literacy* (1996), Snyder's *Hypertext* (1996), Tyner's *Literacy in the Digital Age* (1998), and Lankshear and Snyder's *Teachers and Techno-literacy* (2000). More recent works on the topic – particularly on pedagogical issues – have included Moseley and Higgins' *Ways Forward with ICT* (1999), Leask and Meadows' *Teaching and Learning in the Primary School* (2000), Gamble and Easingwood's *ICT and Literacy* (2000), Loveless and Ellis' *ICT Pedagogy and the Curriculum* (2001), plus a chapter on 'ICT in English and literacy' in Andrews (2001). There is a new series planned from Open University Press, with *Teaching Primary Literacy with ICT* (Monteith 2002) and *ICT in the Primary School* (Loveless and Dore 2002) to be published in 2002.

Tweddle (1997) gives a comprehensive account of the applications of computers in English lessons at primary and secondary levels in schools in England and Wales in the period 1980–1996. Recent reports by the British Educational Communication and Technology Agency (BECTa - e.g. BECTa

2002) offer estimates of the number of computers in use in primary and secondary schools.

Two recent Organisation for Economic Co-operation and Development (OECD) reports, *Literacy in the Information Age* (Werquin *et al.*, 2000) and *Schooling for Tomorrow: Learning to Bridge the Digital Divide* (OECD 2000), point out there is considerable disparity between nations in the access to and use of ICT in education, and that within countries, there is also a wide range of competence in literacy – and in familiarity with the implications of ICT for literacy learning (and vice versa). The Werquin report sets out five levels of literacy for the 'information age': highly competent use (e.g. the creation and manipulation of digital text and images); competent use (e.g. the ability to read, download and make use of digital text); a middle level (the level at which most school leavers will attain for entry to further and higher education); inadequate use of ICT in literacy; and very poor understanding of literacy and ICT use. The UK, for example, scores well at the top levels in relation to other countries, but has a large proportion of people at the bottom two levels.

Although the Werquin report focuses on adult literacy, its significance for the present study is evident. There are new definitions for literacy for the 21st century and the present study must be sensitive to them. OECD is also funding a major international research project into ICT and the quality of learning at school level. Furthermore, the launch of a new, refereed international journal, *Education, Communication & Information* in May 2001 signifies an interest in the proposed study topic at all levels of education. In Australia, a major government-funded project, *Digital Rhetorics* (included in the in-depth analysis as part of the systematic study) reported a diversity of practice and possibility and also set out some of the theoretical issues underpinning the new digital rhetoric (Bigum, Lankshear *et al.* 1997).

More specifically, as far as schooling is concerned, there have been a number of evaluations of the impact of ICT/education initiatives in the UK. A recent book, *English in the Digital Age* (Goodwyn 2000) sets out some of the curricular issues about ICT in the application of English at primary/elementary and secondary/high school levels. Andrews (2000) explores the relationship between ICT, learning and literacy, suggesting that there is a new convergence between theories of learning (especially based on dialogue and transformation) with advances in digital literacy and its application in English. A recent special edition of *Convergence* (3.4, Winter 1999) presented accounts of the use of digital media with young people. These describe the kinds of competences and learning styles that characterize young people's engagement with film, the internet and multimedia both within and beyond formal schooling, emphasizing the importance of the wider cultural contexts of such work, as well as the need to build models of progression to structure such experiences through the age phases of the curriculum.

An interim report that was not published in time for us to include in the systematic study is *ImpaCT2* (DfES, 2001), produced by the British BECTa. The *ImpaCT2* project is part of a wider evaluation of the UK government's National Grid for Learning (NGfL), established in 1998. The NGfL aims to stimulate the development of "high quality online and digital content" for UK education, part of which is the creation and development of the NGfL website (www.ngfl.gov.uk). It also aims to ensure that schools and other educational institutions have the means to access these resources effectively; and it provides teachers with appropriate training opportunities. BECTa is also

interested in the relationship between ICT and learning outcomes in general, and to this end established an ICT research network in 2001 (BECTa 2001b).

ImpaCT2's contribution is to undertake a longitudinal study (1999–2002) involving sixty schools via the identification of the impact of networked technologies on the school and out-of-school environment; by determining "whether or not this impact affects the educational attainment of pupils aged 8–16 years"; and by providing "information that will assist in the formation of national, local and school policies on the development of ICT" (DfES 2001, p. 3). In order to achieve these objectives, *ImpaCT2* will also devise methods of assessing pupils' attainment and devise a framework for measuring the ICT environment. Emerging findings from the project suggest that "data from pupils' logs shows that the majority of pupils spend more time using ICT at home than at school" (ibid, p. 10) and "the integration of ICT into subject teaching depends upon teacher confidence and skill and varies widely within a school" (ibid, p. 11). Furthermore, "the spatial organisation of computers within the school influences flexibility in teacher and pupils' usage. The ideal situation appears to be to have both ICT suites and clusters of computers in the classroom, with dedicated subject-related software with which teachers are both confident and familiar" (ibid, p. 11).

There are significant and complementary differences between the *ImpaCT2* project and the current systematic study as reported here. *ImpaCT2* is a primary evaluation focussing across the curriculum on learning outcomes for the 8–16 age group; the EPPI study is a secondary systematic literature study of research on the impact of ICT on literacy learning for the 5–16 age group. The *ImpaCT2* project undertook a preliminary study in 1999, *Establishing the Relationship between Networked Technology and Attainment,* in which it "reviewed the relevant literature, including 102 published studies of ICT and attainment" (MacFarlane *et al.*, 2000; DfES 2001, p. 4); the EPPI study is reviewing 188 studies on ICT and literacy learning. The *ImpaCT2* preliminary study was not a systematic literature review, but covered a wide range of recent studies on the impact of ICT on attainment, including reference to a survey of research literature relating to the use of ICT at Key Stage 2 in English, Mathematics and Science. There is also a separate unpublished systematic review by BECTa (BECTa, 2001a) but this was not available by the time we closed our database for the present version of our review.

The *ImpaCT2* project also produced a preliminary report (Lewin *et al.*, 2000) which "focused on devising new methods of measuring the impact of ICT on the wider learning environment, including homes" and which "also considered methods of identifying any additional learning gains that may not be reflected in national tests currently used in schools" (DfES, 2001, p. 4).

Both the *ImpaCT2* study and the present in-depth review on the impact of ICT on literacy learning focus on networked technologies (email, the internet, etc.) and their impact on learning. Another key sub-section of the work on the impact of ICT on literacy learning – particularly because computer screens bring the visual and verbal into close juxtaposition – will be an exploration of the relationship between visual and verbal literacies, drawing on traditions in cognitive science (Cox and Brna, 1993), social semiotics (Kress and van Leeuwen, 1996), moving image research (Burn, 1999a, 1999b; Burn and Parker, 2001) and the visual arts (Raney, 1997). A study of this aspect of ICT and literacy will be undertaken as part of the second phase of the study on the impact of ICT on literacy learning.

2. AIMS OF REVIEW AND REVIEW QUESTION

2.1 Introduction

This review is the first in a series which aims to identify the impact of Information and Communication Technologies (ICT) on literacy learning in English for ages 5–16 years. As background to the review series, the report contains a descriptive mapping of the range of research studies that investigate the impact of ICT as a whole on literacy in this age group. The present report's main aim is to identify the impact of *networked* ICT on literacy learning in English for ages 5–16 years through an in-depth review of the characteristics, quality and findings of studies with this focus. The original research question for the review, as described in the review protocol, was:

- What is the impact of ICT on literacy learning in English for 5-16 year olds?

Subsidiary or more specific questions for the review originally included:

How does impact vary with

- gender
- different kinds of media/multimedia
- English as a first or additional language
- cultural mediation
- learning difficulties or specific learning difficulties?

The review was further delimited by the following criteria.

We aimed to confine our search to English in the curriculum for 5–16 year olds. While our principal focus is on the use of ICT in English in schools, there is important research on the individual use of ICT in, for example, the creation of websites (e.g. Abbott, 2001) and other home or out-of-school use and we did not wish to exclude related research that might shed light on the issues we are trying to address.

In order to delimit the scope of the review further, and because of the rapidly changing nature of ICT, we focused on research published since 1990, the beginning of the decade in which the internet became widely used and in which schools began to use it in significant numbers. The review was also restricted to published research. We have not included reference to Masters and doctoral theses for pragmatic reasons; it would have been too costly and time-consuming to access all such theses on the topic in the time available. We have assumed that, where such research is significant, it will have been published in article, report or book form.

Furthermore, the review is delimited by its focus on literacy learning *in English*. That is to say, we have included studies that focus on English as a mother tongue and as a second or additional language, but not on English as

a foreign language. In other words, the studies come from contexts in which English is used as a first, second or additional language in home, school and other environments.

The review uses the definitions of study types drawn up by the EPPI-Centre (EPPI-Centre 2001a). A broad range of study types are included in the in-depth stage of the review, for the following reasons:

- *Outcome evaluations* are included on the basis that randomised trials and controlled trials, and to a lesser extent pre- and post-test studies, can be used to help to answer questions about the effectiveness of interventions designed to use ICT to increase aspects of literacy.

- *Process evaluations* are included on the basis that, in a field of research that is relatively young and under-developed, investigations that look at the development of interventions are helpful. Process evaluations examine the acceptability and feasibility of interventions, i.e. how the intervention is delivered, rather than whether it works or not.

- *Other study designs*, such as systematic reviews or needs assessments that have an evaluative component, are included on the basis that we expected many of the studies in the field to be small-scale case studies that evaluated something other than the outcomes or processes associated with specific interventions. We wanted to be able to access the qualitative data that might exist in other studies, but only where this is produced through some form of analysis (e.g. by reference to theory, to previous literature in the field, or formally within the methodology). A purely descriptive case study would be excluded on these grounds.

2.2 Consultation with user groups

User perspective is strong in the membership of the advisory group. A number of serving secondary and primary schoolteachers were invited to sit on the group. A member of the project team was recently a serving secondary schoolteacher before moving to the Institute of Education. We have changed the composition of the advisory team during the year by the addition of another secondary schoolteacher and an advisory primary literacy expert. There are parent governors on the advisory group from both the primary and secondary sectors. In addition, many of the researchers and lecturers on the advisory group have children at school, were teachers themselves, and/or have affiliations to national organisations with interests in literacy development. Furthermore, we have representations from initial and continuing teacher education in English, and EAL/EFL experience.

The advisory group has been involved at every stage of the research. It contributed to the application for review group status and to the development of the protocol. At each advisory group meeting, members have commented on the progress of the systematic study. The group as a whole was involved in selecting and defining the study's scope. Dissemination of the work of the project has brought the study into contact with teachers, researchers, lecturers, students and other educationalists whose feedback has all contributed toward shaping the progress of the work.

One example of such consultation so far has been a seminar given on the review to the University of Warwick's Centre for New Technologies and Research in Education (CeNTRE) in which the audience consisted of teachers, researchers, academics and teacher educators. The seminar was part of a series on the relationship between ICT and specific subject disciplines. Other examples include a presentation at a research network on ICT and education at the European Conference on Educational Research, Lille, September 2001; presentations at BERA in 2001 and 2002; a presentation at the 2001 DfES research conference; a presentation to primary teachers on an MA in primary education at the University of York; and one to research students and staff at York.

Another is the close involvement of a parent governor at both a primary and secondary school in the design, direction and output of the study. This particular person also has expertise in systematic reviews in the health sector.

The omission of two other key groups is acknowledged as a potential lack. Firstly, there has been no involvement from children and young people during the course of the first year of the study, other than in the writing of a user summary for 5–16 year olds. Secondly, software companies have not been involved.

Those users who have contributed, as outlined above, have seen their comments incorporated into successive drafts of the protocol and the report; they have also contributed to the refinement of the research questions and have critiqued processes and procedures.

3. IDENTIFYING AND DESCRIBING STUDIES: METHODS

3.1 Identification of studies

Appendix A contains full details of searching. The bibliographic details of all papers identified through database searches and the potentially relevant papers found by hand, website and bibliography searching and through personal contact were entered into a series of EndNote bibliographic databases created for the review. A hierarchical system of sourcing was established, with database searches logged in the order presented below, followed by the results of handsearching, bibliographies, websites and personal contacts. The citations found for each search of a new source were entered onto a separate database, after first being checked against sets already collected, and duplicates were removed.

3.2 Electronic databases

In collaboration with the review team, searches were developed and implemented by the National Health Service Centre for Reviews and Dissemination (NHS CRD) for the following electronic databases: PsycINFO, ERIC (Educational Resources Information Center), BEI (British Education Index), SSCI (Social Science Citation Index), the Cochrane Library, SIGLE (System for Information on Grey Literature in Europe) and Dissertation Abstracts. In addition, the Review Group (ICT) searched C2-SPECTR (The Campbell Collaboration's Social, Psychological, Educational and Criminological Trials Register).

Searches looked for studies by combining sets of terms for English literacy processes and outcomes (e.g. 'literacy near English', 'learning near spelling', 'dyslexia near english'), ICT intervention (e.g. 'ICT', 'computer'. 'mobile phones') and children or young people (e.g. 'child', 'children', 'infants', 'pupils') – see Appendix A for full details of these searches. A combination of controlled term and free-text (abstract and title) searches were used for ERIC, BEI and PsycINFO. All other databases were searched using free-text terms only.

3.3 Hand and website searches, bibliographies and personal contacts

Six members of the review team and the advisory group handsearched the following 11 key journals in the fields of literacy and ICT: *English in Education (RA); Australian Journal of Language and Literacy (TL); Education, Communication and Information (RA); Changing English (AB); Dyslexia (MS); Journal of Educational Computing Research (CT); Research in the Teaching of English (RA); Literacy Learning: Secondary Thoughts (TL); English in Australia (TL); English in Aeoteroa (TL); Reading and Writing (PH) and Education Media International (TL).* Where editions were available, the indexes of these journals for the years 1990 – 2001 were scanned using the

inclusion and exclusion criteria for the mapping study described below. All papers identified as potentially relevant were screened by four members of the review team on the basis of the abstracts and, where necessary, a reading of the full paper.

The NHS CRD also searched relevant websites and downloaded publication lists. Potentially relevant documents were identified from these lists and screened as described above for journals. (See Appendix A for a log of the hand and website searches.)

A similar searching process was carried out on the bibliographies of all relevant systematic reviews and potentially relevant studies were also identified on an ad-hoc basis on reading full reports. Members of the Review Group were also invited to identify potentially relevant studies from their knowledge of the field.

3.4 Inclusion and exclusion criteria

To be included in the mapping study, a paper had to be about the impact of ICT on literacy learning in English and focus on study populations of children and young people aged between 5 and 16. In addition, papers were only included if they were one of the following study types: systematic reviews; evaluations of the processes or outcomes associated with an intervention; evaluations of something other than an intervention, e.g. a needs assessment. In an additional round (following screening with the above mentioned working document for inclusion and exclusion), papers were excluded if they were published before 1990 or were the preliminary findings of as yet unpublished research.

3.4.1 Screening

The English Review Group working document for inclusion and exclusion of papers for the mapping study was developed by the review team (Appendix B) to enable reviewers to systematically include or exclude papers. Screening was first done on titles and/or abstracts alone. One reviewer (CT) screened all the citations found through electronic database searching. 90% of these (those retrieved from the PsycINFO, ERIC and BEI databases) were also screened independently by a second reviewer (RA). Any disagreements were discussed and resolved. For purposes of quality assurance, a further screening exercise of a 5% random sample was undertaken independently by two members of the review team and a 2.5% random sample by a further two. Scores of inter-rater reliability were calculated using the Cohen's Kappa.

3.4.2 Keywording

Full reports were obtained and first classified according to a standardised 'core' keywording system developed by the EPPI-Centre (EPPI-Centre, 2001a). This classifies studies in terms of the type of study (e.g. outcome evaluation, process evaluation, needs assessment); the country where the study was carried out; the educational focus of the study; and the study population. For outcome evaluations, studies were also keyworded in terms of the intervention provider and the type of intervention. In addition, studies were then classified according to an additional standardised keywording

system, developed for the purposes of the review (review-specific keywords). The strategy classifies studies in terms of literacy, learning and ICT focus of the study; type of information technology intervention and outcomes reported. In addition, the principal aspect of literacy focused upon by the study was categorised into 'psychological' or 'social and/or cultural /critical', where:

- *Psychological* aspects or representations of literacy are those which focus principally on internal dimensions: cognitive advances, mental processing, literacy as expressed via thought, internal dialogue, and individual expression. The underlying conception of literacy is one which sees it as the development of individual skills and capabilities.

- *Social* and/or *cultural/critical* aspects or representations are those which are not only socially embedded – most classroom practices or interactions with a computer are – but which inform literacy with an interactive, social dimension, whether that interaction is between student and student, student and teacher, student and different audience. The underlying conception of literacy is one which sees it as the development of social skills and capabilities.

All members of the Review Group completed a pre-keywording moderation exercise involving four papers to standardise keywording procedures. Moderation began with a meeting of the project team on 25th July 2001 to pilot the keywording document, which consisted of both the generic EPPI-Centre 'core' section and the section specific to the review of the impact of ICT on literacy learning.

Thereafter, the English Review Group co-ordinator double-keyworded 5% of the total number of included papers; three members of the review team (including one from the EPPI Centre) double-keyworded 2.5% of the total number of included papers. In a post-keywording moderation exercise on 9th November 2001, all members of the project team plus a representative from the EPPI-Centre double-keyworded two included papers, one of which was discussed at the meeting.

The keywords assigned to each study were recorded in a paper form attached to the study and by annotation of the review's bibliographic database.

4. IDENTIFYING AND DESCRIBING STUDIES: RESULTS

4.1 Identification of reports

Table 1 illustrates the process of identifying, obtaining and describing reports for this review. A total of 1871 potentially relevant reports were identified. Just over 80% (1,510) of these 1,871 reports were excluded by screening titles and/or abstracts and 361 were sent for. Fewer than 2% of these (30) were not received within the timeframe of the review or were unavailable. A reading of the full report resulted in the exclusion of a further 143 reports, leaving a total of 188. These 188 reports each contained only one study and no studies were reported in more than one report.

Table 1: The process of retrieval of the reports in the mapping study

Total number of 'hits'	1,871
Met mapping study inclusion criteria on the basis of the title or abstract	361
Not received or unavailable	30
Full reports available	331
Full reports that did not meet mapping study inclusion criteria	143
Met mapping study inclusion criteria and keyworded	188

Table 2 presents the origin, by database or other method of retrieval, of all the 188 reports included in the mapping study. It also shows the process of retrieval for each database. As has been described, a hierarchy of databases and handsearches was established which is reflected in the order of presentation. PsycINFO was imported into the library first with de-duplication occurring on subsequent importation of the other databases. Figures for ERIC are those reports that were not also found by PsycINFO, those for BEI are those not found on either PsycINFO or ERIC, etc.

The great majority of the reports found to meet the mapping study's inclusion criteria (165: 88%) were found with the database searches. Handsearching found an additional 18 (10%). The checking of citations (systematic review bibliographies and citations in the text of full reports) and reviewers' searches of their own shelves identified a further 4 and 1 relevant reports respectively. No studies were identified solely through C2-SPECTR or Webpage searches.

Table 2: Origin of reports in the mapping study

	Found	Included
PsycINFO	736	92
ERIC	709	48
BEI	233	19
SSCI	22	2
Cochrane	26	0
Sigle	46	4
C2-SPECTR	38	0
DisAbs	11	0
Handsearch	37	18
Citation	8	4
Website	3	0
Contact	2	1
TOTAL	1871	188

Note: Reports could originally have more than one origin but a hierarchy of databases and other sources was created resulting in each category being made mutually exclusive.

4.1.2 Quality assurance: screening and keywording

Screening: The inter-rater reliability score between the first two reviewers undertaking screening of titles and abstracts was very good (0.90); the inter-rater reliability score between the second two reviewers was also very good (0.84). The EPPI-Centre representative was consistently more cautious in excluding reports in the initial screening.

Keywording: Agreement between members of the review team on keywording was reasonable but not full. Where there was disagreement this tended to occur on study type.

4.2 Mapping the field of ICT for literacy learning in 5-16 year olds

4.2.1 Characteristics of included studies: the impact of ICT on literacy learning in English for 5-16 year olds

The remaining tables in this section present analyses on the basis of research studies, as opposed to research reports (although for this review, as has been described above, the number of studies found was equal to the number of reports).

Table 3 shows the number and proportion of studies according to the country in which they were conducted. Most (64%) were conducted in the US. A total of 30 (16%) were from the UK. In 4 cases (2%) it was not possible to determine where a study had taken place. These figures may reflect bias within the bibliographic sources searched towards reports published within the North America, Australasia and the UK.

Table 3: Study country

	Number
USA	121
UK	30
Australia	16
Canada	9
New Zealand	2
Sweden	2
Germany	1
Holland	1
Israel	1
Italy	1
Not stated	4

Note: All studies were conducted in one country only.

Table 4 describes the educational setting for the 188 studies. A study could be conducted in more than one setting. Primary education was the most frequently studied (67% of reports look at this kind of setting, compared with 44% that look at secondary settings). A total of 21 studies were conducted in both types of setting.

Table 4: Educational setting

	Number
Primary education	126
Secondary education	83

Note: A single study could be conducted in more than one type of educational setting.

Table 5 presents the number of studies that conceptualised literacy in psychological and/or social/cultural/critical terms and the number that focused on reading and/or writing. Of the 188 studies, about two-thirds (65%) assume a psychological representation of literacy. A third (32%) adopts a more sociological conception of the practice. Over half (57%) focus on writing, graphical or pictorial production, whereas 46% have an interest in reading. Studies could have more than one focus with respect to both of these dimensions of literacy. For both dimensions there were a number of studies where reviewers were unable to categorise the aspect of literacy under study.

Table 5: Principal aspect(s) of literacy

	Number
Conceptualisation of literacy	
Psychological aspects or representations	122
Social representations and/or cultural/critical representations	61
Unclear	15
Reading/writing	
Writing print and graphical or pictorial representation	106
Reading print and graphical or pictorial representation	87
Unclear	10

Note: Studies could theoretically focus on two to four of these aspects of literacy.

Table 6 shows the overall distribution of reports according to study type. Most (154) of the 188 studies meeting the inclusion criteria for the mapping study evaluated outcomes. Several (35) evaluated processes. Three studies looked concurrently at outcomes and processes. One needs assessment was identified and one systematic review.

Table 6: Study type

	Number
Outcome evaluation	154
RCT	40
Trial	39
Pre- and post-test	33
Post test only	7
Reversal design	10
Cohort study	6
Case control	2
Other	17
Process evaluation	35
Needs assessment	1
Systematic review	1

Note: Three reports contained evaluations of both outcomes and processes.

The type of ICT focused on by the 188 identified studies is illustrated by Table 7. This shows the relative popularity of 'stand alone' ICT as a topic of study in comparison with networked ICT systems. The use of email was studied more frequently than internet use.

Table 7: Type of ICT

	Number
Computer – stand alone (software)	165
Computer – networked (email and/or internet)	16
Computer – networked (email)	13
Computer – networked (internet)	6

Note: Studies could focus on more than one category of ICT.

A broader description of the focus of research of the 188 studies that met the inclusion criteria for the mapping study is provided by Table 8. Of the topics identified, writing and reading, at 95 and 90 studies respectively, were the most frequent, closely followed by 'teaching or learning' (75). Word-processing, composition, learning difficulties and text or text production were also common.

Table 8: Topics of study by research type

Keyword	Total studies	Outcome evaluation	Process evaluation	Needs assessment	Systematic review
Composition	45	37	7	1	0
Dyslexia	8	8	0	0	0
ESL	7	4	3	0	0
Hypertext	15	8	7	0	0
Learning difficulties	41	37	4	0	1
Learning disabilities	24	22	1	0	1
Literature	12	6	6	0	0
Literacies	39	24	15	0	0
Moving image	4	2	2	0	0
Multimodality	13	4	9	0	0
Networked	16	8	7	1	0
Reading	90	78	12	0	1
Spelling	30	28	2	0	1
Teaching or learning	75	50	27	1	0
Text or text production	43	30	14	0	0
Visual design	6	5	1	0	0
Word-processing	61	47	14	1	1
Writing	95	73	22	1	1

Note: Studies could focus on more than one topic. Three reports describe evaluations of both outcomes and processes.

5. IN-DEPTH REVIEW: METHODS

5.1 Moving from broad characterisation (mapping) to in-depth review

During the course of the mapping described in the previous two chapters, it became clear that there was a large number of studies in the field. It would clearly not be possible to review in-depth all of the 188 studies found within the required framework of a year. We therefore needed to identify a sub-section of the studies found for in-depth analysis, with other studies being reserved for in-depth review at a future time. The group chose to focus on networked ICT and the question for the in-depth review therefore became:

- What is the impact of *networked* ICT on literacy learning in English for 5-16 year olds?

The definition of 'networked ICT' used by the review team was as follows:

- Information and communication technologies that operate by linking computers or mobile phones to each other, thereby creating a network of communication possibilities. The most common applications are texting, email and the internet, though we include in the definition local area networks and intranets. A system of interrelated elements that is interconnected in a dedicated or switched linkage to provide local or remote communication (of voice, video, data etc) and to facilitate the exchange of information between users with common interests.

The 16 studies identified using this definition as studying networked ICT were therefore subjected to data extraction and quality appraisal, as described in the next section.

As described in Chapter 2, the review protocol also laid out the group's aims to analyse how impact was influenced by a number of factors (gender, learning difficulties, different kinds of media, the presence of cultural mediation, whether English was a first or additional language). Given the redefinition of the review question, it was decided instead solely to identify when these issues arose in the studies reviewed in depth.

5.2 Inclusion criteria for the in-depth review

In addition to meeting the criteria described in Chapter 3 for the mapping study, to be included in the in-depth review, studies had to be about the impact of networked information and communication technologies on literacy learning.

5.3 Data extraction

Data extraction began with the entire project team extracting data from Allen and Thompson (1995), a study that had previously been keyworded and moderated by the team, with moderation and discussion of the process at a meeting on 29th November 2001. Following this moderation, data extraction began on the remaining articles selected for in-depth review. Data were double entered onto EPPI Reviewer (software) by two reviewers working independently. In cases where there was initial disagreement about data extraction or quality appraisal, this was discussed and resolved. Two members of the EPPI-Centre were involved in this process.

A standardised data extraction framework was used: the EPPI-Centre's *Review guidelines for extracting data and quality assessing primary studies in educational research* (EPPI-Centre, 2001b). For each study, regardless of study type, data were collected on the aims, study sample and recruitment and data collection and analysis methods. The collection of data and judgements about soundness of study methods that are specific to different study types is described below.

5.3.1 Outcome evaluations

For outcome evaluations, reviewers used the guidelines further to extract data on the development and content of the intervention evaluated, the design of the outcome evaluation, use of allocation (random or otherwise) to different groups, pre- and post-intervention data, attrition rate and findings for all outcomes.

The outcome evaluations were then appraised according to four central methodological criteria, in order to assess whether they were judged by the reviewers to be 'sound' or 'unsound' within their study type:

- Employing a control/comparison group equivalent to the intervention
- Providing pre-intervention data for all individuals or groups
- Providing post-intervention data for all individuals or groups
- Reporting on all outcomes

'Sound' outcome evaluations were assessed as being of sufficiently high methodological quality in order for their results to be able to be judged to be reliable in indicating the effectiveness of interventions to increase the literacy of pupils aged 5–16 using networked information and communication technologies.

5.3.1 Process evaluations and other study types

In the case of process evaluations and other study types, the EPPI-Centre data extraction guidelines were again used. These contain a set of quality criteria designed to be generic to all study types. The distinction between 'sound' and 'not sound' studies is not so clear in these cases, so a holistic judgement was made on the quality of the study based on the EPPI criteria and moderated judgements (between at least two reviewers in each case). Although the English Review Group is developing a separate set of criteria for qualitative research, these were not used in the present study. Readers are

referred to EPPI Reviewer for the template used to extract data from this kind of study.

5.4 Synthesis

Information from those studies which addressed similar questions was brought together.

Within these questions, the studies were also assessed for how much weight (high/medium/low) to give to their findings within the review. Three dimensions and an overall weight were used:

A. Soundness of method (general and study type specific) apparent from the research reports i.e. the extent to which a study is carried out according to accepted best practice within the terms of that method. (The criteria of this type used to assess outcome evaluations have already been described above.)
B. Appropriateness of study type to answer the review question/sub-question i.e. the extent to which the methods used in the study are well suited to answer the review question or sub-question.
C. Relevance of the topic focus of the study to the review question/sub-question i.e. the extent to which the concepts and measures used in the study address the review questions and sub-questions.
D. OVERALL weight of evidence that can be attributed to results of study.

Because of the way the inclusion / exclusion criteria were stated, categories B and C were generally classified to have medium to high weight to address the review questions, and hence the main driver for reducing the overall weight for this review (D) was likely be the soundness of the study *within* its study type (C). We adopted the following algorithm in order to move from our categorisation of A, B and C to the overall weight, D:

- For a study to be considered of **high** overall weight, A, B and C all need to be high.
- For a study to be considered of **high/medium** overall weight, at two of A, B and C need to be high, and the third must not be less than medium.
- For a study to be considered of **medium/high** overall weight, at least one of A, B or C must be high, and all need to be greater than medium.
- For a study to be considered of **medium** overall weight, A, B and C all need to be at least medium.
- For a study to be considered of **medium/low** overall weight, at least two of A, B and C need to be at least medium.
- For a study to be considered of **low/medium** overall weight, at least one of A, B and C must be low, and none can be greater than medium.
- For a study to be considered of **low** overall weight, two or more of A, B and C must be low.

The weights were used in decisions about whether to include a study in the synthesis at all, and if so, how much weight it should be given. Three members of the Review Group made decisions about these weights.

If the data were in a quantitative form suitable for statistical synthesis, they were considered for inclusion in a meta-analysis. Otherwise, synthesis took the form of a narrative summary or qualitative overview. The synthesis was

drafted, discussed, revised and redrafted by the review team and the English Review Group in consultation with the EPPI-Centre.

6. IN-DEPTH REVIEW: RESULTS

6.1 Quality assurance

Agreement on data extraction and quality appraisal was generally very good, with most disagreement occurring in the extraction of statistical data. The moderation described earlier that was required to agree on the quality of studies other than outcome evaluations did not prove difficult in practice.

6.2 In-depth review: study type and characteristics

Table 9 presents the set of studies that reached the in-depth review, ordered by study type. A total of 16 studies met the inclusion criteria for the in-depth review. Of the 16, half (8) evaluated literacy outcomes of various types of networked ICT. Seven studies solely evaluated the processes associated with networked ICT and one study was classified as a needs assessment.

Table 9: Summary of studies reviewed in-depth in order of study type

OUTCOME EVALUATIONS	
RCT	Allen and Thompson, 1995 Golden, Gersten and Woodward, 1990 Spaulding and Lake, 1992
Trial	Moore and Karabenick, 1992
Pre- and post-test	Clouse R, 1992 Peyton J K, 1991
Post-test	Erickson *et al.*, 1992 Garner, Tan and Zhao, 2000
PROCESS EVALUATIONS AND OTHER DESIGNS	
Process evaluation	Bigum, Lankshear *et al.*, 1997 Ewing J, 2000 Love K, 1998 McKeon and Burkey, 1998 McNamee G, 1995 Morgan W, 1997 Stuhlmann and Taylor, 1998
Needs assessment	Collins J, 1993

Table 10 presents the key characteristics of each of the 16 studies ordered by study type. Over two-thirds (11) of the studies were conducted in the USA, three in Australia and two in the UK. In many (6) of the studies, the number of participants contributing data was unclear from the authors' report. In the remainder of cases sample sizes were relatively small, ranging from a single case study of the experiences of one student and their mentor to a trial involving 93 pupils. While several studies examined a range of literacy outcomes, the principal areas of interest for the studies were reading (5 studies) and writing (10). In two studies, the age group studied is unclear; however, most of the studies focus on the primary/elementary school sector, with seven concentrating on students aged eleven or younger. Three of the studies look at out-of-school activities, and only two (and both indirectly) turn their attention to the impact of ICT solely on literacy at secondary or high school level. Four of the studies look at word-processing; two at new conceptions of literacy; and one each on hybridity (multi-channelled composition e.g. writing, images and sound in combination); speaking and listening; and special educational needs.

Table 10: Characteristics of studies included in the in-depth review in order of study type

Author, date and country	Study type	Aim	What was studied?	How was it studied?
Allen, Thompson (1995) USA	Outcome evaluation: RCT	To examine the effects of a computer-mediated networked learning system on the writing of 5th grade students who used word-processing to write four texts collaboratively during an 8-week period	Sample: 93, yr. 5 students in 4 classes in K-12 public schools Classes randomly assigned to intervention or control Intervention group writing assignments sent by email to college student readers for supportive, non-judgemental comments Control group writing assignments: Teachers responded in their normal fashion by writing comments on the paper. Measured: Quality of writing	RCT (cluster design), post-test data (written assignments) Unit of allocation – cluster Unit of randomisation – individual
Golden, Gersten, Woodward (1990) USA	Outcome evaluation: RCT	To evaluate the effect of computer networking program in providing guided practice in teaching reading comprehension	Sample: 31, middle-school (yrs. 6, 7 and 8) students 'receiving remedial instruction in reading' randomly assigned to intervention or control Intervention group received guided practice: Computer networking provided the teacher with information for determining the nature and extent of guided practice necessary. Control group: The pupils completed a worksheet containing the same questions that were given to the guided practice group. The teacher corrected and analysed the worksheets. Measured: Rule-based inferences test and QAR2 (metacognitive strategy)	RCT, pre- and post-test data and test, re-test Descriptive statistics 2x2 ANOVAS
Spaulding, Lake (1992) USA	Outcome evaluation: RCT	To investigate the effects of having student writers use a set of networked computers to assist them in their writing lessons	Sample: 28, 'remedial writers' assigned to intervention or control Intervention students collaborated by means of an electronic network Control group students did not participate in the collaborative project and did not have access to computers. However, they studied other places across the country and around the world. Measured: gains in essay scores	RCT cluster randomisation 3 regression analyses, one for each outcome variable

Table 10: Characteristics of studies included in the in-depth review in order of study type (cont'd)

Author, date and country	Study type	Aim	What was studied?	How was it studied?
Moore, Karabenick (1992) USA	Outcome evaluation: trial	To examine the effect of a computer telecommunications program on writing performance of fifth graders	Sample: 50, 5th grade students in two 'middle class suburban schools' (two classes) assigned to control or intervention Intervention students collaborated via a computer conferencing system Control group students participated in a variety of writing activities including journal writing. These students also used computer software that emphasised drill and practice of mathematics and reading skills. Measured: Writing production, clarity and the use of details and examples to support ideas	Controlled trial, post-test data on writing samples (change) – 'holistic scoring'
Clouse R. (1992) USA	Outcome evaluation: pre- and post-test	To establish whether grade 1-4 students using the 'Teaching and Learning with Computers' system and following Jostens reading, maths and writing curriculum for K-4 made gains in main skills and selected sub-skill areas	Sample: Number not stated, selection of grade 1-4 (5-10 yr olds) Whole rural high school district Students using the 'Teaching & Learning with Computer' system and following the Jostens reading, maths and writing curriculum for K-4, made gains in main skill areas and selected subskills Intervention, but also a naturalistic experiment (as intervention was taking place anyway). Relevant topics studied: Reading and other language skills Outcomes measured: scores on comprehensive test of basic skills	Sampling: Whole school district used Data-collection: By comparing test scores against national percentile scores Period: Students studied across a one-year period Assessment: Curriculum-based Analytic tools: Means, SD, %, percentiles. No inferential statistics reported. Cognitive, affective and classroom management benefits claimed, but no supporting data or analysis reported.

Table 10: Characteristics of studies included in the in-depth review in order of study type (cont'd)

Author, date and country	Study type	Aim	What was studied?	How was it studied?
Peyton JK (1991) USA	Outcome evaluation: pre- and post-test	To explore the use of a local area computer network within a classroom for written real-time communication with students who have hearing problems and other learning difficulties.	Sample: 6, 7-13 year old students with hearing problems Setting: elementary school in Kendall. Intervention: Use of Electronic Network for Interaction (ENFI) to stimulate real-time writing Measured: Methods not described but findings reported for broad range of outcomes, including motivation and quality	Sampling methods: unclear, but six students took part in the study. Data-collection tools: ENFI transcripts, interviews, observation Methods of analysis: Not stated, except "analysis of transcripts"
Erickson *et al.* (1992) USA	Outcome evaluation: post-test	To examine the independent home behaviours of 4th graders on a network in terms of online and choices of videotext programs	Sample: 40, 4th grade students Urban, low socio-economic area of inner-city; 99% Black community Intervention: Retrospective design, so no real intervention as such except study of the use of videotext to promote online learning in a summer programme Measured: Use of online programs and software preferences	Sampling methods: not stated Data-collection methods: documentation Methods of analysis: not stated
Garner, Tan, Zhao (2000) USA	Outcome evaluation: post-test	Aims are not explicitly stated, but are broadly in the region of trying to determine whether writing on networked computers in an out-of-school environment can motivate young people to write more freely than in-school approaches	Sample: 7, 13-14 year olds. Setting: 10 computer clubhouses in Michigan. Intervention: (Naturalistic) students acting as reporters on internal newsletter for computer networked clubhouses Measured: number of stories submitted to an internal newsletter and quality of writing	Sampling methods: not stated Data-collection tools: documentation (drafts of stories by children); records of chat sessions. Methods of analysis: examination of written drafts and electronic field notes

Table 10: Characteristics of studies included in the in-depth review in order of study type (cont'd)

Author, date and country	Study type	Aim	What was studied?	How was it studied?
Bigum, Lankshear *et al.* (1997) Australia	Process evaluation	To investigate relationships between literacy and technology as well as to explore the impact of technology on the nature, definitions and views of literacy	Sample: Number not stated, 5-16 year olds in eleven school sites Setting: Primary and secondary schools in rural and city locations in Queensland, New South Wales and Victoria Interventions: None as such Measures: Exploratory	Sampling methods: diversity of location, context and ICT practices Data-collection methods: documentation; interviews; observation Methods of analysis: standard template for site descriptions; triangulation between methods; drew on conceptual framework developed by researchers to identify patterns and principles
Ewing J (2000) UK	Process evaluation	To look at a range of views about using ICT in support of learning and to postulate a model for ICT in support of learning	Sample: Number not stated, 8 & 14 year olds plus 3rd year of Scottish 4-year Hons course Setting: Scottish remote primary & secondary schools and college of higher education Interventions: A set of problem-solving tasks focused on the development of critical and creative thinking; a trial presentation of an established course module, using First Class; and a project to enable tutors who were not computer specialists to manage a group of students and learning resources. Measured: Role of offline and online learning	Sampling methods: not clear Data-collection tools: not stated Methods of analysis: broadly qualitative, but otherwise unclear

Table 10: Characteristics of studies included in the in-depth review in order of study type (cont'd)

Author, date and country	Study type	Aim	What was studied?	How was it studied?
Love K (1998) Australia	Process evaluation	To consider how English teachers are using computers in their classrooms and how they are being helped to integrate computer technology into their teaching	Sample: One student teacher working with year 8 and 9 (1-14 year old) pupils Setting: Melbourne Catholic Girls' School Intervention: Student brought girls to university's networked computer laboratory; introduced them to email and internet; helped them to research; helped them to develop a critical approach to information available through networked technologies. Measures: Exploratory, included pupils conceptual and technical expertise	Sampling methods: not stated Data-collection tools: student teacher's documentation (logs, lessons plans); interview, observation Methods of analysis: not stated
McKeon and Burkey (1998) USA	Process evaluation	The study described "the nature of an email collaborative between pre-service teachers and 4th & 5th graders in which literature was used as a vehicle for language and reading enhancement"	Sample: Number not stated, 4/5th graders and pre-service teachers Setting: Five local elementary schools in Mid-West Intervention: Email collaborative in which ICT used as a vehicle for language and reading enhancement Measured: Methods not described but findings reported for motivation, interest in reading, purposeful computer usage, critical reading skills	Sampling methods: schools known to researchers – an opportunity and convenience sample Data-collection methods: documentation; email exchanges Methods of analysis: not stated
McNamee G (1995) USA	Process evaluation	To discover what the effects were of tele-communications opportunities on children's writing development in an after-school computer club	Sample: Case study of mentor and one 8 year old child Setting: Urban - a Chicago community centre Intervention: Adult mentor in role as online mythical helper, along Vygotskian lines as collaborative 'real' audience Measured: Confidence and communicative ability	Sampling methods: not stated Data collection methods: documentation of on-line communication with mythical helper (Wizard); plus field notes by adult Methods of analysis: not stated

Table 10: Characteristics of studies included in the in-depth review in order of study type (cont'd)

Author, date and country	Study type	Aim	What was studied?	How was it studied?
Morgan W (1997) Australia	Process evaluation	To present 'snapshots' of practice at the interface of technology and literacy education	Sample: One teacher of Aboriginal and Caucasian year 6 and year 10 children Setting: Rural Intervention: The setting up of "the BushNet infrastructure" which encouraged participating schools to set up their own websites Measures: Exploratory	Sampling method: not stated. Data collection tools: interview, observation. Methods of analysis: not stated.
Stuhlmann, Taylor (1998) USA	Process evaluation	"The purpose of this paper is to provide a detailed description of a replicable project, benefits to the participants and avoidable pitfalls" on the impact of telecommunications on learning outcomes in elementary classrooms	Sample: Number not stated, 3rd/4th grade classes plus elementary education majors and graduate students Setting: Schools associated with Louisiana State University Intervention: Online exchanges – two 3rd grade classes correspond with a fictional character for a reading session, partly monitored by a 4th grade class Measured: Involvement in 'complex learning', self-esteem, motivation to read	Sampling methods: not stated Data collection methods: documentation of on-line exchanges between pupils; and between adult (i.e. student) participants Methods of analysis: not stated
Collins J (1993) UK	Needs assessment	To identify teacher areas of concern in the development of writing skills in secondary pupils, and how ICT might be used to answer these concerns	Sample: 16, secondary school Heads of English (and, through them, the needs of 11-16 year olds) Setting: Belfast secondary schools, Northern Ireland Intervention: None as such, as this is a needs assessment study Measured: popularity of different forms of computer use, beliefs about potential for different forms of ICT to develop writing skills, needs for in-service training.	Sampling methods: not stated, but it is assumed researcher used Education and Library Board mailing lists to identify schools and Heads of English; response rate was 35%. Data collection tools: questionnaire. Methods of analysis: not stated.

6.3 In-depth review: findings and methodological quality of studies

As the settings and interventions in the studies were often heterogeneous, it was not felt to be appropriate to pool the data. We were also unable to statistically synthesise information from these studies as many did not provide data in a form suitable for meta-analysis. In addition, only one of the trials was sufficiently robust to be judged 'sound' according to the aforementioned criteria for the soundness of outcome evaluation study methods.

We have separated the main questions addressed by the studies in terms of impact on outcomes, impact on processes and needs assessment. Appendix C is a summary of the results of the 16 studies reviewed in-depth, within these three questions, with an assessment of how much weight to put on the findings of each study. To accompany Appendix C, a detailed narrative description of each of all of the 16 studies follows.

6.3.1 Impact on outcomes

Randomised controlled trials and controlled trials

Randomised controlled trials, and, to a lesser extent, non-randomised controlled trials, are the most rigorous methods for assessing whether networked computers are actually *effective* in improving literacy learning. As such, this kind of outcome evaluation will be weighted more highly than others in terms of appropriateness of study type for answering this research question. In this section of the report, we consider all the experimental studies identified in our systematic review.

Four randomised controlled trials or controlled trials met our inclusion criteria for the in-depth review: three were randomised controlled trials: Allen and Thompson (1995), Golden *et al.* (1990), and Spaulding and Lake (1992). One study was a controlled trial without random allocation: Moore and Karabenick (1992).

The only experimental study that our review identified and that was judged sufficiently sound for reasonable conclusions to be drawn was by **Golden *et al.** (1990). The aim of the study was to see if 'instant' guided practice by a classroom teacher in conjunction with a classroom intranet would improve literacy among low-achieving pupils. The researchers investigated the effectiveness of the use of guided practice in teaching reading comprehension to middle-school students in a remedial reading class. Teachers used a low-cost computer networking system immediately to assess and tabulate student performance to determine which segments of the curriculum required additional remediation. This study can help to show whether or not the use of a low-cost networked computer system for guided practice can have an impact on the reading comprehension and inferential learning of low-achieving students compared with the use of a worksheet for the same purpose. The study can also help to show levels of student engagement on task, and the impact of this use of networked computers on student satisfaction. There is a significant main effect for the instructional method (intervention) for the rule-based inferences test. On both testing occasions, the guided practice group performed significantly better than the comparison group: "(the) results

indicate that the guided practice had a significant positive effect on students' acquisition of the more complex material in the rule-based inferences curriculum but had no discernible effect on their performance on the more familiar material in the QAR test. The effect on the rule-based inferences was maintained over a 2-week period" (p.298).

There is no description of the process of randomisation (i.e. who did it and precisely how it was done). The study does state that the children were individually randomised into two groups: a group receiving 'normal' classroom instruction plus the use of networked computers to input their answers, versus normal classroom teaching. The study used a matched pairs randomised design. In a matched design, pupils are formed into pairs if the study is a two 'armed' trial (or triples if it is a three 'armed' study). The pairing is usually done on the basis of the likely most important predictors of outcome. In this instance, children were paired on the basis of an IQ test. Thus, the researchers gave all the children an IQ test (the California Achievement Test) and 'paired' an individual with the student that most closely attained a similar score. After pairing, one of the students in each pair was randomly allocated to be in the intervention group whilst the remaining student acted as a control. The advantage of this arrangement is that it reduces the possibility of 'chance' differences where, despite randomisation, groups are dissimilar in an important variable by chance. Using matching, the groups should be of equal size: in Golden *et al.*, there were 31 children at the start of the study, meaning that a true matched pair method could not be used. Further, at follow-up, there were only 30 pupils: 16 in the intervention group and 14 in the control group. This indicates that either a matched pair design was not actually used or that matching was used and there were drop-outs soon after the matching, which was not described in the study. From the study, we are aware of at least one drop out (i.e. the sample fell from 31 to 30) but his/her characteristics were not described. If a matched pair design had been used, then a sensitivity analysis of the results should have been undertaken, excluding the matched pair that had not dropped out of the study.

The curriculum was delivered by two teachers: the author and her research assistant. To try to avoid a 'teacher' effect, the teachers swapped classes six days into the 17-day intervention period. This was to avoid the confounding effects of either teacher on the study outcomes. Had this not been done, the study could have been completely confounded by the effect of an individual teacher and it would not have been possible to attribute any change to the intervention itself. For example, if one of the two teachers had been a significantly better teacher than her colleague and she was allocated the intervention group, then any beneficial effect could have been due to the superior teacher; not the intervention. Whilst the arrangement chosen by the researchers does help reduce this bias to some extent, it may still not have been entirely eliminated. If, for instance, there was an important difference between the teachers and there was also an ordering effect – that is, children were more or less receptive to a teacher at the beginning (or end) of the study – then one group of children would have been exposed to the superior teacher during the time they were most receptive to learning. Further, if there were significant differences between the teachers, one group would have received 11 days of teaching from the 'superior' teacher (i.e. double the input). This extra input could have been responsible of any observed effects of the intervention.

There is another potential problem with both internal and external validity which follows from using so few teachers to deliver the intervention. In terms of internal validity, there could have been an interaction effect, in that the intervention may have only worked given certain teaching abilities. If we assume both teachers had unusual characteristics, it might be that the intervention would only work among a small number of teachers possessing these unusual attributes. To remedy these problems, future trials of this technology would need to use a much large sample size of 'ordinary' teachers.

The sample size of the study was relatively small. With about 30 learners in the study, the trial would have had *a priori* only modest power to detect a large difference between the groups. For instance, whilst differences between rule-based inference tests were statistically significant, the differences between the literal tests at final follow-up were not. Nevertheless, the differences in the means between the latter were large, at approximately ¾ of a standard deviation.

The analysis presents means and standard deviations for both groups. The authors state that the differences in means in the rule-based inference tests were 'significantly' different but the statistical tests of the raw means were not specified. The authors then perform an Analysis Of Variance (ANOVA) with Group and Time as dependent variables. They state that there was a statistically significant difference, although they appear to use a p value of < 0.10 to indicate significance, which was not specified in advance. In terms of student satisfaction, 79% (no number reported) of the intervention group liked their method of instruction compared with only 25% (no number reported) of the control group.

The statistical analysis has a number of problems. Although the authors do use a multivariate method of analysis, strangely, they do not use baseline CAT scores as a co-variate. Introducing the CAT scores as a co-variate would have improved the precision of their analysis as the students had been matched on these scores. Further, other variables could have been modelled in the analysis, with the most obvious being pupil gender. A test of proportions could have been applied to the satisfaction scores, but this was not undertaken either. Finally, there may be a problem with the type of statistical analysis used. Although the pupils were randomised as individuals, there would have been a clustering effect on outcomes, because teachers would have represented an analytical level common to all outcome scores (which ideally should have been taken into account in the statistical model).

The study shows a relatively large difference between the groups in rule-based inference work. The study also shows a large difference between the literal-based tests, although the authors discount this because it is not statistically significant. Thirdly, the authors also found that academic engagement and student satisfaction was superior among the network group.

Although this study is highly relevant to addressing the outcome question in the review, it has a number of methodological flaws that mean its results should be treated with caution. The authors could have improved on their study using the following relatively simple methods. First, random allocation of the students should have been carried out by someone other than the researchers. Second, something was clearly wrong with the randomisation process itself, as there were unequal numbers of students at baseline (which

cannot happen in a paired design) and then one student went 'missing'. Third, delivery of the intervention was not balanced, with students receiving 11 days with one teacher and only six days with the other.

At best, Golden *et al.* (1990) represents a pilot trial that provides some intriguing results, which need to be tested in a larger, more rigorous study. Nevertheless, it provides a relatively higher weight of evidence than any of the other studies for addressing the outcome question in the review.

Allen and Thompson (1995) sought to ascertain whether using email helped fifth grade US students to improve the quality of their writing. The authors took four classes of students and randomised them to receive the intervention or act as controls. The study did not meet the quality criteria for the review for a number of reasons. It is unclear how many classes received the intervention: was it 1, 2 or 3? No pre-test data on the main outcome measures are given by group allocation; as a result, we are unable to ascertain whether the groups were similar at baseline. The authors give a pooled group mean of the pre-test values and then describe the mean post-test scores by group allocation. The post-test scores of the control are lower than the group average mean test scores, whilst the post-test scores of the intervention group are higher. However, unless the pre-test scores are presented by group allocation, we cannot be sure whether some part of the difference is due to group imbalance at randomisation. Indeed, there is a suggestion of a baseline imbalance from the implication in the results section that the differences in word-count on the post-test writing sample were statistically significant after adjusting for initial differences in pre-test scores. The data are of a clustered nature and the authors should not have used analysis of covariance to analyse them. Rather they should have used some form of multi-level modelling to take into account the clustering effects of the class. Further, the use of only four clusters is relatively small for any differences between clusters to be balanced out by the randomisation process. There were also three students who appeared to have been lost to the analysis after pre-testing. In summary, although this study is highly relevant to addressing the outcome question in the review, its study design is not fully appropriate and its methods are judged 'not sound' according to two of this review's criteria for the soundness of outcome evaluation study methods; therefore, the results provide only medium to low weight of evidence for the review.

Spaulding and Lake (1992) undertook a cluster randomised trial to see if using networked computers would improve literacy. The allocation process of eight classes resulted in extremely unbalanced groups. The groups were significantly unbalanced at baseline on linguistic efficacy and computer efficacy. The problem is that the results are entirely consistent with 'regression to the mean' and/or ceiling effects of the test: students with high linguistic abilities showing little gain and those with low linguistic competence scores appearing to show greater gains. This effect is consistent with outliers of either end of the distribution 'regressing to the mean'. In particular, if the high-scoring students are close to the maximal score of the test, then they cannot improve on that test, no matter how beneficial their teaching is. Because the control group contained students with high linguistic abilities, the students in it tended to 'regress' downwards towards the mean, whilst the control group, which contained nearly all students with low linguistic abilities, regressed upwards towards the mean giving the appearance of a differential effect. As with the study by Allen and Thompson, this study had a cluster

design and multi-level analysis should therefore have been used. Hence, although highly relevant to addressing the outcome question in the review, and of a potentially appropriate study type, this study is judged 'not sound' according to the EPPI Reviewer criteria; therefore the results provide only medium to low weight of evidence for the review.

In the study by **Moore and Karabenick** (1992), a class of 26 primary schoolchildren was compared with a control class of 24 children. The children in the comparison group obtained higher scores than the children in the treatment group at baseline. Therefore, the groups were not balanced. At post-test, changes in scores converged, which eliminated the difference between the groups. As with the study by Spaulding and Lake, the results are entirely consistent with the regression to the mean phenomenon, rather than any effect of the intervention. The only significant effect was on word-production, where the intervention group had a significant improvement from the pre-test. No data are presented on the control group. As a result, we do not know whether the control group improved or, if they did, by how much. Again, it is entirely possible the control group improved at the same rate as the intervention group. This study is judged 'not sound' according to two of this review's criteria for the soundness of outcome evaluation study methods: therefore the results are deemed unreliable. Taking this into account with the relevance and appropriateness to the review question, the results provide only medium to low weight of evidence for the review.

Because all three of the above trials are judged 'not sound' methodologically, it is not possible to give them more than medium to low weight evidence for drawing conclusions on the impact of networked ICT on literacy learning.

Pre- and post-test studies

Peyton (1991), Clouse (1992), Erickson (1992) and Garner, Tan and Zhao (2000) are all outcome evaluations, using a pre- and post-test or a post-test design. Such designs are less able to answer questions of effectiveness. There are also shortcomings in the reporting of study methods for each of these studies.

Peyton (1991) is the most useful as far as the present study is concerned. It explores the use of a local area network within a classroom for written real-time communication with students who have hearing problems and other learning difficulties. The hypotheses generated by the research from the Electronic Networks for Interaction (ENFI) Project – a wider project referred to in the 1991 paper – are that all writing does not have to consist of extended, autonomous text; that writing does not have to grow from signed or oral communication; and that a small amount of writing can serve as a starting point for communication in speech and other media. A range of outcomes is reported, some attitudinal: "students were more motivated and willing to write"; and others more skills-based: "They have begun to initiate topics, maintain and elaborate on topics, request and provide clarification, ask and respond appropriately to questions, and write increasingly sophisticated and complex English".

These findings have some strength as illustrations or supporting evidence for the hypotheses of propositions generated from previous research such as the ENFI project. The study is suggestive of the capacity of ENFI to motivate deaf

students to write and raise the possibility that immediate guided practice can facilitate engagement with tasks and satisfaction with learning tasks. Although the study appears to be a pre-test and post-test outcome evaluation, there is no stated research question and no clear indication of the nature of the pre- and post-tests. The genre in which the article is written may conspire against the explicit elaboration of method; but the lack of explicitness means that we take the results on trust.

The aim of the research reported in **Clouse** (1992) was to establish whether US grade 1–4 students using a Teaching and Learning with Computers system and following the Jostens reading, writing and math curriculum for K-4 made gains in main skills and selected sub-skill areas. Although the authors report that the greatest absolute gains are reported as being made by Grade 1 students (a 23.4% gain for reading), methodological weaknesses in the study make it impossible to draw conclusions about the impact of ICT on literacy learning. A large-scale study compared to national norms could have indicated what sort of learners gain what sort of benefit from ICT support in language skills. However, the sample size is not reported; there are no details of who was included or excluded from the sample; no indication of the composition of the sample, or whether special needs students were included; no baseline data are reported; and other shortcomings as listed in the results table (Appendix C).

Erickson *et al.* (1992) examined the independent home behaviours of fourth-graders on a network in terms of online choices of videotext. They report that students did use online programmes over the summer vacation and that the usage peaked at an average rate which exceeded that observed in the latter part of the previous term. The authors claim that some programmes were preferred (on average) over others. However, the study is poorly designed and carried out and as such provides limited evidence that elementary school students in socially-disadvantaged circumstances might be motivated to engage in literacy-related work online from home during the summer vacation. The data could have provided evidence for a detailed retrospective analysis, but the study worked exclusively with average figures for time spent online and for programs preferred by the participants. As a result, it is impossible to tell whether the figures indicating increased time online in the vacation compared with term-time are evidence of general increase in usage across the whole sample, or the result of intensive usage by a small sub-sample. Similarly, the extent to which some programmes were preferred to others by individuals as opposed to the whole group is impossible to tell. There is no evaluation of the impact on literacy or of wider benefits, and no examination of the quality of time spent online or with videotext programs.

The broad aim of the study by **Garner, Tan and Zhao** (2000) is to try to determine whether writing on networked computers in an out-of-school environment can motivate young people to write more freely than within school. The authors use not-very-clearly defined measures of student behaviour to conclude that students taking part in an on-line newsletter in the out-of-school environment appear to have written as if they were in school; and they see the failure rate (50%) on completion of writing assignments as indication of such a response from the students. However, the data presented do not substantiate the conclusions presented in the abstract (that it was mainly the adult audience that was unmotivating for the children) though this could have been one of the reasons. The study has no control group and does not report pre-intervention data; the post-intervention data are not presented

for all individuals, nor for all outcomes. There is an insufficiently detailed description of the context, intervention or the outcomes of the study, which seems poorly focused overall.

These four studies have high relevance to the outcome question in the review, but do not use the most appropriate research design, and have methodological problems which mean that they can only provide medium to low weight of evidence for this question.

6.3.2 Impact on process

There are seven process evaluations in the in-depth review, from which the study by Love (1998) carries the highest weight, and those studies by Morgan (1997), Bigum, Lankshear *et al.* (1997) and Ewing (2000) carry medium weight.

In the studies by Ewing (2000) and Morgan (1997), there are projections from available data – a process of hypothesis-forming about practice as well as questions raised about how best to move forward research in the field.

'Enhancement of online and offline student learning' by **Ewing** looks at a range of views about using ICT in support of learning and postulates a model for ICT in support of learning. Its focus is not only on literacy learning. The study takes a constructivist approach to the enhancement of learning and, because constructivism (in the wake of Vygotsky, e.g. 1986) assumes communication is at the heart of a social, collaborative learning process, literacy learning is central to the process. While collaborative learning, it is suggested, requires enhanced literacy skills in speaking and listening, there are implications for reading and writing on screen (both online and offline). A useful distinction is made in the study between network literacy skills and computer literacy skills (see OECD 2001). Network literacy skills include "accessing and creating resources and communication with others" (p. 212). The study proceeds by evaluating data from three projects in the light of a composite model for ICT in support of learning. The other most significant elements of the model for the purposes of the present study are that:

- Computer-based learning must include electronic mail and conferencing facilities.
- The computer learning environment should provide opportunities for student activities other than word-processing.
- Student use of hard copies of electronic learning material may be the preferred approach offline.

For a full account of the model, readers are recommended to consult the original paper. Methodological issues arising from the study are the fact that the emerging model is based on qualitative research outcomes and that the data is used to illuminate the model. Ewing suggests that data from the three projects on which he draws to illuminate the emerging model of online and offline computer enhancement of learning is qualitative and needs to be balanced by quantitative data. There is, however, no detailed account of how the qualitative data is gathered and analysed. As in the Peyton (1991) study, data are quoted in support of an emerging hypothesis; there is no questioning of the hypothesis by the data. The implications, which are fully accepted by the author, are that further development of the model in the light of new data,

and in due course a testing of the model/hypothesis in a wider number of contexts, are required.

The study by **Morgan** (1997) is based on a keynote address to a Teacher Refresher Course Conference in New Zealand in January 1997. The research is part of a larger project, reported in Bigum, Lankshear *et al.* (1997) – also part of the present in-depth review – and takes the form of 'snapshots' of practice at the interface of technology and literacy education. The examples on which the report is focused come from the BushNet project in northern Queensland, a series of linked websites between rural schools. These examples are used to suggest implications for our understanding of the relationship between literacy, networked technologies and education; to suggest that we need critical frames with which to make sense of new literacies; and to suggest that 'empowerment' and 'ownership' are essential for young people who are engaged with these new literacies. The issues arising from Morgan (1997) are different. This is a print version of a keynote address and also part of a larger study. The genre of the keynote address requires communication with a wide audience and an emphasis on clearly definable 'snapshots' of practice, from which speculations and inferences are made. There is very little reflection on the processes of data collection, or of research in the field of digital rhetoric or new literacies. However, the study raises important issues: how to capture the richness behind the 'snapshots'; how instances of practice, such as those described in the study, can be translated in other contexts; what kinds of research can best investigate those practices; and how to convey the excitement of such practices to other practitioners, students, researchers and others interested in the interface of technology and literacy. A further point is that research that is reported in genres like keynote addresses may well not reveal its processes as explicitly as research reported in research-oriented journals. The question of *audience* is thus an important one arising from a reading of this particular study.

The *Digital Rhetorics* project is of a different order form the other three small-scale studies discussed in this section. It was a large-scale government-funded project which, as has already been suggested, used a non-intervention methodology to record and comment on innovation at the interface of networked technologies and literacy/literacies. The empirical studies are carefully designed and executed, following a standard template which builds up snapshots and commentaries via a 'grounded theory' approach. Theoretical models of the relationship between ICT and literacies are derived from previous research and from the case studies described in the report. Just as the overarching paradigm in which the investigation operates is one which assumes a symbiotic relationship between literacy and technology, so too the research methodology operates via a to-and-fro oscillation between described practice and theory-making.

While Morgan's focus is on the processes of implementing initiatives like BushNet, the larger study (**Bigum, Lankshear *et al.*** 1997) from which her study is derived is more of an evaluative/descriptive study. It does not set out to test a hypothesis, nor attempt to intervene in ongoing practice or measure effect. The project is driven more by a notion of a symbiotic relationship between new technologies and literacy development, rather than by a scientific or causal paradigm. As such, it does not seek to deliver 'results'; rather, to shed light on current practice, to suggest implications for future practice and to inform further policy-making in the field.

The aim of the study is to investigate relationships between literacy and technology, as well as to explore the impact of technology on the nature, definition and views of literacy. Through a study of a wide range of types of educational institution, of children's ages and geographical and socio-economic settings, the project generates a general theory of literacy learning as promoted by ICT; this includes a notion of dynamic text, extended meta-knowledge of literacy, new genres, and new audiences and presentational opportunities online. It provides and tests a model of patterns and principles to explain why, how and in what contexts new technologies work or are impeded from working; and also provides empirical evidence in support of its emerging theory. In its kaleidoscopic form, it operates via snapshots of current practice plus commentaries which shape the principles and patterns of emerging theory. It therefore operates via a 'grounded theory' approach.

The other process studies are all intervention descriptions with a degree of evaluation. Where evaluation does take place, it is often embodied in the description or is implicit.

The study by **Love** (1998) considers how English teachers are using computers in their classrooms and how they are being helped to integrate computer technology into their teaching. It takes the form of reflections on a student teacher's experience of the interventions she made in teaching English to secondary school pupils in Melbourne. She finds that while 'young cyborgs' have a wide range of technological experience, there is unevenness in terms of their conceptual and technical expertise that needs to be addressed; and that teachers need to help students to develop a critical as well as an appreciative approach to electronic texts. Case studies of this kind can suggest possible impacts and/or clarify the research questions that need to be asked in the field. They can also shed light on received assumptions, emerging hypotheses or quantitative results. As Appendix C details, methodological reporting is relatively strong for this study and the methods described appear appropriate.

The study by **McNamee** (1995) illustrates how hybridity in online genres is a resource for building collaboration and promoting literacy learning through the work of an adult mentor and a child. It provides evidence, qualitatively analysed, on the benefits of online mentoring for literacy learning; and suggests that hybrid literacy practices improve writing in terms of its variety, complexity of grammatical structure, adaptability to context and genre, and ability to incorporate aspects of bilingual competence into email exchanges; and that roles of positioning (the adult mentor plays the role of online 'wizard') are important in this process. The aim of the McNamee study was to discover what the effects were of telecommunications opportunities on children's writing development in an after-school computer club (also see Garner, Tan and Zhao, 2000). Findings are based on small-scale case study evidence and suggest a growth in confidence and communicative ability of the child in question over the year of the study. There is also a suggested growth in the confidence of the mentor, an African-American community worker operating under the supervision of a university-devised scheme; and – while not strictly within the parameters of the present study – a transformation in the ability of the community workers to manage the communicative tools and forms of language for the benefit of their children (e.g. an assertion of the need to incorporate African-American forms of English into the email exchanges). However, our cautious use of 'suggested' as a qualifier to the reported findings (not 'results') indicates that the claims are not all fully supported by evidence.

The study by **McKeon and Burkey** (1998) describes "the nature of an email collaborative between pre-service teachers and 4th and 5th graders in which literature was used as a vehicle for language and reading enhancement". The authors claim that "the motivation for the project was evident" (p. 90) and that parents were impressed with "the students' increased interest in reading and purposeful computer usage" (ibid). Furthermore, "the elementary students had the opportunity to enhance their critical reading and social skills using the computer, while pre-service teachers developed their teaching and communication skills" (p. 91). However, due to a lack of reporting of study methods, the evidence for all these claims is thin, as it is for enhanced reading and social skills.

Finally, the purpose of the research by **Stuhlmann and Taylor** (1998) is to look at the impact of telecommunications on learning outcomes in elementary classrooms. It provides limited evidence on the literacy benefits of networked exchanges between students in different schools and of 'success factors', assuming the reported success to be the case. The authors claim that (a) students became involved in complex learning and that (b) the self-esteem of many children was increased; furthermore, (c) motivation increased, as did use of email for third graders. The enthusiasm of the teachers was noted as a critical success factor and other factors were seen as significant: the provision of training, the close monitoring of the project and a limited timeframe to keep the project fresh and dynamic. As these factors are described, the impact of ICT on literacy learning is implied, possibly through the anonymity provided by email exchanges as a communicative element in the project as a whole. However, there are problems with this study's reporting of context, sample, data collection and analysis, making the strength of this evidence relatively weak.

6.3.3 Other study types

There is one other study in the in-depth review: that of **Collins** (1993). This is essentially a needs assessment study of English teachers in secondary schools in Belfast, through whose views we access information about the use of computers by 11–16 year old pupils for the purposes of extending the range of their writing practices. There is a suggestion that word-processing was still the predominant use of the computer in secondary English classrooms in the city – in 1993 at least – with 75% of respondents reporting such a perception. Under half of the teachers in the sample believed that email and computer conferencing could be used to develop writing skills, although two-thirds at that time had access to computers. On the basis of these perceptions, the author proposes a need for in-service training in email and computer conferencing, if ICT is to fulfil its potential in secondary English classes. Because the methodological approach is relatively weak, however, these results have to be taken as provisional; there is insufficient evidence to justify the claims, so it is hard to determine the relationship between data and conclusions. The study has broad aims which are difficult to match to the study's methods. The abstract refers to an investigation of teacher concerns, but a later statement refers solely to an investigation of the extent of teacher use of ICT. There is no socio-demographic information about the respondents, which is particularly problematic in the light of the low response rate (35%, resulting in 16 responses from 45 schools). Overall, the relevance and appropriateness of this study to the review question are of medium weight and there are methodological problems, which mean that the study provided low to medium weight of evidence.

7. DISCUSSION

The study has identified 188 papers published since 1990 which examine the impact of ICT on literacy learning in English for 5–16 year olds. Most of these originate from the USA, though a significant minority arise from research in the UK, Canada, Australia and New Zealand. Of the total, over 60% are set in primary/elementary schools (especially in the 7-11 age range), with about 44% set in secondary/high schools (some studies were conducted in both types of setting). About two-thirds of the papers assume a psychological representation of literacy, with a third adopting a sociological conception of the practice. Of the 188 studies, 57% are focussed on writing, graphical or pictorial production, whereas 46% have an interest in reading (again, studies could have more than one focus).

It is not surprising that the papers originate largely from countries where English is the principal language, given the parameters of the study; nor it is surprising that most of the research projects on which the papers are based are set in primary schools, where it is possible to study the impact of ICT across the curriculum more easily than in secondary schools – and where there are more easily identifiable outcomes in terms of an impact on emerging literacy capabilities. What might be surprising to some readers is that two-thirds of the papers assume a psychological model of literacy, i.e. that the development of literacy is a matter of individual, interior processes rather than being shaped and acquired socially. We see the problem here as one of the researchers' received assumptions, rather than with practices currently underway in the classroom or at home. The social construction of literacy development has been accepted for at least a generation and has, among other influences, given rise to the notion of 'literacies', to the importance of interaction (between computer and learner, teacher and learner, learner and learner) and to the symbiotic model of the relationship between technology and literacy development. It may be the case that the majority of researchers interested in the topic of the impact of ICT on literacy learning from 1990 to the present have been unaware of contemporary theories of literacy development.

There is one further point to make about the mapping stage of the study. The range of papers identified within the field of ICT/literacy is large, ranging from those focusing on composition, word-processing and writing on the one hand to visual design, multimodality and moving image on the other; from reading, dyslexia and spelling to studies of literature. Although our focus was limited to 'reading' and 'writing' in their broadest senses, it is probably true to say that there is no aspect of literacy learning or 'English' as a school subject that has not been touched by ICT.

As far as the in-depth study on *networked* ICT goes, results are inconclusive. Overall, few of the studies in the in-depth review provide any firm basis for accepting their findings and therefore can have little bearing on the answering of the main research question for the in-depth review. Nevertheless, two studies provide theoretical and practical insights into widening conceptions of literacy; five suggest increased motivation and/or confidence in pupils as a result of ICT use with regard to literacy development; and one sees empowerment and ownership as an important factor to bear in mind in an

increasingly diverse digital world. In general, these studies assume that a positive impact is made on literacy development by networked ICT, and explore *how* that impact is made; in most of the studies, the conception of literacy is narrow, based on pre-digital notions of reading and writing. The results are suggestive rather than conclusive.

How reliable is the methodology by which we have come to the above results? The strengths of the systematic literature review approach are that it is what it says it is: a *systematic* secondary *review* of existing *literature* on the topic. These strengths are characterized by stringent attempts to minimize bias at every stage of the process: via peer review, multi-rater reliability and a team-based approach. There are papers we would have included but did not, because we stuck closely to the parameters of our initial protocol. The whole process is transparent and subject to replication.

But there are also several weaknesses in the overall approach and in the design of this particular study, which we are willing to acknowledge. First, by asking a research question on the *impact* of *x* on *y*, we have assumed a causal paradigm. Had we fully wished to operate within such a paradigm, we might have been better asking what was the *effect* of *x* on *y*. Using the term 'impact' gave us the scope to look at the wider influence of ICT on literacy learning, but at the same time made it more difficult for us to contain the study.

Second, the methodological apparatus is still at an early stage of development as far as education research is concerned. Its current weakness is that it is unable to deal with qualitative research outcomes as well as it can with quantitative outcomes. There is a tendency to see the results of larger trials as giving more substantial research evidence that those of case studies or small-scale investigations. Nevertheless, the application of such a methodology has shed light on the strengths and weaknesses of both 'outcome evaluations' and 'process evaluations', thus enabling a more productive commerce between the two. One of the strengths of the current review is that it has managed to keep an open mind and a balanced perspective on a range of study types that might help it to answer its principal research question.

Third, there will be, inevitably, lacunae in the research. Although we have tried to be as comprehensive as possible in our pursuit of sources, we will have missed some important papers. The publication of the present report allows us to reveal what we have found to date and to invite respondents to send us papers which we have missed.

In the opening section on the background to the present study, we noted that most of the papers we have unearthed seem to assume a similar conceptual framework to that of the present study, namely one which sees literacy learning practices at home and at school being affected by changing information and communication technologies. We are aware that our contribution to the wider question of the symbiotic relationship between ICT and literacy development is a partial one; we hope, nevertheless, as a ground-clearing exercise, it is a useful one.

There remain many unanswered questions: these are detailed in Chapter 8 (section 8.3) in our recommendations for further research.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusion

The answer to the research question for the in-depth review – What is the impact of networked ICT on 5-16 year olds' literacy in English? – is inconclusive and patchy because there is insufficient research of high quality.

Many of the studies focus on the primary/elementary school sector, with at least four studies concentrating on 4th/5th graders (i.e. 9-10 year olds). Three of the studies look at out-of-school activities and only two (and both indirectly) turn their attention to the impact of ICT on literacy at secondary or high school level. The principal areas of interest for the studies are reading and writing, but those twin aspects of literacy are often narrowly conceived, so that we are looking at the impact of new technologies on old practices rather than at the symbiosis between new technologies and new forms of literacy. Four of the studies look at word-processing; two at new conceptions of literacy; and one each on speaking and listening, and on special educational needs.

In general, as suggested above, conceptions of literacy are narrow. Many of the studies show how an impact can be made rather than whether it is made. They tend to show how ICT can help in terms of 'exchange of information' rather than in the quality of writing or comprehension or some other aspect of literacy; as such, they highlight a practice that ICT has made more accessible to children and young people.

Overall, 11 of the studies in the in-depth review provide no firm basis (i.e. less than a medium weight of evidence) for accepting their findings and can therefore have little bearing on the answering of the main research question for the in-depth review. Of the remainder, two provide theoretical and practical insights into widening conceptions of literacy; others suggest increased motivation and/or confidence in pupils as a result of ICT use with regard to literacy development; and one sees empowerment and ownership as important factors to bear in mind in an increasingly diverse digital world.

Methodologically, there is a wide variety of study types in the in-depth review, characteristic of education research in general but not reflective of the types of study found in the overall study on the impact of ICT on literacy learning – the majority of which, unsurprisingly, are outcome evaluations. The range of study types in the in-depth review on the impact of *networked* ICT on literacy learning makes synthesis difficult. Meta-analysis of the outcome evaluations was not possible because (a) only one of the studies with quantitative outcomes was judged to be methodologically sound and (b) the studies were heterogeneous. The synthesis was therefore narrative in nature.

Virtually all the studies (14) were of high relevance to the review questions. In addition, two used a highly appropriate study type to address the review question (whether it was to evaluate outcomes, processes or needs) and the remainder could be given medium weight for appropriateness. However, seven of the eight outcome evaluations were judged poor or weak in design and/or execution and/or reporting. The remaining study was methodologically 'borderline' in terms of robustness, so its results should be treated with

caution. Nevertheless, it did indicate that using a network system which allowed teachers to respond immediately to the comprehension levels of their class was beneficial. There is no good evidence from the outcome evaluations that the widespread use of network technologies will lead to an improvement in children's literacy; however, this does not mean that there is no impact. Although four of the studies provided at least medium weight of evidence for addressing 'process' questions, their findings were also suggestive rather than conclusive.

8.2 Recommendations for policy and practice

We ought to speak more in terms of implications for policy and practice arising from the present study, rather than of firm recommendations at this interim stage in the review. There is still much work to do on other aspects of the impact of ICT on literacy learning – much of which will be completed within the forthcoming year. Nevertheless, there are pointers for policy and practice, which are outlined below.

8.2.1 Policy

- More needs to be done to focus research funding for large-scale studies.
- There needs to be consideration given to the balance of study-type expertise in research teams.
- The provision of computer hardware and software to schools, and the application of ICT in teaching and learning, needs to be informed by research and evaluation.

8.2.2 Practice

- More attention needs to be given to the ways in which ICT is used in the classroom in support of teaching.
- Teachers need to take more account of the ways in which young people work at home on computers.
- ICT needs to be seen as one tool among many for the improvement and support of literacy learning.

8.3 Recommendations for future research

Whereas our recommendations for policy and practice are tentative at this stage in the systematic reviewing of literature, our recommendations for research are more assured.

At the end of our report on the first year of reviewing the interface between ICT and literacy/literacies, we offer here a table that sets out areas for future research. Our belief is that each of the areas has only just begun to be examined. Although we have pointed out shortcomings, as we see them, in many of the studies we have examined, we also wish to acknowledge that each of the studies in the in-depth review has indicated (sometimes indirectly) new areas for research.

Table 11 shows where work has been undertaken and where there are gaps. It provides a map of where future research on the impact of networked ICT on literacy learning might take place.

Table 11: Gaps in research

Aspects of ICT→ Aspects of literacy↓	Computer-mediated networked systems	Wider conceptions of information and communication technology	Email, conferencing and the internet	Software systems	Video text
Word-processing	Allen, Thompson (1995)	Love (1998) McNamee (1995)	Collins (1993)		
New literacies		Bigum, Lankshear *et al.* (1997) Morgan (1997)			
Writing skills	Garner, Tan, Zhao (2000) Spauldin, Lake (1992)		Collins (1993)	Clouse (1992) Moore, Karabenick (1992)	
Reading skills		Love (1998)	McKeon, Burkey (1998), Stuhlmann, Taylor (1998)	Clouse (1992) Golden *et al.* (1990)	
Videotext					Erickson *et al.* (1992)
Speaking and listening		Ewing (2000)			
Hybridity					
Special needs	Peyton (1991)				
Moving image					
Other aspects					

There is a need for research in a range of study types. We need large scale RCTs in order to gauge effect. The study by Golden *et al.* provided evidence that using network technology that allowed immediate feedback to the teacher was associated with quite large effect sizes. The study, however, did have a number of key methodological flaws, which need addressing in larger randomised trials. We recommend that the Golden *et al.* experiment be repeated with a larger sample of pupils and teachers.

We also recommend that a series of small pilot trials be undertaken to evaluate other uses for network technology with a view to informing the design of large pragmatic trials. Given the paucity of experimental data, more randomised trials are needed.

We also need more research with qualitative outcomes. Small-scale studies (e.g. evaluated case studies) are needed as they are able to provide multi-factor analyses of the use of ICT in literacy teaching and learning. Because the field of research in ICT applications is young, there is also a need for more process evaluations.

There is a need for a large-scale longitudinal study, focused on literacy development, to complement the work currently being undertaken by the ImpaCT2 project, mentioned in Chapter 1.

Furthermore, more work needs to be done on the compatibility of results from quantitative and qualitative research in education.

Even though we have limited the period of review to studies since 1990, many of the earlier studies will be outdated, describing ICT arrangements that are no longer typical. We expect to update the review to take account of recent research and, importantly, of research we have missed in the current review. We welcome correspondence that will help us improve the quality and range of our study, both with regard to the present in-depth review on the impact of ICT on literacy learning which focuses on *networked* ICT, and for the rest of the study in the wider field of ICT and literacy.

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Nicolson RI, Fawcett AJ, Nicolson MK (2000) Evaluation of a computer-based reading intervention in infant and junior schools. *Journal of Research in Reading* 23(2): 194-209

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Olson RK, *et al.* (1997) Computer-based remedial training in phoneme awareness and phonological decoding: effects on the posttraining development of word recognition *Scientific Studies of Reading* 1(3): 235-253

Owston RD, *et al.* (1991) On and off computer writing of eighth grade students experienced in word processing. *Computers in the Schools* 8(4): 67-87

Owston RD, Murphy S, Wideman HH (1992) The effects of word-processing on students writing quality and revision strategies. *Research in the Teaching of English* 26(3): 249-276

Owston RD, Wideman HH (1997) Word processors and children's writing in a high-computer-access setting. *Journal of Research in Computing in Education* 30(2): 202-220

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Parker D (1999) You've read the book, now make the film: moving image media, print literacy and narrative. *English in Education* 33(1): 24-35

Parr JM (1997) Computer assisted learning with an integrated learning system: Another front for raising literacy and numeracy amongst secondary students*? New Zealand Journal of Educational Studies* 32(1): 37-51

Peterson SE (1993) A comparison of student revisions when composing with pen and paper versus word-processing. *Computers in the Schools* 9(4): 55-69

Peyton JK (1991) Electronic communication for developing the literacy skills of elementary school students: the case of ENFI. *Teaching English to Deaf & Second Language Students* 9(2): 4-9

Potter L, Small J (1998) Utilizing computers for reading improvement in a junior high: a case study. *International Journal of Instructional Media* 25(4): 383-387

Rauenbusch F, Bereiter C (1991) Making reading more difficult: a degraded text microworld for teaching reading comprehension strategies. *Cognition and Instruction* 8(2): 181-206

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Reinking D, Watkins J (2000) A formative experiment investigating the use of multimedia book reviews to increase elementary students' independent reading. *Reading Research Quarterly* 35(3): 384-419

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Roberts GC, Mutter G (1991) A celebration of literacy: computer-assisted writing in the St. James-Assiniboia School Division No.2. How It Started and How It Works. *Education Canada* 31(2): 4-7

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Rosenbluth GS, Reed WM (1992) The effects of writing-process-based instruction and word processing on remedial and accelerated 11th graders. *Computers in Human Behavior* 8(1): 71-95

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Russell G (1998) Elements and implications of a hypertext pedagogy. *Computers & Education* 31(2): 185-193

Russell G (1998) Hypertext stories: a radical transformation in English pedagogy? *English in Australia* 121

Seawel L, *et al.* (1994) A descriptive study comparing computer-based word processing and handwriting on attitudes and performance of third and fourth grade students involved in a program based on a process approach to writing. *Journal of Computing in Childhood Education* 5(1): 43-59

Sharples M, Evans M (1991) Computer support for the development of writing abilities. *Instructional Science.* 21(1-3) 99-108

Shaw EL, Nauman AK, Burson D (1994) Comparisons of spontaneous and word processed compositions in elementary classrooms: a three-year study. *Journal of Computing in Childhood Education* 5(3-4): 319-327

Shears L (1998) Of value to you: the results of a school-based study into the use of laptop computers in schools. Set Special. *Technology* 10

Silver NW, Repa JT (1993) The effect of word processing on the quality of writing and self-esteem of secondary school English-as-second-language students: writing without censure. *Journal of Educational Computing Research* 9(2): 265-283

Sinatra R, *et al.* (1994) Using a computer-based semantic mapping, reading and writing approach with at-risk fourth graders. *Journal of Computing in Childhood Education* 5(1): 93-112

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Steelman JD (1994) Revision strategies employed by middle level students using computers. *Journal of Educational Computing Research* 11(2): 141-152

Steg DR, *et al.* (1994) A cybernetic approach to early education. *Journal of Educational Computing Research* 10(1): 1-27

Stevens KB, Blackhurst AE, Slaton DB (1991) Teaching memorized spelling with a microcomputer: time delay and computer-assisted instruction. *Journal of Applied Behavior Analysis* 24(1): 153-160

Stoddard B, MacArthur CA (1993) A peer editor strategy: guiding learning-disabled students in response and revision. *Research in the Teaching of English* 27(1): 76-103

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Swanson HL, Trahan MF (1992) Learning disabled readers' comprehension of computer mediated text: the influence of working memory, metacognition and attribution. *Learning Disabilities Research and Practice* 7(2): 74-86

Tjus, T, Heimann M, Nelson KE (1998) Gains in literacy through the use of a specially developed multimedia computer strategy. *Autism* 2(2): 139-156

Topping, K.J (1997) Family electronic literacy: Part 1 - Home-school links through audiotaped books. *Reading* 31(2): 7-11

Underwood J (1996) Are integrated learning systems effective learning support tools? *Computers and Education* 26: 1-3

Underwood JDM (2000) A comparison of two types of computer support for reading development. *Journal of Research in Reading* 23(2): 136-148

Utay C, Utay J (1997) Peer-assisted learning: the effects of cooperative learning and cross-age peer tutoring with word processing on writing skills of students with learning disabilities. *Journal of Computing in Childhood Education* 8(2-3): 165-185

Van Haalen T, Bright GW (1993) Writing and revising by bilingual students in traditional and word processing environments. *Journal of Educational Computing Research* 9(3): 313-328

Vaughn S, Schumm JS, Gordon J (1992) Early spelling acquisition: does writing really beat the computer? *Learning Disability Quarterly* 15(3): 223-228

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Vollands SR, Topping KJ, Evans RM (1999) Computerized self-assessment of reading comprehension with the accelerated reader: action research. *Reading and Writing Quarterly: Overcoming Learning Difficulties* 15(3): 197-211

Walker SA, Pilkington RM (2000*) Computer-mediated communication in the development of writing skills.* Computer Based Learning Unit, University of Leeds

Weller LD, Carpenter S, Holmes CT (1998) Achievement gains of low-achieving students using computer-assisted vs regular instruction. *Psychological Reports* 83(3, Pt 1): 834

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Wild M, Ing J (1994) An investigation into the use of a concept keyboard as a computer-related device to improve the structure of young children's writing. *Journal of Computing in Childhood Education* 5(3/4): 299-309

Wild M (1997) Using CD-Rom storybooks to encourage reading development. Set special. *Language and Literacy* 6: 1-4

Wise BW, Olson RK (1992) How poor readers and spellers use interactive speech in a computerized spelling program. *Reading and Writing* 4(2): 145-163

Wise BW, Olson RK (1995) Computer-based phonological awareness and reading instruction. *Annals of Dyslexia* 45: 99-122

Wise BW, *et al.*(1998) Interactive computer support for improving phonological skills. In Metsala JL, Ehri LC (eds) *Word recognition in beginning literacy*: 189, 208Mahwah, New Jersey, US: Lawrence Erlbaum Associates Inc.

Wise BW, Ring J, Olson RK (1999) Training phonological awareness with and without explicit attention to articulation. *Journal of Experimental Child Psychology* 72(4): 271-304

Wise BW, Ring J, Olson RK (2000) Individual differences in gains from computer-assisted remedial reading. *Journal of Experimental Child Psychology* 77(3): 197-235

Wishart E (1994) Using a TTNS electronic mailbox in a junior class: a case study. In Wray D (ed) *Literacy and computers: insights from research*: 23-30. United Kingdom Reading Association

Wolfe EW, *et al.* (1996) A study of word processing experience and its effects on student essay writing. *Journal of Educational Computing Research* 14(3): 269-284

Zammuner VL (1995) Individual and cooperative computer-writing and revising: who gets the best results? *Learning and Instruction* 5(2): 101-124

Zellermayer M, *et al.* (1991) Enhancing writing-related metacognitions through a computerized writing partner. *American Educational Research Journal* 28(2): 373-391

Zhang Y, *et al.* (1995) Quality of writing by elementary students with learning disabilities. *Multimedia Today* 3(4): 30-39.

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Allen G, Thompson A (1995) Analysis of the effect of networking on computer-assisted collaborative writing in a fifth grade classroom. *Journal of Educational Computing Research* 12(1): 65-75

Bigum C, Lankshear C, Green B, Honan E, Morgan W, Murray J, Snyder I, Wild M (1997) *Digital rhetorics: literacies and technologies in education - current practices and future directions.* Australia: Queensland University. 26

Clouse RW (1992) Teaching and learning with computers: a classroom analysis. *Journal of Educational Technology Systems* 20(4): 281-302

Collins J (1993) Beyond the word processor: computer-mediated communication with pupils and teachers. *Computer Education*. 73(93): 13-17

Erickson B, *et al.* (1992) Telecommunications promotes summer reading and writing: a pilot project report. *Journal of Computing in Childhood Education* 3(3): 295-302

Ewing J (2000) Enhancement of online and offline student learning. *Education Media International* 37(4): 205-217

Garner R, Tan S, Zhao Y (2000) Why write? *Computers in Human Behavior* 16(3): 339-347

Golden N, Gersten R, Woodward J (1990) Effectiveness of guided practice during remedial reading instruction: an application of computer-managed instruction. *Elementary School Journal* 90(3): 291-304

Love K (1998) Old cyborgs, young cyborgs (and those in between). *English in Australia* 121: 63-75

McKeon CA, Burkey LC (1998) A literature based e-mail collaborative. In Sturtevant EG, Dugan J (eds) *Literacy and community: the twentieth yearbook - a peer reviewed publication of the College Reading Association*: 84-93 Carrollton, GA, US: College Reading Association

McNamee GD (1995) A Vygotskian perspective on literacy development. *School Psychology International* 16(2): 185-198

Moore MA, Karabenick SA (1992) The effects of computer communications on the reading and writing performance of fifth-grade students. *Computers in Human Behavior* 8(1): 27-38

Morgan W (1997) From the margins to the centre: schools on line. *English in Aotearoa:* 4-11

Peyton JK (1991) Electronic Communication for Developing the Literacy Skills of Elementary School Students: The Case of ENFI. *Teaching English to Deaf & Second Language Students* 9(2): 4-9

Spaulding CL, Lake D (1992) Interactive effects of computer network and student characteristics on students' writing and collaborating. *High School Journal* 76(1): 67-77

Stuhlmann JM, Taylor HG (1998) Analyzing the impact of telecommunications on learning outcomes in elementary classrooms*. Journal of Computing in Childhood Education* 9(1): 79-92.

9.3 Excluded studies

The 1683 studies excluded from the systematic review are listed on the EPPI-Centre's English Review Group website (http://eppi.ioe.ac.uk/review_groups/english_home.htm) where reasons are given for their exclusion.

9.4 Others (background for the current report)

Abbott C (2001) Some young male website owners. Paper given at BFI colloquium, BECTa, Coventry, January 2000. *Education, Communication, Information* 1(2)

Andrews R (2000) Learning, literacy and ICT: what's the connection? *English in Education* 34(3)

Andrews R (2001) *Teaching and Learning English: a guide to recent research and its applications.* London: Continuum

BECTa (2001a) A survey of the research literature relating to the use of ICT and key stage 2 in English, mathematics and science. Unpublished report.

BECTa (2001b) *Building an ICT research network: helping to create schools of the future.* Report on a conference hosted by BECTa, 15 June 2001, Barbican Centre, London. Coventry: BECTa

BECTa (2002) *Connecting schools, networking people: ICT practice, planning and procurement for the national grid for learning.* Coventry: BECTa

Bigum C, Lankshear C, Green B, Honan E, Morgan W, Murray J, Snyder I, Wild M (1997) *Digital rhetorics: literacies and technologies in education - current practices and future directions.* Australia: Queensland University. 26

Burn A (1999a) Digiteens: media literacies and digital technologies in the secondary classroom. *English in Education* 33(3)

Burn A (1999b) Grabbing the werewolf: digital freezeframes, the cinematic still and technologies of the social. *Convergence* 3(4)

Burn A, Parker S (2001) Making your mark: digital inscription, animation and a new visual semiotic. *Education, Communication, Information* 1(2)

Cox R, Brna P (1993) Analytical reasoning with external representations. *University of Edinburgh*: Department of Artificial Intelligence research paper RP636 Department for Education and Employment (1999) *The National Curriculum for England.* London: DfEE and Qualifications and Curriculum Authority

Department for Education and Skills (2001) *ImpaCT2: emerging findings from the evaluation of the impact of information and communications technologies on pupil attainment (National Grid for Learning Research and Evaluation series).* London: DfES

EPPI-Centre (2001a) *Core keywording strategy: data collection for a register of educational research, version 0.9.4.* London: EPPI-Centre, Social Science Research Unit

EPPI-Centre (2001b) *Review Guidelines for Extracting Data and Quality Assessing Primary Studies in Educational Research, Version 0.9.4.* London: EPPI-Centre, Social Science Research Unit

EPPI-Centre (2002) *Core keywording strategy: data collection for a register of educational research, version 0.9.5.* London: EPPI-Centre, Social Science Research Unit

Gamble N, Easingwood N (2000) (eds) *ICT and literacy: information and communications technology, media, reading and writing.* London: Continuum

Goodwyn A (2000) (ed) *English in the digital age.* London: Continuum

Haas, C (1996) *Writing technology: studies on the materiality of literacy*. Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

Hammersley M, Scarth J (1993) Beware of wise men bearing gifts: a case study in the misuse of educational research*. British Educational Research Journal* 19(5)

Kress G, van Leeuwen T (1996) *Reading images*. London: Routledge

Lanham R (1993) *The electronic word.* Chicago: Chicago University Press

Lankshear C, Snyder I (2000) *Teachers and techno-literacy*. St Leonards, New South Wales: Allen & Unwin

Leask M, Meadows J (eds) (200) *Teaching and learning with ICT in the primary school.* London: RoutledgeFalmer

Lewin *et al.* (2000) Promoting achievement: pupils, teachers and contexts. ImpaCT2, Preliminary study 2, April 2000

Loveless A, Ellis V (eds) (2001) *ICT, pedagogy and the curriculum*. London: RoutledgeFalmer

Loveless A, Dore B (eds) (2002) *ICT in the primary school*. Buckingham: Open University Press

McFarlane A *et al.* (2000) *Establishing the Relationship between Networked Technology and Attainment.* ImpacT2 project, preliminary study 1, April 2000

Mitchell S, Riddle M (2000) *Improving the Quality of Argument in Higher Education: final report.* London: Middlesex University School of Lifelong Learning and Education (Reports and Evaluations series)

Monteith M (ed) (2002) *Teaching Primary Literacy with ICT*. Buckingham: Open University Press

Moseley D, Higgins, S (1999) *Ways Forward with ICT: effective pedagogy using information and communications technology for literacy and numeracy in primary schools.* Newcastle: University of Newcastle

OECD (Organisation for Economic and Collaborative Development) (2000) *Schooling for tomorrow: learning to bridge the digital divide.* Paris: OECD

OECD (Organisation for Economic and Collaborative Development) (2001) *Review of Assessment Activities.* (OECD/INES/Network A newsletter, issue 14, November 2001) Paris: OECD

Peersman G, Oliver, S (1997) *EPPI-Centre Keywording strategy: data collection for the Bibliomap database.* London: EPPI-Centre, Social Science Research Unit

Raney K, *Visual Literacy: Issues and Debates.* London: Middlesex University School of Lifelong Learning and Education (Reports and Evaluations series), 1997

Smeaton R (2000) *Researching Education*. Swansea: University of Wales, Librarians in Schools of Education (LISE)

Snyder I (1996) *Hypertext*. Melbourne: University of Melbourne Press

Toulmin S (1958) *The use of argument*. London: Macmillan

Tweddle S (1997) A retrospective: 15 years of computers in English. *English in Education* 31(2): 5-12

Tyner K (1988) *Literacy in the digital age*. Mahwah, NJ: Lawrence Erlbaum Associates

Vygotsky L (1986) *Thought and Language.* Cambridge, MA: MIT Press

Werquin *et al.* (2000) *Literacy in the information age.* Paris: OECD

APPENDIX A: Search strategy

Search plan proforma
Searcher: Julie Glanville, NHS Centre for Reviews and Dissemination,
University of York
Start date: Monday, 21 May 2001

Subject: Impact of ICT on literacy learning 5-16

(Delete those which do not apply)

Condition	Literacy
Intervention	ICT
Outcomes	Literacy
Population	children aged 5-16
Study design	**Focus on** process evaluation; outcome evaluation; reviews But don't limit to.
Limits: Language	**English**
Limits: Date	no date limits (although nominally 1980 to date)

Search terms

Condition/outcome

Literacy near English
Literacies near English
Reading English
Writing English
Learning near English
Teaching near English
Dyslexia near English
(Read or reading) near (learn* or teach*)
learn* near (writing or write or spell or spelling)
teach* near (writing or write or spell or spelling)
reading disability

Intervention technology

ICT
Information and communication technology*
CAL
CAI
Networked technolog*
Computer*

Mobile phones
Multimodal communication technologies
IT
Digital media
Internet
Multimedia
cd-rom
hypertext
interface* and software

Population

Child or children
Infants
Teenagers
Pupils
Adolescents

1. Databases

1a. ERIC

ERIC was searched on 25/5/01 using the BIDS Ovid interface. The database was searched for the period 1985–April 2001 and 2,595 records were retrieved. The search sensitivity could be improved by the addition of more text words and by not restricting using the 'children' facet. Using the 'children' fact means that a record has to have a textword or indexing term capturing the idea of children/teenagers or the education of children/teenagers. It is quite possible to have records about ICT and literacy which don't mention children or schools in the abstract or indexing. However, improving the sensitivity of the search by omitting the 'children' facet will produce many false drops (about 5,000 additional records would need to be assessed).

The results of the search are in files erec1.txt to eric13.txt.

```
1       exp children/ or exp adolescents/
2       exp early adolescents/ or exp late adolescents/
3       exp preadolescents/ or exp secondary school students/
4       students/ or elementary school students/ or high risk
        students/
5       lower class students/ or middle class students/
6       middle school students/ or special needs students/
7       exp special schools/ or disadvantaged youth/
8       disadvantaged youth/ or exp early childhood education/
9       exp elementary education/ or exp british infant schools/
10      exp elementary schools/ or exp middle schools/
11      exp public schools/ or exp secondary schools/ or exp
        state schools/
12      or/1-11
13      exp computers/ or computer centers/ or computer games/
14      computer graphics/ or exp computer interfaces/ or
        computer managed instruction/
15      computer mediated communication/ or exp computer
        networks/ or exp computer software/
16      exp computer uses in education/ or exp expert systems/
17      hypermedia/ or gateway systems/ or information systems/
18      information technology/ or exp man machine systems/
19      multimedia materials/ or natural language processing/
```

```
20    exp optical disks/
21    "Screen design (computers)"/
22    telecommunications/ or virtual reality/ or workstations/
23    multimedia instruction/ or nonprint media/ or world wide
      web/ or internet/
24    or/13-23
25    12 and 24
26    literacy/ or exp functional literacy/ or exp reading/ or
      "writing (composition)"/
27    literacy education/ or exp reading skills/ or reading
      ability/
28    reading failure/ or reading habits/ or reading
      improvement/
29    exp reading instruction/ or basic writing/ or children's
      writing/
30    creative writing/ or descriptive writing/ or exp
      handwriting/
31    exp sentences/ or spelling/ or exp writing ability/
32    writing exercises/ or writing improvement/ or writing
      instruction/
33    sentence structure/ or syntax/ or alphabetizing skills/
34    or/26-33
35    25 and 34
36    *adult education/
37    *postsecondary education/ or exp *adults/
38    *adult learning/ or *adult literacy/
39    *adult learning/ or exp *adult programs/
40    *adult basic education/ or *workplace literacy/
41    or/36-40
42    35 not 41
43    limit 42 to english language
44    (computer$ adj3 (literacy or literacies)).mp.
      [mp=abstract, title, headings word, identifiers, full
      text]
45    (computer$ adj3 (read or reading or spell or spelling or
      write or writing or learn or learning)).mp. [mp=abstract,
      title, headings word, identifiers, full text]
46    ((cal or cai or call) adj3 (read or reading or spell or
      spelling or write or writing or learn or learning)).mp.
      [mp=abstract, title, headings word, identifiers, full
      text]
47    ((multimedia or ict or www or software) adj3 (read or
      reading or spell or spelling or write or writing or learn
      or learning)).mp. [mp=abstract, title, headings word,
      identifiers, full text]
48    or/44-47
49    48 not (43 or 41)
50    limit 49 to english language
51    50 and 12
52    42 or 51
```

1b.   British Education Index (BEI)

The BEI was searched on 23/5/01 using the BIDS Ovid interface. The database was searched for the period 1986–December 2000 and 331 records were retrieved. Given the low numbers of records, this strategy omits the 'children' aspect of the search and concentrates on excluding records which are focusing on adult literacy. The results are in files bei1.txt and bei2.txt.

```
1     (ict or (information adj technolog$) or (communication adj
      technolog$)).mp. [mp=title, abstract, heading word]
2     (cal or cai or (networked adj technolog$) or computer$ or
      (mobile adj phone$) or mulitmodal or multimedia).mp.
      [mp=title, abstract, heading word]
```

```
3      (multimodal or (digital adj media) or internet or cdrom or
        hypertext or (world adj wide adj web) or www).mp.
        [mp=title, abstract, heading word]
4      (worldwide adj web).mp. [mp=title, abstract, heading word]
5      software.mp. [mp=title, abstract, heading word]
6      "computer uses in education".sh.
7      "computer assisted learning".sh. or "educational
        software".mp. or "information systems".mp. [mp=title,
        abstract, heading word]
8      ("educational technology" or "screens (displays)").sh.
9      ("electronic books" or "multimedia approach" or "computer
        games").sh.
10     or/1-9
11     (literacy or literacies).mp. [mp=title, abstract, heading
        word]
12     "spelling teaching".sh.
13     ("reading comprehension" or "reading skills" or "reading
        teaching").sh.
14     (learn adj4 (english or read or reading or writing or
        write or spell$)).mp. [mp=title, abstract, heading word]
15     (learning adj4 (english or read or reading or writing or
        write or spell$)).mp. [mp=title, abstract, heading word]
16     (teach$ adj4 (english or read or reading or writing or
        write or spell$)).mp. [mp=title, abstract, heading word]
17     (develop$ adj4 (english or read or reading or writing or
        write or spell$)).mp. [mp=title, abstract, heading word]
18     (reading adj3 disab$).mp. [mp=title, abstract, heading
        word]
19     ("reading ability" or "reading improvement" or
        spelling).sh.
20     ("writing skills" or "reading difficulties").sh.
21     or/11-20
22     ("computer assisted reading" or "computer assisted
        language learning").sh.
23     10 and 21
24     or/22,23
25     "adult literacy".sh. or "adult basic education".id.
26     ("higher education" or "professional education").id.
27     or/25-26
28     24 not 27
```

1c   PsycINFO

PsycINFO was searched on 1/6/01 using the WINSPIRS interface. The
database was searched for the period 1886 (truly!) – 2001/3; 1,509 were
retrieved. The results are in files lit1.txt to lit8.txt.

```
1. explode "Computers"
2. explode "Computer-Applications"
3. "Computer-Games" in DE
4. explode "Computer-Simulation"
5. explode "Computer-Software"
6. "Electronic-Communication" in DE
7. explode "Information-Systems"
8. "Internet-" in DE
9. "Word-Processing" in DE
10.#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9
11."Literacy-" in DE
12."Literacy-Programs" in DE
13.explode "Language-Arts-Education"
14.explode "Reading"
15."Reading-Development" in DE
16.explode "Reading-Measures"
17.explode "Reading-Skills"
```

```
18."Writing-Skills" in DE
19.#11 or #12 or #13 or #14 or #15 or #16 or #17 or #18
20."Computer-Assisted-Instruction" in DE
21.#10 or #20
22.#21 and #19
23.(ict near (literacy or read or reading or spell or spelling
   or write or writing)) in ti,ab
24.(information technolog* near (literacy or read or reading or
   spell or spelling or write or writing)) in ti,ab
25.(communication technolog* near (literacy or read or reading
   or spell or spelling or write or writing)) in ti,ab
26.((cal or cai or networked technolog*) near (literacy or read
   or reading or spell or spelling or write or writing)) in
   ti,ab
27.((multimodal or digital media or internet) near (literacy or
   read or reading or spell or spelling or write or writing))
   in ti,ab
28.((cdrom or hypertext or wide web or www or worldwide web)
   near (literacy or read or reading or spell or spelling or
   write or writing)) in ti,ab
29.((software or computer* or electronic) near (literacy or
   read or reading or spell or spelling or write or writing))
   in ti,ab
30.#23 or #24 or #25 or #26 or #27 or #28 or #29
31."Adult-Development" in DE
32."Adult-Education" in DE
33."Adult-Learning" in DE
34.exact{ADULTHOOD} in AG
35.exact{AGED} in AG
36.exact{MIDDLE-AGE} in AG
37.exact{THIRTIES} in AG
38.exact{VERY-OLD} in AG
39.exact{YOUNG-ADULTHOOD} in AG
40.#31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39
41.#22 or #30
42.#41 not #40
43.#42 and (LA = "ENGLISH")
```

1d. Cochrane Library

Issue 2001/1 of the Cochrane Library was searched. 147 records were
identified. The records were hand-sifted by the information officer to exclude
large numbers of records about computer-based training of health
professionals. The resulting records are in files cliblit, cliblit3 and cliblit4.
Given the low volume of relevant records on the Cochrane Library, the search
was not limited to children.

```
1.  (COMPUTER* near LITERACY)
2.   (COMPUTER* near LEARN*)
3.  (COMPUTER* near SPELL*)
4.  (COMPUTER* near READ*)
5.  (COMPUTER* near WRIT*)
6.  (HYPERMEDIA near ((((LITERACY or LEARN*) or SPELL*) or
    READ*) or WRIT*))
7.  (SYSTEM* OR TECHNOLOG*) NEAR ((((LITERACY OR LEARN*) OR
    SPELL*) OR READ*) OR WRIT*))
8.  (SYSTEM* near ((((LITERACY or LEARN*) or SPELL*) or READ*)
    or WRIT*))
9.  (TECHNOLOG* near ((((LITERACY or LEARN*) or SPELL*) or
    READ*) or WRIT*))
10.(MULTIMEDIA near ((((LITERACY or LEARN*) or SPELL*) or
    READ*) or WRIT*))
11.(DISK* near ((((LITERACY or LEARN*) or SPELL*) or READ*) or
    WRIT*))
```

```
12.(TELECOMMUNICATION* near ((((LITERACY or LEARN*) or SPELL*)
   or READ*) or WRIT*))
13.(VIRTUAL near ((((LITERACY or LEARN*) or SPELL*) or READ*)
   or WRIT*))
14.(WORKSTATION* near ((((LITERACY or LEARN*) or SPELL*) or
   READ*) or WRIT*))
15.((WORLD next WIDE) NEAR ((((LITERACY or LEARN*) OR SPELL*)
   OR READ*) OR WRIT*))
16.(WORLDWIDE near ((((LITERACY or LEARN*) or SPELL*) or READ*)
   or WRIT*))
17.(WWW near ((((LITERACY or LEARN*) or SPELL*) or READ*) or
   WRIT*))
18.(INTERNET near ((((LITERACY or LEARN*) or SPELL*) or READ*)
   or WRIT*))
19.(ICT near ((((LITERACY or LEARN*) or SPELL*) or READ*) or
   WRIT*))
20.(CAL near ((((LITERACY or LEARN*) or SPELL*) or READ*) or
   WRIT*))
21.(CAI near ((((LITERACY or LEARN*) or SPELL*) or READ*) or
   WRIT*))
22.((((((((((((((((((((#1 or #2) or #3) or #4) or #5) or #6) or
   #7) or #8) or #9) or #10) or #11) or #12) or #13) or #14) or
   #15) or #16) or #17) or #18) or #19) or #20) or #21)
```

1e.   Dissertation Abstracts

Dissertation Abstracts was searched using the Dialog Service. The search
covered the period 1861– 2001/June. 935 records were identified and the
free formats were downloaded. These records give title and indexing only and
should be scanned. Any of interest can then be sent back to the Information
officer who will obtain bibliographic details and abstracts.

The weakness of this search is that it looks for a 'computing word' (sets 1 to
9) within three words (any order) of a 'literacy word' (sets 10 to 11). The
search would have increased sensitivity if the allowable gap between words
was increased.

```
S COMPUTER?
S EXPERT()SYSTEM? ?
S HYPERMEDIA OR INFORMATION()SYSTEMS
S INFORMATION()TECHNOLOGY
S MULTIMEDIA OR NATURAL()LANGUAGE()PROCESSING
S OPTICAL()DISK? ?
S TELECOMMUNICATIONS OR VIRTUAL()REALITY OR WORKSTATION? ?
S WORLD()WIDE()WEB OR INTERNET OR WWW
S ICT OR CAL OR CAI
S LITERACY OR READING OR WRITING
S SENTENCES OR SPELLING OR SYNTAX
S ADULT? ? OR POSTSECONDARY OR UNIVERSITY OR HIGHER()EDUCATION
S S1:S9
S S10:S11
s s13(3n)s14
s S15 NOT S12
s S16/ENG
```

1f.   Social Science Citation Index

This database was searched using the Dialog service (file 7). This was used
in preference to the Web of Science interface because it allows more focused
searching. The database was searched for the period 1972–2001/May week

4. 549 records were identified and the free formats were downloaded. These records give title and indexing only and should be scanned. Any of interest can then be sent back to the Information officer who will obtain bibliographic details and abstracts.

The weakness of this search is that it looks for a 'computing word' (sets 1 to 9) within three words (any order) of a 'literacy word' (sets 10 to 11). The search would have increased sensitivity if the allowable gap between words were increased.

```
1      COMPUTER?
2      EXPERT()SYSTEM? ?
3      HYPERMEDIA OR INFORMATION()SYSTEMS
4      INFORMATION()TECHNOLOGY
5      MULTIMEDIA OR NATURAL()LANGUAGE()PROCESSING
6      OPTICAL()DISK? ?
7      TELECOMMUNICATIONS OR VIRTUAL()REALITY OR WORKSTATION? ?
8      WORLD()WIDE()WEB OR INTERNET OR WWW
9      ICT OR CAL OR CAI
10     LITERACY OR READING OR WRITING
11     SENTENCES OR SPELLING OR SYNTAX
12     ADULT? ? OR POSTSECONDARY OR UNIVERSITY OR
HIGHER()EDUCATION
13     S1:S9
14     S10:S11
15     s13(3n)s14
16     S15 NOT S12
17     S16/ENG
```

1g.   SIGLE

The SIGLE database was searched using the WinSPIRS CD-ROM version. The database was searched from 1980–2000/12. 74 records were retrieved.

```
1. (ict near (literacy or read or reading or spell or spelling
   or write or writing)) in ti,ab
2. (information technolog* near (literacy or read or reading or
   spell or spelling or write or writing)) in ti,ab
3. (communication technolog* near (literacy or read or reading
   or spell or spelling or write or writing)) in ti,ab
4. ((cal or cai or networked technolog*) near (literacy or read
   or reading or spell or spelling or write or writing)) in
   ti,ab
5. ((multimodal or digital media or internet) near (literacy or
   read or reading or spell or spelling or write or writing))
   in ti,ab
6. ((cdrom or hypertext or wide web or www or worldwide web)
   near (literacy or read or reading or spell or spelling or
   write or writing)) in ti,ab
7. ((software or computer* or electronic) near (literacy or
   read or reading or spell or spelling or write or writing))
   in ti,ab
8. #1 or #2 or #3 or #4 or #5 or #6 or #7
```

2.   Web pages

A selection of key internet sites were searched.

2a.   Voice of the Shuttle (http://vos.ucsb.edu/)

Web page for humanities research. Accessed 12 June 2001.

Search terms: literacy computer
                       Literacy computers

No search results were obtained as the search engine does not seem to be functioning: there is a warning message on the search page that the search engine may be offline from March 2001 until further notice.

2b.   British Educational Communications and Technology Agency (http://www.becta.org.uk)

Printed out web page on Literacy information (http://www.becta.org.uk/start/literacy.html) and other 'research' oriented BECTA pages.

Followed links to Literacy Time web site (http://vtc.ngfl.gov.uk/literacy/index.html).
Printed out Research and Reports page (http://vtc.ngfl.gov.uk/literacy/features/research_reports.html) and Links page.

These sites focus less on the research underpinning effort to improve literacy by using computers and more on providing a range of resources to support teachers

2c.   OFSTED (http://www.ofsted.gov.uk)

The A-Z of OFSTED Publications list was printed out (12 June 2001) (http://www.ofsted.gov.uk/public/index.htm).

2d.   National Literacy Trust (http://www.literacytrust.org.uk)

This website was searched on 12 June 2001.

Searched ICT subsections.
Searched Ongoing research database.
Searched Research Findings database using Subject heading assigned by NLT: "Information technology and literacy". Retrieved 19 records. Records were printed out and also saved as two files: nlt1 and nlt2.
Searched Literacy researchers list.

2e.   Teachers Evaluating Educational Multimedia (http://www.teem.org.uk)

Accessed the website, 12 June 2001. Focuses on case studies, teachers' evaluations of software and publishers' product information. Formal and structured evaluation process is outlined. Little information on the research basis of assessment.

C2SPECTR

When this electronic database became available, it was searched by Carole Torgerson. A sensitive but nor very specific strategy was devised, using the following keywords:

Information and communication technology or ICT
Literacy or reading or writing or spelling

Hand Searches Log

All journals were searched for the period 1990 to 2001 unless otherwise stated.

Australian Journal of Language and Literacy
Editions searched: Feb 1992 – July 2001

English in Australia

English in Aeoteroa

Literacy Learning
Editions searched: August 1996 – July 2001

Education Media International
Editions searched: 1996 – June 2001

Dyslexia

Reading and Writing

Education, Communication and Information

English in Education

Research in the Teaching of English
Journal of Educational Computing Research
Editions searched: 1990 – July 2001

Changing English

APPENDIX B: Inclusion/exclusion criteria

English Review Group Working Document

Systematic review on 'The impact of networked ICT on 5-16 year olds' literacy in English'
Screening studies for inclusion in 'Mapping' section of review.
Exclusion criteria: to be included, a study must NOT fall into any one of the following categories.

IF A STUDY IS TO BE EXCLUDED, RECORD REASON BY USING APPROPRIATE EXCLUSION CODE (ONE, TWO, THREE, FOUR, OR FIVE)

EXCLUSION ON SCOPE

ONE   Not ICT or literacy:

⟨ *Definition of ICT: ICT stands for 'information and communication technologies', networked technologies with a multimodal interface, ie. networked and stand-alone computers, mobile phones with the capacity for a range of types of communication, and other technologies which allow multimodal and interactive communication.*

⟨ *Definition of literacy: Literacy can be defined narrowly, as the ability to understand and create written language. It is, however, frequently defined in two broader senses, and both are included in the present study. Firstly, the scope can be expanded so that written language becomes written language and graphical or pictorial representation. Secondly, the skill can be treated as social, rather than psychological; in this view literacy is the ability to operate a series of social or cultural representations. Since sets of expectations and norms differ depending on the situation, the social view of literacy entails a number of different 'literacies'.*

TWO   Not children aged 5–16, or main focus not children aged 5–16

THREE   Not about the impact of ICT on literacy learning and/or teaching, or
vice versa

⟨ *Definition of the impact of ICT on literacy: Impact will be defined as the result on end-users (here children between 5 and 16) of an intervention aimed at improving the teaching or learning of literacy. It may also be the result of a non-intervention activity which could reasonably be expected to increase or decrease literacy. Either can be considered as 'literacy-related activities'. Entailment: A research study which focuses on teachers' or learners' perspectives, opinions or strategies, may be considered to deal with the impact of ICT on literacy as long as it refers to a specific literacy-related activity.*

EXCLUSION ON STUDY TYPE

FOUR   (a) Editorials, commentaries, book reviews
      (b) Policy documents
      (c) Prevalence or incidence of ICT in literacy learning
      (d) Non-systematic reviews
      (e) Non-evaluated interventions
      (f) Surveys examining a range of curricular activities
      (g) Resources
      (h) Bibliography
      (i) Theoretical paper
      (j) Methodology paper
      (k) Non-evaluated non-interventions
      (l) Dissertation abstracts (unless RCTs)

EXCLUSION ON SETTING IN WHICH STUDY WAS CARRIED OUT

FIVE   Settings in which a language other than English is being used as a primary medium for literacy learning, i.e. include ESL and EAL, exclude EFL.

Acknowledgements: This document was developed from the EPPI-Centre Working document on Inclusion Criteria for Mapping. Training and support are acknowledged.

APPENDIX C: Data extraction summary tables
Outcome evaluations, process evaluations and needs assessment

Research question for in-depth review: What is the impact of *networked* ICT on literacy learning in English, 5 – 16?
Outcome evaluations

Study ID	Authors' report of study findings	Weight of evidence				Reviewers' report of study findings
		A: Soundness of study within design: how well was it designed and carried out?	**B: Ways in which this type of study helps to answer review question about outcomes**	**C: How close is topic focus to review question addressed?**	**D: Overall**	
Allen and Thompson (1995): Analysis of networking on computer-assisted collaborative writing in a fifth-grade classroom	Inconsistent: 1. p.68 – writing quality and word-count: Statistically significant differences on the holistic rating of writing quality and the text word count measure with students in the experimental group significantly higher than the control. 2. p.70 'The males in the experimental group scored significantly higher	**Low** Cluster RCT (2 group design in 4 classes) only total number of pupils reported (and gender), but not number of pupils (or gender) in each arm. Judged 'not sound' according to 2 out of the 4 EPPI Reviewer criteria. Number of clusters very small (4) and number of clusters in each arm not reported. 3 pupils lost to follow-up. No pre-	**Medium** This study focuses on effectiveness; it could help to show whether or not a computer-mediated networked learning environment can have a positive effect on the quality of writing of the 93 fifth-grade students in the study.	**High**	**Medium/low**	Reviewers concluded that no strong conclusions can be drawn about the effect or impact of ICT on literacy learning.

APPENDIX C: Data extraction summary tables (cont'd)

I   Outcome evaluations

Study	Outcome findings	Low	Medium	High	Conclusions
	than the males in the control on the writing holistic ratings.' 3. There was no significant difference between the females in the experimental and control groups. 4. Attitude questionnaires – no difference in results, yet implied that it was positive in the conclusion.	test scores reported. Analysis by individuals, yet randomisation by cluster, therefore statistically significant values will be inaccurate.			
Clouse R (1992): Teaching and learning with computers: a classroom analysis	1. Greatest absolute gains made by Grade 1 students (+23.4% gain for reading). 2. Authors draw no conclusion about comparison vs national norms. 3. Claimed to have been cognitive benefits, affective benefits and classroom management (p.295) 4. "If these students continue to score as they did during this project, they are not likely to be one of the dropouts when they become high school	**Low** None of the four key criteria for assessing the quality of outcome evaluations were met. Sample size not reported. No details of who was included or excluded or dropped out. No indication of ethnic composition of sample, or whether special needs students involved. No baseline data reported. Unclear whether gathered. No report of hours spent by learners. No indication of how the programme was	**Medium** A large-scale study compared to national norms could give some indications about what sort of learners gain what sort of benefit from networked ICT.	**High**	**Medium/low** Reviewers concluded that, with so few details about the sample and the study, no conclusions can be drawn about the effect or impact of ICT on literacy learning. Nor is the conclusion about a decline in future drop-out numbers being caused by the programme being studied is not valid from the report as it stands. With no discussion by the author, it is impossible to know if he felt his aims had been met.

APPENDIX C: Data extraction summary tables (cont'd)

I   Outcome evaluations

students." (p.295)	used within broader teaching programmes. Small groups implied (p.282) but no further detail and all analysis is by individuals. No inferential statistics (significance tests or effect size) reported. No discussion of whether any outcome variables were correlated (as one might expect). No discussion on relevance or importance of results re national norms. No reports of validation or reliability work undertaken on any part of the study.				
Erickson *et al.* (1992): Tele-communications promotes summer reading and writing: a pilot project report	1. Students in the sample did use online programmes over the summer vacation. 2. The usage peaked at an average rate which exceeded that observed in the latter part of the previous term.	**Low** Poorly designed and carried out. None of the four key criteria for assessing the quality of outcome evaluations were reported. The data would have made available evidence for a detailed retrospective analysis, but the study worked exclusively with average figures for time	**Medium** Such a study could provide limited evidence that elementary school students in socially-disadvantaged circumstances might be motivated to engage in literacy-related work online from home during the summer vacation.	**High**	**Medium/ low** The reviewers consider the findings of limited value and, with so few details about the sample and the study, no conclusions can be drawn about the effect or impact of ICT on literacy learning.

APPENDIX C: Data extraction summary tables - outcome evaluations, process evaluations and needs assessment (cont'd)
I Outcome evaluations

3. Some programmes were preferred (on average) above others.	spent online and programs preferred (the only two variables reported). As a result, it is impossible to tell whether the figures indicating increased time online in the vacation compared to the termtime are evidence of general increase in usage across the whole group or the result of intensive usage by a small number. Similarly, the extent to which some programmes were preferred to others by individuals as opposed to the whole group is impossible to tell. Other obvious variables which might have been useful (e.g. gender, groupings by prior reading/writing attainment) are not employed. No evaluation of the literacy-related programmes or their benefits is made.			

APPENDIX C: Data extraction summary tables (cont'd)

I Outcome evaluations

Study	Outcome evaluation				Reviewers' conclusions
Garner, Tan, Zhao (2000): Why write?	1. The authors did not make explicit conclusions about the impact of student participation as reports in the online newsletter. 2. The authors use their measures of student behaviour to conclude that students taking part in the on-line newsletter appear to have written as if they were in school when they were not. 3. The authors see the failure rate (50%) on completion as indication of such a pattern.	**Low** Methodologically, the study is not sound. None of the four key criteria for assessing the quality of outcome were met. There is an insufficiently rich description of the context, intervention and outcomes of the study.	**Medium** In a robust study design of this type, limited evidence might be provided of the impact of an intervention on pupils' motivation to write. However, there is not much help in answering the review question here, because the aims are too broad and the methodology insufficiently explicit or precise.	**High**	**Medium/low** Reviewers concluded that no conclusions can be drawn about the effect or impact of ICT on literacy learning. The data presented do not substantiate the conclusions presented in the abstract; that it was mainly the adult audience that was unmotivating for the children, though this could have been one of the possible reasons. Generally, there are insufficient data to be able to make a judgement as to whether the authors are justified in making their conclusions.
Golden, Gersten, Woodward (1990): Effectiveness of guided practice during remedial instruction:	Student mastery: 1. No significant effects for the QAR2 test 2. Significant main effect for the instructional method (intervention) for the rule-based inferences test 3. On both testing occasions, the guided-		**Medium** This is a pilot study, individually randomised RCT. The research is reasonably well designed and carried out. The reviewers judge it to be borderline 'sound' on the basis of four key criteria for assessing the quality of outcome	**High** This study focuses on effectiveness: it could help to show whether or not the use of a low-cost networked computer system (Teacher Net) for guided (or controlled) practice can have an impact on the reading	**High/medium** Reviewer calculated effect sizes: 1. QAR2 (1st test) 0.13 (-0.59 – 0.84) not significant 2. QAR2 (2nd test) 0.79 (0.03 – 1.53) significant 3. Inferential learning (1st test): 0.63 (-0.11 – 1.36) not significant

APPENDIX C: Data extraction summary tables - I Outcome evaluations (cont'd)

an application of computer-managed instruction	practice group performed significantly better than the comparison group: '(the) results indicate that the guided practice had a significant positive effect on students' acquisition of the more complex material in the rule-based inferences curriculum, but had no discernible effect on their performance on the more familiar material in the QAR2 test. The effect on the rule-based inferences curriculum was maintained over a 2-week period' (p.298). Academic engagement (observational data): 1. Median of intervention group – 88.9% of time on task 2. Median of comparison group – 57.9% of time on task 3. 'the use of the networking system to provide immediate	evaluations, although there is a potentially serious flaw in the randomisation procedure. The authors claim to have done 'paired' randomisation, but they started off with 31 pupils, and the group sizes for intervention and control were 17 and 14. One pupil is missing from the intervention group at post-test. Two teachers were involved in the intervention (senior author and RA). To control for teacher effect they 'switched conditions' on the 6th day (out of 17 days), but there is still a theoretical risk of teacher interaction.	compre-hension and inferential learning of low achieving students; compared with the use of a work- sheet (i.e. whether or not it is effective in increasing literacy in these areas). The study could also help to show levels of student engagement on task and the impact of this use of networked computers on student satisfaction.	4. Inferential learning (2nd test): 1.16 (0.37 – 1.93) significant 5. Lower SD of 1.4 supports the authors' claim of all Ss benefiting from rapid response. Reviewers and author agree that a low-cost networked computer system for guided practice has a positive impact on the reading comprehension and inferential learning, student engagement on task, and student satisfaction of low-achieving students compared with the use of a worksheet for the same purpose.

APPENDIX C: Data extraction summary tables (cont'd)

I Outcome evaluations

	feedback based on group performance resulted in increased student engagement and involvement' (p.299). Students' reactions: 1. 79% of intervention group indicated that they liked the intervention (57% gave reasons) 2. 25% of control group indicated that they liked the instruction.				
Moore, Karabenick (1992): The effects of computer communications on the reading and writing performance of firth-grade students	There were no significant changes in attitudes toward reading and writing attributable to students' communication experience. Attitudes toward computers, however, became more positive for	**Low** Reviewers judged study 'not sound' on the basis of four key criteria for assessing the quality of outcome evaluations. Treatment and control not equivalent at baseline for student attitude toward computers (Figure 3 on p.33); therefore results could be accounted for	**Medium/high** This controlled trial (pre-post treatment/ comparison group study) focuses on effectiveness: it could help to determine whether these fifth-grade students using computer communication improved their communication skills and their attitudes	**High**	**Medium/low** Not possible to draw any conclusions on the effect or impact of ICT on literacy learning.

APPENDIX C: Data extraction summary tables (cont'd)
I   Outcome evaluations

			High	Medium/low
	Students using computer communication than for students using computers without the communication experience. Examination of students' computer communications showed an increase in writing production, clarity and the use of details and examples to support ideas.	by regression to the mean. Writing: mean word production on first and final responses are presented for treatment group only; results for control not presented. Missing data (students absent during pre- or post-tests) reduced the number for some statistical comparisons. toward reading, writing and computers more than students not using computer communication.		
Peyton JK (1991): Electronic communication for developing the literacy skills of elementary school students: the case of ENFI	A range of outcomes is reported, some attitudinal (e.g. "students were more motivated write") and others more skill-based (e.g. "They have begun to initiate topics, maintain and willing to and elaborate on topics,	**Low** Reviewers judged the study 'not sound' on the basis of the criteria for assessing the quality of outcome evaluations. Although the study appears to be pre- and post-test outcome evaluation,	**Medium** Although a pre-test/post-test design ought to provide limited evidence of impact, this particular study is more useful in its presentation of hypotheses generated by the research: *all writing does not have to	It is not possible to draw any conclusions on the effect or impact of ICT on literacy learning, although there is no evidence to doubt the author's conclusions, most of which are suggestive of the capacity of ENFI (the Electronic Networks for Interaction project) to motivate deaf students to write.

APPENDIX C: Data extraction summary tables (cont'd)

I   Outcome evaluations

				Medium/high	Medium/low	
	request and provide clarification, ask and respond appropriately to questions, and write increasingly sophisticated and complex English"). 2. The hypotheses are illustrated rather than proved or disproved.	there is no stated research question and no clear indication of the nature of the pre- and post-tests. The reporting, in a professional journal, is not always explicit. For example, one would have liked more explicit description of evaluative criteria for student written language development.	consist of extended, auto-nomous text *writing does not have to grow out of signed or oral communication *a small amount of writing can serve as a starting point for communication in speech or other media.			
Spaulding, Lake (1992): Interactive effects of computer network and student characteristics on students' writing and collaborating	1. Authors claim that results are tentative' (p.75). 2. The authors were hesitant but concluded that the greatest gains in writing quality were made by treatment students who reported lower linguistic	**Low** Reviewers judged the study 'not sound' on the basis of the criteria for assessing the quality of outcome evaluations. Cluster randomised trial with 8 clusters, but not stated how many clusters in each arm (group) or numbers in each cluster. Clusters may not be equivalent at baseline. There was a correlation between the allocated intervention and the independent variables.	**High** This study focuses on effectiveness; it could help to show whether or not 28 student 'remedial' writers using a set of networked computers to assist them in their writing lessons would show greater gains in the quality of their written essays compared with students who did not experience the computer network system.		**Medium/low**	Reviewers concluded that no conclusions can be drawn about the effect or impact of ICT on literacy learning.

APPENDIX C: Data extraction summary tables (cont'd)
  I   Outcome evaluations

efficacy.	Analysis at level of individual – different from allocation (cluster). 13 out of 28 students lost to follow-up.	It can also help to show whether or not these students would report enjoying the class more and would recall collaborating with peers more than would the students not experiencing the computer network.	**Medium/high**	**Medium/low**	Reviewers concluded that no conclusions can be drawn about the effect or impact of ICT on literacy learning.

APPENDIX C: Data extraction summary tables (cont'd)

II   Process evaluations

Study ID	Authors' report of study findings	Weight of evidence				Reviewers' report of study findings
		A: Soundness of study within design - how well was it designed and carried out?	**B: Ways in which this type of study helps to answer review question about process**	**C: How close is topic focus to review question addressed?**	**D: Overall**	
Bigum, Lankshear *et al.* (1997): Digital rhetorics: literacies and technologies in education – current practices and future directions	1. It provides a general theory of literacy learning as promoted by aspects of ICT (dynamic text, extended meta-knowledge of literacy, new genres, new audiences and presentational opportunities online). 2. It provides and tests a powerful model of patterns and principles to explain why, how and in what contexts new technologies work or are impeded from working. 3. It provides detailed empirical evidence of this theory and these	**Medium** The empirical studies are well-designed and executed, following a standard template which builds up a picture of snapshots and commentaries, indicating strong patterns. The theoretical model of ICT and literacies is derived from a detailed use of prior research The model of patterns and principles for the effective implementation of new technologies is tested against the empirical data, and confirmed.	**Medium** It is a very large study, covering a wide range of types of educational institution, ages of child, and geographical and socio-economic setting. Its methodology is very sensitive to nuances of context and practice in the empirical study. Its detailed synthesis of prior research, its robust model of how ICT can be effective and in what circumstances, and its wide-ranging	**High**	**Medium**	Reviewers are in agreement with the authors.

APPENDIX C: Data extraction summary tables (cont'd)
II   Process evaluations

	patterns and principles at work in the series of empirical studies in vol.2 of the whole report; in particular, the impact on writing, on literacy-related special needs, and on met knowledge of literacies of the use of internet and email in remote rural schools in Australia)	empirical study, could help answer questions about the process by which ICT might have an effect (if it does).		
Ewing J (2000): Enhancement of online and offline student learning	1. Describes a model for ICT in the support of learning, then constructs a table to see how the major issues identified for the constructivist approach and for collaborative learning might fit. 2. Greater attention given to communication using ICT, but important that personal contact is not compromised by introduction of 'distance' into the learning experience.	**Medium** Information from the three empirical projects is largely subjective but suggests this model is sufficiently robust to allow further investigation. However, it is difficult to see how to see how the information from the empirical projects has been used as almost no information on these is presented.	**Medium** The postulation and exploration of models from the use of ICT in support of learning (including literary learning) might shed light on the nature of the impact we could expect.	**High**
				Medium Not able to draw any conclusions. The focus of the study is more general than most of the papers in the in-depth review. But because the paper takes a constructivist approach to the enhancement of offline and online learning, *communication* between teacher and pupil, pupil and computer is at the heart of the study. Collaborative learning, it is suggested, requires enhanced literacy (principally speaking and listening) skills.

APPENDIX C: Data extraction summary tables (cont'd)

II Process evaluations

		High	Medium / high	
	3. Personalised feedback is deemed very important. 4. Role of offline learning plays a greater part than online learning; the relationship needs to be studied. 5. The ICT element of ICT learning is only a small part of the learning picture. **Teachers should be in position to decide when ICT helps or hinders learning.**			
Love K (1998): Old cyborgs, young cyborgs (and those in between)	According to the author, "Katrina's [the student teacher through whom we access pupils' work] experiences highlight a number of issues of relevance to other teachers". While 'young cyborgs have a wide range of technological experience, there is still unevenness in terms of students' conceptual and technical expertise	**Medium/high** The research method is appropriate to the research question The context is adequately described. The researcher/ respondent relationship is explicit and understood. There is a clear theoretical framework. The data are systematically collected. There are sufficient data for a reader to make connections between interpretation and	**High/medium** Case studies of this kind can suggest possible impacts and/or clarify the research questions that need to be asked. They can also shed light on received assumptions, emerging hypotheses or quantitative results.		The reviewers couldn't say that they would want to differ from Love over her findings. The issues identified relate relatively clearly to the fairly rich description of Katrina's classroom practices

APPENDIX C: Data extraction summary tables (cont'd)
II   Process evaluations

that needs to be addressed. Teachers need to help students develop 'a critical as well as appreciative approach to electronic texts'. Teachers need to be aware of technologies limitations as well as its possibilities. Teaching in a digital environment requires new classroom management (and technological management) strategies. Pupils were able critically to compare websites; use search engines; search and download text; be discriminating about navigating through sites; and evaluate electronic information. These findings were reported by Katrina, a student teacher in a Melbourne year 8 English class. In this two-level study, she is the principal focus	evidence. There is an effort to establish validity and credibility. While other aspects of the methodology are opaque, we would say – on balance – this is a sound study.

APPENDIX C: Data extraction summary tables (cont'd)
II   Process evaluations

	(i.e. teachers) rather than the pupils she reports on.		High	Medium / low	
McKeon B (1998): A literature-based e-mail collaborative	The authors claim that "the motivation for the project was evident" (p.90) and that parents were impressed with "the students' increased interest in reading and purposeful computer usage" (ibid). Furthermore, "the elementary students had the opportunity to enhance their critical reading and social skills using the computer, while the pre-service teachers developed their teaching and communication skills" (p.91).	**Low/medium** The context is inadequately described, neither is there an adequate description of the sample, data-collection methods nor of the reliability of the data analysis. The aims are clear and some data are included so that it is possible to try to mediate between data and interpretation.		**Medium** A study of this kind can be useful in gauging the extent to which email "is used in elementary classrooms to enhance authentic language learning", i.e. through communication with pre-service teachers about literature.	The evidence for increased motivation, increased interest in reading and purposeful computer usage is thin, as it is for enhanced reading and social skills. The reader is asked to accept these claims largely on trust, as reported by the authors.
McNamee G (1995): A Vygotskian perspective on literacy development	The findings are dispersed through the narrative, to some extent; but can be summarised as: (1) a growth in confidence and communicative ability of the child over the year of the study;	**Medium/low** Quite well designed and carried out: nuanced narrative of the online exchange between mentor and child; developed relation of the events observed and analysis of documents to the		**Medium** This study can provide small-scale case-study evidence which can be read as part of a larger picture.	**Medium / low** 1. The reviewers agree broadly with the findings, especially in relation to the adult workers, and their growth through an online relationship with a remotely-supervised programme. 2. However, the move in the introductory section to characterise communication technologies as a form of Vygotskian psychological tool, while promising as a basis for

APPENDIX C: Data extraction summary tables (cont'd)
II Process evaluations

	(2) a growth in the confidence of the mentor, an African- (3) transformation in the ability of the community workers to manage the communicative tools and forms of language involved for the benefit of their children (e.g., an assertion of the need to incorporate African-American forms of English into the exchanges).	Vygotskian model of language learning employed. However: The analysis of the child's writing is brief, tending to move quickly to assertions about the development of her voice; There is no method to describe or analyse the benefit of technologies, as opposed to adult mentoring in general.			distinguishing the specific benefits of online communication as opposed to face-to-face or conventional mail, is not carried through in the analysis of the data, though the claim is asserted again in the conclusion.
Morgan W (1997): From the margins to the centre: schools online	The findings as reported by the author are: that there are implications for our understanding of the relationship between literacy, networked technologies and education; that we need critical frames with which to make sense of such data; that 'empowerment' is crucial for students; that they must 'own'	**Medium** The BushNet infrastructure consisted of a series of linked websites between schools. Students were provided with access to computers that had internet facilities. The article is a study of a pilot study; 'snapshots' are presented of practice arising from use of the BushNet..	**High**	**Medium** Such a study can provide examples of networked computer use that are suggestive of possible practice in contexts other than that of the study.	**Medium** 1. The reviewers don't differ from the author. 2. The genre of keynote address, in which the report is couched, determines the nature of the reporting, which is necessarily more elliptical than a research report.

APPENDIX C: Data extraction summary tables (cont'd)
II   Process evaluations

			Medium	High	Medium / low	
	the work they produce with such media.	The methodological quality of the study is not clearly evident as it is part of a larger study, *Digital Rhetorics*.				
Stuhlmann, Taylor (1998): Analyzing the impact of telecomm-unications on learning outcomes in elementary classrooms	Students became involved in complex learning. The self-esteem of many children was increased. The 4th grade children role-playing a crawfish online for the benefit of 3rd graders in two other schools began to use email to write to family members. The third-graders' motivation to read the series around which the project was built was increased. The college students who supported the teachers were proud of their work. The enthusiasm of the teachers was a critical success factor. The provision of training was important. Close monitoring of the project was important. A limited timeframe kept the project fresh and dynamic.	**Low** Weak design: The context and sample are inadequately described. The methods of data collection and analysis are not reported. The findings depend more on assertion than on analysis.	**Medium** Such a study can provide limited evidence of the beneficial effects on literacy of networked exchanges between students on different schools; and of the "success factors", assuming the reported success to be the case. The evidence is not evaluated, however – at least explicitly.			1. The reviewers accept the conclusions related to successful management of the project – training, support, monitoring, timeframing – because they have a strong practical flavour and are to some extent self-evident. 2. The findings to do with improved reading, writing, complex learning patterns and improved self-esteem have to be taken at their word; they depend on teacher reports, and no other evidence is adduced. 3. As in several other accounts of online audiences or mentors, no specific investigation is made of the benefits of the networked computers – though it is implied, perhaps, that part of the success of the role-play depends on the anonymity provided by emailed exchanges.

APPENDIX C: Data extraction summary tables (cont'd)

III   Needs assessment

Study ID	Authors' report of study findings	Weight of evidence				Reviewers' report of study findings
		A: Soundness of study within design: how well was it designed and carried out?	B: Ways in which this type of study helps to answer review question about needs	C: How close is topic focus to review question addressed?	D: Over-all	
Collins J (1993): Beyond the word processor: computer-mediated communication with pupils and teachers	This study notes that 75% of the respondents reported that word-processing was the most popular form of computer use Less than 50% of teachers in the sample believed that email and computer conferencing could be used to develop writing skills, although two-thirds had access to email and computer conferencing. There is a need for INSET in email and computer conferencing if ICT is to realise its potential in English 11–16.	**Low** The aims of the study are rather vague and are difficult to match to the study's methods. The author's statement of aims in the study's abstract contains reference to an investigation of teacher concerns. A later statement of aims refers solely to an investigation of the extent of teacher use of ICT. There is no socio-demographic information about the respondents, which is particularly problematic given the low response rate.	**Medium** This kind of study might indicate the (then) current state of impact of ICT on the practice of English teachers, departments and therefore pupils in secondary schools. Measurement of the state of practice is a necessary preliminary to identifying training needs.	**Medium**	**Low / medium**	There is insufficient evidence to justify claims, so it is hard to determine the relationship between data and conclusions

Appendix D: EPPI-Centre Educational Keywording Sheet

EPPI-CENTRE EDUCATIONAL KEYWORDING SHEET VO9.4 Keyworder....................... Author.......................

1. Type of printed material

Primary report
Secondary report
Resource
Policy document

2. Identification of report

Citation
Contact
Handsearch
Unknown
Electronic database
(*please specify*) ....

3. Status

Published
In press
Unpublished

4. Language (*please specify*)

....

5. Programme name

....

6. Which type of study does this report describe?

A. Outcome evaluation
    (i)   RCT
    (ii)   Trial
    (iii) Pre and post test
    (iv)   Post test
    (v)   Reversal design
    (vi)   Cohort study
    (vii) Case control study
    (viii) Other design
B. Process evaluation
C. Economic evaluation
D. Intervention description
E. Methods
    (i)   Instrument design
    (ii) Other
F. Needs assessment
G. Review
    (i)   Systematic
    (ii)   Non-systematic
    (iii) Meta-analysis
H. Descriptive study

7. In which country/countries was the study carried out?

....

8. What is the topic focus of the study?

Curriculum*
Disciplines
Methodology
Policy
Organization
Teacher careers
Teaching and learning
Other

*Curriculum

Art
Business Studies
Citizenship
Cross-curricular
Design & Technology
English
Environment
General
Geography
Hidden

History
Languages
Maths
Music
PSE
Phys. Ed.
Religious Ed.
Science
Vocational
Other ....

9. What is the educational setting of the study?

Adult education
Community based
Correctional institution
Further education
Government department
Higher education
Home
Informal education
Initial teacher training
Nursery education
Post-compulsory education
Primary education
Pupil referral unit
Secondary education
Workplace
Other educational body

APPENDIX D: EPPI-Centre Educational Keywording sheet (cont'd)

10a. What is the population focus of the study?

Preschool children (0-4)	Teaching staff
Primary children (5 –10)	Non-teaching staff
Secondary children (11-16)	Parents
Post compulsory learners (17-20)	Governors
Adult learners (21+)	Local education authority officers
Head	Government
Senior management	Other education practitioners

10b. Sex of population

Female
Male
Mixed sex

11. Intervention provider
(only for study types keyworded as 6A, 6B, 6C and/or 6D)

Advisor	Inspector
Community worker	Lawyer
Computer	Lay therapist
Counsellor	Local education authority
Examination board	Parent
Government	Peer
Headteacher	Psychologist
Health professional	Researcher
Health promotion	Residential worker
Practitioner	Social worker
Induction pack	Teacher/lecturer

12. Type (s) of intervention
(only for study types keyworded as 6A, 6B, 6C and/or 6D)

Advice	Instruction
Anger management	Legislation/regulation
Counselling	Parent training
Curriculum	Professional training
Daycare	Rehabilitation
Environmental modification	Resource access
Examinations	Sanctions
Family therapy	Screening
Feedback	Service access
Funding	Skill development
Incentives	Social support
Inspection	Staff ratios
	Treatment

Please state here if keywords have not been applied from any particular category (1–12) and the reason why (e.g. no information provided in the text)

....

....

....

Appendix E: EPPI English Review Group Keywording sheet

14. Focus of the report (tick all that apply)	15. Type(s) of intervention or non-intervention (tick all that apply)	16. What principal aspect(s) of literacy is the study focused on increasing? (tick all that apply)	17. Which outcomes are reported? (tick all that apply)
literacy composition	computer – stand alone (software)		test results - reading
learning accelerated learning	computer – networked (e-mail)		- writing
genre achievement	computer – networked (internet)	**16a.** ☐ psychological aspects or representations	- spelling
litprac attainment	mobile phone	☐ social representations and/or cultural/critical representations	examination results
literacies distributed learning	other technology _____ (please specify)		motivation/engagement
literature dyslexia		**16b.** ☐ writing print and graphical or pictorial representation	self-esteem/attitude
multimodality engagement		☐ reading print and graphical or pictorial representations	quality of writing
reading ESL			increased awareness of process
semiotics learning			quality of reading
spelling learning difficulties			quality of response to multimedia
text learning disabilities			
text production motivation			
viewing scaffolding			
writing skills			
teaching			
transformation			
visual learning			
ICT authoring			
computer			
CAI			
CAL			
digital			
email			
hypertext			
interface			
internet			
moving image			
multimedia			
visual design			
website			
word-processing			

KEYORDER..   **DATE**.............................